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2022
CONGESTION MANAGEMENT PROCESS (CMP)
TECHNICAL REPORT

June 30, 2022

DRAFT
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Reviewed by the TPB Technical Committee on June 3, 2022)

National Capital Region Transportation Planning Board
Metropolitan Washington Council of Governments

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AGENCY:

The Metropolitan Washington Council of Governments (COG) is the regional organization of the Washington area's major local governments and their governing officials. COG works toward solutions to such regional problems as growth, transportation, the environment, economic development, and public safety. The National Capital Region Transportation Planning Board (TPB) conducts the continuing, comprehensive transportation planning process for the National Capital Region under the authority of the Federal-Aid Highway Act of 1962, as amended, in cooperation with the states and local governments.

ABSTRACT:

This report provides technical details and documents the Congestion Management Process in the National Capital Region. It contains updated congestion information and congestion management strategies on the region's transportation systems, as well as the process integrating the Congestion Management Process into the region's Financially Constrained Long-Range Transportation Plan.

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Commuter Connections Subcommittee

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ABBREVIATIONS AND ACRONYMS

AADT	Annual Average Daily Traffic
ACS	American Communities Survey
ART	Arlington Transit
ATIS	Advanced Traveler Information Systems
ATM	Active Traffic Management
ATRI	American Transportation Research Institute
AVL	Automatic Vehicle Location
BRAC	Base Closure and Realignment Commission
BWI	Baltimore/Washington International Thurgood Marshall Airport
CAFE	Corporate Average Fuel Economy
CAV	Connected and Autonomous Vehicle(s)
CATT	Center For Advanced Transportation Technology
CCTV	Closed-Circuit Television
CHART	Coordinated Highway Action Response Team
CLRP	Constrained Long-Range Plan
CLV	Critical Lane Volume
CMP	Congestion Management Process
CMS	Congestion Management System
CNG	Compressed Natural Gas
CO	Carbon Monoxide
COC	Commuter Operations Center
CUE	City-University-Energysaver
DASH	Driving Alexandrians Safely Home
DCA	Ronald Reagan Washington National Airport
DMS	Dynamic Message Signs
DOT	Department of Transportation
EPC	Emergency Planning Council
FAF	Freight Analysis Framework
FHWA	Federal Highway Administration
MPSTOC	McConnell Public Safety and Transportation Operations Center
MTA	Maryland Transit Administration
MWAA	Metropolitan Washington Airports Authority
MWCOG	Metropolitan Washington Council of Governments
MWRITSA	Metropolitan Washington Regional Intelligent Transportation Systems Architecture
NCHRP	National Cooperative Highway Research Program
NCR	National Capital Region
NEPA	National Environmental Policy Act
NGA	National Geospatial Agency
NHS	National Highway System
NOx	Nitrogen Oxides
NPMRDS	National Performance Management Research Data Set
NPRM	Notice of Proposed Rulemaking
NTOC	National Transportation Operations Coalition
NVRC	Northern Virginia Regional Commission
NVTC	Northern Virginia Transportation Commission
PBPP	Performance-Based Planning and Programming
PM	Particulate Matter
PRTC	Potomac and Rappahannock Transportation Commission
PSTOC	Public Safety Transportation Operations Center
PTI	Planning Time Index
RITIS	Regional Integrated Transportation Information System
RFC	Region Forward Coalition
RTPP	Regional Transportation Priorities Plan
SAFETEA-LU	Safe Accountable Flexible Efficient Transportation Equity Act - A Legacy for the Users
SIP	State Implementation Plans
SOC	State of the Commute Survey
SOV	Single Occupancy Vehicle
SRTS	Safe Routes to Schools

FSCPPE	Federal State Cooperative Program for Population Estimates
GHG	Greenhouse Gas Emissions
GPS	Geographic Positioning System
GRH	Guaranteed Ride Home
HOT	High Occupancy/Toll
HOV	High Occupancy Vehicle
HPMS	Highway Performance Monitoring System
IAD	Washington Dulles International Airport
ICC	Inter-County Connector
ICM	Integrated Corridor Management
IMR	Incident Management and Response
IS	Interstate System
ITS	Intelligent Transportation Systems
IVR	Interactive Voice Response
LATR	Local Area Transportation Review
LAUS	Local Area Unemployment Statistics
LOS	Level of Service
MAP-21	Moving Ahead for Progress in the 21st Century Act
MARC	Maryland Area Rail Commuter
MAROps	Mid-Atlantic Rail Operations
MATOC	Metropolitan Area Transportation Operations Coordination
MATOps	Mid-Atlantic Truck Operations
MDSHA	Maryland State Highway Administration
MNCPPC	Maryland – National Capital Park and Planning Commission
MOITS	Management, Operations, and Intelligent Transportation Systems
MPO	Metropolitan Planning Organization
TARS	Travelers Advisory Radio System
TAZ	Traffic Analysis Zone
TCSP	Transportation, Community and System Preservation
TDM	Transportation Demand Management
TE	Transportation Enhancements
TERM	Transportation Emission Reduction Measure
TIGER	Transportation Investment Generating Economic Recovery
TIP	Transportation Improvement Program
TLC	Transportation/Land Use Connections
TMA	Transportation Management Area
TMC	Traffic Management Center; Traffic Message Channel
TOC	Transportation Operations Center
TOD	Transit-Oriented Development
TPB	Transportation Planning Board
TTI	Travel Time Index
TTID	Transportation Technology Innovation and Demonstration
UPT	Unlinked Passenger Trip
VDRPT	Virginia Department of Rail and Public Transportation
VHD	Vehicle Hours of Delay
VHT	Vehicle Hours of Travel
VMT	Vehicle Miles of Travel
VOC	Volatile Organic Compound
VPL	Variably Priced Lane
VPP	Vehicle Probe Project
VRE	Virginia Railway Express
WMATA	Washington Metropolitan Area Transit Authority

EXECUTIVE SUMMARY

Background

A Congestion Management Process (CMP) has been a requirement since the 2005 Safe Accountable Flexible Efficient Transportation Equity Act - A Legacy for Users (SAFETEA-LU) federal legislation. The Fixing America's Surface Transportation (FAST) Act and its supporting federal regulations, as well as the recent Infrastructure Investment and Jobs Act, also known as the Bipartisan Infrastructure Law (IIJA/BIL), maintained the requirements of the CMP. This legislation and regulations are a basis for the CMP component that is wholly incorporated in the region's long-range transportation plan, Visualize 2045. The CMP component of Visualize 2045 constitutes the region's official CMP, and serves to satisfy the federal requirement of having a regional CMP.

This CMP Technical Report serves as a background document to the official CMP within Visualize 2045, providing detailed information on data, strategies, and regional programs involved in congestion management. This 2022 CMP Technical Report is an updated version of the previously published CMP Technical Reports (2008-2020).

Components of the CMP

The National Capital Region's Congestion Management Process has four components as described in Visualize 2045:

- Monitor and evaluate transportation system performance
- Define and analyze strategies
- Compile project-specific congestion management information
- Implement strategies and assess

This report documents and provides technical details of the four components of the CMP. It compiles information from a wide range of metropolitan transportation planning activities, as well as providing some additional CMP-specific analyses, particularly travel time reliability and non-recurring congestion analyses.

Congestion on Highways

REGIONAL CONGESTION TRENDS, 2010-2021

Based on the results revealed by the Eastern Transportation Coalition Vehicle Probe Project (VPP)/INRIX traffic monitoring[1], peak period congestion in the Washington region decreased between 2010 and 2012, increased moderately through 2019, and then was impacted by the COVID-19 pandemic.

The congestion intensity, measured by the Travel Time Index (TTI)[2] from a traveler's perspective, decreased 6.7% between 2010 and 2012 and increased by 1.9% from 2012 to 2019 (Figure E-1). The Peak Period congestion in 2020 dropped significantly due to measures in response to the

[1] Eastern Transportation Coalition Vehicle Probe Project, https://tetcoalition.org/projects/vpp-marketplace/

[2] Travel Time Index (TTI) is an indicator of the intensity of congestion, calculated as the ratio of actual experienced travel time to free flow travel time. A travel time index of 1.00 implies free flow travel without any delays, while a travel time index of 1.30 means one has to spend 30% more time to finish a trip compared to free flow travel.

unprecedented COVID-19 pandemic. In 2021, the regional congestion intensity was still lower than those in pre-pandemic years even though a rebound from 2020 was observed.

The spatial extent of congestion, measured by Percent of Congested Miles[3] from a system perspective, varied similarly to the TTI (Figure E-2). Regionally 21% of all monitored roadways were congested during peak periods in 2010. This number decreased to approximately 9% in 2013, the lowest in the last eight years, and then increased to about 14% in 2019. This region observed about 7% of all monitored roads congested during peak periods in 2021, and that was a slight increase from 5% in 2020.

Figure E-1: Annual Average Travel Time Index by Highway Category: Total AM and PM Peaks

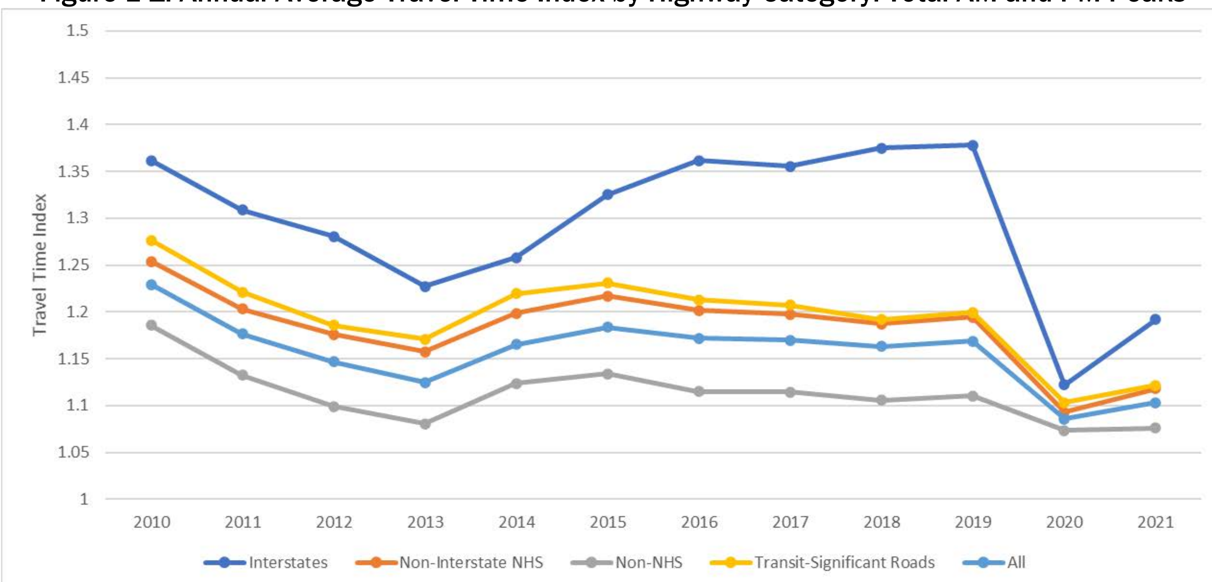
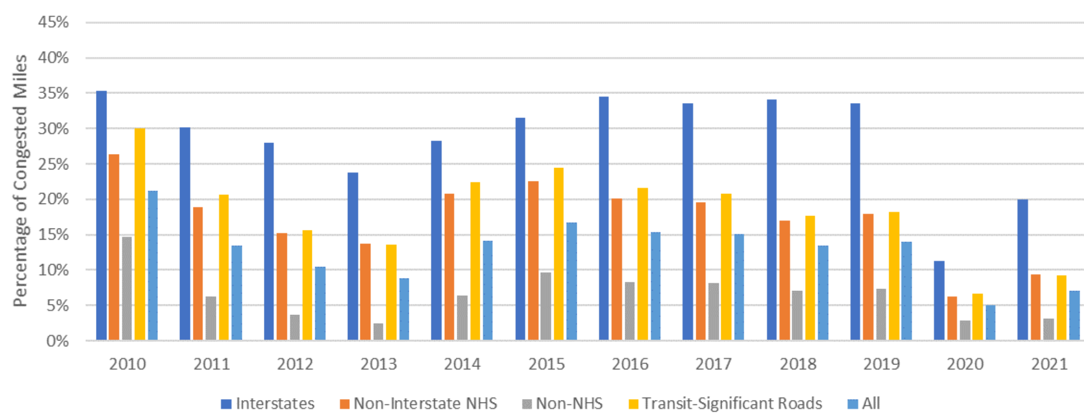


Figure E-2: Annual Average Percent of Congested Miles by Highway Category: Total AM and PM Peaks



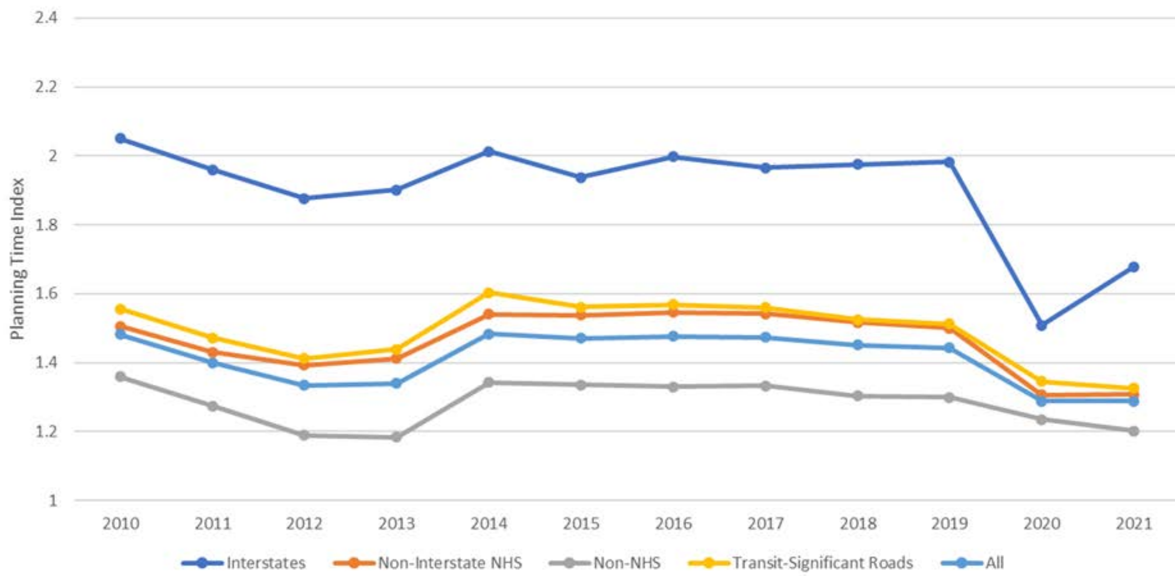
[3] Percent of Congested (Directional) Miles is a system-wide measure that captures the spatial extent of congestion. Congestion is defined if actual travel time is 30% longer than the free-flow travel time[3], i.e., Travel Time Index > 1.3, based on recommendations made by the National Transportation Operations Coalition in 2005.

REGIONAL TRAVEL TIME RELIABILITY TRENDS, 2010-2021

Travelers in the Washington region typically will need to budget about two times the free flow travel time during peak periods to ensure on-time arrivals. These numbers are based on all directions of travel, therefore for those traveling in the peak direction would need to budget even more.

Similar to the trends observed in traffic congestion, travel time reliability improved approximately 10% between 2010 and 2012, returned almost back to the 2010 level in 2014, then consistently down to slightly above 1.4 in 2019 (Figure E-3). The Peak Period travel time reliability for all monitored roads in 2020 showed significant improvement due to measures in response to the unprecedented COVID-19 pandemic. In 2021, the numbers were still better than those in pre-pandemic years even though a rebound from 2020 could be observed.

Figure E-3: Annual Average Planning Time Index by Highway Category: Total AM and PM Peaks



CONGESTION MONTHLY VARIATION

Congestion varies from month to month within a year, as shown for 2021 in Figure E-4. Monthly variations of congestion were most noticeable on the Interstate System, followed by the Transit-Significant Roads, the Non-Interstate National Highway System (NHS), and the Non-NHS.

In pre-COVID-19 years, the region overall had increasing congestion from January to May, then decreasing congestion through August. September and October again had higher levels of congestion, with decreasing congestion in November and December. Notably, monthly patterns were different with COVID-19 measures implemented in 2020 and 2021. Traffic in the NCR rebounded slowly in 2021, especially those on Interstates. The pattern of dropping in August looked similar to pre-COVID-19 years.

CONGESTION DAY OF WEEK VARIATION

Congestion also varies within a week (Figure E-5). Even with COVID-19 measures, the two-peak pattern of congestion variation in 2021 looks similar to that in pre-COVID-19 years. The most congested PM peak was found on Friday.

Monday and Friday had unique traffic patterns in 2021. Monday morning's traffic was lower than that of the middle weekdays but higher than Friday; Monday had the least afternoon congestion among weekdays. Friday had the least morning congestion among weekdays, but congestion on Friday afternoons was worse than all other weekdays.

Weekend days had the lowest traffic in the week, Sunday lower than Saturday, with no pronounced AM and PM peaks. During these two days, traffic was highest mid-day (1:00 – 3:00 PM).

Figure E-4: 2021 Monthly Variation of Congestion: Total AM and PM Peaks

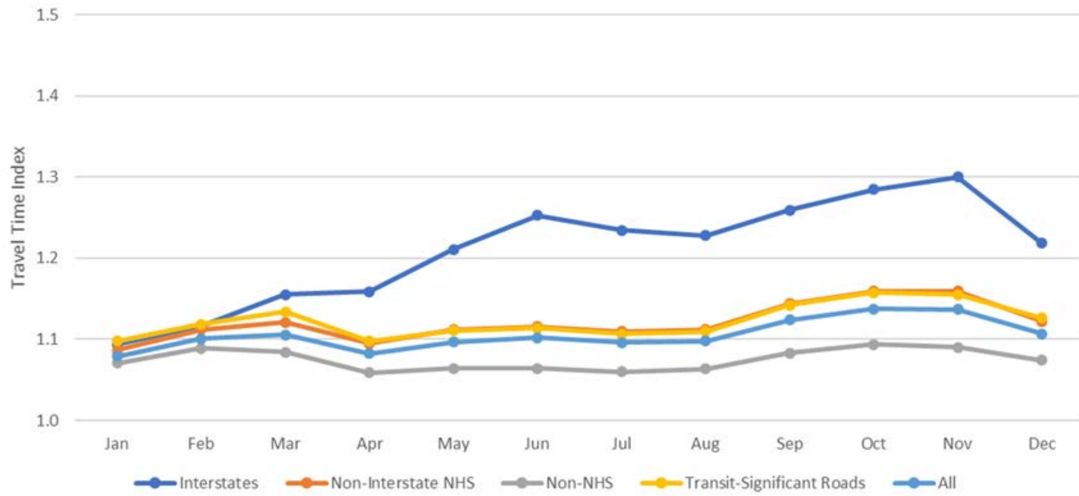
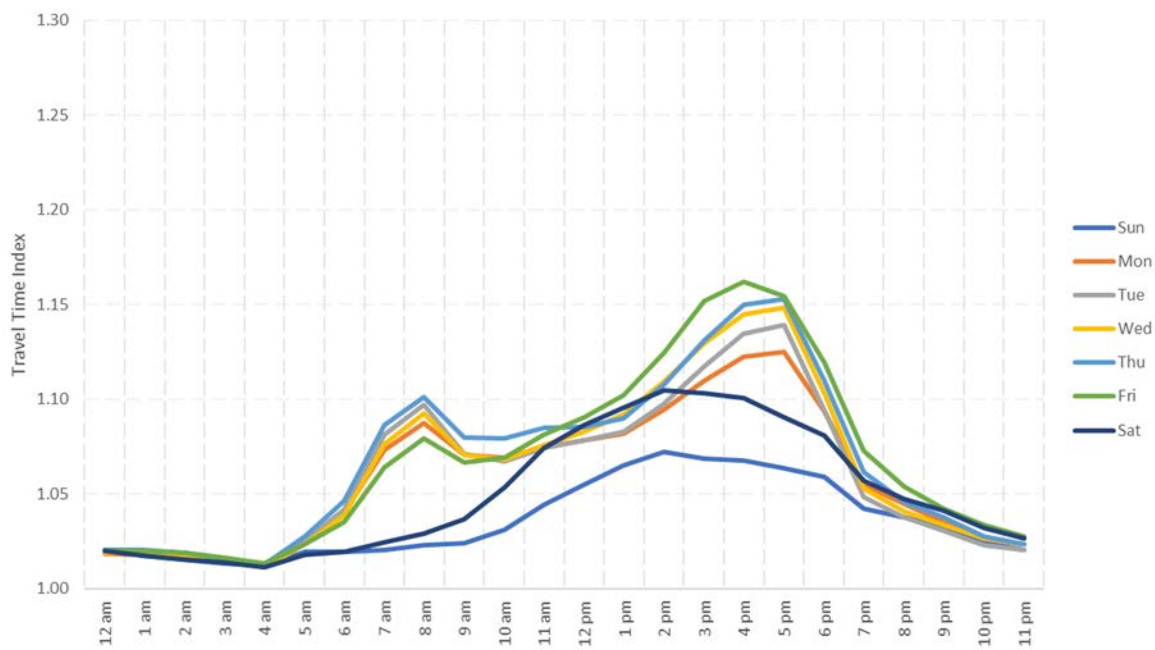


Figure E-5: Time of Day and Day of Week Variation of Congestion in 2021



TOP BOTTLENECKS

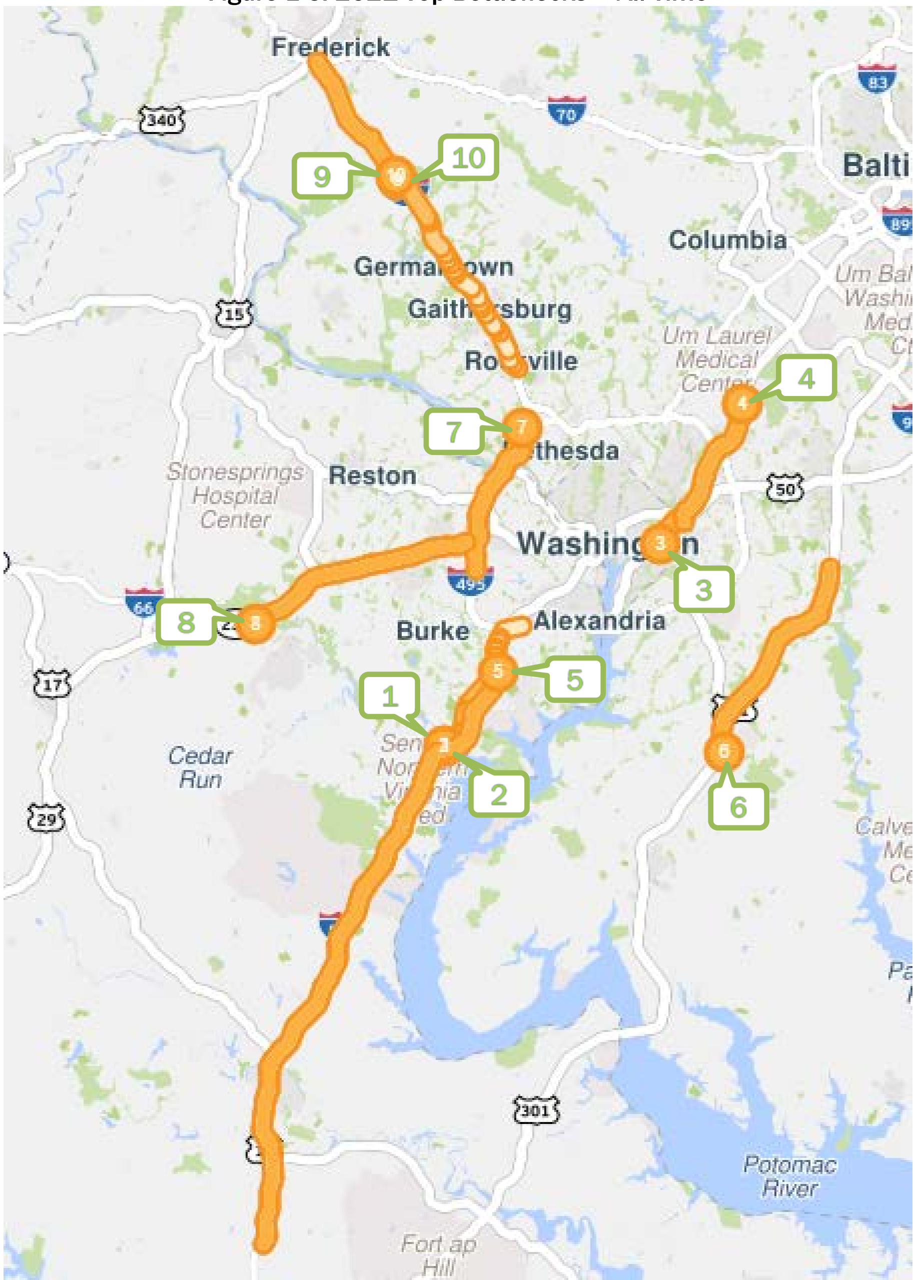
This report presents "all-time", i.e. 24/7/365, top bottlenecks by taking advantage of the Bottleneck Ranking tool in the Probe Data Analytics (PDA) Suite of the Regional Integrated Transportation Information System (RITIS) provided by the University of Maryland. A measure of "Base Impact" in the tool, defined as the sum of queue lengths over the duration, was chosen to rank the bottlenecks for this report. The "all-time" top bottlenecks in 2021 are summarized in Table E-1 and mapped in Figure E-6.

It is worth noting that the bottleneck ranking method for this report is different from those in previous editions of the CMP Technical Report. Travel Time Index (TTI) – an indicator of the intensity of congestion and the ratio of actual travel time to free flow travel time – and Annual Average Daily Traffic volume (AADT) were used as the essential factors in ranking the bottlenecks in the previous reports. While the methods are similar but ultimately different, use caution in comparing bottlenecks of this report to those reported in the previous editions.

Table E-1: 2021 Top Bottlenecks – All Time

Rank	Location	Average duration	Average max length (miles)	Total duration	Impact factor
1	I-95 S @ VA-123/EXIT 160	8 h 9 m	4.01	124 d 4 h 5 m	530,457
2	I-95 N @ VA-123/EXIT 160	4 h 11 m	4.45	63 d 19 h 32 m	386,481
3	DC-295 S @ CAPITOL ST	9 h 4 m	1.51	137 d 22 h 41 m	278,813
4	MD-295 N @ POWDER MILL RD	5 h 11 m	2.92	78 d 19 h 59 m	255,314
5	I-95 N @ VA-617/BACKLICK RD/EXIT 167	2 h 33 m	4.02	38 d 22 h 50 m	216,574
6	US-301 S @ MCKENDREE RD/CEDARVILLE RD	3 h 51 m	2.45	58 d 14 h 43 m	196,300
7	I-495 CW @ I-270-SPUR	1 h 21 m	5.92	20 d 17 h 56 m	176,892
8	I-66 W @ VA-234/VA-234-BR/EXIT 47	1 h 15 m	6.21	19 d 3 h 24 m	159,189
9	I-270 S @ MD-109/EXIT 22	1 h 54 m	3.89	29 d 2 h 53 m	153,541
10	I-270 N @ MD-109/EXIT 22	1 h 30 m	4.73	22 d 23 h 44 m	146,933

Figure E-6: 2021 Top Bottlenecks – All Time



Major Freeway Commute Routes

In addition to the regional summaries as presented by the above performance measures, route- or corridor-specific analysis has also been carried out in this report. A total of 18 major freeway commute routes are defined between major interchanges and/or major points of interest for each peak period. Travel times along the 18 major commute routes in both directions were plotted by the "Performance Charts" tool of the PDA Suite for every Tuesday, Wednesday and Thursday in 2010 and 2019-2021, as described in Chapter 2 and Appendix C.

Congestion on Arterials

Using emerging data sources such as the VPP/INRIX data, NPMRDS[4] and Bluetooth data, staff now applies such data in arterial traffic monitoring as a successor to field monitoring. Travel Time Index and Planning Time Index on all monitored roads including arterials are provided in detail in Appendices A and B.

Traffic Signals

Delays occurring at signalized intersections account for a significant portion of overall arterial and urban street delays. Improving traffic signal timing has been identified as an LRP priority area.

The TPB has conducted surveys of the status of signal optimization, most recently in 2017. Similar to previous surveys, the 2017 survey found that of the approximate total of 5,900 signalized intersections in the region, 73 percent were retimed/optimized, 24 percent not retimed/optimized, and no report received for 3 percent.

The TPB has also conducted regional surveys on traffic signals power back-up systems. The last survey was conducted as of December 31, 2017 and found that about 37% of the region's 5,900 signals were equipped with battery-based power back-up systems, and 69% were equipped with generator-ready back-up systems (most battery-based systems also have generator-ready features). These power back-up systems can improve the resiliency of the transportation network.

Congestion on Transit and Other Systems

The CMP Technical Report includes information from a variety of sources that have looked at congestion's interaction with a variety of issues and modes. Chapter 2 includes this detailed coverage. The following are a few highlights, especially focusing on the most recently emerging information.

Transit

The National Capital Region features a multimodal and diverse transit system, including Metrorail, commuter rail and a variety of bus operations. Congestion on the transit system is one of the concerns of the CMP.

Congestion on the region's roadway network often has an impact on bus transit systems. The identified congested locations, especially those on the Washington Metropolitan Area Transit Authority's (WMATA's) Priority Corridor Network and the Transit-Significant Roads as identified by the TPB's Regional Public Transportation Subcommittee (further discussed in section 2.3.1.1) are usually also bottlenecks for bus transit. Relieving roadway congestion will directly have a positive impact on bus operations, such as reducing travelers' delay, reducing bus operations costs, improving bus reliability and increasing ridership.

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[4] National Performance Management Research Data Set (NPMRDS), https://ops.fhwa.dot.gov/perf_measurement/index.htm

Congestion can also be an issue within transit. If the demand for buses, rail and trains is high and the capacity cannot keep up with that demand, then transit becomes overcrowded. Metrorail crowdedness may be observed during rush hours along certain stations. Congestion also may exist within certain transit stations, especially multimodal transit centers, e.g. Union Station. Station congestion is a congestion of a different nature, mostly due to limitations in design and circulation as well as ridership growth. Momentum, Metro's strategic plan for 2013-2025 [5] found crowded conditions at peak periods; without rail fleet expansion, most rail lines would be projected to be even more congested by 2025.

Managed Lanes Facilities

A number of HOV facilities in the region have been reconstructed to high occupancy toll lanes where HOVs continue to use the facility for free whereas single occupant vehicles can use them by paying a congestion-responsive toll.

Park-and-Ride Facilities

There are over 160,000 parking spaces at nearly 400 park-and-ride lots throughout the Washington/Baltimore Metropolitan areas where commuters can conveniently bike, walk or drive to and join up with carpools/vanpools or gain access to public transit. According to the region's Commuter Connections program: two thirds of lots have bus or rail service available; parking is free at 89% of the park-and-ride lots; and more than 25% of park-and-ride lots have bicycle parking facilities.

Airport Access

The linkage between airports and local activities is a critical component of the transportation system. The Washington region has two major airports – Ronald Reagan Washington National Airport (DCA) in Arlington, VA, and Washington Dulles International Airport (IAD) in Loudoun County, VA. The region is also served by the nearby Baltimore/Washington International Thurgood Marshall Airport (BWI). According to the most recent TPB Air Passenger Survey the majority (over 90%) of those traveling to the region's airports does so via the highway network (i.e. personal cars, rental cars, taxis, buses). Therefore, understanding ground airport access is important to congestion management.

Freight

The National Capital Region has a responsive freight system to support the vitality of the economy and quality of life. This region features a consumer and service-based economy and approximately 80% of freight by weight moving into, out of and within the region is transported by truck [6].

Future Congestion

The constrained element of Visualize 2045, the Metropolitan Washington region's long-range transportation plan, includes all regionally significant transportation projects and programs planned in the Metropolitan Washington region over the next 25-30 years. The TPB produces a performance analysis of every long-range plan, which examines trends and assesses future levels of congestion as well as other performance measures. The performance analysis of the constrained element of

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[5] WMATA, Strategic Plan 2013-2025, https://www.wmata.com/initiatives/strategic-plans/upload/momentum-full.pdf

[6] National Capital Region Freight Plan, July 2016
https://www.mwcog.org/documents/2010/07/28/national-capital-region-freight-plan-freight/

Visualize 2045 provides an overall assessment of the anticipated impacts and an indication of future levels of congestion relevant to the CMP.[7]

Plan performance analyzes the outlook of growth in the region and forecasts future congestion. The plan performance analysis examines travel demand model data to identify where congestion is expected to occur now and in the future. It looks at criteria that may affect congestion, such as changes in population, employment, transit trips, auto trips, number of lane miles, and congested lane miles. The analysis breaks down lane miles of congestion by examining the total share of congested lane miles, a comparison with a no-build alternative scenario, additional indicators of delay, and, generally, where the most lane miles of congestion would be found in 2045.

Between 2018 to 2045, the region is forecast to be home to 23% more residents and 29% more jobs in 2045 (Figure 2-32). Towards accommodating that growth, 8% more lane miles of roadway and 42% more high-capacity transit miles are planned to be constructed. The total number of trips taken is expected to increase by 22%, and transit, walk, and bike trips are expected to increase at a faster rate than single driver trips. The overall amount of driving (Vehicle Miles Traveled or VMT) is expected to increase by 20%. This is slightly less than forecast population growth, which means that VMT per capita is expected to decline by 3%. The increase in demand on the roadways is forecast to out-pace the increase in supply, leading to a significant increase in congestion.

National Comparison of the Washington Region's Congestion

The Washington region is among the most congested metropolitan areas in the nation, according to three entities that perform congestion analyses across the nation, using varying methodologies. Based on yearly delay per auto commuter, the Texas A&M Transportation Institute ranked metropolitan Washington fifth-worst in the U.S. in 2020 (most recent year available) for congestion[8]. However, based on annual average hours wasted in traffic, the INRIX company ranked the Washington region 13th in 2021[9]. And based on extra travel time compared to free flow conditions, the TomTom company ranked the region eighth in the United States in 2021[10]. See Table E-2: National Comparison of the Washington Region's Congestion.

[7] TPB, Visualize 2045 Documentation, October 17, 2018. https://www.mwcog.org/visualize2045/document-library/
[8] https://mobility.tamu.edu/umr/.
[9] INRIX, Inc., Traffic Scorecard, http://inrix.com/scorecard/
[10] TomTom, Traffic Index, https://www.tomtom.com/en_gb/trafficindex/list

Table E-2: National Comparison of the Washington Region's Congestion

Texas A&M Transportation Institute (2020 data)			INRIX Traffic Scorecard (2021 data)			TomTom Traffic Index (2021 data)		
Annual Person-Hours of Delay per Auto Commuter			Hours Lost in Congestion			Extra Travel Time compared to Free Flow Conditions		
Metro Area	Value	Rank	Metro Area	Value	Rank	Metro Area	Value	Rank
New York	56	1	Chicago	104	1	New York	35%	1
Boston	50	2	New York	102	2	Los Angeles	33%	2
Houston	49	3	Philadelphia	90	3	Miami	28%	3
Los Angeles	46	4	Boston	78	4	Baton Rouge	27%	4
San Francisco	46	4	Miami	66	5	San Francisco	26%	5
Washington	42	5	San Francisco	64	6	Chicago	24%	6
Dallas	40	6	New Orleans	63	7	Honolulu	23%	7
Chicago	39	7	Los Angeles	62	8	Seattle	23%	7
Atlanta	37	8	Houston	58	9	Riverside	23%	7
Philadelphia	37	8	Washington	44	13	Washington	21%	8

Congestion Management Strategies

The CMP has been playing an important role in developing strategies, including strategies in association with capacity-expanding projects, to combat congestion or mitigate the impact of congestion. Visualize 2045 and TPB member agencies have pursued many alternatives to capacity increases, with considerations of these strategies informed by the CMP. Implemented or continuing strategies include demand management strategies and operational management strategies, as shown in Figure E-7. It should be noted that although strategies are divided into two categories for reporting purposes in this document, demand management and operational management strategies should be designed and implemented to work in cooperation.

Demand Management Strategies

Demand Management aims at influencing travelers' behavior for the purpose of redistributing or reducing travel demand. Examples of TPB's demand management strategies include:

- Commuter Connections Program – Including strategies such as Telework, Employer Outreach, Guaranteed Ride Home, Live Near Your Work, Carpooling, Vanpooling, Ridematching Services, Car Free Day, and Bike To Work Day.
- Promotion of local travel demand management – Local demand management strategies are documented in the main body of the CMP Technical Report.
- Public transportation improvements – The Washington region continues to support a robust transit system as a major alternative to driving alone.
- Pedestrian and bicycle transportation enhancements as promoted and tracked through the Bicycle and Pedestrian Planning program – The number of bicycle and pedestrian facilities in the region has increased in recent years; the regional bikesharing program, Capital Bikeshare has more than 5,000 bikes available at 600 stations across six jurisdictions: Washington, DC; Arlington, VA; Alexandria, VA; Montgomery County, MD; Prince George's County, MD; Fairfax County, VA; and the City of Falls Church, VA.

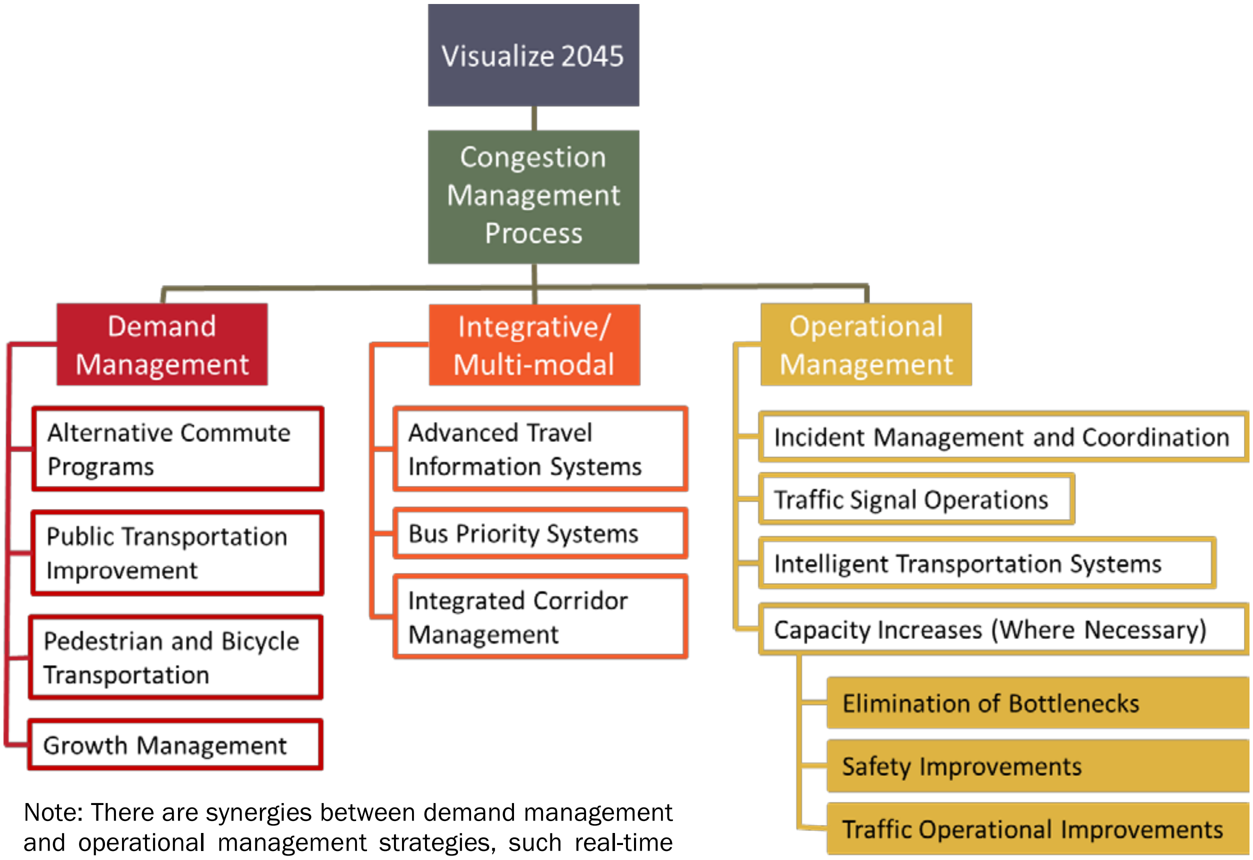
- Car sharing - Local governments work with private companies to make the region's car sharing market viable.
- Land use strategies – Including those promoted by the Transportation-Land Use Connections (TLC) Program.

OPERATIONAL MANAGEMENT STRATEGIES

Operational management focuses on improvements made to the existing transportation system to keep it functioning effectively. Examples of TPB's operational management strategies include:

- Managed Lanes Facilities, which can include high-occupancy vehicle facilities (such as on US-50 and the Dulles Toll Road) and variably-priced facilities (such as on I-66 and I-495).
- Incident Management – The region's state DOTs all pursue strategies for managing their transportation systems, including operation of 24/7 traffic management centers, roadway monitoring, service patrols, and communications interconnections among personnel, centers and systems.
- Regional Transportation Operations Coordination – Notably the Metropolitan Transportation Operations Coordination (MATOC) program, whose development the TPB helped shepherd, uses real-time transportation systems monitoring and information sharing to help mitigate the impacts of non-recurring congestion.
- Intelligent Transportation Systems are considered, particularly through the Systems Performance, Operations, and Technology Subcommittee. Examples include traffic signal optimization, adaptive traffic signal systems, safety service patrols, drone technology for accident reconstruction and traveler information.

Figure E-7: Major CMP Strategies



Note: There are synergies between demand management and operational management strategies, such real-time traveler information on ridesharing opportunities responsive to a real-time traffic incident or situation.

INTEGRATED/MULTI-MODAL STRATEGIES

While there is often overlap in demand management and operational management strategies, for example, real-time traveler information on ridesharing opportunities responsive to a real-time traffic incident or situation, there are projects in the region that fully integrate demand and operational management strategies.

- Integrated Corridor Management - MDOT and VDOT have instituted ICM efforts in major corridors.
- Advanced Traveler Information Systems – Travelers have more ways than ever for obtaining trip planning information such as traffic, incidents, real-time transit arrivals, and emergency information. The prevalence of internet capable mobile devices and social media provide new means of communication between travelers and operators.
- I-270 Innovative Congestion Management Project – MDOT's FY 2020-2025 Consolidated Transportation Program (CTP) included the I-270 Innovative Congestion Management (ICM) project to implement a series of roadway and technology-based improvements on I-270. The project would contain both roadway improvements and innovative technology and techniques to achieve the goal.

- The Virginia Regional Multi-Modal Mobility Program (RM3P) aims to leverage the collaborative use of real-time data, by both the public and private sectors in Virginia, to improve travel safety, reliability, and mobility. Combining information on conditions, incidents, and available options helps enable travelers to make beneficial travel choices.

Additional System Capacity

Federal law and regulations list capacity increases as another possible component of operational management strategies, for consideration in cases of elimination of bottlenecks, safety improvements and/or traffic operational improvements. These capacity increase projects are documented in Visualize 2045 or in the Transportation Improvement Program (TIP).

There have been relatively few major capacity-increasing projects in recent years, however. This region has an emphasis on demand and operational management strategies, such us transit improvements, the Commuter Connections program and the strategies developed by the System Performance, Operations and Technology Subcommittee.

Assessment of Congestion Management Strategies

Assessment of Implemented Strategies

The TPB assesses the implemented congestion management strategies in a variety of ways. Many strategies have specific assessments and the overall effectiveness of all strategies is evaluated by ongoing congestion monitoring and analysis.

Specific assessments (of individual or several strategies):

- A variety of surveys within the Commuter Connections Program are regularly conducted to provide firsthand data inputs for the assessments, including the Guaranteed Ride Home Customer Satisfaction Survey, Commuter Connections Applicant Placement Rate Survey, State of the Commute Survey, Employee Commute Surveys, Carshare Survey, Vanpool Driver Survey, Employer Telework Assistance Follow-up Survey, and the Bike-to-Work Day Participant Survey.

- Public transportation improvements, pedestrian and bicycle transportation improvements, and land use strategies are assessed in Regional Household Travel Surveys, and Regional Travel Trends Reports.

Overall assessments (of all implemented strategies):

a) Eastern Transportation Corridor Coalition probe-vehicle-based traffic monitoring data.
b) National Performance Management Research Data Set (NPMRDS).
c) Maryland, Virginia and the District of Columbia's Highway Performance Monitoring Systems (HPMS).

Assessment of Potential Strategies Through Scenario Planning

The TPB has conducted scenario planning studies over the years. The three most recent scenario studies are the Long Range Plan Task Force Report which identified seven initiatives for inclusion in Visualize 2045: the Multi-sector Working Group identified projects in the transportation and land use sectors with the aim of reducing greenhouse gases; and the TPB Climate Change Mitigation Study of 2021 included three “top-down” scenarios and 10 “bottom-up” scenarios exploring single and combination pathways to reduce on-road, transportation-sector greenhouse gas emissions.

The TPB has also undertaken the Transportation/Land Use Connections (TLC) Program. The TLC Program addresses the "how to" challenges related to improving transportation/land-use coordination and realizing an alternative future for the region, through providing both direct technical assistance and information about best practices and model projects.

TPB also has assessed special potential strategies on an as-needed basis.

Compiling Project-Specific Congestion Management Information

Pursuant to Federal regulations, the TPB encourages consideration and inclusion of congestion management strategies in all Single Occupancy Vehicle (SOV) capacity-increasing projects. This involves compiling and analyzing information in the Technical Inputs Solicitation Congestion Management Documentation Forms, which are submitted from regional agencies when the long-range transportation plan is developed.

The Technical Inputs Solicitation documentation requests any project-specific information available on congestion that necessitates or impacts the proposed project. Agencies compile this information from various sources, including TPB-published congestion information (if available), internal or other directly measured information, or by conducting engineering estimates.

Specifically for SOV capacity-increasing projects, the TPB requests documentation that the implementing agency considered all appropriate systems and demand management alternatives to the SOV capacity. In the Technical Inputs Solicitation documentation a special set of SOV questions is completed by implementing agencies and the TPB compiles this information.

Key Findings of the 2022 CMP Technical Report

1. Congestion – Impacts of the COVID-19 pandemic dramatically decreased congestion in the Washington region, with the Travel Time Index being much lower/better (1.17 in 2020 and 1.28 in 2021, in weekday TTI) than at any time since vehicle probe data became available for analysis in 2010. Congestion in 2021 did increase versus 2020, but was still dramatically lower than historic norms. (Sections 2.2.1.1 and 2.2.1.3).

2. Reliability – Travel time reliability (as measured by Planning Time Index) in the region improved in 2020 and 2021 versus historic norms, reflecting significantly decreased congestion due to pandemic impacts (Section 2.2.1.2).

3. Bottlenecks – Bottleneck locations in the region did change somewhat due to pandemic impacts compared to the 2019 bottlenecks reported in the 2020 CMP Technical Report, though many of the region's historic bottlenecks remained in 2021. A segment of I-95 southbound between US-1/EXIT 161 and VA-123/EXIT 160 was ranked the top bottleneck in 2021, as it was in 2019. (Section 2.2.1.6).

4. Travel Demand Management – Travel demand management continues to be an important tool for day-to-day congestion management. The Commuter Connections program remains the centerpiece to assist and encourage people in the Washington region to use alternatives to the single-occupant automobile. The transit system in the Washington region serves as a major alternative to driving alone – transit mode share is among the highest several metropolitan areas in the country (Section 3.2.1).

5. Walking and Bicycling – Walking and bicycling continue to grow in the region in part due to bikesharing and increasing connectivity in the bicycle and pedestrian network (Sections 3.2.4 and 3.2.5).

6. Variably Priced Lanes (VPLs) - VPLs provide additional options to travelers in the region. Facilities include 95Express, 395Express, 495Express, I-66, and Maryland Route 200 (Intercounty Connector (ICC)) (Section 3.3.2).

7. Regional Transportation Operations Coordination – The Metropolitan Washington Area Transportation Operations Coordination (MATOC) program continues to play an important role in coordination and communicating incident information during both typical travel days and special events such as severe weather and construction work (Section 3.3.3.4).

8. Real-time Travel Information – The increasing availability of technology to monitor, detect, and evaluate travel conditions allows operators to make changes to the transportation network through active travel demand management, traffic signal timing, and integrative corridor management. For travelers, real-time traffic and transit information are available from a number of sources through mobile applications and mobile versions of websites. Social media provides a mutually beneficial direct connection between transportation providers and users. Mobile applications related to non-auto modes, such as bikesharing and carsharing, allow travelers to be flexible with their mode choices (Section 3.4.6).

9. COVID-19 Pandemic Impacts – Beginning in March 2020, the COVID-19 pandemic had dramatic impacts on travel and transportation in the Washington region (as well as nationally). Among the transportation impacts reported were dramatic increases of telework, reduced transit ridership, increased freight movement, and increased home delivery of goods. It remains to be seen what these trends will be over the longer term, as recovery from the pandemic evolves. (Sections 2.2.1.1 and 2.2.1.2; Section 2.2.3; Section 2.3).

Recommendations for the Congestion Management Process

The 2022 CMP Technical Report documents the updates of the Congestion Management Process in the Washington region. Looking forward, the report leads to several important recommendations for future improvements.

1. **Continue the Commuter Connections program.** The Commuter Connections program is a primary key strategy for demand management in the National Capital Region and it is beneficial to have a regional approach. Meanwhile, this program in addition to reducing trips and vehicle miles of travel, reduces transportation emissions and improves air quality.

2. **Continue and enhance the MATOC program and support agency/jurisdictional transportation management activities.** The MATOC program/activities are key strategies of operational management in the National Capital Region. Future enhancements of the MATOC program should be considered when appropriate to expand the function and participation of the program.

3. **Continue to coordinate the region's Performance-Based Planning and Programming (PBPP) with the CMP.** Performance measurement and analysis are key components of both requirements, and can be accomplished synergistically.

4. **Continue to encourage integration of operations management and travel demand management components of congestion management for more efficient use of the existing**

transportation network. State DOTs are encouraged to continue to explore management strategies along congested freeways and actively manage nearby arterials. Transportation agencies (including transit agencies) and stakeholders are encouraged to work collaboratively along congested corridors.

5. **Pursue sufficient investment in the existing transportation system, which is important for addressing congestion.** Prioritizing maintenance for the existing transportation system as called for in TPB's Regional Transportation Priorities Plan is critical to congestion management.

6. **Continue variable pricing and other management strategies in conjunction with capacity increasing projects.** Variably priced lanes (VPLs) provide an option to avoid congestion for travelers and an effective way to manage congestion for agencies.

7. **Continue to encourage transit in the Washington region and explore transit priority strategies.** The transit system in the Washington region serves as a major alternative to driving alone, and it is an important means of getting more out of existing infrastructure. Local jurisdictions are encouraged to work closely with transit agencies to explore appropriate transit priority strategies that could have positive impacts on travelers by all modes.

8. **Encourage implementation of congestion management for major construction projects.** The construction project-related congestion management has been very successful in the past such as for the 11th Street Bridge and Northern Virginia Megaprojects.

9. **Continue to encourage access to non-auto travel modes.** The success of the Capital Bikeshare program and increased mode share for bicycling in a number of jurisdictions indicate that improvements can engender shifts to non-automobile transportation.

10. **Continue and enhance providing real-time, historical, and multimodal traveler information.** Providing travelers with information before and during their trips can help them to make decisions to avoid congestion and delays and better utilize the existing road and transit infrastructure. Share travel/incident information and/or partner with private sector providers of travel and navigation information, including information on multi-modal alternatives to driving.

11. **Encourage implementation of projects, programs, and processes that support the TPB Aspirational Initiatives.** The TPB included seven Aspirational Initiatives in the aspirational element of Visualize 2045 for future concerted action. These initiatives, if funded and enacted, would have the potential to significantly improve the region's transportation system performance compared to current plans and programs, offering a broad range of congestion management benefits.

12. **Encourage connectivity within and between Regional Activity Centers.** The current Regional Activity Centers map, adopted in 2013, helps coordinate transportation and land use planning for future growth. Geographically-focused Household Travel Surveys can collect data which allows planners to see local level travel patterns and behaviors impacting mode shifts.

13. **Continue and enhance the regional congestion monitoring program with multiple data sources.** There are a wealth of sources, both public and private sector, for data related to congestion which have their individual strengths and shortcomings. Private sector probe-based monitoring provides unprecedented spatial and temporal coverage on roadways, but still needs to be supplemented with data from other sources including data on traffic volumes and

traffic engineering considerations. There should be continual review of the quality and availability of data provided by different sources and the structuring of a monitoring program that is adaptable for potential future changes in data reporting and/or data sources.

14. **Monitor trends in freight, specifically truck travel.** Interrelationships between freight movement and congestion differ from interrelationships between passenger travel and congestion.

15. **Participate in collaborative planning connected and autonomous vehicle readiness.** These emerging technologies will dramatically alter future transportation planning. Standards and interoperability are critical issues and should be addressed through extensive collaboration with a variety of stakeholders.

16. **Monitor impacts of and interactions with shared mobility services.** Transportation Network Companies (TNCs) continue to have an evolving impact on a variety of aspects of congestion management, mode share, and transportation overall, but data for regional analysis remain scarce. Regulating agencies are encouraged to arrange for TNC data to be collected and shared with the TPB and other official transportation planning and operating entities, to enable analysis of impacts.

17. **Encourage Traffic Incident Management (TIM).** COG's 2018 creation of its Traffic Incident Management Enhancement (TIME) initiative highlighted the importance of TIM within congestion management. Continued TIM efforts will be beneficial to the region.

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MAIN REPORT

1. INTRODUCTION

1.1 Need for a CMP Technical Report

This report presents a technical review of the Congestion Management Process (CMP), as addressed by the National Capital Region Transportation Planning Board (TPB) at the Metropolitan Washington Council of Governments (COG).

The Fixing America's Surface Transportation (FAST) Act, signed into law by President Obama on December 4, 2015, continued the requirement for the use of the CMP in Transportation Management Areas (TMA) that was first stipulated in the SAFETEA-LU and maintained in the MAP-21 legislation.

The Infrastructure Investment and Jobs Act, also known as the Bipartisan Infrastructure Law (IIJA/BIL) was signed into law by President Biden on November 15, 2021. Although rulemaking following the IIJA/BIL has yet to occur as of this writing, the IIJA/BIL itself was silent on the topic of the CMP. This report proceeds with the assumption that previous federal requirements as updated under the FAST Act remain in place.

The CMP is similar to the previous requirements for a Congestion Management System (CMS) introduced in the Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA), except that the change in name and acronym of CMS to CMP was intended to place a greater emphasis on the planning process and environmental review process, while maintaining and developing effective management and operation strategies. Federal regulations state that Metropolitan transportation planning areas with a population of 200,000 or more, designated as a TMA, are required to have a CMP, and that long-range transportation plans developed after July 1, 2007 must contain a CMP component. Also, in metropolitan planning areas classified as non-attainment for Ozone and Carbon Monoxide (CO) under the Clean Air Act, no single occupant vehicle (SOV) capacity expanding project can receive federal funds unless it shows that the CMP has been considered.

Federal regulations state that:

> *"The transportation planning process … shall address congestion management through a process that provides for <u>safe and effective integrated management and operation</u> of the multimodal transportation system, based on a cooperatively developed and implemented <u>metropolitan-wide</u> strategy, of <u>new and existing</u> transportation facilities…*
> *…through the use of <u>travel demand reduction</u> …, job access projects, and operational management strategies."*[11]

[11] "Statewide and Nonmetropolitan Transportation Planning; Metropolitan Transportation Planning; Final Rule," *Federal Register*, Vol. 81, No. 103, May 27, 2016, § 450.322 (a) page 34152 – emphasis added.

Additionally, a previous federal certification of the TPB planning process, dated March 2006, addressed CMS/CMP as related to the region's long-range transportation plan, then known as the Constrained Long Range Plan or CLRP[12], with the following recommendation:

> *The TPB should develop a comprehensive description of a regional Congestion Management System to demonstrate its application at critical stages of the metropolitan planning process, including the development of the CLRP, TIP, and the development of major projects and policies.*
>
> *The description should be part of the next update to the CLRP or a stand-alone document that is completed in one year from the issuance of this report. The description can build on key elements in place, including monitoring and evaluating alternatives to new capacity (such as for the Mixing Bowl Springfield Exchange and the Woodrow Wilson Bridge) and the range of congestion related strategies (such as the Commuter Connections Program).*[13]

The Congestion Management Process is intended to operate within or in conjunction with the planning process, which is the focal point for consideration of other factors, such as equity, safety, Clean Air Act requirements, transit, funding, land use scenarios, and non-motorized alternatives. The planning process also leads to decisions on which projects are programmed and implemented. The CMP provides important information to decision-makers, such as the TPB, who consider transportation planning in our region.

This report is a step in the CMP, which is an ongoing activity. Just as there are many causes of congestion, there are also many solutions. While this report documents the region's recent CMP activities, the concept of addressing congestion and meeting regional goals will continue to be an integral part of the metropolitan planning process.

1.2 The Institutional Context of the CMP in the Washington Region

The federally designated Metropolitan Planning Organization (MPO) for the region is the National Capital Region Transportation Planning Board (TPB) at the Metropolitan Washington Council of Governments (COG). The TPB is charged with producing long-range transportation plans and Transportation Improvement Programs (TIPs) for the region, which includes the District of Columbia as well as portions of the State of Maryland and the Commonwealth of Virginia. The members of the TPB include representatives from state, county, local government agencies, as well as the Washington Metropolitan Area Transit Authority (WMATA), non-voting members of the Metropolitan Washington Airports Authority, and federal agencies.

The TPB is advised by a standing Technical Committee for transportation. The TPB Technical Committee oversees details of transportation planning and engineering studies and efforts required to support the region's transportation decision-making process. The Technical Committee has a number of standing subcommittees that focus on particular aspects of the transportation planning

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[12] Prior to 2018, the TPB's long-range transportation plans were known by the name Constrained Long-Range Plan, or CLRP. TPB published a successor to the CLRP in 2018, expanding the plan and naming it Visualize 2045; the term "CLRP" is no longer used. Henceforth the CMP Technical Report will use the terminology of either Visualize 2045, when referring to the specific 2018 document, or to the regional long-range transportation plans for more general references. The label CLRP will not be used, except for historical references and quotes.

[13] *Transportation Planning Certification Summary Report* (March 16, 2006). Prepared by Federal Highway Administration and Federal Transit Administration. Page 10. http://www.mwcog.org/uploads/committee-documents/tVpXVls20060405140322.pdf

process, such as aviation, bicycle and pedestrian planning, regional public transportation planning, travel forecasting, transportation safety, freight planning, and systems performance, operations, and technology[14].

The TPB Technical Committee is the oversight committee for the CMP, as the committee that guides long-range plan activity and oversees interaction of the various subcommittees. The Technical Committee is also advised by a number of the standing subcommittees who have knowledge about particular aspects of the CMP (for example, the Systems Performance, Operations, and Technology Subcommittee, the Commuter Connections Subcommittee, and the Travel Forecasting Subcommittee).

Original CMS/CMP activities of the region were steered by a CMS Task Force, developed in the mid-1990s. Congestion Management System reports were developed in FY 1995 and FY 1996. However, a decision was then made to fully incorporate congestion management information into the region's long-range transportation plan itself rather than having a stand-alone document, in order to achieve continuity between the CMS and the long-range plan. As such, over the years the CMS/CMP process has included data collection and analysis through compilation of information from implementing agencies associated with projects submitted to the long-range plan and TIP, and through consideration of management and operations strategies under the TPB Technical Committee and its relevant subcommittees. Following the recommendation from the 2006 federal certification review of the TPB's planning process, the 2008 CMP Technical Report represented a return to the practice of developing a separate congestion management document.

The 2010 CMP Technical Report was the first report that incorporated the Vehicle Probe Project (VPP)/INRIX data[15] and developed new performance measures. The 2012 CMP Technical Report utilized even more third-party data than the previous one, including expanded VPP/INRIX data, and traffic volume information from the Transportation Technology Innovation and Demonstration (TTID) Program of the FHWA[16]. The 2014 CMP Technical Report included updates or initiatives taking place between mid-2012 to mid-2014 and adjusted itself toward meeting MAP-21 requirements. The 2016 and 2018 CMP Technical Report summarized the region's travel trends including congestion up to the end of 2015, and 2017 respectively and congestion management strategies up to mid-2016 and 2018 respectively. The elements of the CMP were incorporated in to Visualize 2045 the region's long range plan using the 2018 Technical Report as resource document. The 2020 Technical Report continued analyses based on available vehicle probe data. The current 2022 CMP Technical Report summarizes the region's travel trends including congestion up to the end of 2021 including congestion management strategies. Section 1.5 summarizes the highlights of the 2022 Report.

1.3 Coverage Area of the CMP

The Washington region CMP covers the TPB Planning Area (Figure 1-1). As of June 30, 2022, the TPB's planning area covered the District of Columbia and surrounding jurisdictions. In Maryland these jurisdictions include Charles County, Frederick County, Montgomery County, and Prince George's County, plus cities and towns therein. In Virginia, the planning area includes Alexandria, Arlington

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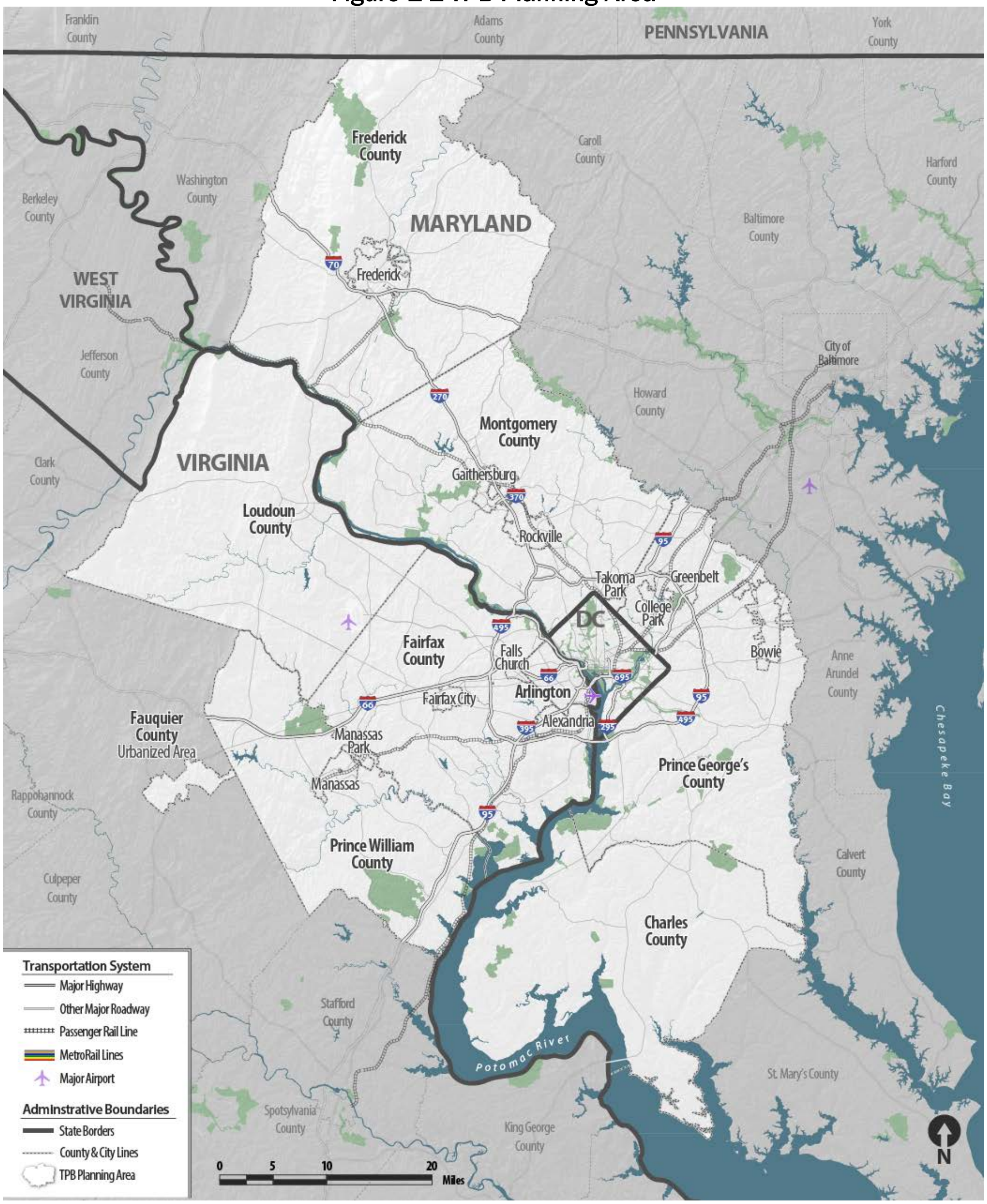
[14] As of July 2016, under the auspices of the FY2017 Unified Planning Work Program (UPWP), the former Management, Operations, and Intelligent Transportation Systems (MOITS) Technical Subcommittee was renamed the Systems Performance, Operations, and Technology Subcommittee (SPOTS), reflecting a focus on both existing and emerging topics.
[15] From the Eastern Transportation Coalition (formerly I-95 Corridor Coalition), https://tetcoalition.org/projects/vpp-marketplace/
[16] The TTID Program was discontinued in the mid-2010's, and data are no longer available.

County, the City of Fairfax, Fairfax County, Falls Church, the urbanized area in Fauquier County, Loudoun County, the Cities of Manassas and Manassas Park, and Prince William County.

Figure 1-1 TPB Planning Area



1.4 Components of the CMP

The Congestion Management Process in the National Capital Region consists of the following four components, all of which are wholly integrated into the long-range transportation plan:

1. **Monitoring and Evaluating Transportation System Performance.** This TPB effort includes congestion analyses leveraged by emerging data sources (Vehicle Probe Project (VPP) data and analysis tools), the regional transportation data clearinghouse, special studies.

2. **Defining and Analyzing Strategies.** This component involves identification of existing and potential strategies by the TPB Technical Committee, subcommittees, and staff. The TPB considers a number of demand management and operational management strategies.

3. **Compiling Project-Specific Congestion Management Information.** Pursuant to Federal regulations, the TPB encourages consideration and inclusion of congestion management strategies in all SOV capacity-increasing projects. This involves compiling and analyzing information in the CMP documentation forms that are part of the TPB's Technical Inputs Solicitation process, submitted by regional agencies when the long-range transportation plan is developed.

4. **Implementing Strategies.** This TPB effort is to focus on compiling information on strategies that have been implemented, particularly on a regional-level basis. Feedback from the process is beneficial for updating the CMP and considering additional strategies and technical methods.

1.5 Highlights of the 2022 Update of the CMP Technical Report

The 2022 CMP Technical Report builds upon the congestion facts and analyses added to the 2020 report, while still maintaining a comprehensive and updated documentation of the congestion management strategies that are considered and implemented in the National Capital Region. The highlights of the 2022 update include:

- **System Performance/Freight/CMAQ Performance Measures Final Rule.** The FHWA published a Final Rule in the Federal Register on January 18, 2017 (82 FR 5886) to establish performance measures for State Departments of Transportation (DOTs) and metropolitan planning organizations (MPOs) to report on the performance of the Interstate and non-Interstate National Highway System (NHS) to carry out the National Highway Performance Program (NHPP); freight movement on the Interstate system; and traffic congestion and on-road mobile source emissions for the purpose of carrying out the Congestion Mitigation and Air Quality Improvement (CMAQ) Program. The rule, as effective on May 20, 2017, established four congestion-related performance measures, including:

    - Percent of reliable person-miles traveled on the Interstate.
    - Percent of reliable person-miles traveled on the non-Interstate NHS.
    - A measure that assesses freight movement on the Interstate by the percentage of Interstate system mileage providing for reliable truck travel time (Truck Travel Time Reliability Index).
    - A measure that assesses annual hours of peak hour excessive delay per capita.

  TPB continues to comply and report performance measures and targets as required, with coordination as necessary with the CMP.

- **Enhanced Event-Related Analysis.** The CMP continues to use vehicle probe data and other sources to conduct event-related transportation systems performance analysis to better inform planning for operations. In addition, TPB staff has participated in after-action reviews and training/exercises held by member transportation agencies as well as under the Metropolitan Area Transportation Operations Coordination program.

- **Analysis of the Transportation Impacts of the COVID-19 Pandemic.** The COVID-19 pandemic caused major impacts and disruption to transportation demand and services beginning in March 2020. These impacts have varied since, but continue as of the writing of this report. TPB staff has compiled information and analyzed impacts on traffic and transit throughout the pandemic, providing quantification of the magnitude of impacts, short-to-mid-term trends, and observations for lessons learned for future planning. Note that short-term trends are not assumed to be an absolute prediction of trends over the long term, though there is a general sense in the transportation planning profession that transportation demand and services will experience at least some long-term impacts in the aftermath of the pandemic. Among the noted transportation impacts of the pandemic were the significantly increased use of telework, and a (likely temporary) ability for transportation agencies to make quicker-than-typical progress on roadway and transit construction projects due to reduced travel demand.

- **Disruptive Technologies and Shared Mobility.** The CMP has been monitoring the advancement of disruptive technologies such as connected and automated vehicles, enhanced mass transit systems, and the integration of such technologies with shared mobility such as ride-hailing services. These new technologies along with changed travel behaviors could potentially transform the transportation industry and alter future travel trends predicted by existing models and assumptions. The CMP will continue this monitoring and inform the long-range transportation plan and the TIP as needed.

- **Variably Priced Lanes (VPLs) Provide Options to Travelers.** The Intercounty Connector (ICC or MD 200) was opened between 2011 and 2014. The 495 Express Lanes were opened on the Virginia side of the Capital Beltway in 2012. The 95 Express Lanes in Northern Virginia were opened in 2014. The I-66 Express Lanes inside the Capital Beltway opened in 2017. I-395 Express Lanes inside the Capital Beltway opened in 2019. There are more variably priced lanes planned for the future or under construction, including on I-66, I-95 (Virginia), and I-270.

- **Periodic updates.** Since the release of the 2020 CMP Technical Report, a variety of planning and program periodic updates and outside data sources have been released. This current report uses these updates to provide the most up-to-date information for the CMP. Some critical updates include, but are not limited to:

    - Round 9.1a Cooperative Forecasts of the region's demographics
    - 2017/2018 Household Travel Survey completed and results released
    - 2020 Transportation Emissions Reductions (TERMs) Analysis Report

2. STATE OF CONGESTION

2.1 Regional Travel Trends

The Washington region had robust population growth and overall employment increase between 2010-2020 (Figure 2-1)[17]. The latest update of weekday vehicle miles traveled (VMT) per capita, available in Regional Transportation Data Clearinghouse[18], showed a 6% increase between 2014 and 2017, stayed almost the same through 2018, and then increased more than 1% in 2019. It dropped about 20% in 2020 due to measures in response to the COVID-19 pandemic.

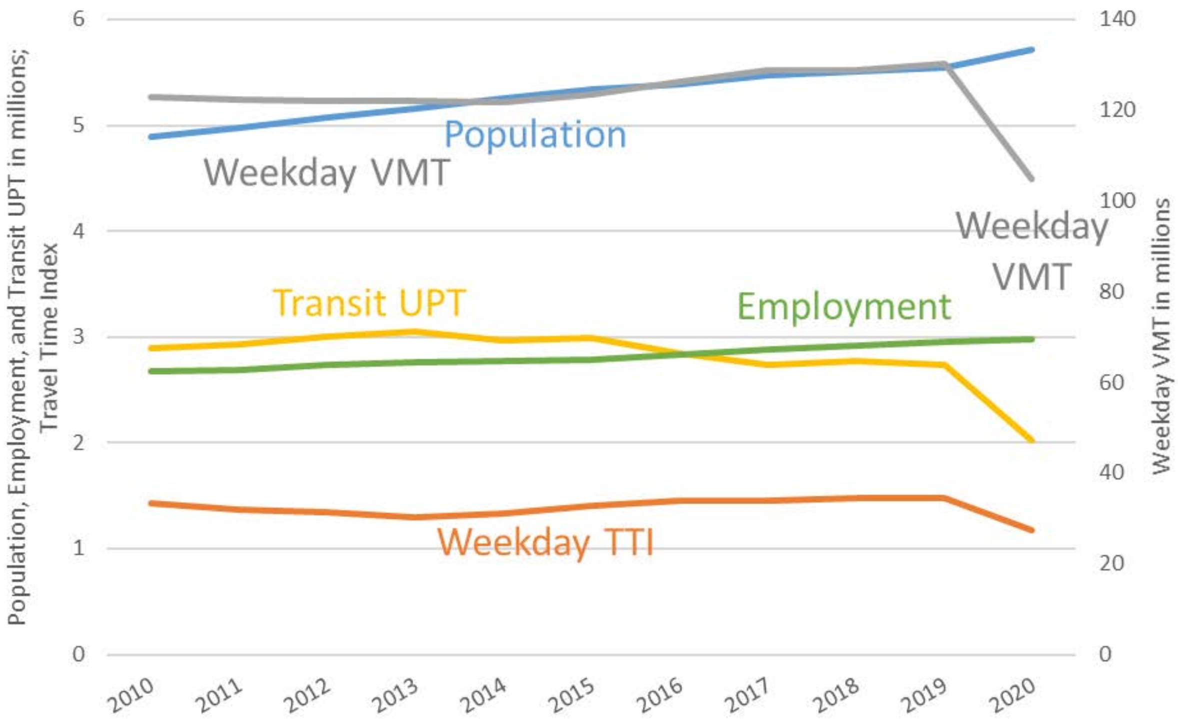
Peak period congestion, indicated by Weekday Travel Time Index (TTI), on the area's 550 directional miles of Interstates decreased slightly from 2010 to 2013, but increased in 2014 then remained almost the same until the unprecedented COVID-19 pandemic hit in early 2020. An approximate 21% drop of the Weekday Interstate TTI in 2020 was observed due to COVID-19 impacts.

Weekday transit ridership, including Metrorail, Metrobus, local transit and commuter rail, shows a consistently downward trend since 2013. There was a further 26% decrease from 2019 to 2020 due to impacts of COVID-19.

[17] Data Sources: Population – U.S. Census Bureau, Annual Estimates of the Resident Population; Transit Unlinked Passenger Trips (UPT) - The National Transit Database (NTD) in selected Reporting Year (RY usually equals July-June fiscal year); Employment – U.S. Bureau of Labor Statistics, Quarterly Census of Employment and Wages; Weekday VMT – National Capital Region Transportation Planning Board, Regional Transportation Data Clearinghouse; Weekday Transit Trips – National Capital Region Transportation Planning Board, Regional Transportation Data Clearinghouse; Weekday Travel Time Index (TTI) – This Report.

[18] https://rtdc-mwcog.opendata.arcgis.com/.

Figure 2-1 Population, Employment, Weekday VMT and Transit Ridership, and Peak Period Travel Time Index in the TPB Planning Area



With these regional trends in mind, the rest of this chapter will discuss congestion on highways, transit systems and other travel monitoring activities. A national comparison of the Washington region's congestion and an outlook of future congestion in the long-range transportation plan will be provided towards the end of this chapter.

2.2 Congestion on Highways

The Federal Highway Administration of the U.S. Department of Transportation has established a set of performance measures [82 FR 5970][19] for State departments of transportation (State DOT) and Metropolitan Planning Organizations (MPO) to use as required by the Moving Ahead for Progress in the 21st Century Act (MAP-21) and the Fixing America's Surface Transportation (FAST) Act for assessing performance of the National Highway System, Freight Movement on the Interstate System, and the Congestion Mitigation and Air Quality Improvement (CMAQ) Program, effective May 20, 2017 [82 FR 22879].

The final rule, as effective on May 20, 2017, has established the following four performance measures relevant to the CMP, including

- percent of reliable person-miles traveled on the Interstate.
- percent of reliable person-miles traveled on the non-Interstate NHS.
- percentage of Interstate system mileage providing for reliable truck travel time (Truck Travel Time Reliability Index)

[19] Federal Register, Vol. 82. No. 11, January 18, 2017.

- annual hours of peak hour excessive delay per capita.

2.2.1 The Eastern Transportation Coalition Vehicle Probe Project Traffic Monitoring

Since 2010[20], major roadways in the Metropolitan Washington area have been monitored under The Eastern Transportation Coalition Vehicle Probe Project (VPP)[21]. This project was a groundbreaking initiative and collaborative effort among the Coalition, the University of Maryland and private sector data vendors, providing comprehensive and continuous real-time and historical traffic information to members.[22] The objective of this project is to acquire travel times and speeds on freeways and arterials using probe technology. While the dominant source of data is obtained from systems that use GPS to monitor vehicle location, speed, and trajectory, other data sources such as sensors may also be used.

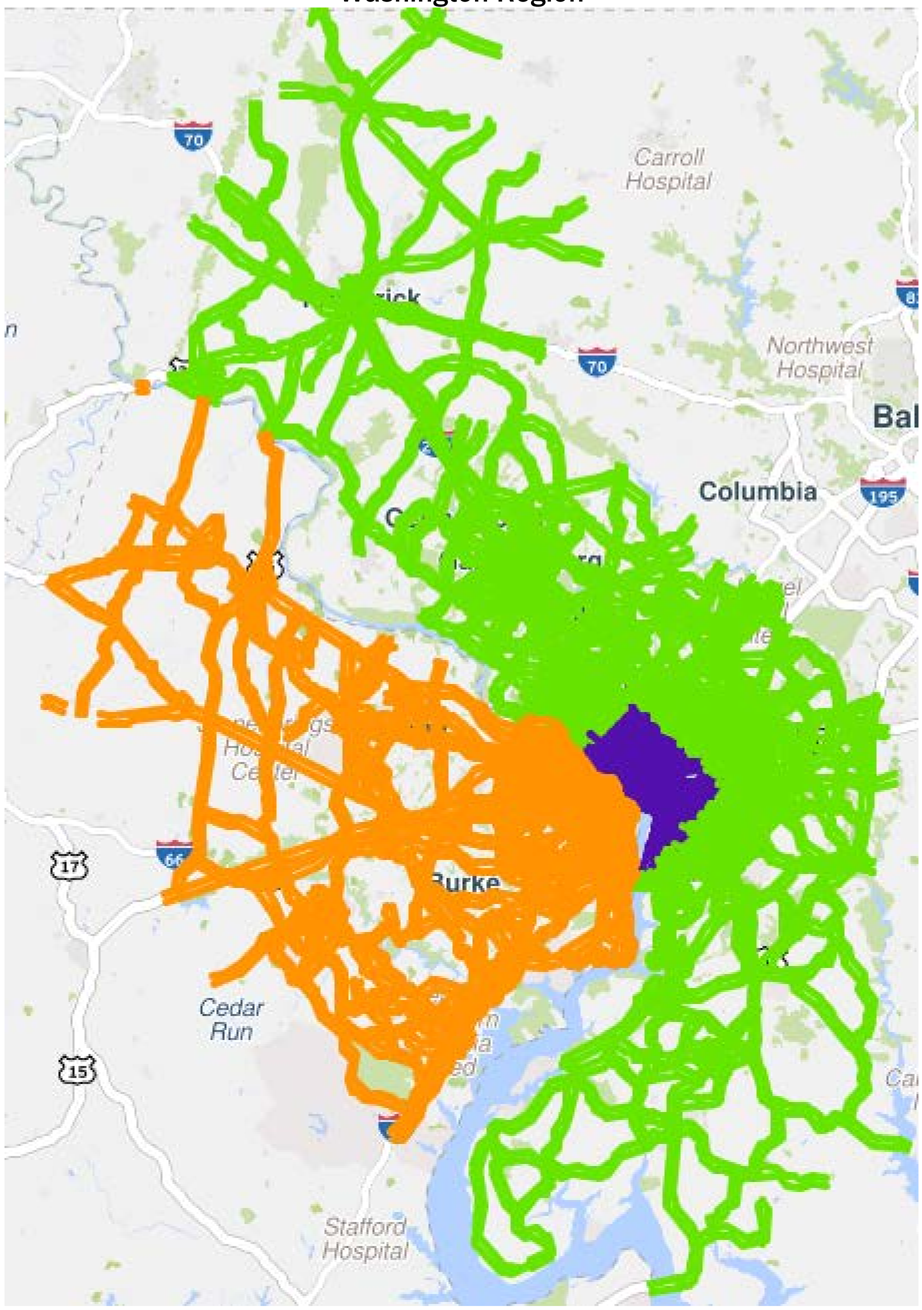
As an affiliate member of the coalition, the TPB was granted gratis access to the historical archive data in 2009. Data from vendor INRIX has been made available to the TPB. The INRIX system fuses data from various sources to present a comprehensive picture of traffic, including vehicle speed and travel time at 5-minute granularity for each road segment.

As of February 9, 2022, the VPP/INRIX data covers approximately 6,831 directional miles of roads in the TPB Planning Area (Figure 2-2), including 550 miles of the Interstate System, 2,450 miles of Non-Interstate NHS, and 3,800 miles of Non-NHS; if categorized by freeway/arterial, this coverage includes around 800 miles of freeways and around 6,000 miles of arterials.

This VPP/INRIX data source has become the TPB's major source of traffic monitoring for both freeways and arterials in the Washington region, transforming the way by which highway congestion and travel time reliability are analyzed and presented.

[20] Data for some roadways are available back to July 1, 2008.
[21] The Eastern Transportation Coalition (formerly the I-95 Corridor Coalition), https://tetcoalition.org/projects/vpp-marketplace/
[22] In 2014, the VPP data contract was re-competed by the I-95 Corridor Coalition; HERE and TomTom joined INRIX as data providers. As of this report, among those vendors, only data from INRIX has been made available gratis to TPB.

Figure 2-2 The Eastern Transportation Vehicle Probe Project/INRIX Data Coverage in the Washington Region



(Screenshot captured on the VPP Suite developed by the CATT Lab of University of Maryland.)

2.2.1.1 Travel Time Index

Travel Time Index (TTI) is an indicator of the intensity of congestion, calculated as the ratio of actual experienced travel time to free flow travel time. A travel time index of 1.00 implies free flow travel without any delays, while a travel time index of 1.30 means one has to spend 30% more time to finish a trip compared to free flow travel.

The annual average Travel Time Index on monitored highways in the TPB Planning Area is shown below. Figure 2-3 is the average TTI of total AM Peak (6:00-10:00 am) and PM Peak (3:00-7:00 pm) on all weekdays in a year, Federal holidays excluded, Figure 2-4 is the TTI for the AM Peak, and Figure 2-5 is the TTI for the PM Peak. The TTI is reported by the following five highway categories:

i. Interstate System, about 550 directional miles.
ii. Non-Interstate NHS, about 2,450 directional miles. The NHS designation used in this report was defined on October 1, 2012. The MAP-21 NHS includes all principal arterials[23].
iii. Non-NHS, about 3,800 directional miles. This category mainly includes minor arterials covered by the VPP/INRIX data.
iv. Transit-Significant Roads[24], about 950 directional miles. This category consists of road segments with at least 6 buses in the AM Peak Hour (equivalent to one bus in either direction every 10 minutes) and the total length is about 1,400 directional miles in the TPB planning area, but only 950 miles of which are covered by the VPP monitoring. This category could include Interstate, Non-Interstate NHS and Non-NHS by definition.
v. All Roads, about 6,831 directional miles. This is the set of all roads covered by the VPP/INRIX data in the TPB Planning Area.

Observations from examining the regional annual average TTI for 2010-2021 include:

- Overall, the Peak Period congestion in 2020 dropped significantly due to measures in response to the unprecedented COVID-19 pandemic. In 2021, the regional congestion intensity was still lower than those in pre-pandemic years even though a rebound from 2020 was observed.

- Even with the COVID-19 impacts, the Interstate was the most congested and the Non-NHS was the least congested roadway network among all highway categories. Transit-Significant Roads was the second most congested category, highlighting the challenges facing transit bus operations.

- The region's PM Peak Period was more congested than the AM Peak Period over the years, especially on Interstates. One exception was on the Non-NHS roads, where the difference between the two peak periods was minimal. The differences in congestion among the five highway categories were more pronounced in the PM peak than the AM peak.

2021 weekday (Monday through Friday) peak hour (8:00-9:00 am; 5:00-6:00 pm) Travel Time Index on the Interstate System and other monitored roads were visualized by the "Trend Map" tool of the I-95 Vehicle Probe Project (VPP) Suite Developed by the CATT Lab of the University of Maryland[25], as provided in Appendix A.

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[23] FHWA, National Highway System, http://www.fhwa.dot.gov/planning/national_highway_system/nhs_maps/
[24] Pu, W. National Capital Region Congestion Report, 1st Quarter 2015, p.11-12. https://www.mwcog.org/file.aspx?D=IhCuCwV1tlyW641B%2bg%2b4SF%2bN6k9XjI4cbRqIHxnFodA%3d&A=Z7cxzRwPfUbEVw2pIDS3kvWdOO5DkTrGjfVIJNmt8XE%3d
[25] Center for Advanced Transportation Technology Laboratory (CATT Lab), University of Maryland, Vehicle Probe Project Suite, http://www.catt.umd.edu/research/vehicle-probe.

Figure 2-3 Annual Average Travel Time Index by Highway Category: Total AM and PM Peaks

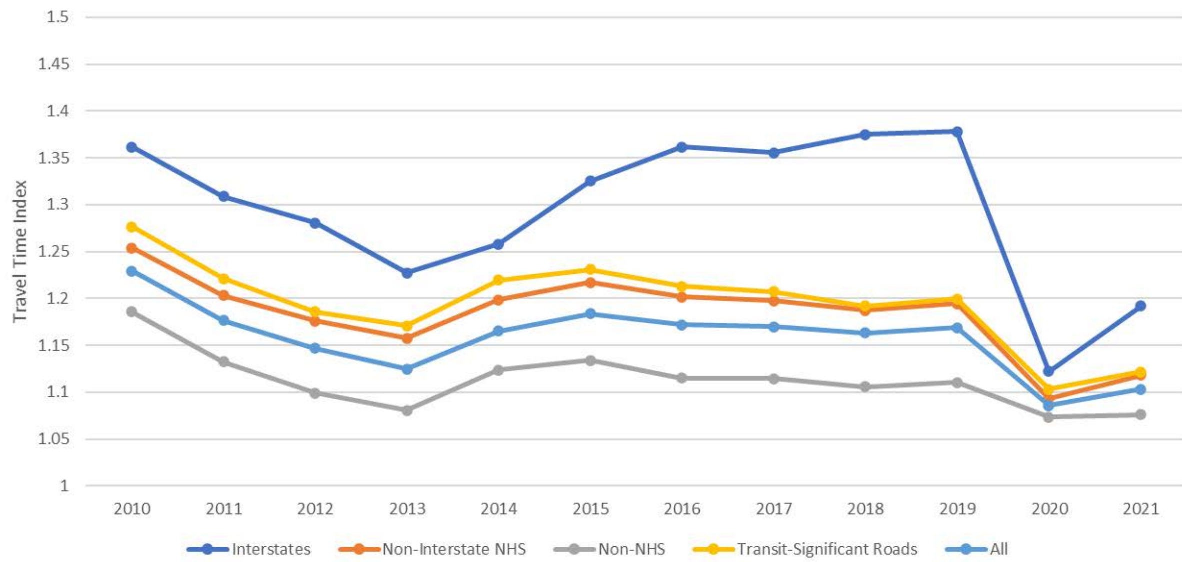


Figure 2-4 Annual Average Travel Time Index by Highway Category: AM Peak

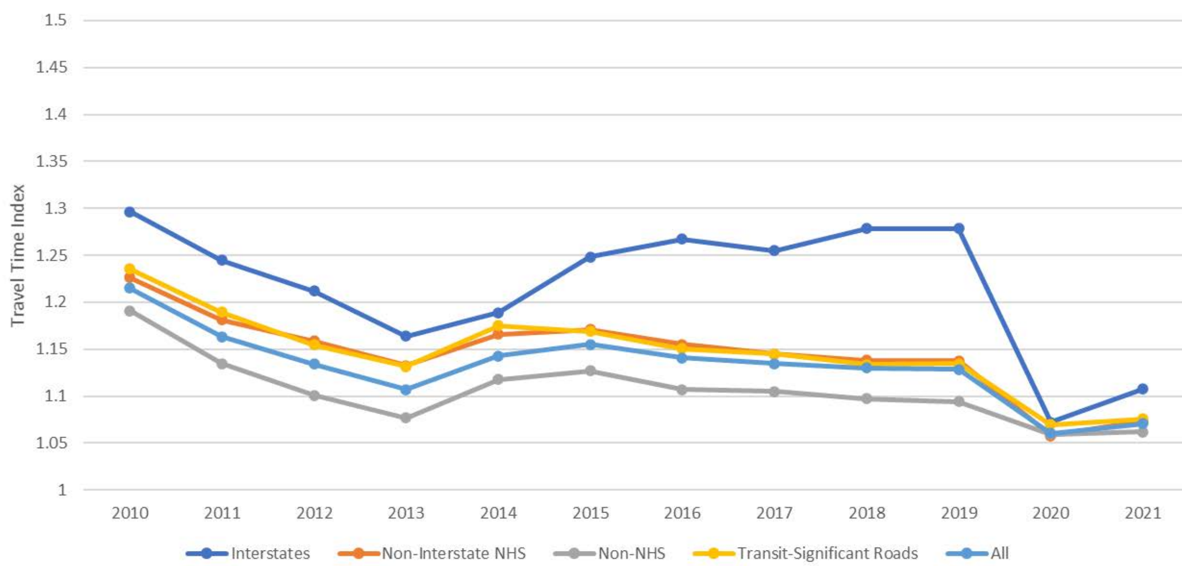
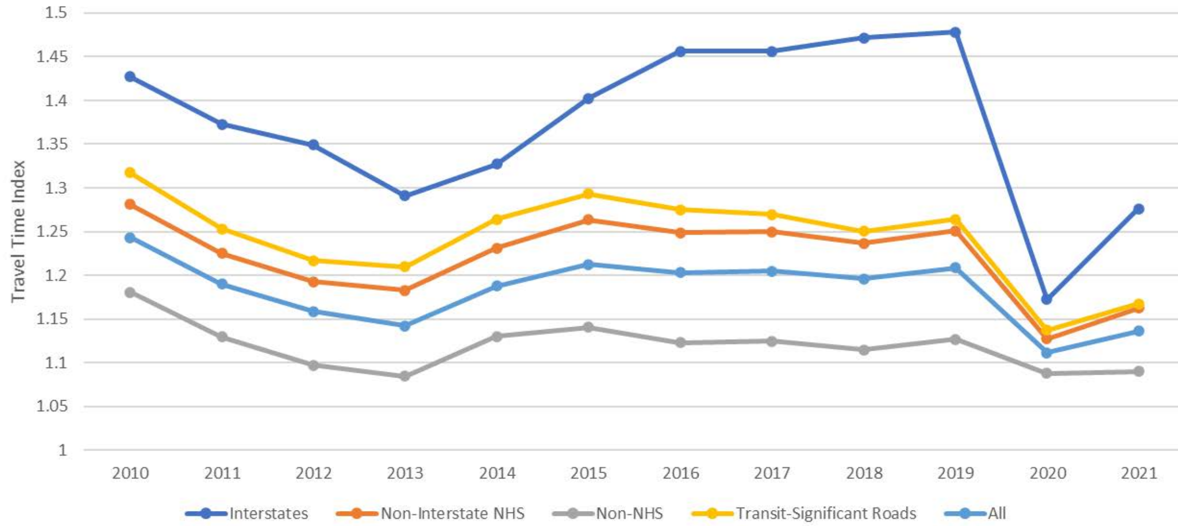


Figure 2-5 Annual Average Travel Time Index by Highway Category: PM Peak



2.2.1.2 Planning Time Index

To most travelers, everyday congestion, particularly peak period congestion, is common and they often adjust their schedules or plan extra time to allow for the expected delays; what troubles travelers most are unexpected or much-worse-than-expected delays, which can be caused by incidents, inclement weather, work zones, and the like. Travelers thus want travel time reliability - a consistency or dependability in travel times, as measured from day to day or across different times of day[26] - to avoid being late.

To quantify travel time reliability (or unreliability), this report adopts Planning Time Index (PTI), the ratio of 95th percentile travel time over free flow travel time. It expresses the extra time a traveler should budget in addition to free flow travel time in order to arrive on time 95 percent of the time. The difference between 95th percentile travel time and free flow travel time is called Planning Time. For example, a 30-minute free flow travel with a Planning Time Index of 2.00 requires 60 minutes in budget to ensure on-time arrival, and thus the Planning Time is 30 minutes.

The annual Planning Time Index on monitored highways in the TPB Planning Area is shown below. Figure 2-6 is the average PTI of total AM Peak (6:00-10:00 am) and PM Peak (3:00-7:00 pm) on all weekdays in a year, Federal holidays excluded. Figure 2-7 is the PTI for the AM Peak, and Figure 2-8 is the PTI for the PM Peak. The PTI is reported by the five highway categories described above in the Travel Time Index section.

Observations from examining the regional annual average PTI for 2010-2021 include:

- On average, this region's travelers should budget 1.29 times of their free-flow travel times to arrive destinations on-time 95% of the time, a little less budget if traveling in the AM peak and a little more in the PM peak. If traveling mostly on freeways, the budgeted time should be about one and a third times of the free-flow travel time, i.e. 1.21 times in the AM peak and 1.36

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[26] Federal Highway Administration, *Travel Time Reliability Measures*, http://ops.fhwa.dot.gov/perf_measurement/reliability_measures/index.htm

times in the PM peak. These numbers are based on all directions of travel, therefore for those who traveling in the peak direction would need to even budget more.

- Overall, the Peak Period travel time reliability for all monitored roads in 2020 showed significant improvement due to measures in response to the unprecedented COVID-19 pandemic. In 2021, the numbers were still better than those in pre-pandemic years even though a rebound from 2020 could be observed.

- Even with the COVID-19 measures, the Interstate was the most unreliable and the Non-NHS was the most reliable among all highway categories. The Transit-Significant Roads system was the second most unreliable category, highlighting the reliability challenges facing transit bus operations.

- The region's PM Peak Period was less reliable than the AM Peak Period over the years, especially on Interstates. Only on the Non-NHS roads, the difference between the two peak periods seemed minimal. The differences in congestion among the five highway categories were more pronounced in the PM peak than the AM peak.

The 2021 weekday (Monday through Friday) peak hour (8:00-9:00 am; 5:00-6:00 pm) Planning Time Index on the Interstate System and other monitored roads were visualized by the "Trend Map" tool in the VPP Suite, as provided in Appendix B.

Figure 2-6 Annual Average Planning Time Index by Highway Category: Total AM and PM Peaks

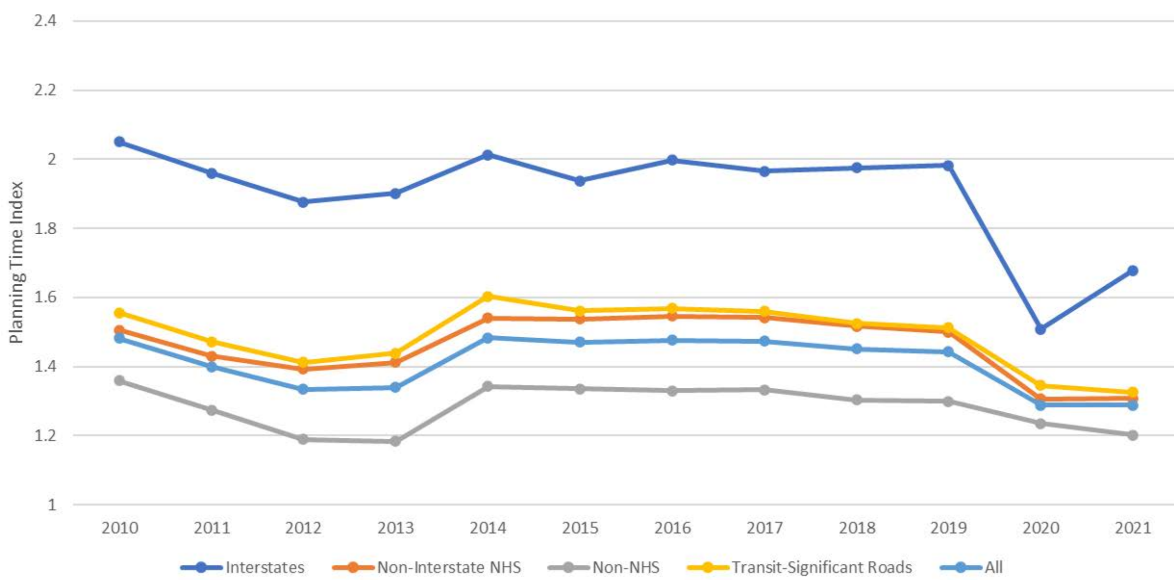


Figure 2-7 Annual Average Planning Time Index by Highway Category: AM Peak

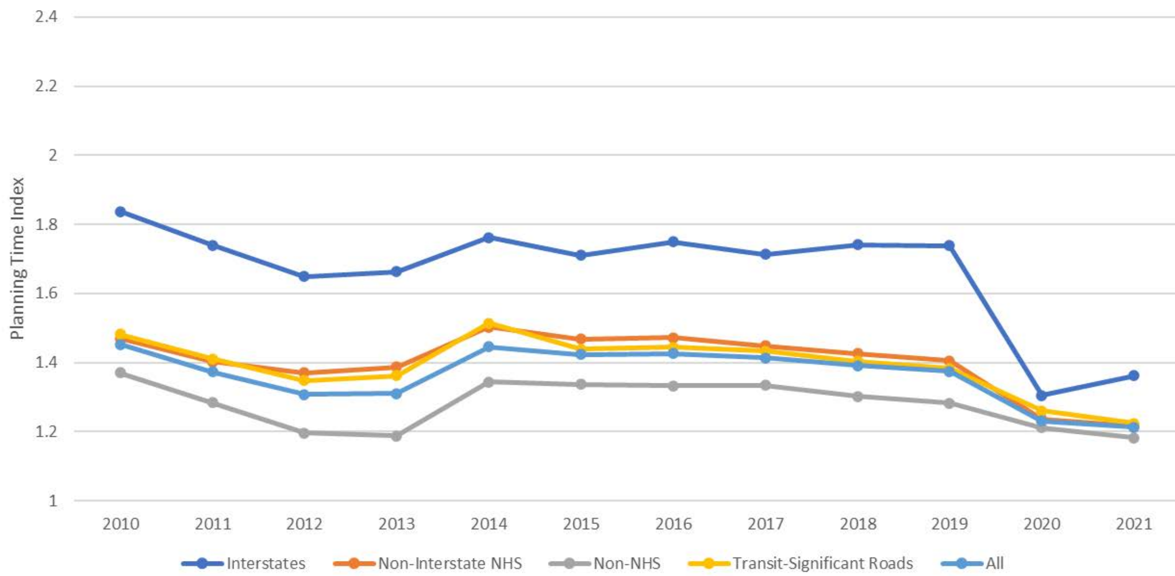
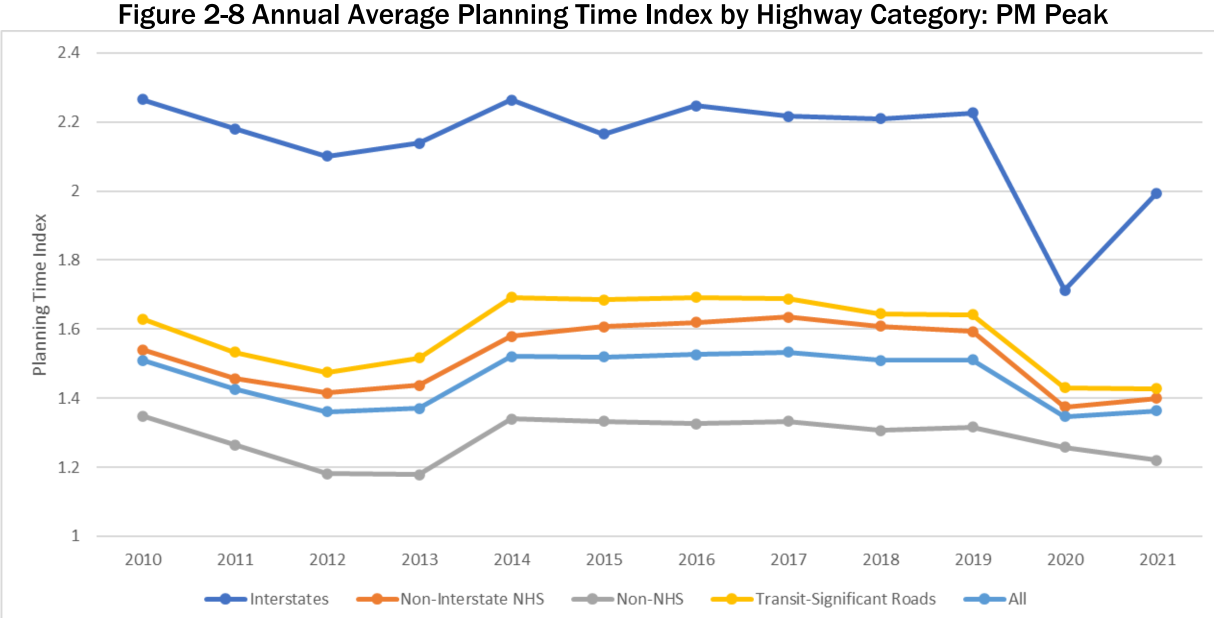


Figure 2-8 Annual Average Planning Time Index by Highway Category: PM Peak



2.2.1.3 Percent of Congested Miles

Percent of Congested (Directional) Miles is a system-wide measure that captures the spatial extent of congestion. According to the National Transportation Operations Coalition, if actual travel time is 30% longer than the free-flow travel time, i.e., Travel Time Index > 1.3, congestion is defined.

The annual average Percent of Congested Miles on monitored highways in the TPB Planning Area is shown below. Figure 2-9is the average percentage of both AM Peak (6:00-10:00 am) and PM Peak (3:00-7:00 pm) on all weekdays in a year, Federal holidays excluded, Figure 2-10 is the percentage for the AM Peak, and Figure 2-11 is the percentage for the PM Peak. The percentage is reported by five highway categories as described earlier.

Observations from examining the Percent of Congested Miles for 2010-2021 include:

- Overall congestion trends are similar to what was observed in the Travel Time Index as described earlier.
- On average, this region observed about 7% of all monitored roads congested during peak periods in 2021, and that was a slight increase from 5% in 2020. More specifically, 20% of Interstate, 9% of non-Interstate NHS, 3% of non-NHS, and 9% of transit-significant roads were congested in 2021.
- There were fewer roads congested in the AM peak period than the PM peak period. 30% of congested miles on Interstate were observed during the PM peak period in 2021. It is about the same level in 2013 and a rebound from 18% in 2020,

Figure 2-9 Annual Average Percent of Congested Miles by Highway Category: Total AM and PM Peaks

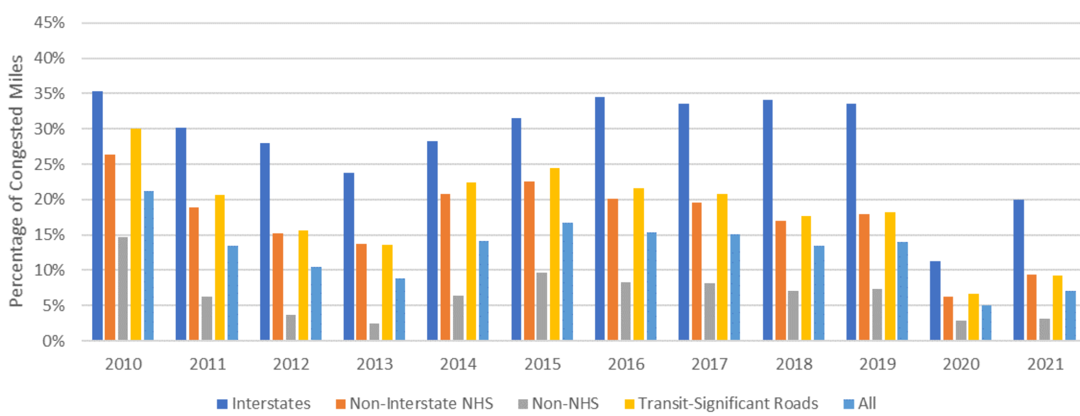


Figure 2-10 Annual Average Percent of Congested Miles by Highway Category: AM Peak

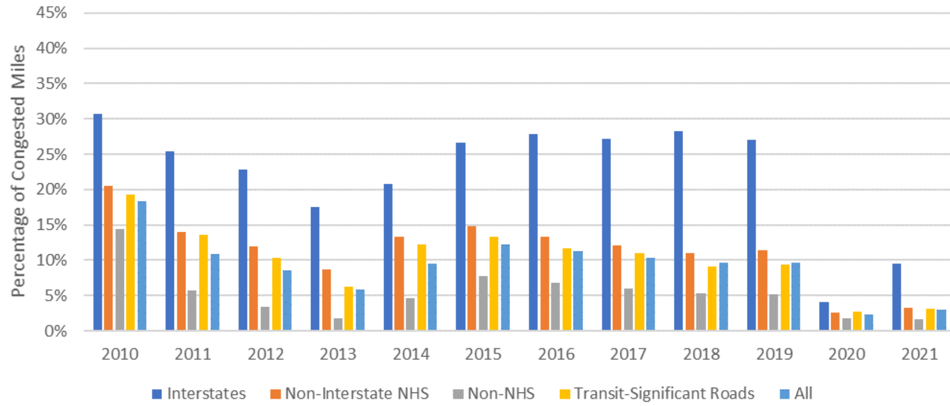
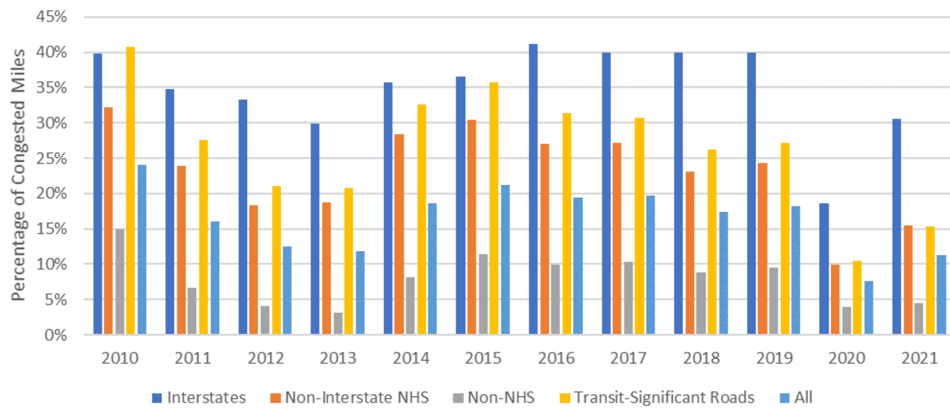


Figure 2-11 Annual Average Percent of Congested Miles by Highway Category: PM Peak



2.2.1.4 Congestion Monthly Variation in 2021

Congestion varies from month to month within a year, as shown in Figure 2-12 (total AM and PM peaks), Figure 2-13 (AM Peak), and Figure 2-14 (PM Peak). Monthly variation of congestion in 2021 had the following characteristics in the Washington region:

- Monthly variations of congestion were most pronounced on the Interstate System, followed by the Transit-Significant Roads, the Non-Interstate NHS, and the Non-NHS had the least fluctuations.
- In pre-COVID-19 years, the region overall had increasing congestion from January to May, then decreasing congestion through August. September and October again had higher levels of congestion, with decreasing congestion in November and December. Notably, monthly patterns were different with COVID-19 measures implemented in 2020 and 2021. Traffic in the NCR rebounded slowly in 2021, especially those on Interstates. The pattern of dropping in August looked similar to pre-COVID-19 years.
- Congestion showed a great deal of variation between the AM Peak and PM Peak on the Interstate System in 2021. For the AM Peak, September represented the undoubtedly "high" month; November was the "high" month for the PM Peak.

Figure 2-12 Monthly Variation of Congestion in 2021: Total AM and PM Peaks

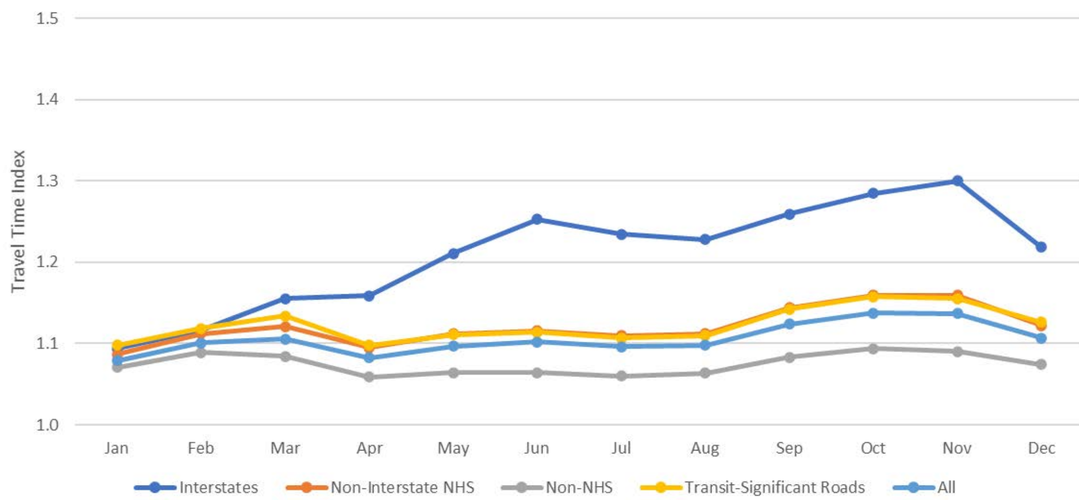


Figure 2-13 Monthly Variation of Congestion in 2021: AM Peak

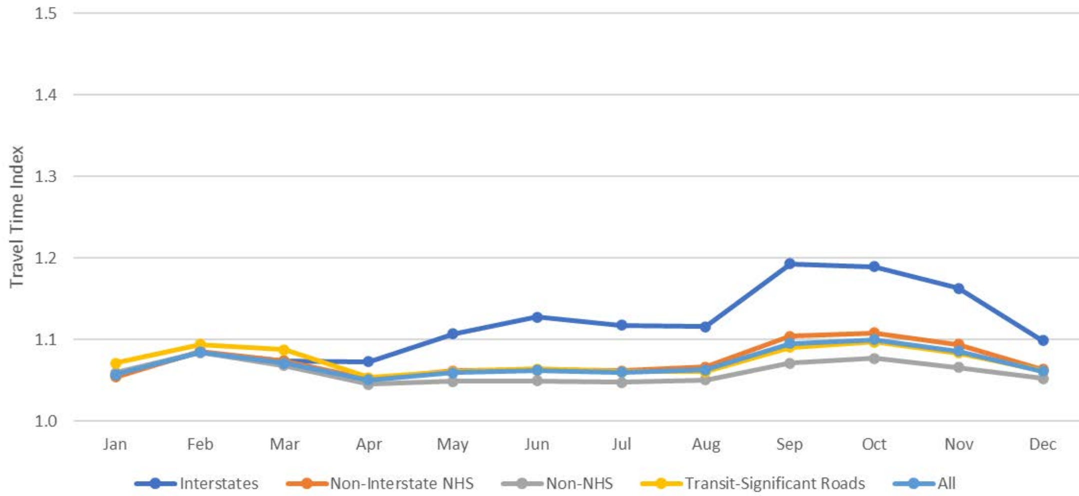
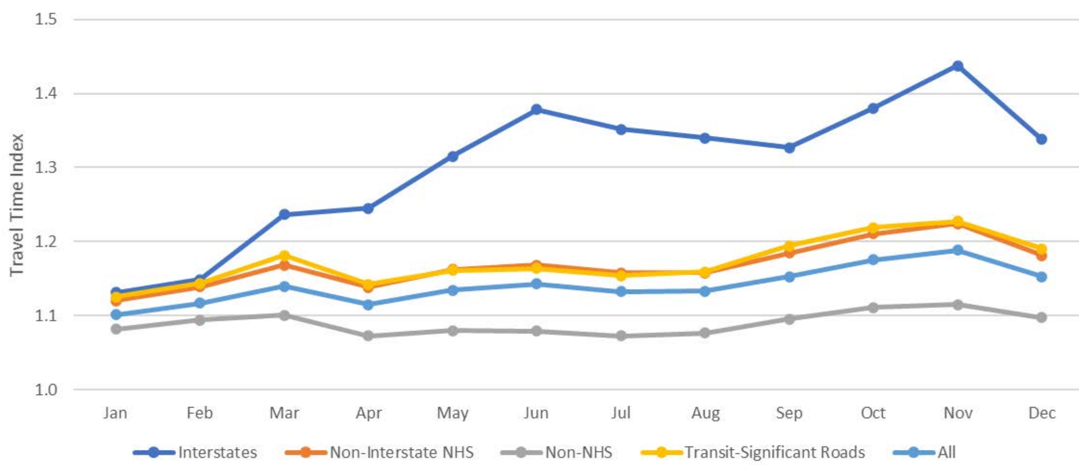


Figure 2-14 Monthly Variation of Congestion in 2021: PM Peak



2.2.1.5 Congestion Time of Day, Day of Week Variation in 2021

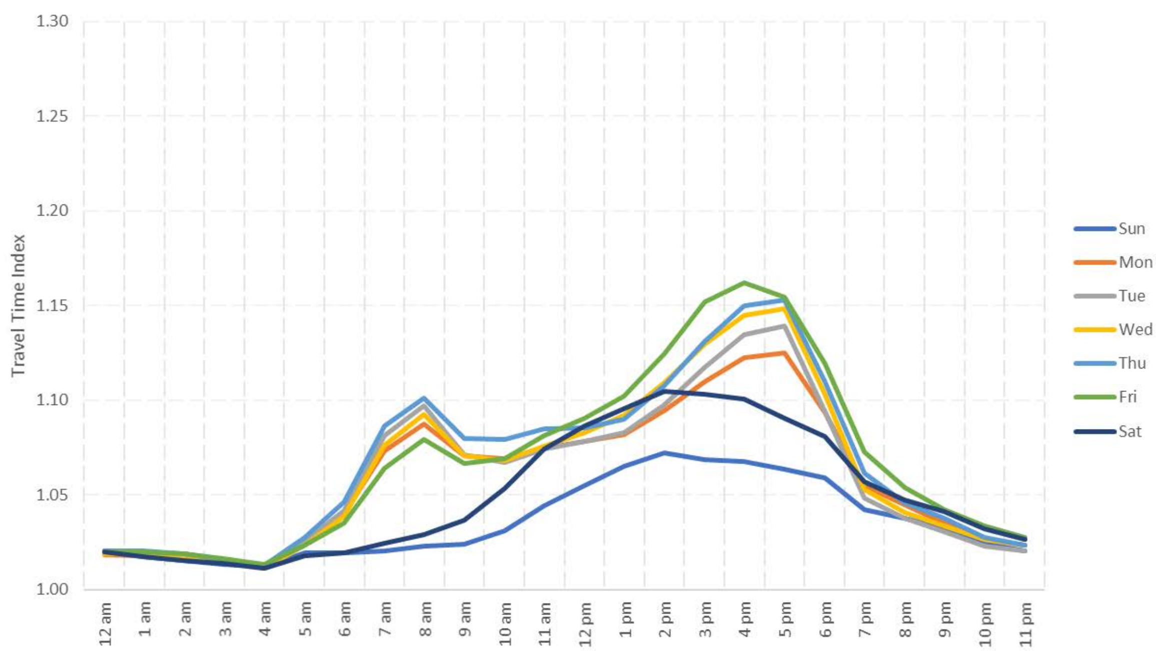
Congestion also varies within a week, as shown in Figure 2-15. The day of week variation of congestion in the Washington region in 2021 had the following trends. Note that these trends are a summary of all the 6,831 directional miles of roads in the region; different areas, highway facilities and routes may vary differently.

- Even with COVID-19 measures, the two-peak pattern of congestion variation in 2021 looks similar to that in pre-COVID-19 years. The most congested PM peak was found on Friday.

- Monday and Friday had unique traffic patterns in 2021. Monday morning's traffic was lower than that of the middle weekdays but higher than Friday; Monday had the least afternoon congestion among weekdays. Friday had the least morning congestion among weekdays, but congestion on Friday afternoons was worse than all other weekdays.

- Weekend days had the lowest traffic in the week and Sunday lower than Saturday with no pronounced AM and PM peaks. During these two days, traffic was highest mid-day (1:00 – 3:00 PM).

Figure 2-15 Time of Day and Day of Week Variation of Congestion in 2021



2.2.1.6 Top Bottlenecks

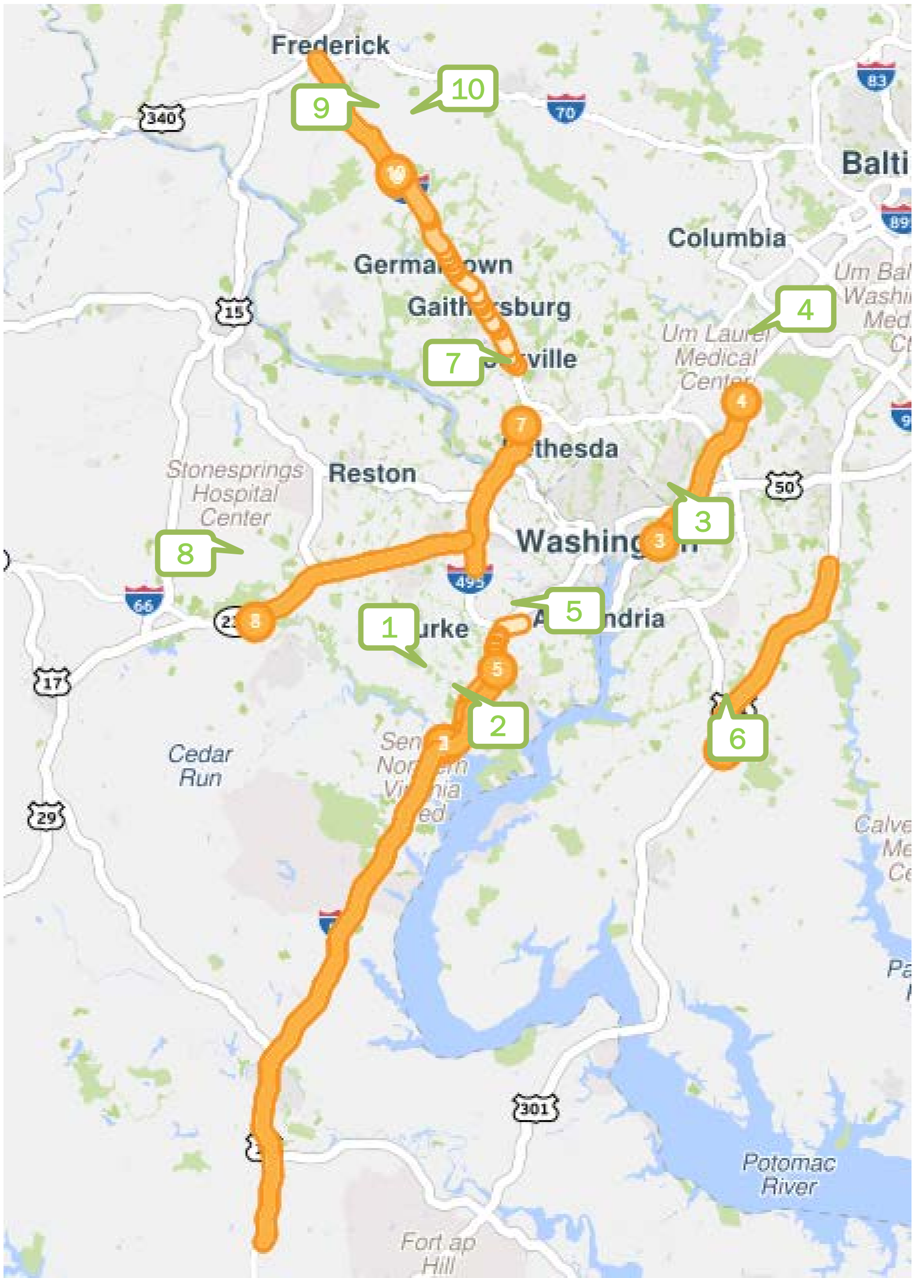
This report presents “all-time”, i.e. 24/7/365, top bottlenecks by taking advantage of Bottleneck Ranking tool in the Probe Data Analytics (PDA) Suite of the Regional Integrated Transportation Information System (RITIS) provided by the University of Maryland. To be consistent with the ranking method in National Capital Congestion Reports since 2019, a measure of “Base Impact” in the tool was chosen to rank the bottlenecks for this report. According to RITIS, the “Base Impact” measure was defined as the sum of queue lengths over the duration. The “all-time” top bottlenecks in 2021 are summarized in Table 2-1 and mapped in Figure 2-16.

It is worth noting that the bottleneck ranking method for this report is different from those in previous editions of the CMP Technical Report. Travel Time Index (TTI) – an indicator of the intensity of congestion and the ratio of actual travel time to free flow travel time – and Annual Average Daily Traffic volume (AADT) were used as the essential factors in ranking the bottlenecks in the previous reports. While the methods are similar but ultimately different, use caution in comparing bottlenecks of this report to those reported in the previous editions.

Table 2-1 2021 Top Bottlenecks – All Time

Rank	Location	Average duration	Average max length (miles)	Total duration	Impact factor
1	I-95 S @ VA-123/EXIT 160	8 h 9 m	4.01	124 d 4 h 5 m	530,457
2	I-95 N @ VA-123/EXIT 160	4 h 11 m	4.45	63 d 19 h 32 m	386,481
3	DC-295 S @ CAPITOL ST	9 h 4 m	1.51	137 d 22 h 41 m	278,813
4	MD-295 N @ POWDER MILL RD	5 h 11 m	2.92	78 d 19 h 59 m	255,314
5	I-95 N @ VA-617/BACKLICK RD/EXIT 167	2 h 33 m	4.02	38 d 22 h 50 m	216,574
6	US-301 S @ MCKENDREE RD/CEDARVILLE RD	3 h 51 m	2.45	58 d 14 h 43 m	196,300
7	I-495 CW @ I-270-SPUR	1 h 21 m	5.92	20 d 17 h 56 m	176,892
8	I-66 W @ VA-234/VA-234-BR/EXIT 47	1 h 15 m	6.21	19 d 3 h 24 m	159,189
9	I-270 S @ MD-109/EXIT 22	1 h 54 m	3.89	29 d 2 h 53 m	153,541
10	I-270 N @ MD-109/EXIT 22	1 h 30 m	4.73	22 d 23 h 44 m	146,933

Figure 2-16 2021 Top Bottlenecks – All Time



2.2.1.7 Travel Times along Major Freeway Commute Routes

In addition to the regional summaries as presented by the above performance measures, route- or corridor-specific analysis has also been carried out in this report. A total of 18 major freeway commute routes are defined between major interchanges and/or major points of interest, as shown in Table 2-2 and Figure 2-17.

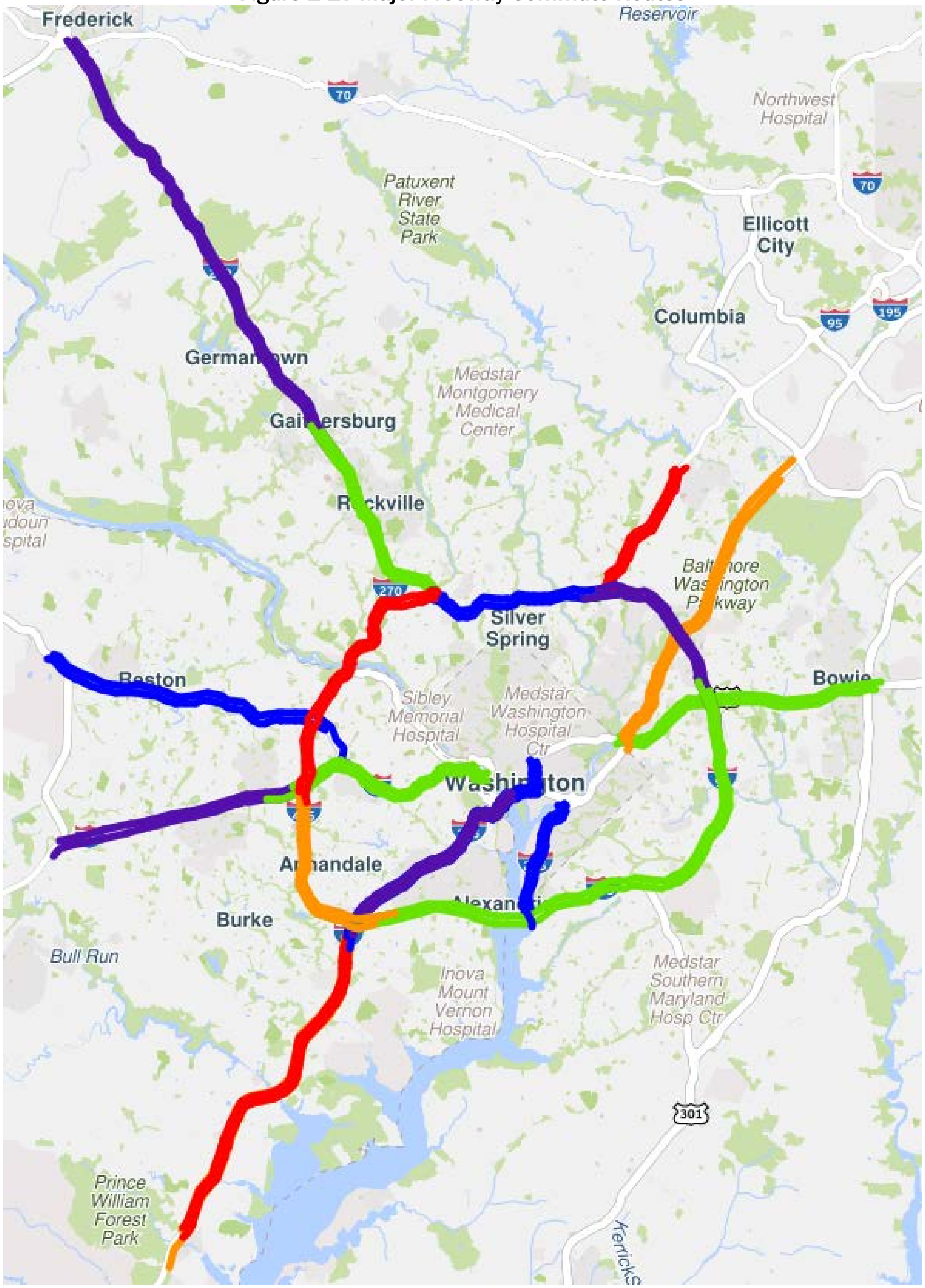
Travel times along the 18 major commute routes in both directions were plotted by the "Performance Charts" tool of the VPP Suite for every Tuesday, Wednesday and Thursday in 2010 and 2019-2021, as shown in Figure 2-18 below (one example) and Appendix C (all 18 corridors). The travel times and planning times (95th percentile travel times) during AM Peak Hour (8:00-9:00 am) and PM Peak Hour (5:00-6:00 pm) are also provided in Table 2-3 and Table 2-4.

One caveat of the method employed in the major commute route analysis is that the route travel time is calculated as *instantaneous travel time* other than *experienced travel time*. Instantaneous travel time is the travel time that would result if prevailing traffic conditions remained unchanged; in other words, the instantaneous route travel time is simply the sum of all segment travel times. The experienced travel time is the travel time of the user who has just completed the considered trip, and is generally not equal to the sum of segment travel times, especially during unstable traffic conditions. This caveat in the methodology merits future improvements.

Table 2-2 Major Freeway Commute Routes

Route Code	Description
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	Balt-Wash Pkwy 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 11th St. Bridge

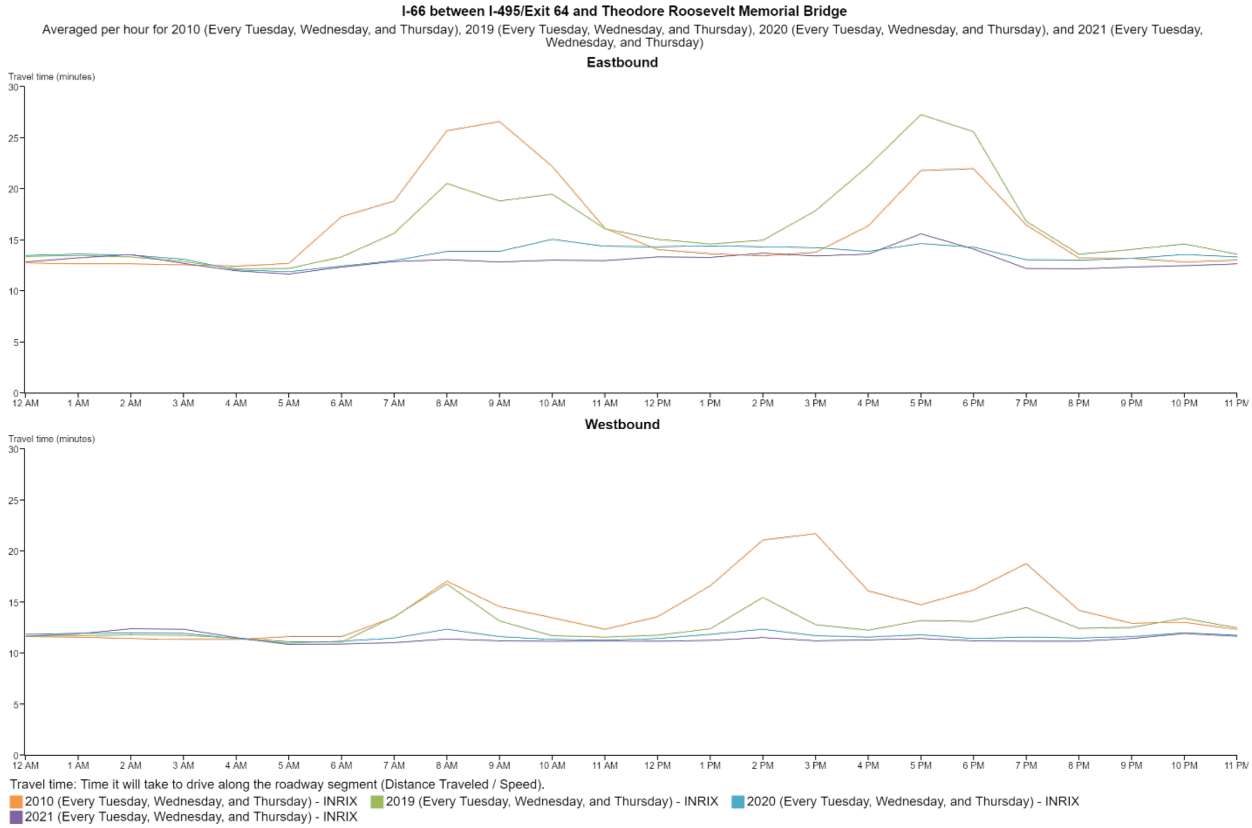
Figure 2-17 Major Freeway Commute Routes



(Screenshot was captured from vpp.ritis.org in Feb 2022)

Figure 2-18 Sample of Travel Times along Major Freeway Commute Routes

Travel time (minutes) for I-66 between I-495/Exit 64 and US-50/Arlington Memorial Bridge



NOTE: Travel time: time it will take to drive along the stretch of road (Distance traveled / Speed)

Table 2-3 Time on Major Freeway Commute Routes in AM Peak Hour (8:00-9:00 am)

Route	Length (miles)	Average Travel Time in AM Peak Hour 8:00-9:00 am (min)				Reliable (95th) Travel Time* in AM Peak Hour 8:00-9:00 am (min)				2021 Changes in Average Travel Time in AM Peak Hour (min)			2021 Changes in 95th Travel Time in AM Peak Hour (min)		
		2010	2019	2020	2021	2010	2019	2020	2021	vs. 2010	vs. 2019	vs. 2020	vs. 2010	vs. 2019	vs. 2020
C1: I-270 SB from I-70 to I-370	24	42	39	27	32	86	67	48	57	-11	-7	5	-28	-10	9
C2: I-270 SB from I-370 to I-495	11	25	21	13	12	47	35	24	18	-13	-9	-1	-29	-16	-6
C3: VA-267 EB from VA-28 to VA-123	14	26	21	15	14	59	38	22	15	-12	-7	-1	-45	-23	-7
C4: I-66 EB from VA-28 to I-495	13	29	24	17	20	63	39	31	38	-9	-5	3	-25	-1	7
C5: I-66 EB from I-495 to TR Bridge	12	26	21	14	13	47	34	22	15	-13	-8	-1	-31	-19	-7
C6: I-95 NB from VA-234 to Exit 169	19	27	28	21	25	62	49	32	42	-2	-3	4	-20	-7	10
C7: I-95 NB HOV from VA-234 to Exit 169	18	18	16	15	15	25	18	16	15	-4	-1	0	-10	-2	0
C8: I-395 NB from I-95 to H St.	14	38	40	20	26	82	77	43	47	-12	-14	5	-34	-30	4
C9: I-395 NB HOV from I-495 to US-1	11	15	17	10	10	31	30	15	11	-6	-7	-1	-20	-19	-4
C10: US-50 WB from US-301 to MD-295	13	23	23	15	16	40	37	25	26	-7	-7	1	-14	-11	1
C11: Balt-Wash Pkwy SB from MD-198 to US-50	16	28	28	20	21	62	48	47	39	-7	-7	1	-24	-9	-8
C12: I-95 SB from MD-198 to I-495	7	12	12	8	8	25	18	14	14	-4	-4	0	-12	-5	-1
C13: I-495 IL from I-270/Exit35 to I-95/Exit 27	10	14	14	11	12	22	22	15	18	-2	-2	1	-4	-4	3
C14: I-495 IL from I-95/Exit 27 to US-50/Exit19	9	11	13	10	13	14	19	14	21	2	0	3	7	2	7
C15: I-495 IL from US-50/Exit19 to I-95/Exit57	28	27	43	30	31	44	66	48	47	4	-12	1	4	-19	-1
C16: I-495 IL from I-95/Exit57 to I-66/Exit9	10	30	20	12	14	50	29	23	19	-15	-6	2	-31	-10	-4
C17: I-495 IL from I-66/Exit9 to I-270/Exit35	14	19	21	15	14	30	35	24	18	-5	-7	0	-12	-17	-5
C13: I-495 OL from I-95/Exit27 to I-270/Exit35	10	32	33	16	22	52	55	36	38	-11	-11	6	-14	-17	3
C14: I-495 OL from US-50/Exit19 to I-95	10	17	14	10	11	29	22	16	20	-5	-3	1	-9	-2	4
C15: I-495 OL from I-95/Exit57 to US-50/Exit19	29	32	38	29	30	49	60	40	40	-2	-8	1	-10	-21	-1
C16: I-495 OL from I-66/Exit9 to I-95/Exit57	10	11	11	10	10	12	15	11	11	-1	-1	0	-1	-4	0
C17: I-495 OL from I-270/Exit35 to I-66/Exit9	13	17	19	15	15	25	30	24	23	-1	-4	1	-2	-6	-1
C18: I-295 NB from I-495 to 11th St. Brdg.	6	13	19	9	11	32	38	24	25	-2	-8	2	-7	-13	1

* The majority (95%) of trips spent equal to or less than the reliable (95^{th}) travel time on the specified route. On average, a traveler could successfully complete the travel on the specified route within the reliable travel time during 19 out of 20 trips (only 1 trip could exceed the reliable travel time).

Table 2-4 Travel Time on Major Freeway Commute Routes in PM Peak Hour (5:00-6:00 pm)

Route	Length (miles)	Average Travel Time in PM Peak Hour 5:00-6:00 pm (min)				Reliable (95th) Travel Time* in PM Peak Hour 5:00-6:00 pm (min)				2021 Changes in Average Travel Time in PM Peak Hour			2021 Changes in 95th Travel Time in PM Peak Hour (min)		
		2010	2019	2020	2021	2010	2019	2020	2021	vs. 2010	vs. 2019	vs. 2020	vs. 2010	vs. 2019	vs. 2020
C1: I-270 NB from I-370 to I-70	24	37	40	29	34	74	66	49	56	-4	-7	5	-18	-10	8
C2: I-270 NB from I-495 to I-370	10	17	19	12	12	29	32	22	22	-5	-7	0	-7	-10	0
C3: VA-267 WB from I-66 to VA-28	17	20	23	17	16	33	36	23	17	-5	-7	-1	-16	-19	-5
C4: I-66 WB from I-495 to VA-28	13	28	33	21	23	49	56	49	54	-4	-10	2	5	-3	5
C5: I-66 WB from TR Bridge to I-495	11	15	13	12	11	25	18	15	13	-3	-2	0	-12	-5	-2
C6: I-95 SB from Exit 169 to VA-234	17	46	38	29	33	99	59	50	55	-12	-5	4	-44	-4	5
C7: I-95 SB HOV from Exit 169 to VA-234	17	19	16	15	15	31	21	16	16	-4	-1	1	-15	-5	0
C8: I-395 SB from H St. to I-95	14	29	40	21	25	51	71	44	47	-3	-15	4	-4	-24	3
C9: I-395 SB HOV from US-1 to I-495	11	10	12	10	10	15	15	11	11	0	-2	0	-4	-4	-1
C10: US-50 E8 from MD-295 to US-301	13	18	17	14	14	26	24	18	18	-3	-3	1	-8	-6	0
C11: Balt-Wash Pkwy NB from US-50 to MD-198	15	32	31	22	27	57	54	39	48	-5	-4	5	-9	-6	9
C12: I-95 NB from I-495 to MD-198	7	8	9	7	8	14	15	9	11	-1	-2	0	-4	-5	1
C13: I-495 IL from I-270/Exit35 to I-95/Exit 27	10	25	30	19	23	47	52	41	41	-2	-8	4	-6	-11	0
C14: I-495 IL from I-95/Exit 27 to US-50/Exit19	9	17	21	12	14	31	33	22	26	-2	-6	3	-5	-7	4
C15: I-495 IL from US-50/Exit19 to I-95/Exit57	28	30	39	30	34	44	60	41	53	5	-5	5	10	-7	12
C16: I-495 IL from I-95/Exit57 to I-66/Exit9	10	14	11	10	10	26	13	12	12	-3	0	0	-14	-1	0
C17: I-495 IL from I-66/Exit9 to I-270/Exit35	14	42	40	18	31	95	73	41	60	-11	-9	13	-35	-13	19
C13: I-495 OL from I-95/Exit27 to I-270/Exit35	10	21	13	11	13	50	22	13	22	-8	0	2	-28	0	8
C14: I-495 OL from US-50/Exit19 to I-95/Exit57	10	15	19	12	16	30	31	22	26	0	-3	4	-4	-5	4
C15: I-495 OL from I-95/Exit57 to US-50/Exit19	29	31	55	34	46	57	100	63	88	14	-10	11	31	-12	25
C16: I-495 OL from I-66/Exit9 to I-95/Exit57	10	16	21	13	16	24	32	22	26	0	-5	3	1	-7	4
C17: I-495 OL from I-270/Exit35 to I-66/Exit9	13	35	35	17	22	71	66	35	48	-13	-13	5	-24	-18	13
C18: I-295 SB from 11th St. Brdg. to I-495	7	12	21	10	13	22	33	20	28	0	-8	2	6	-5	7

* The majority (95%) of trips spent equal to or less than the reliable (95^{th}) travel time on the specified route. On average, a traveler could successfully complete the travel on the specified route within the reliable travel time during 19 out of 20 trips (only 1 trip could exceed the reliable travel time).

2.2.1.8 Congestion on Arterials

Congestion Characteristics on Arterials

An arterial highway is defined as an interrupted flow roadway. Arterials are different than freeways in that they tend to have multiple ingress and egress points, intersections, fewer lanes, and lower speeds. Due to these characteristics, the congestion on arterials can be caused from reasons different from that of freeways.

As mentioned earlier, the TPB had carried out Arterial Floating Car Travel Time Studies from 2000 – 2011 on selected NHS arterial highways in the region. These studies had identified some common themes and trends about general arterial congestion:

- There are competing demands of traveler mobility and accessibility to adjacent land uses affecting arterial operations.
- Growth and development can contribute to rapid worsening of congestion at specific locations.
- Intersections and driveways can cause slow-downs and backups along arterials.
- Arterials often experience spillover from freeways.
- Arterials tend to be heavily traveled in densely developed corridors.
- Traffic engineering improvements, such as extending a turn lane or traffic signal timing, can help soften the impacts of growth.
- By nature of design and other factors, arterials can be a mix of speeds, depending on things such as number of traffic signals, intersections, and lanes.
- Since the Washington region has a limited number of freeway lane miles, the region is especially dependent upon its arterial highways for mobility.
- Cars share the road with transit and delivery vehicles with frequent stops.

Although congestion occurs on arterials throughout the region, there are also common trends that are generally associated with the land use and urban form surrounding the arterial. For the purposes of this report, we will classify these as metro core, inner suburban and outer suburban arterials.

Arterials in the Inner Core

The characteristics of the inner core of a region, by their urban nature, can greatly impact the flow of traffic on the core's arterials:

- Pedestrian and transit access to densely populated land uses are a major focus of inner core roadways. Traffic speeds must be at a level that ensures pedestrian safety.
- The flow of traffic is more frequently interrupted by a higher concentration of signaled intersections and driveways/alleyways in the inner core.
- Intersections tend to be close together. If traffic is stopped at an intersection, sometimes backups can occur through the intersection behind it. In addition, traffic blocking an intersection could impact the flow of traffic on the cross street.
- There are not always turn lanes present, so drivers may have to wait while a car in front of them makes a turn.
- On-street parking necessitates slower traffic speeds. In addition, some inner core arterials experience worse congestion in the off-peak period because two lanes of capacity are lost due to on-street parking during the day.

- In many older areas, a grid pattern of streets allows for multiple travel routes at moderate speeds.

For example, many of these inner core characteristics play a role in the congestion on Connecticut Ave NW, between K Street NW and Nebraska Ave NW. This segment of Connecticut Ave is a dense corridor of retail and commercial activity which attracts a large number of pedestrians and drivers searching for on-street parking.

Congestion management strategies that can help manage congestion on core arterials include operations management strategies such as optimized traffic signal timing and traffic engineering improvements. Relevant demand management strategies include robust transit services in these densely populated areas, employer outreach of alternative commute programs, as well as improved pedestrian and bicycle facilities.

Arterials in the Inner Suburbs

Arterials in the inner suburbs have characteristics combined from that of the inner core and outer suburban arterials.

- Signalized intersections, especially the intersections of major arterial roadways, have capacity limitations, especially when there are high percentages of turning movements at those intersections.
- Traffic from both nearby offices and residences can cause congestion.
- There can be spillover from adjacent congested freeways.
- Strip retail and other “destination” retail activities are often located along arterials. In the inner suburbs the density of these uses is likely higher than that of the outer suburbs, and ingress/egress points are closer together. This could cause disruptions in traffic flow during peak times.
- Inner suburban areas have been experiencing welcome increases in pedestrians and transit usage in recent years, which must be considered in operations planning for arterials in these areas.

For example, these inner suburban arterial qualities are true of US 29, which extends from Arlington, VA to Centreville, VA. The segment between M Street NW in DC and Harrison Street in Arlington is lined with several strip retail areas.

US 29 is also a major alternative commuting route of I-66, and it provides access to I-66 at several different locations. US 29 experienced spillover from several major freeways in the vicinity, including I-66 and the Beltway.

Georgia Ave, between Eastern Ave NW (DC boundary) and MD 28 also experiences situations typical of inner suburban arterials. Georgia Ave links Aspen Hill area to Silver Spring, serving as one of the major commuting routes to and from DC for the communities between I-270 and I-95 in Montgomery County in Maryland. The southern part of the corridor connects to US 29 in Silver Spring, a major arterial cross the region. Georgia Ave also experienced spillover from the Beltway in Silver Spring.

Congestion management strategies that can help inner suburban arterials include operational management strategies such as optimized traffic signals, operational management improvements on nearby freeways, and traffic engineering improvements. Often off-peak signal timing in inner suburban arterials can be worse than the peak hours, as a high number of people are moving in all directions and not with peak flow movement. Relevant demand management strategies include transit services, bus rapid transit, and Commuter Connections programs (especially employer-based programs).

Arterials in the Outer Suburbs

Arterials in the outer suburbs have their own unique characteristics:

- New development in the outer suburbs may quickly overwhelm the capacities of what were until recently lightly traveled rural roads.
- Because commute distances in the outer suburbs tend to be longer, peaking characteristics of traffic are much sharper.
- Transit services and pedestrian facilities are limited.
- Not unlike the inner suburbs, strip retail and other "destination" retail activities are likely to be located along outer suburban arterials. This could cause disruptions in traffic flow during peak times.
- Outer suburban arterials can also experience spillover from major freeways. This is especially expected during the morning and evening peak period when commuters drive to and from the inner core for work.

Congestion management strategies that can help outer suburban arterials include operational management strategies such as bottleneck removal, dedicated turn lanes, and other traffic engineering improvements. Relevant demand management strategies include park-and-ride lots, commuter bus and rail services and Commuter Connections programs (especially employee-focused programs).

Congestion on Selected Arterials

Given the availability of the RITIS VPP/INRIX data, the TPB has adopted this third-party probe-based data for arterial travel time monitoring. This data source enabled more detailed analysis of travels along arterials including travel time reliability. Appendices A and B provide the peak hour Travel Time Index and Planning Time Index on most of the region's NHS arterials and other probe data monitored roadways for 2021.

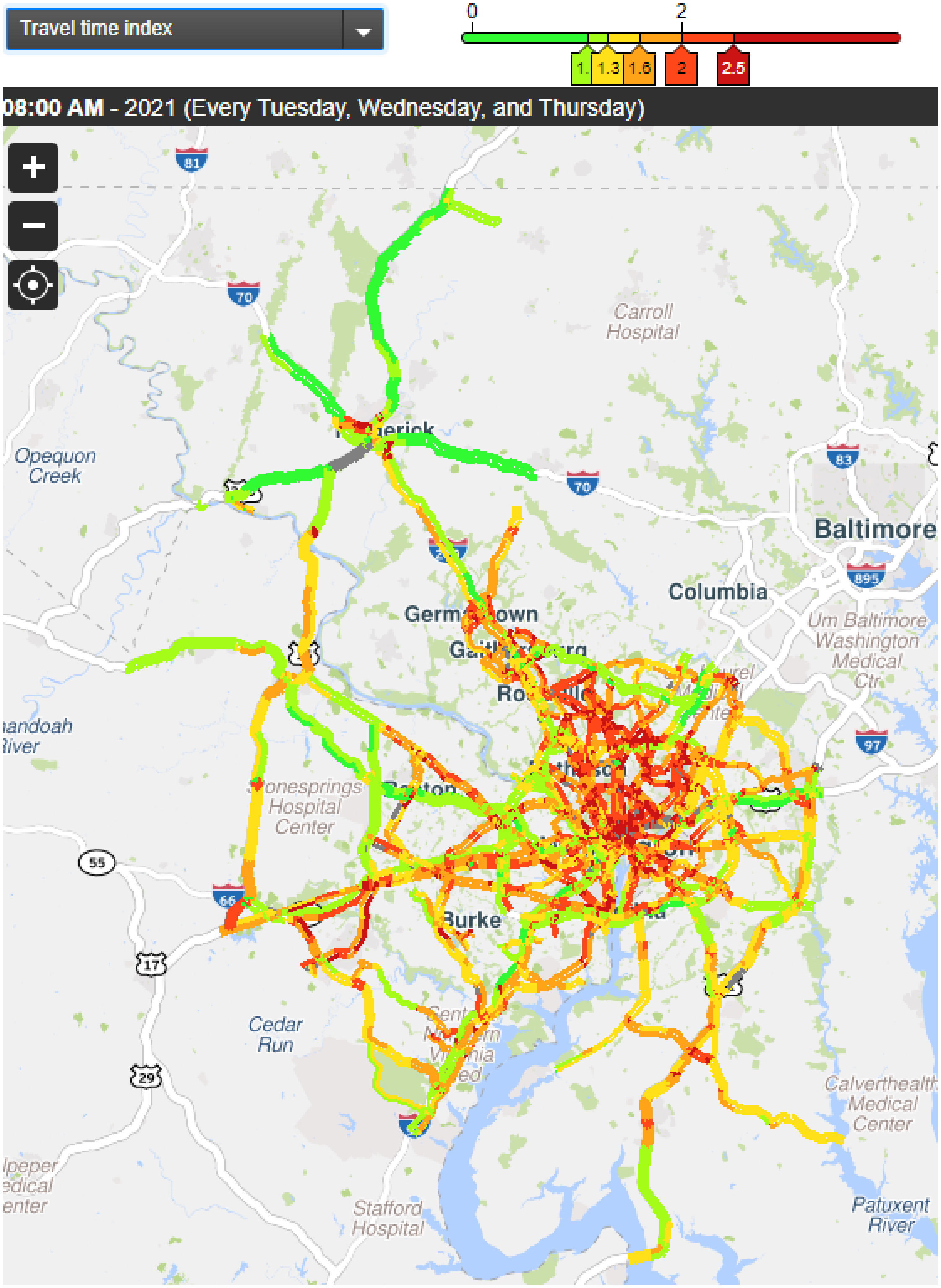
In addition to the regional summaries and congestion mapping on arterials that have been presented earlier in this chapter, this report also investigates the travel times along the study routes under the historical floating car surveys. This includes 58 routes shown in Table 2-5 below. Travel Time Index of the studied routes and other NHS arterials for middle weekday peak hours (8:00-9:00 am and 5:00-6:00 pm on Tuesdays, Wednesdays, and Thursdays) are mapped in Figure 2-19 and Figure 2-20.

Table 2-5 Arterial Travel Time Study Routes

State	Route	From/To	To/From	Length (miles)
DC	14th St	Independence Ave	K St	1.0
DC	16th St	K St	Eastern Ave	6.1
DC	17th St	Pennsylvania Ave	Independence Ave	0.5
DC	7th St/Georgia Ave Sec. 1	Independence Ave	New Hampshire Ave	2.8
DC	7th St/Georgia Ave Sec. 2	New Hampshire Ave	Eastern Ave	3.5
DC	Canal Rd/M St	30th St	Chain Bridge	3.7
DC	Connecticut Ave	K St	Nebraska Ave	4.0
DC	Constitution Ave	Louisiana Ave	14th St NE	1.5
DC	H St	Pennsylvania Ave	14th St NW	0.6
DC	Independence Ave	17th St	2nd St SE	1.9
DC	K St/New York Ave	21st St NW	Bladensburg Rd	4.2
DC	L St	Pennsylvania Ave	14th St NW	1.1
DC	Military Rd	Connecticut Ave	Georgia Ave	2.5
DC	Pennsylvania Ave	Constitution Ave	15th St NW	0.8
DC	Rhode Island Ave	7th St	Eastern Ave	3.5
DC	South Dakota Ave	Bladensburg Rd	Riggs Rd	3.0
DC	US 50	17th St	T. R. Bridge	0.9
DC	US 29	M St	Whitehurst Fwy	0.5
DC	Wisconsin Ave	M St	Western Ave	4.1
MD	MD 117	Muddy Branch Rd	Clarksburg Rd	6.8
MD	MD 193	Colesville Rd	Adelphi Rd	4.6
MD	MD 198	MD 650	Old Gunpowder Rd	5.2
MD	MD 210	Southern Ave	Livingston Rd	10.5
MD	MD 355 Sec. 1	MD 124	MD 547	10.1
MD	MD 355 Sec. 2	MD 547	Western Ave	5.3
MD	MD 4	Southern Ave	Dowerhouse Rd	7.0
MD	MD 450	US 301	B. W. Pkwy	12.1
MD	MD 586	MD 28	MD 193	5.0
MD	MD 193	US 29	MD 185	4.2
MD	MD 28	Veirs Mill Rd	New Hampshire Ave	9.0
MD	MD 5	Suitland Pkwy	Accokeek Rd	12.2
MD	MD 97 Sec. 1	Eastern Ave	University Blvd	4.2
MD	MD 97 Sec. 2	University Blvd	MD 28	5.3
MD	Randolph Rd	MD 355	Columbia Pike	9.1
MD	US 1 Sec. 1	MD 198	MD 193	8.1
MD	US 1 Sec. 2	MD 193	Eastern Ave	5.3
MD	US 29	East-West Hwy	Fairland Rd	7.1
VA	US 15	VA 7	Lovettsville Rd	12.6
VA	US 50 Sec. 1	VA 28	Nutley St	13.4
VA	US 50 Sec. 2	Nutley St	Fort Myer Dr	12.3

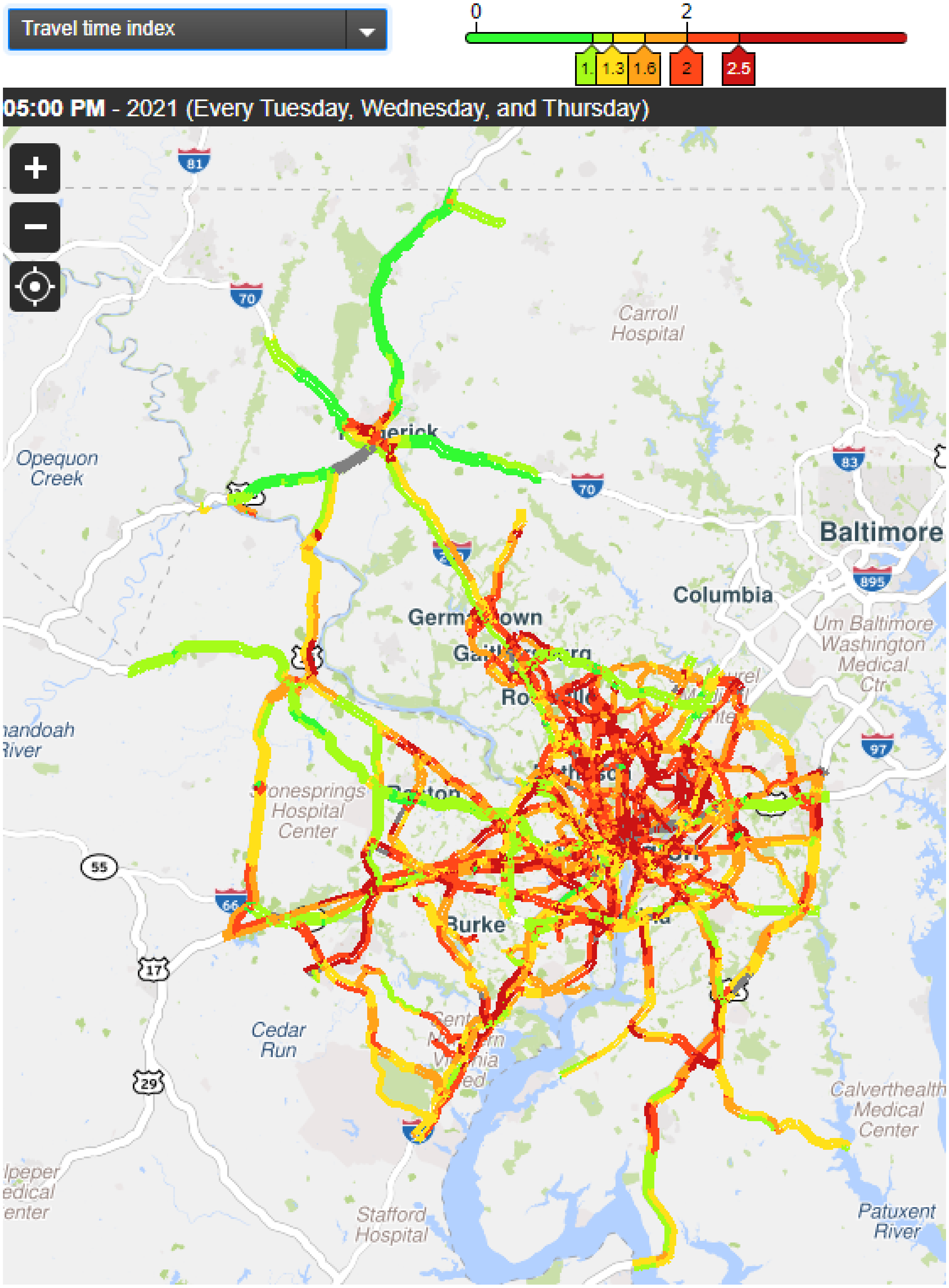
VA	US 1	15th St	VA 123	20.0
VA	US 29 Sec. 1	G.W. Pkwy	Gallows Rd	9.0
VA	US 29 Sec. 2	Gallows Rd	VA 236	8.8
VA	US 29 Sec. 3	VA 236	Bull Run PO Rd	7.5
VA	VA 120	I 395	Chain Bridge	8.3
VA	VA 123 Sec. 1	VA 193	VA 7	5.8
VA	VA 123 Sec. 2	VA 7	VA 236	7.1
VA	VA 123 Sec. 3	VA 236	US 1	14.8
VA	VA 234 Sec. 1	US 1	Hoadley Rd	10.2
VA	VA 234 Sec. 2	Hoadley Rd	US 29	13.2
VA	VA 28 Sec. 1	Wellington Road	Compton Rd	7.0
VA	VA 28 Sec. 2	Compton Rd	VA 7	17.0
VA	VA 7 Sec. 1	Braddock Rd	Gallows Rd	9.5
VA	VA 7 Sec. 2	Gallows Rd	VA 193	10.0
VA	VA 7 Sec. 3	VA 193	VA 28	8.0
VA	VA 286 Sec. 1	Sunrise Valley	US 50	6.2
VA	VA 286 Sec. 2	US 50	Rolling Rd	20.0
VA	Wilson Blvd	Roosevelt Blvd	Fort Myer Dr	4.7
	Total			402.7

Figure 2-19 Travel Time Index on Selected NHS Arterials during 8:00-9:00 am on Middle Weekdays in 2021



Note: Congestion levels are categorized by the value of TTI: TTI = 1.0: Free flow

Figure 2-20 Travel Time Index on Selected NHS Arterials during 5:00-6:00 pm on Middle Weekdays in 2021



Note: Congestion levels are categorized by the value of TTI: TTI = 1.0: Free flow

Improving Congestion on Arterials

Adding capacity on arterials to reduce congestion is seldom feasible, as many arterials are already built to capacity with development on either side. However, there are demand management and operational management strategies that could offer solutions. The addition of express bus or other types of public transportation along an arterial could decrease the amount of cars on the road. Pedestrian and bicycle improvements, such as the implementation of a new bike facility along the arterial can provide an alternative option for travelers. Operational improvements can include the addition of turn lanes, to reduce the amount of back-ups at an intersection, or the creation of additional lanes. Traffic signal timing optimization is also important in ensuring the appropriate movement of vehicles at intersections.

2.2.1.9 Quarterly National Capital Region Congestion Report

Inspired by various agency and jurisdictional dashboard efforts around the country (e.g., the Virginia Department of Transportation Dashboard), driven by MAP-21 and FAST and the availability of probe-based traffic speed data from the Eastern Transportation Coalition Vehicle Probe Project, the quarterly National Capital Region Congestion Report takes advantage of the availability of rich data and analytical tools to produce customized, easy-to-communicate, and quarterly updated traffic congestion and travel time reliability performance measures for the Transportation Planning Board (TPB) Planning Area. The goal of this effort is to, in a timely fashion, summarize the region's congestion, programs of the TPB and its member jurisdictions that would have an impact on congestion, and reliability and non-recurring congestion for recent incidents/occurrences, in association with relevant congestion management strategies.

This quarterly report includes congestion and travel time reliability analysis, top 10 bottlenecks in a quarter, congestion maps, quarterly spotlight focusing on notable event(s) and related transportation impacts during that quarter, background and methodology information. This report can be accessed via www.mwcog.org/congestion. A screenshot of the first page of the 4th Quarter 2021 Report is shown in Figure 2-21.

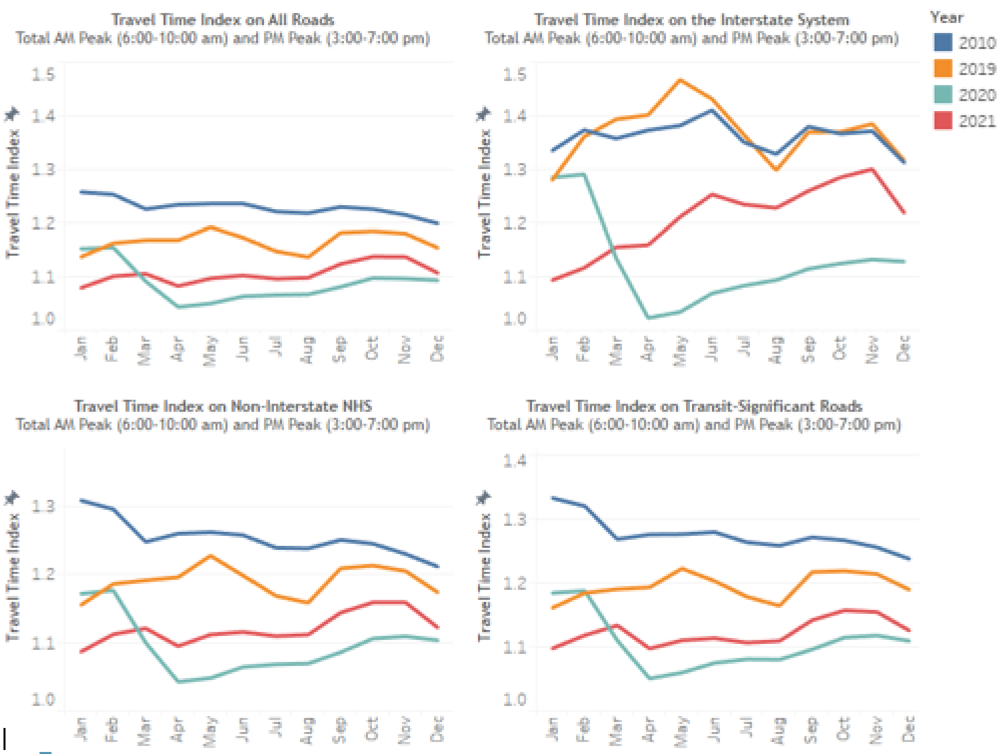
Figure 2-21 National Capital Region Congestion Report Example (First Page)

CONGESTION – TRAVEL TIME INDEX (TTI)

Interstate System			**Non-Interstate NHS[3]**		
TTI 4th Quarter 2021:	**1.27**	↑12.4% or 0.14[1]	TTI 4th Quarter 2021:	**1.15**	↑3.7% or 0.04
TTI Trailing 4 Quarters:	**1.21**	↑7.4% or 0.08[2]	TTI Trailing 4 Quarters:	**1.12**	↑2.3% or 0.03
Transit-Significant[4]			**All Roads**		
TTI 4th Quarter 2021:	**1.15**	↑2.9% or 0.03	TTI 4th Quarter 2021:	**1.13**	↑2.9% or 0.03
TTI Trailing 4 Quarters:	**1.12**	↑1.5% or 0.02	TTI Trailing 4 Quarters:	**1.11**	↑1.6% or 0.02

[1] Compared to 4th Quarter 2020; [2]Compared to one year earlier;[3] NHS: National Highway System; [4] See "Background" section.

Figure 1 Monthly Travel Time Index for Total AM peak (6:00-10:00 am) and PM peak (3:00-7:00 pm)



> ***Travel Time Index** (TTI), defined as the ratio of actual travel time to free-flow travel time, measures the intensity of congestion. The higher the index, the more congested traffic conditions it represents, e.g., TTI = 1.00 means free flow conditions, while TTI = 1.30 indicates the actual travel time is 30% longer than the free-flow travel time.*

2.2.2 Airport Ground Access Travel Time Studies

Studies of travel time to the three major airports[27] that serve the Washington and Baltimore metropolitan areas have been conducted for many years as part of the Continuous Airport Systems Planning (CASP) work program.

The most recent study was completed in 2017 and digital copies are available upon request. The study used vehicle probe data from 2014/2015[28] which were compared with data from 2011/2012[29] for purposes of computing changes in congestion and travel times to the airports. This was the first study of airport ground access that used vehicle probe data from INRIX, obtained through Center for Advanced Transportation Technology Laboratory at the University of Maryland in College Park.

Previous studies were completed in 1988, 1994, 2003 and 2011, all using a smaller network of airport access routes, with data collection performed using in-the-field floating car methodology.

Unlike many studies involving vehicle probe data performed by COG/TPB, the 2017 report placed significant emphasis on monitoring of the highways system on weekends and holidays, since so much air travel takes place during those times.

This report also included sections of the highway system well beyond the TPB planning area, including the Baltimore, Maryland and Fredericksburg, Virginia regions, as well as Hagerstown and Easton in Maryland; Front Royal and Winchester in Virginia; and Gettysburg and York in Pennsylvania. Highway routes between the three airports were also evaluated.

This study will be repeated soon after airport ground access traffic volumes substantially recover following the COVID-19 pandemic and it will once again use vehicle probe data for the analysis.

2.2.3 Freight Movement and Congestion

In addition to congestion's impacts on person movement, congestion in and around major urban areas significantly impacts freight movements. While other modes are not generally affected to the degree that trucks are by surface transportation congestion, the metropolitan Washington region is subject to freight rail bottlenecks in addition to roadway congestion.

Congestion on the region’s highways and arterials slows freight deliveries which impacts both shippers and consumers. Shippers continually adjust their operations in response to congested conditions. Longer term impacts of increased congestion to freight-dependent industries include:

- A shrinking of the delivery area that one driver and vehicle can serve on one shift, causing firms to add smaller and more numerous trucks to their fleets to better serve their customers;
- A decrease in the size of the area that can be served from any given distribution facility, impacting the size, number, and dispersion of distribution facilities in the region;
- A decrease in delivery reliability, causing firms to increase “on hand” or “just in case” inventory, thereby eroding the economic efficiencies associated with just-in-time inventory systems; and

[27] Baltimore/Washington International Thurgood Marshall Airport (BWI), Linthicum, Maryland; Ronald Reagan Washington National Airport (DCA), Arlington, Virginia; Washington Dulles International Airport (IAD), Chantilly, Virginia.

[28] September 1, 2014 through August 31, 2015
[29] September 1, 2011 through August 31, 2012

- An increase in shipper operating costs (time and fuel) which are eventually passed on to consumers.

According to TPB analysis of FHWA Freight Analysis Framework data (FAF), approximately 379 million tons of goods worth over $604 billion are transported to, from, within, and through the National Capital Region annually. Approximately 80 percent of this freight movement (by weight) is by truck. Both recurring and non-recurring congestion increase truck travel and planning time, which add to shipping and inventory holding costs. Trucks also contribute to congestion due to their size and operating characteristics. Because of their importance to the regional and national economy and the way that trucks affect, and are affected by, roadway congestion, freight movement is an important element of regional and local transportation and land use planning efforts.

Employment in the professional and business services, trade and transportation, federal government, and state and local government sectors drives the economy of the metropolitan Washington region. Because of the service-based nature of metropolitan Washington's economy, this region is primarily a consumer rather than a producer of goods. Consumers depend upon trucks to deliver needed goods. This demand puts pressure on the regional surface transportation system as trucks maneuver across the transportation network and attempt to make their deliveries on time.

Both national and regional freight forecasts predict significant growth in freight tonnage and value across most transportation modes. Trucks are more flexible than trains, ships, or airplanes; operate on a broader transportation network; and are usually required to haul goods shipped by other modes to their final destination. Because of these features, trucks are projected to capture much of the forecasted growth in freight demand. According to analysis of the Federal Highway Administration's Freight Analysis Framework, metropolitan Washington is projected to see the amount of tonnage moving to, from, and within the region increase by 44% by 2040. A corresponding 146% increase in the value of goods moved is projected over the same time period.

The rise in e-commerce has exacerbated congestion in urban areas of metropolitan Washington and throughout much of the world. Over the last decade, e-commerce has grown over 15 percent annually[30] and will likely become increasingly prevalent going forward. Growth in e-commerce means growth in the overall number of truck trips which contributes to congestion because trucks account for 12 percent of the cost of congestion in urban areas.[31] Urban congestion is exacerbated when increasing numbers of trucks compete for limited urban curbside space, forcing many of them to block travel lanes, bicycle lanes, and alleys.

The American Transportation Research Institute (ATRI) ranked congestion in the Washington, DC metropolitan area as sixth in the nation in terms of its contribution to increased operating costs for the trucking industry (see Table 2-6).

Table 2-6 Cost of Congestion for Trucking by Metropolitan Area - 2018

Rank	Metropolitan Area	Cost to the Trucking Industry (millions of dollars)
1	New York-Newark-Jersey City, NY-NJ-PA	4,933.0
2	Chicago-Naperville-Elgin, IL-IN-WI	2,277.9
3	Miami-Fort Lauderdale-West Palm Beach, FL	2,242.3
4	Philadelphia-Camden-Wilmington, PA-NJ-DE-MD	1,662.6
5	Los Angeles-Long Beach-Anaheim, CA	1,634.1
6	Washington-Arlington-Alexandria, DC-VA-MD-WV	1,408.8

[30] Calculated based on data from the U.S. Census Bureau
[31] Texas A&M Transportation Institute 2021 Urban Mobility Report

7	Dallas-Fort Worth-Arlington, TX	1,381.9
8	Houston-The Woodlands-Sugar Land, TX	1,359.1
9	Atlanta-Sandy Springs-Roswell, GA	1,115.0
10	Nashville-Davidson-Murfreesboro-Franklin, TN	1,105.6

Source: ATRI

The COVID-19 pandemic temporarily reduced traffic congestion by 60-75 percent in urban areas during March, April, and May 2020 due to the implementation of "lockdown" policies.[32] As a result of the decreased congestion, freight trucks traveled at higher speeds and were able to reduce delivery delays in urban areas during this period. Truck delays returned however at the end of 2020, but they remained seven to 20 percent lower than 2019 levels.[33]

A Panama Canal Expansion was completed in 2016. Much larger "Post-Panamax" ships from Asia are now able to serve East Coast ports, including the port facilities in Baltimore and the Hampton Roads, Virginia area. Container traffic between Asia and the United States is now able to use both West Coast and East Coast ports thus reducing the demand for long hauls from the West Coast and increasing demand for regional hauls from East Coast ports.

The TPB Freight Subcommittee provides a forum for discussion of freight issues and concerns within the metropolitan Washington Region. This gives freight stakeholders the opportunity to share concerns and information with the TPB and other decision-makers. The Freight Subcommittee meets regularly to share information and interact with special guest speakers.

2.2.4 Traffic Signals

2.2.4.1 Traffic Signal Timing Optimization

Delays occurring at signalized intersections are understood to account for a significant portion of overall arterial and urban street delays. Improving traffic signal timing has been identified as a TPB priority area. The TPB conducted surveys of the status of the region's signal optimization in 2005[34], 2009[35], and 2013[36], and 2017. This survey has now been discontinued, as technology has advanced signal, and optimization happens on an ongoing basis and moved away from the three-to-five-year cycles of the past.

TPB member jurisdictions continue to actively conduct signal timing optimizations, exploring and implementing the latest technologies to improve the operations of traffic signals. In 2016, DDOT completed a citywide signal optimization project initiated in 2012, enhancing the District's entire traffic signal network of more than 1,650 signals. The central goal of the optimization project is to

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32 *Id.*

33 *Id.*

34 Andrew J. Meese, *Briefing on the Implementation of Traffic Signal Optimization in the Region*, a presentation to the TPB on November 10, 2005. http://www.mwcog.org/uploads/committee-documents/tVtXWIY20051110144208.pdf

35 Edward D. Jones, *Status Report on Traffic Signal Optimization in the Washington Region*, a presentation to the TPB on March 11, 2009. http://www.mwcog.org/uploads/committee-documents/bV5cXFhc20090312161527.pdf

36 Ling Li, *Briefing on Traffic Signal Timing/Optimization in the Washington Region*, a presentation to the TPB on February 19, 2014. http://www.mwcog.org/uploads/committee-documents/aI1ZXFpb20140212133426.pdf

make DC traffic signals safer and friendlier for pedestrians, improve bus running times, and reduce traffic congestion and vehicular traffic emissions.

Under the TPB's Transportation Investments Generating Economic Recovery (TIGER) grant for Priority Bus Transit in the National Capital Region, in 2015 and 2016 WMATA, City of Alexandria and DDOT implemented Transit Signal Priority (TSP) at intersections along VA-7 (Leesburg Pike), the Van Dorn-Pentagon corridor, and in the District of Columbia.

On the VA-7 corridor, 25 TSP signals were installed in locations in Fairfax County, the City of Alexandria, and the City of Falls Church. A WMATA fleet of 8 Metrobuses was equipped with the onboard equipment and the project began operation in June 2015. The DDOT TSP Project was implemented at 195 locations throughout the District and began operation in December 2016. Onboard bus equipment was installed by WMATA on 116 Metrobuses. The City of Alexandria implemented TSP at nine locations along the Van Dorn-Pentagon corridor in July 2016. WMATA installed onboard equipment on eight Metrobuses for this project.

2.2.4.2 Traffic Signal Power Back-Up

Traffic signal power back-up systems are critical in the event of an emergency, particularly if the event involves a lack of power. Since late 2011, the TPB's Traffic Signal Subcommittee has conducted seven regional surveys on traffic signals power back-up systems[37]. The most recent survey was conducted by the spring of 2018 covering systems as of December 31, 2017 and found that about 33% of the region's 5,900+ signals are already equipped with battery-based power back-up systems, and 70% are equipped with generator-ready back-up systems (most battery-based systems also have generator-ready features). These power back-up systems can improve the resiliency of the transportation network. Like the Traffic Signal Timing Survey, with no recent change in trends, the Power Back-up survey has been discontinued. Staff will continue to keep abreast of traffic signal technology in the region.

2.2.5 Safety and Congestion

2.2.5.1 Overview

The correlation between highway safety and congestion is complex. On one hand, there is a positive correlation between traffic crashes and congestion. Crashes, as well as road construction and repair activities, disabled vehicles, inclement weather, and/or special events contribute to non-recurring congestion. Sources indicate that approximately half of total congestion is non-recurring[38].

Engineering and operational management activities can mitigate congestion and improve safety. Many transportation agencies in the region employ active incident management programs to quickly respond to incidents, reduce their duration, and thereby lessen the likelihood of secondary crashes[39] resulting from traffic backups. These programs are further integrated into the Metropolitan Area Transportation

[37] Andrew Burke, *2018 Signal Surveys, Power Backup and Signal Optimization*, a presentation to the TPB's Systems Performance, Operations, and Technology Subcommittee on June 7, 2018.
Incorporating Travel-Time Reliability into the Congestion Management Process (CMP): A Primer – Figure 1, Federal Highway Administration: https://ops.fhwa.dot.gov/publications/fhwahop14034/ch1.htm.
[39] crashes due to congestion created by an earlier crash or incident or to drivers distracted by the previous incident scene

Operations Coordination (MATOC) program[40], which provides day-to-day, real-time multi-agency coordination and information sharing on transportation systems conditions in the National Capital Region.

The TPB addresses transportation safety through the following programs and activities:

- The ***Transportation Improvement Program (TIP)*** helps the TPB reduce fatal and serious injury crashes on the regions roadways and because crashes are one of the causes of non-recurring congestion, a reduction in these crashes therefore helps to reduce overall congestion. The TIP includes funding under the Highway Safety Improvement Program for priority HSIP projects as programmed by the three states. Examples of HSIP programmed projects include impact attenuators, guardrails, upgrading traffic signal devices, work zone safety reviews, and improved signs and markings. The three states have processes for inclusion of safety-related projects as identified in their Strategic Highway Safety Plans and other state plans and documents. Safety improvements are also included within projects funded with non-HSIP funds and through other state and federal sources, such as the Transportation Alternatives Program Block Grants, including Safe Routes to School grants, and roadway maintenance projects, all of which will provide benefits that contribute to improved safety performance.

- The TPB's ***Transportation Safety Subcommittee***[41] serves as a forum for public- and private-sector safety stakeholders to exchange information on best practices in transportation safety planning. The subcommittee periodically compiles and reviews regional highway safety data, shares this data among member jurisdictions, monitors regional performance on the federally-required regional highway safety performance measures, and advises the Technical Committee and the Transportation Planning Board (TPB) on regional highway safety issues and on the various federal requirements for MPOs to follow related to transportation safety.

- The ***Street Smart Pedestrian and Bicycle Safety*** campaign is an annual region-wide education effort to raise public awareness on pedestrian and bicycle safety[42]. The campaign, uses radio, newspaper, and transit advertising, public awareness efforts, and engages law enforcement to change driver, pedestrian, and bicyclist behavior in an effort to reduce nonmotorist fatalities and serious injuries.

- The ***Regional Roadway Safety Program*** is a TPB technical assistance program that provides consultant services to member jurisdictions or agencies to assist with planning or preliminary engineering projects addressing roadway safety concerns.

2.2.5.2 Safety Trends in the National Capital Region

The TPB Transportation Safety Subcommittee compiles, summarizes, and reports on safety performance measures at the regional level. It is reasonable to infer that increasing numbers of fatal and serious injury crashes could also result in increasing non-recurring congestion associated with crashes. Note that the statistics for 2020 referenced below are preliminary. State figures are being used pending the availability of updated information from the National Highway Traffic Safety Administration's (NHTSA) Fatality Analysis Reporting System (FARS).

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[40] See www.matoc.org for more information.
[41] a subcommittee of the TPB Technical Committee
[42] http://www.bestreetsmart.net/

- After plateauing for much of the first part of this decade, the number of highway fatalities has been on an increasing trend since 2015. In 2020, 321 people were killed on the National Capital Region's roadways, an increase of seven percent over 2019 levels. This is despite a 19 percent decrease in vehicle miles traveled (VMT). Research indicates that reduced traffic volumes during the pandemic encouraged speeding, which increased the severity of crashes.[43] Individuals involved in crashes also engaged in riskier behavior, such as failure to wear seat belts and driving under the influence of alcohol or other drugs.[44]
- The fatality rate per 100 million VMT for the National Capital Region increased from 0.61 in 2015 to 0.88 in 2020.

2.2.5.3 Performance Based Planning and Programming – Highway Safety Targets

Federal regulations require Metropolitan Planning Organizations (like the TPB) to track five highway safety performance measures and set targets for each of them every year. The five performance measures, along with proscribed data sources, are described in Table 2-7 below. These safety performance measures are applicable to all public roads regardless of ownership or functional classification.

Table 2-7 Highway Safety Performance Measures Summary

Performance Measure	Description	Data Source
Number of Fatalities *(5 year rolling average)*	Total number of fatalities during a calendar year	FARS[1]
Rate of Fatalities per 100 million VMT *(5 year rolling average)*	Ratio of total fatalities to VMT	FARS and HPMS[2] (or MPO estimate)
Number of Serious Injuries *(5 year rolling average)*	Total number of serious injuries during a calendar year	State reported serious injury data
Rate of Serious Injuries per 100 million VMT *(5 year rolling average)*	Ratio of total serious injuries to VMT	State reported serious injury data and HPMS
Number of Non-Motorized Fatalities and Serious Injuries *(5 year rolling average)*	Total number of fatalities and serious injuries during a calendar year	FARS and State serious injury data

[1] FARS: Fatality Analysis Reporting System
[2] HPMS: Highway Performance Monitoring System

While these safety performance measures are not specifically related to congestion, the fatalities and serious injuries resulting from congestion-related crashes are part of the overall regional safety picture and will have an impact on whether or not the National Capital Region meets its highway safety targets.

The TPB has set targets for each of these performance measures every year beginning in January 2018.

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[43] USDOT NHTSA, *Examination of the Traffic Safety Environment During the Second Quarter of 2020.*
[44] *Id.*

2.3 Congestion on Transit Systems

2.3.1 Impacts of Highway Congestion on Transit Systems

2.3.1.1 Transit-Significant Roads

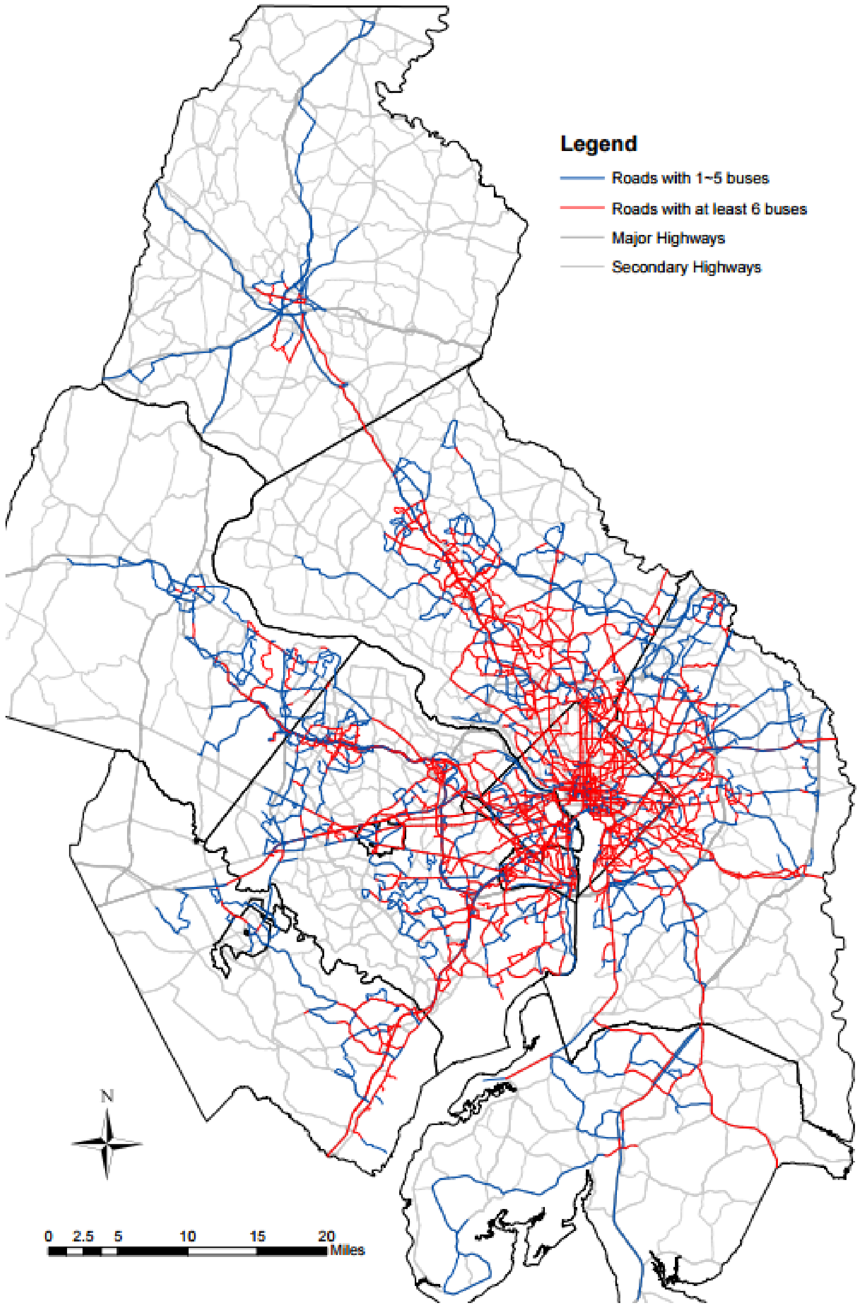
Often the region's highway congestion will have an impact on transit systems. To some extent, transit operations are concentrated in areas of high-density land uses, where traffic congestion may be expected. Bus schedules generally are designed to anticipate and accommodate highway congestion whenever possible. However, there are instances when congestion is unpredictable and can not only impact the timing of one bus, but of the entire bus system and other transit systems the bus connects to (such as commuter rail).

In order to track the differential congestion conditions, between regional overall congestion and transit-significant routes' congestion, the TPB identified a Transit-Significant Road Network in 2014[45] and its performance is now monitored in the quarterly National Capital Region Congestion Report[46] and the CMP Technical Report as a separate highway category.

Any road segments with at least 6 buses in the AM Peak Hour (equivalent to one bus in either direction in 10 minutes) are considered as "transit-significant". By this criteria, there are a total of 1,397 miles of transit-significant road segments in the region, as shown in Figure 2-22.

[45] Wenjing Pu, Update on "Transit-Significant Highway Network" Identification, Presentation to the Regional Public Transportation Subcommittee, November 25, 2014. http://www.mwcog.org/uploads/committee-documents/al1XXV1Z20141125094736.pdf
[46] www.mwcog.org/congestion.

Figure 2-22 Transit-Significant Roads in the TPB Planning Area



Generally, performance analyses have shown that Transit-Significant Roads overall are more congested and more sensitive to change compared to the regional average of all roads, though generally less congested that the region's Interstate highways.

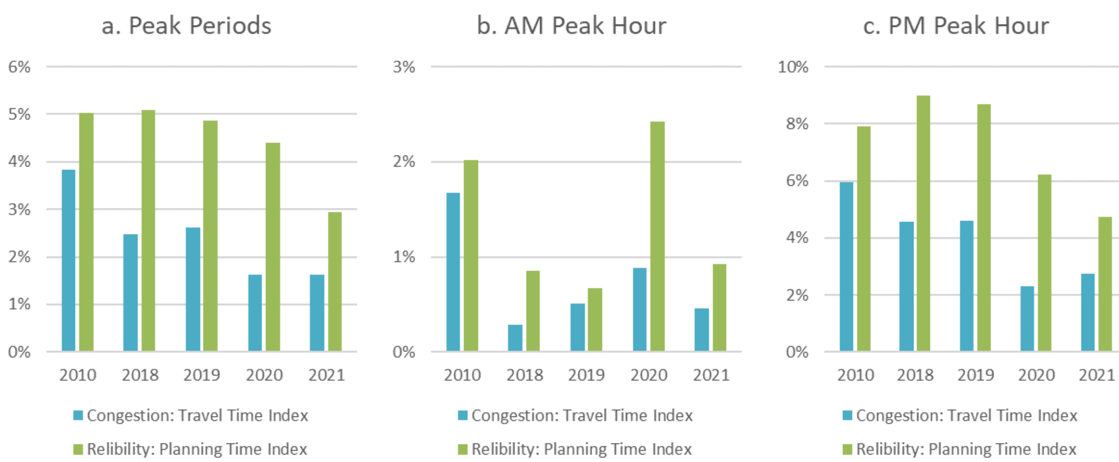
The transit network's congestion, expressed as annual average Travel Time Index, was 3 to 5 percent worse than the regional average of all roads throughout 2010 to 2016 during peak periods, i.e., 6:00-10:00 am and 3:00-7:00 pm (Figure 2-23 a.). It is not unexpected that the transit-significant network is congested, since buses are often routed in dense, urban corridors as a part of multi-modal transportation strategies. This network was also more congested than the non-Interstate National

Highway System (NHS) and the non-NHS roads, but less congested than the Interstate System, which was still the most congested highway category (Figure 2-23 a.).

Figure 2-23 Peak Period Travel Time Index and Planning Time Index of Transit-Significant Roads

The difference in congestion between the transit network and the regional average was more pronounced during PM peak hour, with less than 2 percent difference, compared to the AM peak hour's around 1 percent divergence (Figure 2-24 b. and c.).

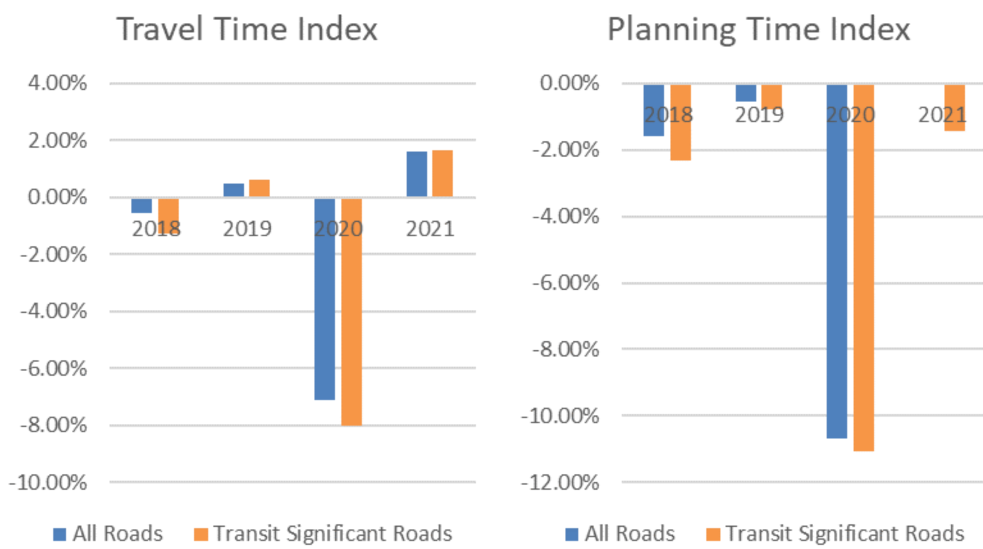
Figure 2-24 Percentage Change for Transit-Significant Roads Compared to All Roads



In terms of travel time relibility, expressed as Planning Time Index, mixed results were found between the transit network and the regional average (Figure 2-24). The transit bus network was over a half percent less reliable than the regional average in the AM peak hour, but over a full percent less reliable in the PM peak hour.

Performance of the Transit-Significant Network varied in accordance with regional average; but the year-to-year changes in the transit network tended to be slightly greater in magnitude than that of the regional average (Figure 2-25).

Figure 2-25 Congestion and Reliability Year-to-Year Changes of Transit-Significant Roads



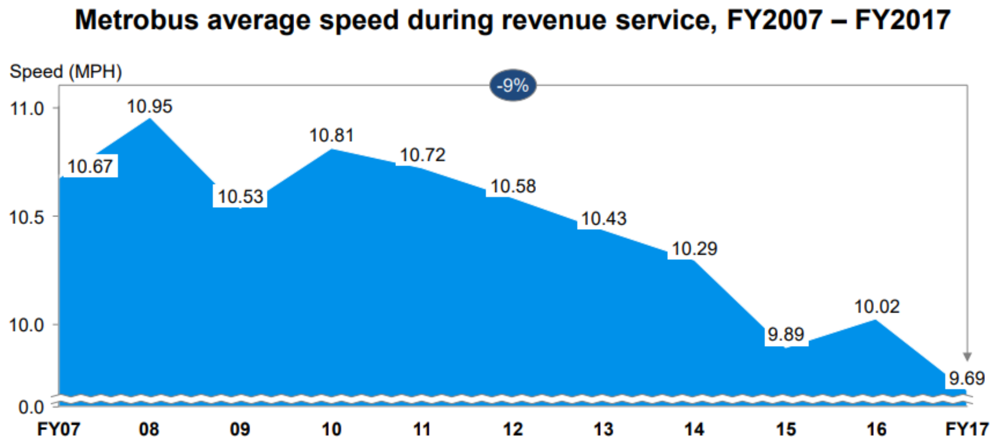
2.3.1.2 Bus Travel Speeds

Another way to assess the impacts of highway congestion on transit is to directly investigate bus travel speed along roads carrying both buses and other vehicles. Bus transit service is affected by travel speed, with slow speeds impacting customers as well as the efficiency of bus scheduling. The traffic congestion that contributes to slow travel speeds is also associated with reduced reliability as travel times increase in variability. Slow bus travel speeds are commonly found in the downtown as well as in dense activity centers elsewhere.

WMATA Metrobus operates through downtown DC and to most major activity centers in the region. According to research done for the Bus Transformation Project study, over the past ten years Metrobus has experienced decelerating bus speeds of 9% or 1 mph.[47] Besides the impact on travel, this slowdown also adds to operational costs.

[47] "The Bus System and its Riders Today", p. 153. October 2018. http://bustransformationproject.com/wp-content/uploads/2019/01/20190118-Bus-System-Today_FINAL.pdf

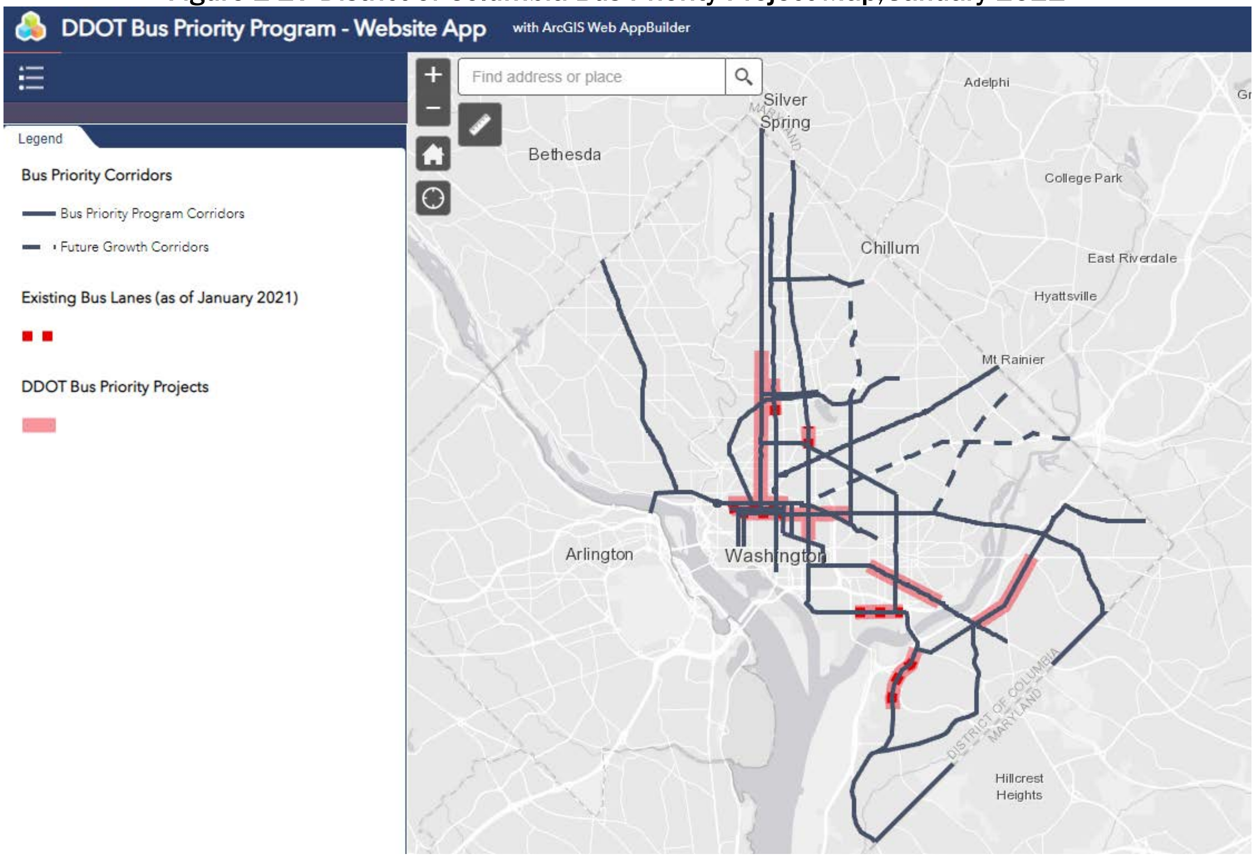
Figure 2-26 Decline in Metrobus Speed, 2007 to 2017



Source: National Transit Database, WMATA FY19 budget book.

The District of Columbia has been the most active jurisdiction in the region in implementing bus lanes; some efforts, especially 16th Street NW, have been under development for years. Additional, sometimes temporary bus lanes were deployed during the COVID-19 pandemic. In addition to 16th Street and the H and I NW Bus Lanes, the pandemic has catalyzed adding bus lanes on M Street SE, MLK Avenue, Pennsylvania Ave SE, and Minnesota Avenue.

Figure 2-27 District of Columbia Bus Priority Project Map, January 2021[48]



2.3.1.3 Connections to Transit

The impact of highway congestion on transit systems can also be assessed by identifying and analyzing the key linkages between transit and other modes. In 2018 Metro conducted a Bus Survey throughout our region. This survey that found about 6% of the region's bus trips accessed the bus via autos or other vehicles (e.g., taxies, vanpools, carpools) and 14% transferred from other buses. These passengers were subjected to the impact of highway congestion if it occurs on pertinent routes.

In August 2016, WMATA published the Metrorail Station Investment Strategy Summary Report[49]. The report states

> "Improving bicycle and pedestrian access to Metrorail stations helps stabilize rail ridership and reduce growth in public subsidy to Metro. In late 2014, as Metro's Planning office began to study the relationship between ridership and station walk access, staff developed walksheds for each Metrorail station, identifying the actual walkable area relative to a ½ mile "as the crow flies" distance using network analysis in GIS. With help from researchers at the University of Maryland, staff has been able to calculate the number of riders walking to Metro that can be expected when jobs and housing are connected [in] the walkshed. The exact numbers vary by station, but, on average, for every ten households connected to the station, Metro sees about seven weekday Metrorail trips."

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48 https://ddot.dc.gov/page/corridor-map and https://fitp.maps.arcgis.com/apps/webappviewer/index.html?id=bf5155130be04b50afb1b4568f4946a5

49 https://planitmetro.com/uploads/MISIS_Report_August_2016.pdf

In short, improved transit accessibility will attract travelers to the transit system, reducing the demand on the highway network.

2.3.2 Congestion within Transit Facilities or Systems

Congestion can also be an issue within transit. If the demand for rail and buses is high and the capacity cannot keep up with that demand, then transit becomes too crowded. Just as incidents can cause non-recurring impacts on roadways, the same can occur on transit facilities. Even a minor bus or train incident can cause back-ups and delays.

Congestion can not only result on transit vehicles themselves, but on station platforms and immediately around stations. Union Station in the District of Columbia is a station that accommodates Metrorail, Metrobus, DC Circulator buses, Maryland Area Rail Commuter (MARC) trains, Virginia Railway Express (VRE) trains, and AMTRAK. With these various transit options, Union Station has become a primary connection point for commuters/visitors, and the busiest station in the Metrorail system, with nearly 60,000 passengers entering and exiting daily pre-pandemic.

The CMP recognizes the impacts of congestion within the region's transit systems. As the region's population grows and "going green" trends advance, projections are that there will be more commuter and residents looking to transit options instead of driving. While increase in transit use is overall a positive trend, it is important that the impacts of transit congestion throughout the region be evaluated and mitigated.

Congestion management will benefit from continuing efforts to encourage transit use in the Washington region and explore transit priority strategies. The transit system in the Washington region serves as a major alternative to driving alone, and is an important means of providing more mobility utilizing current infrastructure. Coordination with appropriate committees and transit agencies to address related data and performance measure issues helps further support the CMP.

2.4 Congestion Monitoring and Data Consolidation Activities

2.4.1 Household Travel Surveys

The TPB conducts regional household travel surveys in the Washington region and adjacent areas about every ten years to gather updated information on area wide travel patterns. These surveys provide information on determinants of travel, including household demographics, income, employment destinations, and number of vehicles available. This data helps guide future transportation planning as the area continues to grow.

The most recent large-scale regional household travel survey conducted by the TPB is the 2017/2018 Regional Travel Survey (RTS), which surveyed 15,976 households in the TPB modeled area from October 2017 through December 2018. The survey consisted of two parts: 1) a recruitment questionnaire (Part 1) and; 2) a one-day travel diary (Part 2). A randomly selected and geographically representative sample of households were recruited through mailed invitation letters and reminder postcards. Households were offered a participation incentive of a gift card or donation to complete the web-based (with a telephone option) survey.

The RTS covered 22 major jurisdictions and 111 geographic strata consisting of Census Public Use Microdata Areas (PUMAs) and COG-defined Regional Activity Centers. These include 11 TPB member jurisdictions including Fauquier County. TPB coordinated with the Baltimore Metropolitan Council (BMC) on its sample plan for the Maryland Travel Survey, which was conducted around the same time. The two agencies collaborated to ensure geographic coverage and to prevent households in Anne Arundel, Howard, and Carroll Counties from being recruited for both surveys. Upon request, TPB conducted an add-on survey of 512 households in Arlington County to allow for further analysis of Arlington County's activity centers. Additionally with the help of CASA de Maryland, a Hispanic/Latino community advocacy organization, the RTS included an outreach effort to increase Hispanic/Latino survey participation.

The RTS consists of multiple data files including the Household File, Person File, Vehicle File, and Trip File. The Household, Person, and Vehicle Files are from the recruitment questionnaire (Part 1). The Trip File is from the travel diary (Part 2). The Household File includes household size, income, number of workers, housing type and tenure, as well as vehicles and bicycles. The Person File includes demographic characteristics such as race/ethnicity, age, gender, number of jobs, and whether one works from home. This file also contains questions about the typical commute and typical weekday travel, including frequency of alternative travel options and delivery services. The Vehicle File includes detailed vehicle data such as vehicle age, fuel type, and type of toll transponder. The Trip File contains information on actual observed trips taken by the respondent on the travel day, such as origin and destination, start and end times, mode of travel, trip purpose and activities, and transit access and egress.

The post-survey processing of the RTS, which included data cleaning, trip linking, and factoring weights for households, persons, and daily trips from the travel diary, was completed in the summer of 2020. TPB staff conducted tabulations of the RTS data files for the TPB Planning Region which were shared in a series of presentations to the TPB Travel Forecasting Subcommittee, TPB Technical Committee, and the Transportation Planning Board from September 2020 to March 2021. Staff also prepared the RTS public data files which was released in January 2021, providing a resource to regional stakeholders, practitioners, and researchers. Staff delivered a series of announcements on RTS resources (e.g., Technical Documentation, RTDC RTS Tabulations, and the RTS Public File) to various TPB committees and subcommittees. All of these resources were made available on the RTS website[50].

While releasing the results of the RTS, TPB staff developed responses to a series of questions from regional stakeholders that they hoped the RTS might help inform. This analysis project ("RTS In-Depth Analysis") took a deeper dive into the RTS data with transportation equity implications. This project was completed in the summer of 2021 and the results were posted on the RTS website; the key findings were shared in a series of presentations to the TPB Technical Committee.

As a follow-on activity to the RTS, TPB conducted the RTS Follow-On Smartphone Panel Survey (SPS) which sampled a panel of respondents from the RTS. The primary objectives of the SPS were to evaluate the effectiveness of the smartphone app-based survey methodology, to assess the quality of the data collected from a smartphone-app based survey, and to determine the feasibility of smartphone surveys for future survey efforts by COG/TPB. Furthermore, the SPS collected detailed travel information for 7 days (the RTS was a one-day travel diary) so the SPS can provide insights on day-to-day variability of travel behavior in the region. The data from the SPS was to be shared in 2022, following post-processing and evaluation.

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[50] Metropolitan Washington Council of Governments. "Regional Travel Survey." Available: https://www.mwcog.org/transportation/data-and-tools/household-travel-survey/

2.4.2 Special Surveys and Studies

The TPB and its member agencies undertake special studies or data collection efforts, on both one-time and recurring bases. Examples include compiling data to form a regional travel trends report, as well as monitoring transit usage.

2.4.2.1 Surveys of Bus Travel in the Region

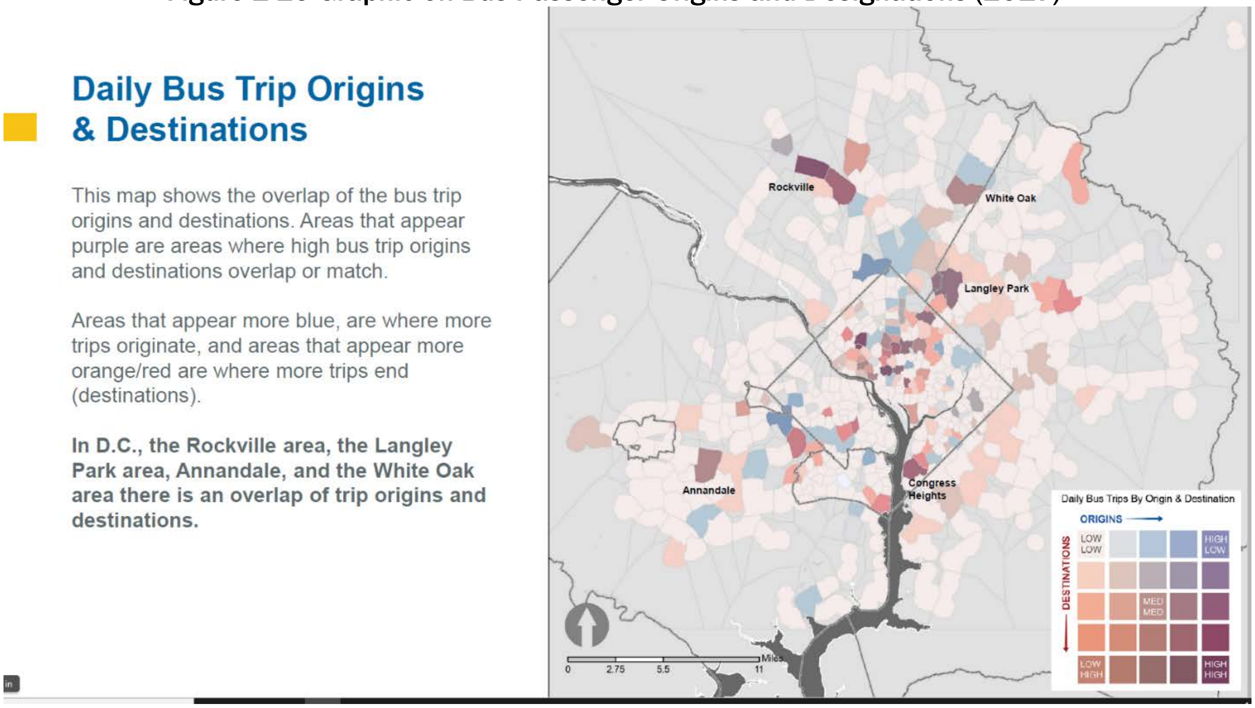
Periodically, the region's bus systems conduct surveys of their passengers. In the past, these surveys were focused on travel patterns, including origin, destination, time of day, and route and mode choice. Increased technology capability has led to a change in survey focus, with more emphasis on meeting Federal Transit Administration civil rights requirements. Instead, smart card and passenger counting data are harvested to determine travel patterns, often with greater detail for the purposes of specific projects and plans. Therefore, WMATA and other agencies have moved to conducting their own surveys to meet agency purposes. While greater data is collected on a more frequent basis, the bus surveys no longer provide a regionally comprehensive reference. The following table lists the dates of the last travel surveys conducted by local bus systems in the region.

Figure 2-28 Date of Most Recent Transit Travel Survey – by Agency (Collected 2021).

Last Agency-Wide Survey	
Agency	**Year**
VRE	2019 (Master Agreement Survey)
DDOT	2019
Fairfax County	2019
City of Fairfax	2019
Frederick County	2019
PRTC	2019
Prince George's County	2018
Charles County	2017 (FY)
City of Fairfax	2016
Montgomery County	2015
Loudoun County	2014
City of Alexandria	2013

The Bus Transformation Project reviewed origins and destinations of bus riders for the WMATA Compact region using 2017 data. The following graphic shows areas where, origins, destinations, and both were clustered.

Figure 2-29 Graphic on Bus Passenger Origins and Designations (2017) [51]



2.4.2.2 Regional Travel Trends Report

The TPB receives periodic updates regarding regional travel trends. The most recent large-scale briefing occurred in 2018, which was documented in an online report[52]. The rate and spatial pattern of population growth, combined with employer sites and other major attractions, are key to the underlying changes in travel trends. The metropolitan Washington region has seen a fast increase in growth over the last several decades, along with major changes in how and why people travel. This is important to congestion management, in that it is important in understanding why congestion may be occurring in particular areas. In addition, travel trends can help predict, and prepare for, future congestion.

In the 2018 Travel Trends report, key travel trends findings and factors included:

- Population in the region increased by 16% between 2007 and 2017.
- Regional weekday vehicle miles traveled (VMT) increased steadily between 2000 and 2008, but decreased in 2009 and has remained relatively flat since then.
- Metrorail ridership increased steadily between 2001 when it recorded 607,000 weekday trips to 2010 when it recorded 748,000 weekday trips. Since then, Metrorail ridership decreased substantially through 2017 when it recorded 613,000 weekday trips, which resembled 2001-2002 ridership levels.
- Although minor shifts are occurring, the predominant mode of commute travel in the region continued to be single occupant vehicles, accounting for 65% of all commute travel, and the next-highest mode is transit, which accounts for 15%.

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[51] Page 69. Bus Transformation Project: The Bus System Today. Final Report, January 2019. http://bustransformationproject.com/wp-content/uploads/2019/01/20190118-Bus-System-Today_FINAL.pdf
[52] https://gis.mwcog.org/webmaps/tpb/traveltrends/.

- The share of commuters teleworking, at least occasionally, increased from 11% in 2001 to 32% in 2016. The 2019 State of the Commute Survey[53] revealed that this share had increased to 35% by 2019.

During the COVID-19 pandemic period, the region experienced significant variations in regional travel. This included significant reductions in daily travel in the earlier stage of the pandemic period when many worksites shut down and employers offered large-scale teleworking. Reductions in work travel were also caused, in part, by significant job losses that occurred as a result of the pandemic. By late 2021, much of the job losses as well as regional travel had largely recovered to near pre-pandemic conditions. TPB staff made periodic presentations on the multisectoral impacts of the pandemic on the region, including regional travel, for example, the update provided to the TPB Technical Committee at its October 2021 meeting[54]. In addition to these periodic briefings, staff also posted monthly "COVID-19 Travel Monitoring Snapshots," which provided monthly updates of key regional travel indicators observed during the pandemic period[55].

2.4.3 The Regional Transportation Data Clearinghouse

Over the years, staff at the National Capital Region Transportation Planning Board (TPB) has collected transportation data from various sources, primarily member jurisdictions, state agencies, and transit authorities. These data have been processed and packaged into tabular, spatial, and document formats and provided publicly for TPB staff, TPB member staff and other interested parties to access, download, customize datasets and visualize the data through the Regional Transportation Data Clearinghouse (RTDC).

The RTDC pages are built upon the ArcGIS Online platform, which includes the ArcGIS Open Data model. This flexible platform allows TPB staff to easily share its spatial and non-spatial data resources, and provides for integration of data, maps, applications, and documents in a single location. Users can search for data by keyword or category and can also choose to show all available datasets. Each RTDC dataset has its own content page with metadata, a link to download data, and a summary of dataset attributes. The RTDC Project Page can be accessed at https://rtdc-mwcog.opendata.arcgis.com/. The datasets in the RTDC are regularly used internally by TPB staff as well as by jurisdictional members and the general public.

Datasets in the RTDC represent various transportation modes (highway, transit, bicycle, aviation) and include a selection of available modes and operators within the metropolitan Washington region. Traffic counts are one of the most utilized data types in the RTDC. Users can find annualized (AADT/AAWDT) traffic volume, hourly traffic, and classification counts for several years. Many of these datasets are available as both spatial and tabular data. Additional road-related datasets include regional managed lanes, truck restrictions, Highway Performance Monitoring System (HPMS) information, and Vehicle Miles Traveled (VMT).

Along with traffic and highway-related datasets, the RTDC includes transit and nonmotorized (bicycle and pedestrian) datasets. Available transit spatial data includes rail lines, stations, and average weekday transit ridership from the region's transit operators. Available bicycle and pedestrian data includes jurisdiction-specific counts for Virginia and the District of Columbia as well as count data obtained from automated counters located throughout the region.

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[53] https://www.mwcog.org/newsroom/2019/09/24/three-big-takeaways-from-the-2019-state-of-the-commute-survey/
[54] https://www.mwcog.org/file.aspx?&A=RPzEQG2VFv%2fkThRVpddQizfwogkMzN2IhIiHjmzKY%2fs%3d
[55] https://www.mwcog.org/documents/2021/09/27/covid-19-travel-monitoring-snapshot-traffic-monitoring/

Although many datasets in the RTDC are related to transportation in some way, the RTDC also includes several datasets focused on land use and demographics. COG's Cooperative Forecast of population, households and employment is one of the more popular items downloaded. These data are used by both COG's regional planners and TPB staff alike and are provided at the transportation analysis zone (TAZ) level. The RTDC includes the latest approved round (currently 9.1a) of the Cooperative Forecast as well as the past rounds. Additional datasets include Regional Activity Centers and TPB and COG TAZs by Activity Centers.

Users can view, interact with and download regional political boundaries, and Census geography boundaries with related tabular Census Transportation Planning Products (CTPP). The CTPP data is organized by where workers live and where they work. The data is based on 2006-2015 five-year American Community Survey data, it is designed to help transportation analysts and planners understand where people are commuting to and from and how they get there.

Current 'core' RTDC datasets such as traffic and transit counts and the Cooperative Forecast data are routinely updated as new data become available. Additionally, new content is added periodically, based on data availability, user requests and/or other means of discovery.

One of the goals of the RTDC catalog and viewer is to provide transportation analysts, planners, and the general public with as much publicly available regional transportation-related data as possible. Aside from being a warehouse for regional data , the RTDC includes a 'Regional GIS Resources' page that provides access to several TPB member jurisdictions' online spatial data (https://rtdc-mwcog.opendata.arcgis.com/pages/resources) resources. Users can also browse data from other MPOs, regional bodies and the federal government using the links provided. TPB staff have included these additional resources and tools to make it easier for users to find related data, for their own use in analysis and planning.

Web maps and applications allow TPB staff to package and present analysis findings, regional plans, and data in a spatially and textual interactive product. The web maps typically include data layers often with pop-ups which identify detailed information on the features. Web applications are set up as a single or multipage product that can have multiple web maps, web tools, tabular data and text all organized to provide users analysis findings and/or highlight the main parts of transportation plans. TPB Board members, jurisdiction staff, and TPB staff use these report/analysis companion products to facilitate discussions and to make decisions. An application can also provide a general public-friendly option for providing transportation plans to increase engagement and education with regional transportation planning. A selection of these web maps and applications shared through the RTDC Application Gallery, can be found on the RTDC homepage under 'Applications.'

The RTDC is a continuously evolving product—dataset and functionality requests are appreciated and are considered.

2.4.4 Other Congestion Monitoring and Data Consolidation Activities

In recent years, some previously undertaken data collection and travel monitoring programs have been discontinued, though some of these projects may be repeated in the future using similar or more-advanced methodologies, including private sector "big data" sources. These discontinued activities include aerial monitoring of the regional freeway network, travel time data collection by in-field vehicles, and an assortment of in-field traffic counts. See Appendix H for more information.

2.5 National Comparison of the Washington Region's Congestion

Regularly since 1982, the Texas A&M Transportation Institute releases an *Urban Mobility Report*[56], which outlines and compares urban congestion and mobility in all urban areas across the United States. The most recent report was released in 2021. INRIX, Inc., an independent live traffic information provider based on GPS units equipped on smartphones, in-vehicle devices and commercial fleets, releases an *INRIX Traffic Scorecard*[57] for the largest 100 metropolitan areas in the U.S. The navigation device firm TomTom also releases online TomTom Traffic Index[58].

The above three national or international reports use different performance measures and underlying methodologies, which greatly impacts the rankings of cities (Table 2-8). The Washington region ranked No. 5, No. 13, and No. 8 in the latest rankings published by the Texas A&M Transportation Institute, INRIX, and TomTom, respectively.

Table 2-8 National Comparison of the Washington Region's Congestion

Texas A&M Transportation Institute (2020 data)			INRIX Traffic Scorecard (2021 data)			TomTom Traffic Index (2021 data)		
Annual Person-Hours of Delay per Auto Commuter			Hours Lost in Congestion			Extra Travel Time compared to Free Flow Conditions		
Metro Area	**Value**	**Rank**	**Metro Area**	**Value**	**Rank**	**Metro Area**	**Value**	**Rank**
New York	56	1	Chicago	104	1	New York	35%	1
Boston	50	2	New York	102	2	Los Angeles	33%	2
Houston	49	3	Philadelphia	90	3	Miami	28%	3
Los Angeles	46	4	Boston	78	4	Baton Rouge	27%	4
San Francisco	46	4	Miami	66	5	San Francisco	26%	5
Washington	42	5	San Francisco	64	6	Chicago	24%	6
Dallas	40	6	New Orleans	63	7	Honolulu	23%	7
Chicago	39	7	Los Angeles	62	8	Seattle	23%	7
Atlanta	37	8	Houston	58	9	Riverside	23%	7
Philadelphia	37	8	Washington	44	13	Washington	21%	8

2.6 Forecast Performance Analysis of Visualize 2045

Visualize 2045, the Metropolitan Washington region's long-range transportation plan, includes all regionally significant transportation projects and programs planned in the Metropolitan Washington region over the next twenty-plus years. For every long-range transportation plan, the TPB produces a performance analysis that examines trends and assesses future levels of congestion. This performance analysis provides an overall assessment of the anticipated impacts and an indication of future levels of congestion relevant to the CMP.[59]

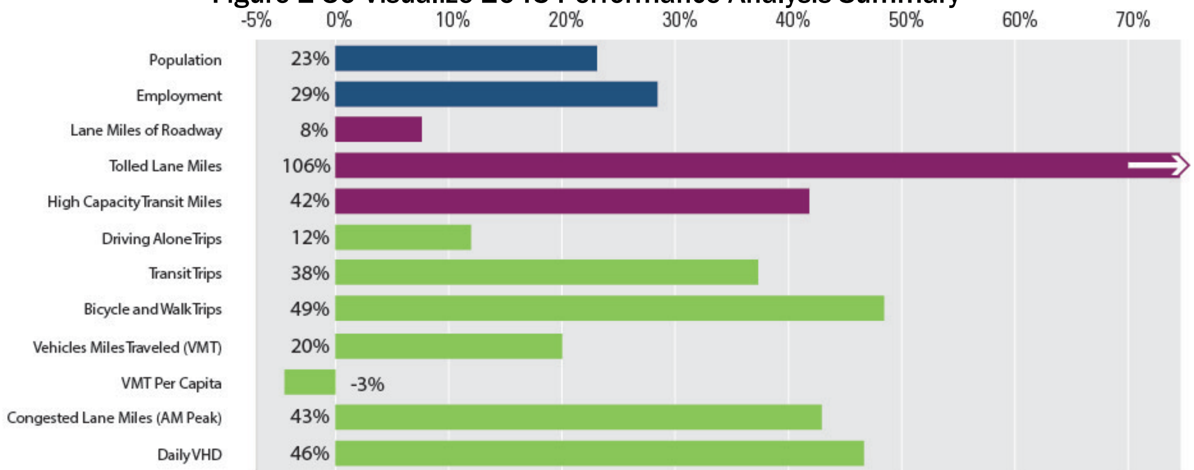
The plan performance analyzes the outlook of growth in the region and forecasts future congestion. The Visualize 2045 plan approved by the TPB in 2018 used 2019 as the base model year referenced as 'Today' in charts, and 2045 as the out year. The plan performance analysis examines travel demand model data to identify where congestion is expected to occur now and in the future. It looks at criteria

[56] https://mobility.tamu.edu/umr/
[57] INRIX, Inc., Traffic Scorecard, http://inrix.com/scorecard/
[58] TomTom, Traffic Index, https://www.tomtom.com/en_gb/trafficindex/list
[59] TPB, Visualize 2045 Documentation, October 17, 2018. https://www.mwcog.org/documents/2018/10/17/visualize-2045-a-long-range-transportation-plan-for-the-national-capital-region-featured-publications-tpb-visualize-2045/

that may affect congestion, such as changes in population, employment, transit trips, auto trips, number of lane miles, and congested lane miles. The analysis breaks down lane miles of congestion by examining the total share of congested lane miles, a comparison with a no-build alternative scenario, additional indicators of delay, and, generally, where the most lane miles of congestion can be found in 2045.

Between 2019 to 2045, the region is forecast to be home to 23 percent more residents and 29 percent more jobs in 2045 (Figure 2-30). Towards accommodating that growth, 8 percent more lane miles of roadway and 42 percent more high-capacity transit miles are planned to be constructed. The total number of trips taken is expected to increase by 22 percent, and transit, walk, and bike trips are expected to increase at a faster rate than single driver trips. The overall amount of driving (Vehicle Miles Traveled or VMT) is expected to increase by 20 percent. This is slightly less than forecast population growth, which means that VMT per capita is expected to decline by 3 percent. The increase in demand on the roadways is forecast to out-pace the increase in supply, leading to a significant increase in congestion.

Figure 2-30 Visualize 2045 Performance Analysis Summary



Congested lane miles in the AM peak hour are projected to increase by 43 percent in 2045 compared to 2019, meaning that 800 lane miles of roadway which were not congested in 2019 will be congested in 2045. The share of lane miles congested in comparison to all the lane miles of roadway in our region helps tell another part of the story: during the AM peak hour, 11 percent of lane miles in the region were congested in 2019 and 14 percent are projected to be congested in 2045 (Figure 2-31). While roadway capacity is expanding, the region's travel demand, due to growth in population and employment, will further congest a small set of the region's most used roadways.

The amount of driving in the region, measured as VMT, is expected to grow over the next 25 years, but at a slightly lower rate than population growth (Figure 2-32). As a result, the average amount of driving per person will be less in 2045 than it is in 2019. The drop in VMT per capita is noteworthy because it signals the reversal of a decades-long trend of increased driving in the region. As recently as the mid-2000s, the region's travel demand model was forecasting significant increases in VMT per capita but changes in projected land-use and travel patterns, as well as mode choice, may drive the reversal of this trend.

Congestion on many segments of the region's major highway system is expected to get worse over this time period but some segments of highway will see slight relief. Drivers of this change may include the impact of capacity expansions and / or changes in travel behavior (Figure 2-33). Major highways seeing improvements in congestion include portions of I-95 southbound in Prince William County and I-495 / I-95 inner- and outer-loop in suburban Maryland.

Figure 2-31 Share of AM Peak Hour Congested Lane Miles

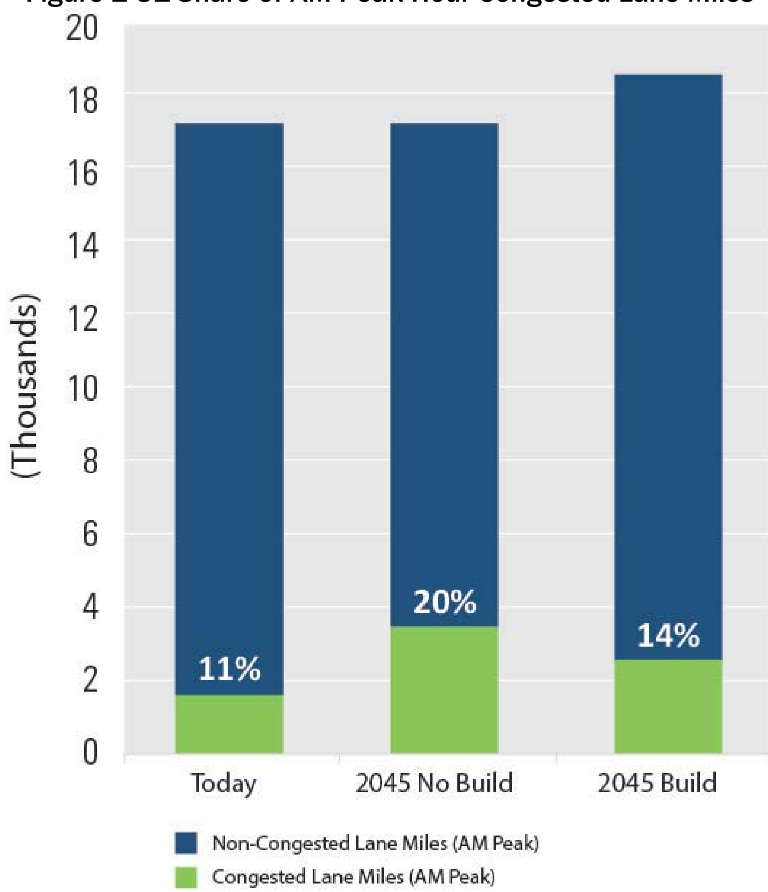


Figure 2-32 Vehicle Miles of Travel: Total and Per Capita

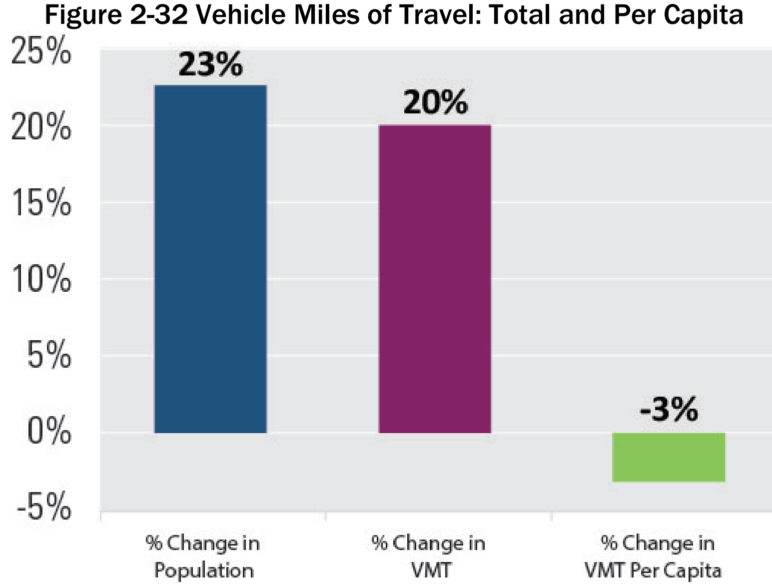
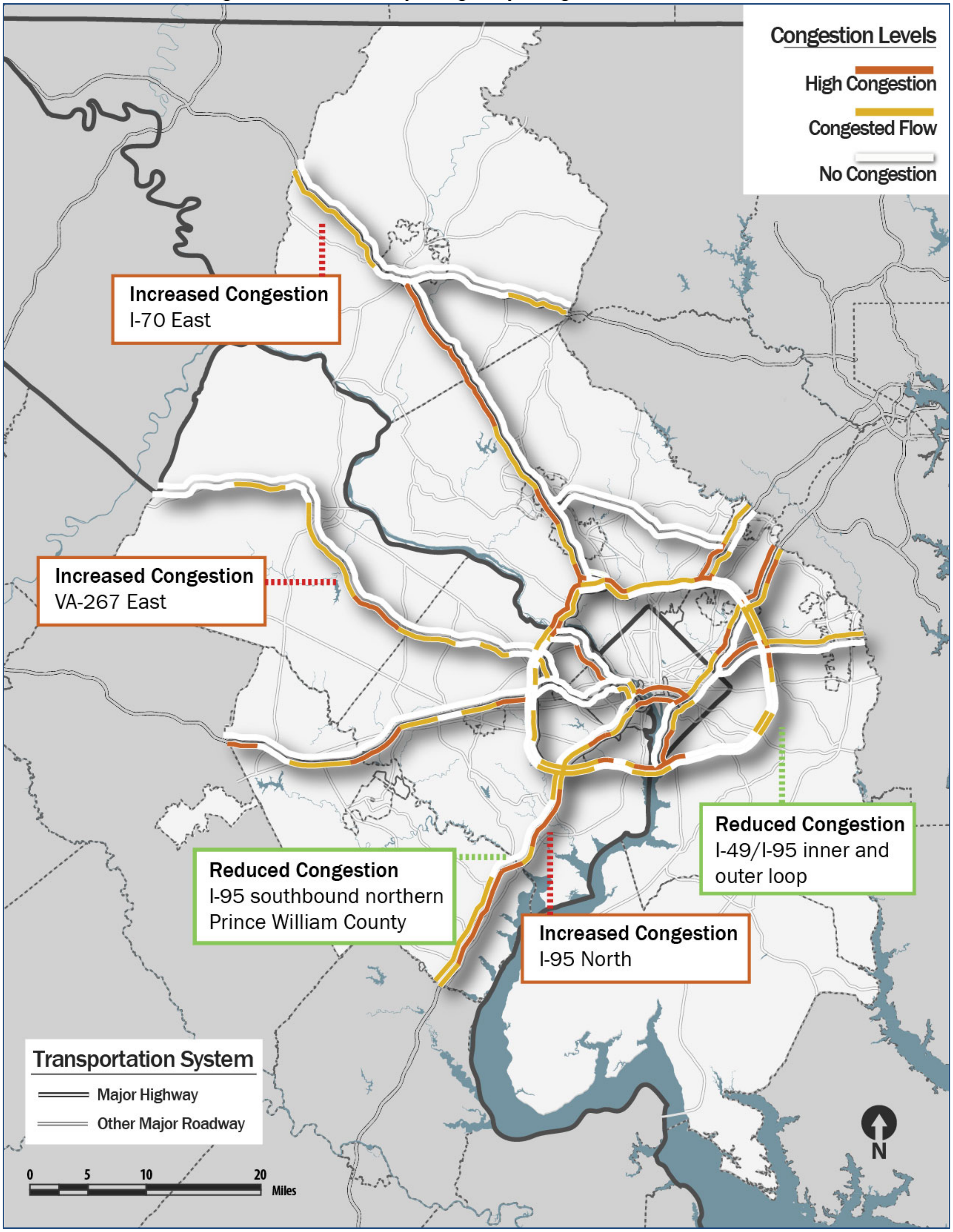


Figure 2-33 2045 Major Highway Congestion in AM Peak



The average number of jobs that are accessible within a 45-minute AM peak commute by automobile is expected to increase by 5 percent between 2019 and 2045. Figure 2-34 shows the geographic distribution of the change in number of jobs accessible from 2019 to 2045. Forecasted increases in job access by automobile are not equally shared across the region, declines in access are expected on the eastern side of the region and in the inner suburbs. These declines are the result of anticipated increases in roadway congestion, which make it more difficult to reach other parts of the region by car within 45 minutes, and the new jobs anticipated between 2019 and 2045 forecasted to more-likely be located on the western side of the region, out of reach of those living in the east.

By 2045, the average number of jobs accessible within a 45-minute commute by transit is expected to increase by 40 percent. Forecasts expect there will be more jobs located near existing transit stations and stops and expansions of the transit system across the region will also bring higher quality service to more areas. Most places that currently have access to transit will experience increases in the number of jobs that are accessible within a 45-minute commute (Figure 2-35). Portions of the region with new transit service will experience improved access, too. However, in 2045 transit may still not be a viable commute option for many people outside the core of the region due to lack of access to transit facilities and potentially long travel times.

Figure 2-34 Change in Access to Jobs by Automobile, 2019-2045

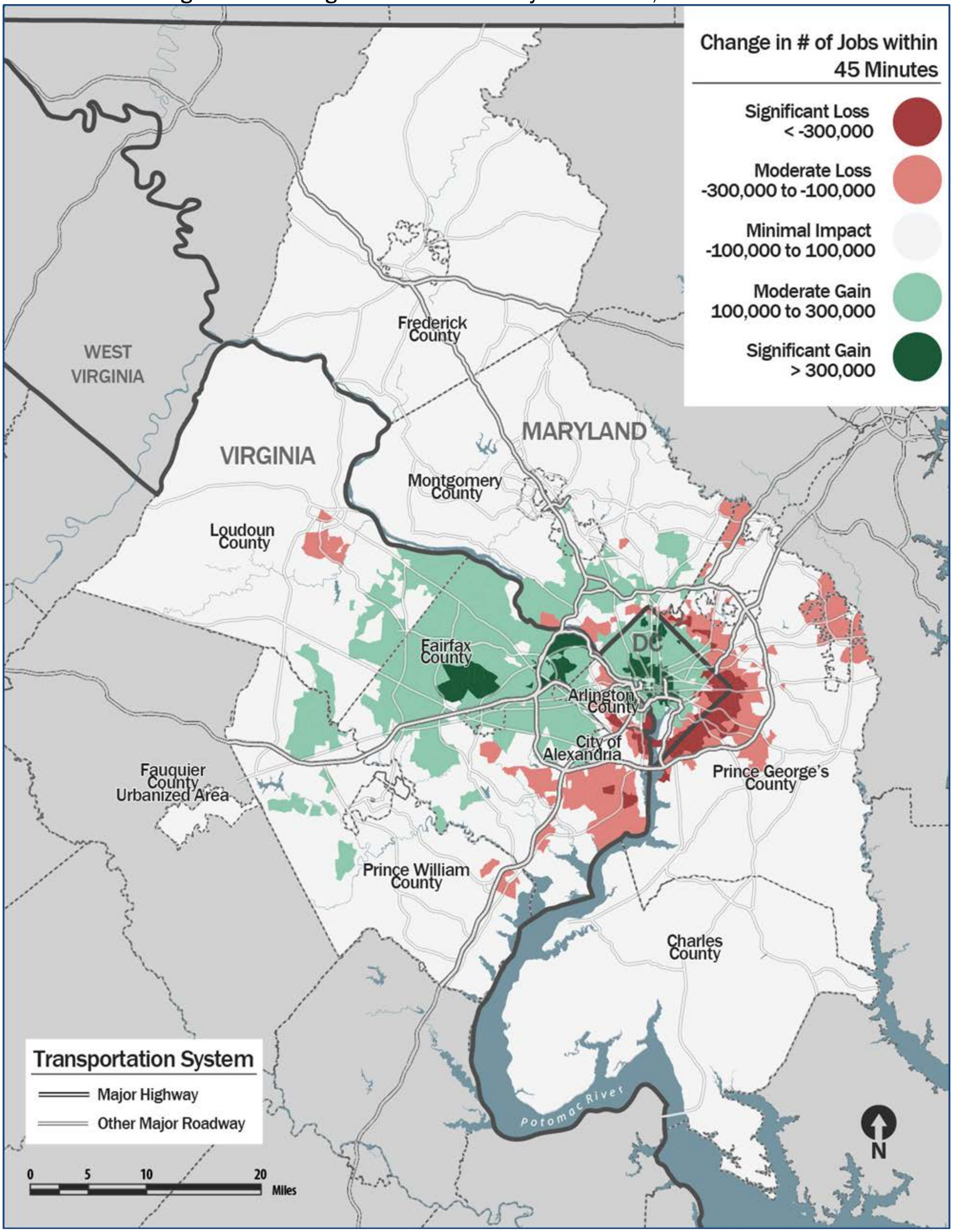
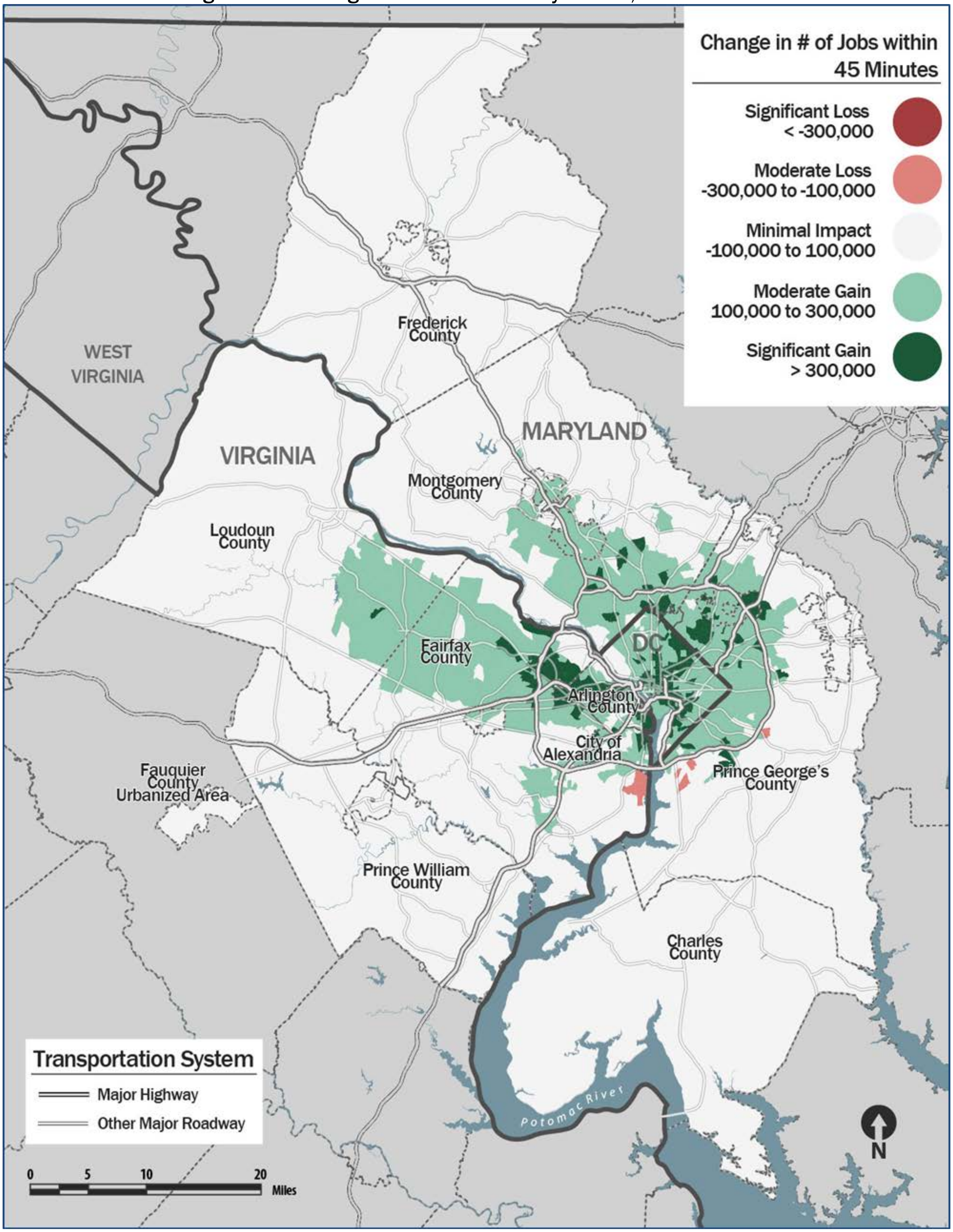


Figure 2-35 Change in Access to Jobs by Transit, 2019-2045

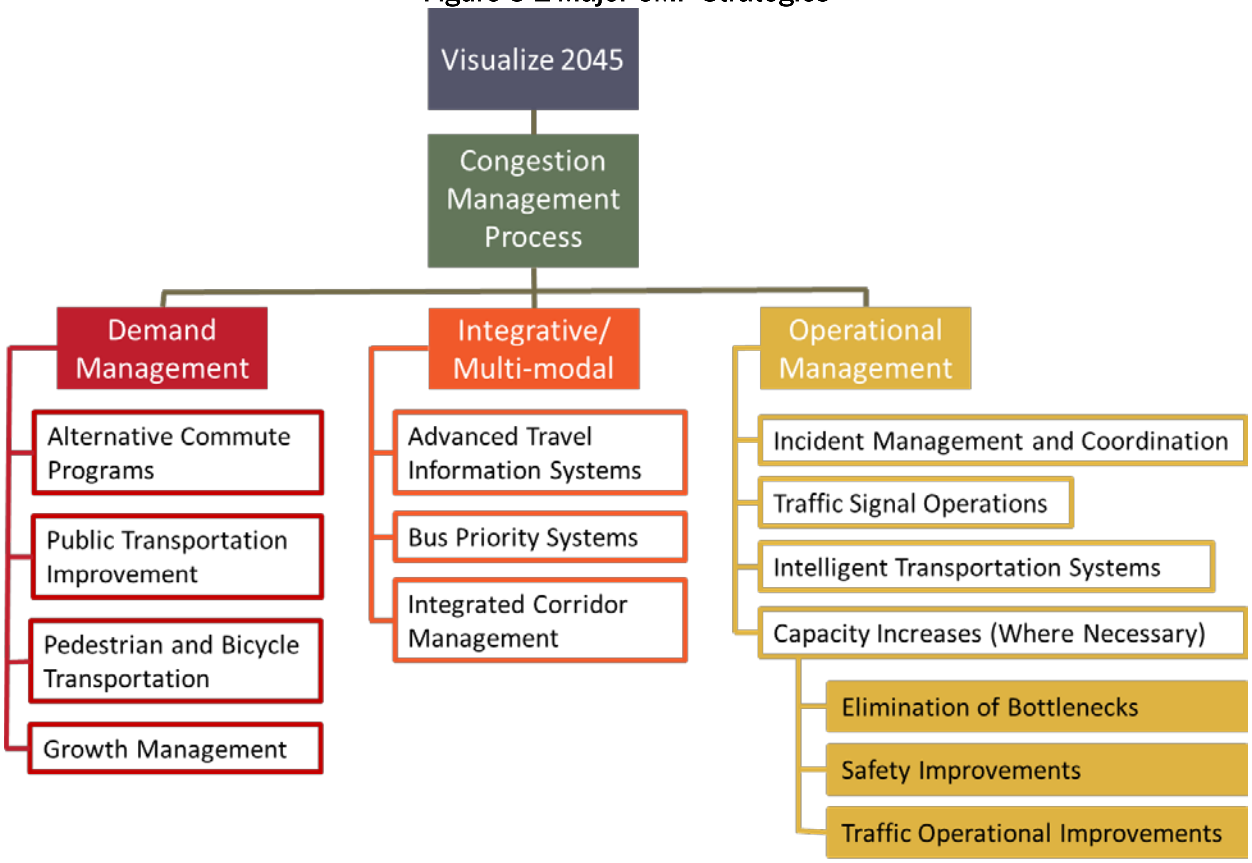


3. CONSIDERATION AND IMPLEMENTATION OF CONGESTION MANAGEMENT STRATEGIES

3.1 Overview of Congestion Management Strategies

Congestion Management Strategies generally can be divided into two types – Demand Management strategies and Operational, or Supply Management strategies. For purposes of this report, a third category, Integrative/Multi-modal, was added to better reflect the integration of demand and operation management in different projects in the region. Figure 3-1 shows examples of congestion management strategies.

Figure 3-1 Major CMP Strategies



Note: There are synergies between strategies categorized as demand management or operational management strategies, such as real-time traveler information on ridesharing opportunities responsive to a real-time traffic incident or situation.

Demand Management is aimed at reducing the demand for travel and influencing travelers' behavior; either overall or by targeted modes. Demand Management strategies can include carpooling, vanpooling, telework programs that allow people to work from home to reduce the amount of cars on the road, and living near your work as a means of reducing commute travel.

Supply or operational management, on the other hand, is managing and making better use of the existing transportation network in order to meet the region's transportation goals and ultimately reduce congestion. Example supply management strategies are High-Occupancy Vehicle (HOV) lanes, variably priced lanes, and traffic management.

Often strategies categorized as either demand management or operational management have components of the other. There are strategies in place in the region that take that combination a step further and integrate demand and operational management strategies into larger projects. In this report, these strategies have been categorized as Integrative/Multi-modal strategies. Examples of these strategies include advanced traveler information systems and integrated corridor management.

These strategies, and how they are implemented throughout the Washington region, are explained in further detail below.

3.2 Demand Management Strategies

3.2.1 Commuter Connections Program

Commuter Connections is a regional network, coordinated by COG/TPB, which provides commuter information and commuting assistance services to those living and working in the Washington, DC region. This program has been in existence since the 1970's under different names and has implemented a number of demand management strategies in the region. The Commuter Connections program is designed to inform commuters of the availability and benefits of alternatives to driving alone, and to assist them in finding alternatives to fit their commuting needs. The program is funded by the District of Columbia, Maryland, and Virginia Departments of Transportation, as well as the U.S. Department of Transportation, and all services are provided free to the public and employers. Continuing the Commuter Connections Program is one of the key recommendations of the 2022 CMP Technical Report.

Commuter Connections evaluates the impacts of their programs through the Commuter Connections Transportation Demand Management Evaluation Project. The evaluation process allows for both on-going estimation of program effectiveness and for annual and triennial evaluations. The most recent Transportation Demand Management (TDM) Analysis Report covered FY2018-2020. [60]

Both qualitative and quantitative types of performance measures are included in the evaluation process to assess effectiveness. First, measures reflecting commuters' and users' awareness, participation, utilization, and satisfaction with the program, and their attitudes related to transportation options are used to track recognition, output, and service quality. Some of the important performance measures are:

- Vehicle trips reduced
- Vehicle miles of travel (VMT) reduced
- Emissions reduced: Nitrogen Oxides (NOx), Volatile Organic Compounds (VOC), Particulate Matter (PM2.5), PM 2.5 pre-cursor NOx, and CO_2 emissions (Greenhouse Gas Emissions - GHG)

Particularly of interest to congestion management is the impact on vehicle trips reduced, vehicle miles of travel (VMT) reduced, and cost effectiveness. Appendix D shows the summary of results for

[60] *Transportation Demand Management (TDM Analysis Report FY 2018-2020*, November 17, 2020. https://www.commuterconnections.org/wp-content/uploads/2020-TDM-Analysis-Evaluation-FINAL-Report-111720-FOR-PUBLICATION.pdf

individual Commuter Connections TDM program elements (i.e., how many daily vehicle trips were reduced and the daily VMT reduced compared to the goals set by Commuter Connections).

Commuter Connections also operates the Commuter Operations Center (COC), providing direct commute assistance services, such as carpool and vanpool matching through telephone and internet assistance to commuters. The Commuter Operations Center also provides transit, bicycling, park and ride lot, and telecommuting information to commuters in the region.

In addition, a variety of surveys (the following lists a subset of them) are conducted by Commuter Connections to follow-up with program applicants and assess user satisfaction on its TDM programs. These surveys provide data used to estimate program impacts. Some of the surveys, such as the Applicant Placement survey and Guaranteed Ride Home (GRH) Survey, also provide information used by Commuter Connections staff to fine tune program operations and policies.

Commuter Connections Applicant Placement Rate Survey – Since May 1997 Commuter Connections has conducted commuter applicant placement surveys to assess the effectiveness of the Commuter Operations Center and other program components. The surveys assess users' perceptions of and satisfaction with the services provided.

GRH Applicant Survey – Commuters who register with the GRH program or use a one-time exception trip will be surveyed to establish how the availability and use of GRH influenced their decision to use an alternative mode and to maintain that mode. Satisfaction with GRH services also will be polled.

State of the Commute Survey (SOC) – The SOC survey, a random sample survey of employed adults in the Washington metropolitan region, serves several purposes. First, it establishes trends in commuting behavior, such as commute mode and distance, and awareness and attitudes about commuting, and awareness and use of transportation services, such as HOV/Express toll lanes and public transportation, available to commuters in the region.

Employee Commute Surveys – Some employers conduct baseline surveys of employees' commute patterns, before they develop commuter assistance programs and follow-up surveys after the programs are in place.

Employer Telework Assistance Follow-up Survey – Sent to employers that received telework assistance from Commuter Connections to determine if and how they used the information they received.

Bike-to-Work Day Participant Survey – A survey among registered participants in the Bike-to-Work Day event is undertaken to assess travel behavior before and after the Bike-to-Work Day, as well as commute distance and travel on non-bike days.

Car Free Day Participant Survey - A survey among registered participants in the Car Free Day event is undertaken to assess travel behavior before and after the Car Free Day, as well as commute distance and travel.

'Pool Rewards Participant Survey -- A survey among registered participants in the 'Pool Rewards program undertaken to assess travel behavior before and after program participation.

Vanpool Driver Survey – a survey that collects data on van ownership and operation, vanpool use and travel patterns, availability and use of vanpool assistance and support services, and issues of potential concern to vanpool drivers.

Transportation Demand Management (TDM) Evaluation – With the introduction of Clean Air Act Amendments in the 1990's reducing vehicle emissions became important in the region. Analysis showed that enhancing existing and introducing new demand management strategies will have a two-fold impact; reducing congestion and at the same time reducing emissions and clearing the air of ozone causing pollutants. These programs were adopted by the TPB and were originally called Transportation Emissions Reduction Measures (TERMs) and the regional programs were implemented through the Commuter Connections Program, in concert with program partners to meet air quality conformity and federal clean air mandates. Initially, Commuter Connections provided transportation emission reduction measure benefits for inclusion in the air quality conformity determination, which was approved by the TPB as part of the annual update of the Long Range Plan and Transportation Improvement Program. However, for the past decade or more the TPB has not required the use of the program's air quality impacts in the conformity analyses. In addition, Commuter Connections transportation impacts from its various programs may be needed to meet Performance Based Planning and Programming (PBPP) regional targets. Commuter Connections sets goals on TDM programs that impact commute trips, and evaluates the programs to determine the impact they are having on reducing congestion and vehicle emissions. These TDM programs include:

Guaranteed Ride Home (GRH) – 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.

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. Projects associated with this program include a regional Bike to Work Day event, Car free day event, and the 'Pool Rewards, CarpoolNow, Flextime Rewards, and incenTrip incentive programs.

Both the TDM program evaluation and associated surveys are keys to assessing the impact these programs have on congestion management and air quality. Following is a more detailed analysis on the above programs and other Commuter Connections demand management strategies in the region.

3.2.1.1 Telework

Teleworking, or telecommuting, can be described as a means of using telecommunications and information technology to replace work-related travel. This can be done by working at one's home, or at a designated telework center one or more days a week. There are designated telework and co-working centers throughout the region, in the District, Maryland, and Virginia. Phones, tablets, wireless communications, and computers make teleworking an easy alternative to getting in a car and driving long distances to an office. Teleworking has shown to boost the quality of life, have economic benefits, reduce air pollution, and ease traffic congestion.

The TPB adopted Resolution R10-2019 in December 2018 as part of the Visualize 2045 aspirational initiatives and one of the initiatives included the development of policy templates for small and mid-size employers to adopt and develop flextime and telework programs at their worksites. In FY2020 the telework materials on the Commuter Connections website were re-vamped and telework policy templates were developed and deployed along with other alternative work hours information. A new teleworking landing page was created on the Commuter Connections website to host the new materials. The landing page also includes select information from teleworking sections located in both the Commuters and Employers menus. Sample agreements and policy templates were uploaded to the website. Updated FAQs, best practices for teleworking, and updated information on alternative work schedules were also posted. These materials were all released just prior to the pandemic and have been helpful for employers who did not have policies or programs in place.

Telework is a TDM program evaluated by Commuter Connections. Telework Outreach is a resource service to help employers, commuters, and program partners initiate telework programs. In evaluating teleworking, several travel changes need to be assessed, including: trip reduction due to teleworking, the mode on non-telework days, and mode and travel distance to telework centers.

Telework impacts are primarily estimated from the State of the Commute survey (SOC) and by surveys conducted of employers directly requesting information from Commuter Connections. The 2019 State of the Commute Technical Report[61] concluded the following regarding teleworking:

- Teleworkers accounted for 35% of all regional commuters. That is, workers who travel to a main work location on non-telework days.[62]
- An additional 25% of commuters, all who do not currently telework, said they "would and could" telework either regularly or occasionally, that is, they have job responsibilities that could be done while teleworking and would be interested in teleworking, if given the opportunity.
- The remaining respondents said they either were not interested in teleworking (6%) or that their jobs could only be performed at their main workplace (34%)
- Over half (59%) of the teleworkers surveyed said they teleworked at least one day a week.

3.2.1.2 Employer Outreach

Employer Outreach is aimed at increasing the number of private and non-profit employers implementing worksite commuter assistance programs, and is ultimately designed to encourage employees of client employers to shift from driving alone to alternative modes.

In this program, jurisdiction-based sales representatives contact employers, educate them about the benefits commuter assistance programs offer to employers, employees, and the region and assist them to develop, implement, and monitor worksite commuter assistance programs.

The *TDM Analysis Report for FY 2018-2020* estimated the impacts of employer outreach. The following are some noteworthy statistics from that report:

- There were 1,962 employers participating in the Commuter Connections Employer Outreach program that represented 630,043 employees .

- The impacts from the Employer Outreach program included an estimated 85,845 daily vehicle trips and 1.5 million miles of VMT .

3.2.1.3 Carpooling, Vanpooling, Ridesharing and other Commuter Resources

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[61] *Commuter Connections State of the Commute Survey 2019 Technical Survey Report*. Prepared for Metropolitan Washington Council of Governments. Prepared by: LDA Consulting in conjunction with: CIC Research September 17, 2019.
https://www.mwcog.org/file.aspx?&A=PfED8xqHUcE2A3I3yNmaqaj6Xpyf3Wutxmh6Y9Hq5NE%3d

[62] Using this base of commuters excludes workers who are self-employed and for whom home is their only workplace.

Commuter Connections provides information on carpooling, vanpooling, and Ridesharing. These alternative commute methods reduce the amount of single occupant vehicles (SOVs) on the road, which is important to congestion management.

Carpooling is two or more people traveling together in one vehicle, on a continuing basis.

Vanpooling is when a group of individuals (usually long-distance commuters) travel together by van, which is sometimes provided by employers. There are typically three kinds of vanpool arrangements:

Owner-operated vans — An individual leases or purchases a van and operates the van independently. Riders generally meet at a central location and pay the owner a set monthly fee.

Third-party vans — A vanpool "vendor" leases the vanpool vehicle for a monthly fee that includes the vehicle operating cost, insurance, and maintenance. The vendor can contract directly with one or more employees. The monthly lease fee is paid by the group of riders.

Employer-provided vans — The employer (or a group of employers) buys or leases vans for employees' commute use. The employer organizes the vanpool riders and insures and maintains the vehicles. The employer may charge a fee to ride in the van or subsidize the service.

'Pool Rewards - 'Pool Rewards is a special incentive program available through Commuter Connections designed to encourage current drive alone commuters to start ridesharing in the Washington Metropolitan region. Commuters who currently drive alone to work may be eligible for a cash payment through 'Pool Rewards when they start or join a new carpool. If eligible, each carpool member can earn $2 per day ($1 each way) for each day they carpool to work over a consecutive 90-day period. The maximum incentive for the 90-day trial period is $130. Carpools may consist of two or more people. For commuters who drive alone to work and can get between seven and fifteen people together to form a vanpool, they may qualify for a $200 monthly 'Pool Rewards subsidy for the new vanpool. [63]

CarpoolNow - CarpoolNow is a dynamic rideshare mobile application that both drivers and riders can use anytime to find and schedule rides to and from work and is available through Commuter Connections. Drivers will receive an incentive payment for picking up a passenger using the mobile application so long as a portion of the trip occurs in the Washington DC Metropolitan Region. Drivers using the mobile app who give riders a lift to work in the non-attainment region are eligible to receive up to $10 per trip as an incentive for using the app. The maximum incentive a driver using the app can receive is $600 per calendar year.

Flextime Rewards - The Flextime Rewards program will pay registered commuters through Commuter Connections an $8 incentive each time they avoid notoriously congested corridors in the Washington D.C. region. It's a simple way to reward commuters that have flextime available through their employers to help reduce traffic congestion during peak hour travel periods. Participants are encouraged to first check with their employer to confirm that flextime is allowable at their worksite, they can then register to the program through Commuter Connections***. Once the commuter has joined*** the program, they will be asked to select an eligible corridor that is part of their commute. Corridors currently eligible for the Flextime Rewards cash incentive include:

[63] https://www.commuterconnections.org/pool-rewards/

- I-495 IL between VA-267 and I-270 Spur
- I-495 OL between I-95 and MD-193
- I-66 EB at VA-267
- DC-295 SB at Benning Rd.

If the commuter does not use any of these corridors for commuting purposes, they can still sign up to receive daily congestion notifications to avoid wasting time sitting in traffic. Once registration is complete, the commuter will begin to receive email notifications if higher-than-average traffic congestion is projected along their commute corridor(s). These emails contain suggested alternative departure times that may help avoid congestion. Those that use the defined Flextime Rewards cash-eligible corridors will receive the program incentive once a trip is logged. If a commuter elects to delay their trip, they'll need to use the Commuter Connections mobile app to record the flextime trip.

<u>incenTrip Mobile Application -</u> The incenTrip mobile app was jointly developed through the TPB's Commuter Connections program and the University of Maryland through federal grants from the USDOT and USDOE. incenTrip motivates commuters to use more efficient and cleaner methods of transportation and features include the multi-modal transportation choices available from a commuter's origin to their destination, the best times to travel, and provides reward points through Commuter Connections for use of cleaner and greener forms of travel such as bikes, buses, trains, walking, and ridesharing. incenTrip even rewards for driving alone in an Eco-friendly manner.

The idea behind incenTrip is to embrace the use of technology on a personalized level to reduce traffic congestion, tailpipe emissions, and improve energy efficiencies. The gamification and rewards aspects use innovative behavioral economics to help increase demand for alternatives to Single Occupant Vehicles and more fuel-efficient driving. By leveraging incenTrip as a tool to help prompt behavior change, the Commuter Connections is actively working to better achieve the broad range of transportation goals embedded in the TPB's adopted Vision 2045 aspirational initiatives. The app allows commuters to plan trips with the best travel modes, departure times, and routes that save time, cost, and fuel, based on person-level traffic prediction and real-time data feeds. With artificial intelligence, the incenTrip learns the users travel patterns and habits, and constantly seeks to improve the experience without requiring commuters to do the heavy lifting by searching for better options; steps that many aren't willing to take.

Drivers can also earn rewards points and save money through incenTrip. Of all the multi-modal transportation methods the incenTrip app identifies, the fewest rewards points earned are for driving alone. So, while drivers are rewarded for improved eco-driving habits and delaying trips to avoid above-the-norm congestion, more rewards points are given for non-SOV travel such as transit use, carpooling, bicycling and walking . Reward points earned through the app can be redeemed for $10, $20, or $50 in cash, up to $600 per commuter per calendar year through Commuter Connections. The incenTrip app takes the carrot approach to maximize transportation system efficiencies. incenTrip is available through the Apple or Android store for downloading and use.

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 options

3.2.1.4 Bike To Work Day

Each May thousands of area commuters participate in Bike to Work Day, sponsored by Commuter Connections and the Washington Area Bicyclist Association.[64] The TPB has a Bike to Work Day Steering Committee which coordinates the event each year.

Bike to Work Day encourages commuters to try bicycling to work as an alternative to solo driving. The program attracted over 17,900 bicyclists in 2019[65].

Biking and other nontraditional modes are expanded upon in Section 3.2.4.

3.2.1.5 Car Free Day

Each year, Commuter Connections implements a regional Car Free Day[66] campaign that encourages residents to leave their cars behind or to take alternative forms of transportation such as public transit, carpools, vanpools, telework, bicycling or walking.

Car Free Day was first held in FY 2009. In 2020, evaluation results showed that there were over 3,800 individuals that pledged to go "car-free" for this event. In addition, participants pledged to reduce 27,576 vehicle miles of travel as a result of participation in this event. This event is held on September 22nd each year and is in tandem with the World Car Free Day event. A marketing campaign along with public outreach efforts will be developed to coincide with this worldwide celebrated event.

3.2.2 Local and Other Transportation Demand Management and Traffic Management Activities

Local agencies and organizations, such as local governments and Transportation Management Areas (TMAs) are doing their part to promote alternative commute methods and other demand management strategies. Table 3-1 provides detailed information on specific ongoing demand management strategies in the Washington region.

[64] http://www.biketoworkmetrodc.org
[65] https://www.commuterconnections.org/wp-content/uploads/BTWD-2019-FINAL-Event-Report-012120.pdf
[66] http://www.carfreemetrodc.org/

Table 3-1 Ongoing State Local Jurisdictional Transportation Demand Management (TDM) Strategies

Geography	Location	Local Jurisdiction / Organization	Strategy Name	Operational or Demand Mngt. Strategy	Project/Program Name	Description	Website
Region-wide	Region- wide	WMATA	Public Transportation Improvements	Demand	Metrobus transit	Public bus service available throughout the region. Connects to other modes: Metrorail, commuter rail, park-and-ride lots, etc.	http://wmata.com/bus/
Region-wide	Region- wide	WMATA	Public Transportation Improvements	Demand	Metrorail transit	Public rail services DC, MD, and VA. Connects to commuter rail, Metrobus and local bus systems.	http://wmata.com/rail/
Region-wide	Region- wide	WMATA	Park-and-ride lot improvements	Demand	Metrorail station park-and-ride lots	Parking offered at 42 Metrorail stations.	https://www.wmata.com/service/parking/
State/Multi-jurisdictional	Maryland State-wide	MDOT	Pedestrian, Bicycle, and Multimodal Improvements	Demand	Maryland Bicycle and Pedestrian Advisory Committee (MBPAC)	Provides information on biking, walking to State government agencies. Master Plan guides bike/ped planning in the State.	https://www.mdot.maryland.gov/tso/pages/index.aspx?PageId=140
State/Multi-jurisdictional	Maryland State-wide	MDOT	Telecommuting	Demand	MDOT's Telework Partnership with Employers/Telework Baltimore.com program	Offers free teleworking consulting services to Maryland employers. Promotes teleworking.	https://dbm.maryland.gov/employees/pages/telework/teleworkhome.aspx
State/Multi-jurisdictional	Maryland State-wide	MTA	Employer outreach / mass marketing	Demand	MDOT's Commuter Choice Maryland	Reaches out to Maryland employers and offers incentives to implement a commuter program.	http://www.commuterchoicemaryland.com/

Geography	Location	Local Jurisdiction / Organization	Strategy Name	Operational or Demand Mngt. Strategy	Project/Program Name	Description	Website
State/Multi-jurisdictional	Maryland State-wide	MTA	Public Transportation Improvements	Demand	MDOT's MARC train	Maryland MTA Public commuter rail serving Montgomery County, Prince William County, Frederick County, and into DC.	https://www.mta.maryland.gov/about
State/Multi-jurisdictional	Maryland State-wide	MTA	Public Transportation Improvements	Demand	Local bus	Maryland MTA Public bus service throughout Maryland, primarily around the Baltimore-DC area.	https://www.mta.maryland.gov/about
State/Multi-jurisdictional	Maryland State-wide	MTA	Public Transportation Improvements	Demand	Commuter Bus	Maryland MTA Commuter bus service in Maryland and DC's inner-ring suburbs.	https://www.mta.maryland.gov/about
State/Multi-jurisdictional	District- wide	DDOT	Pedestrian, Bicycle and Multimodal Improvements	Demand	Bicycle and Pedestrian Programs	Committed to providing safe and convenient bicycle and pedestrian access throughout the City.	https://ddot.dc.gov/page/bicycles-and-pedestrians
State/Multi-jurisdictional	District of Columbia, Arlington County, City of Alexandria, Montgomery County	Partnership of DDOT, Arlington County, City of Alexandria, Montgomery County (Fairfax County – coming soon)	Bicycle Programs	Demand	Capital Bikeshare	A bikesharing program to encourage the use of bicycles.	http://capitalbikeshare.co m/

Geography	Location	Local Jurisdiction / Organization	Strategy Name	Operational or Demand Mngt. Strategy	Project/Program Name	Description	Website
State/Multi-jurisdictional	District- wide	DDOT	Carsharing Programs	Demand	On-Street Carsharing Program	A network of vehicles offered for rent to the public. Allows mobility of a car without owning one.	https://ddot.dc.gov/page/street-carsharing-program
State/Multi-jurisdictional	District- wide	DDOT	Public Transportation Improvements	Demand	DDOT Mass transit	DDOT helps coordinate mass transit with agencies and WMATA.	https://ddot.dc.gov/page/mass-transit-district-columbia
State/Multi-jurisdictional	District- wide	DDOT	District TDM Program	Demand	goDCgo	goDCgo is an initiative of DDOT that is designed to help reduce congestion and improve air quality in the District through the promotion of sustainable transportation modes.	http://godcgo.com/
State/Multi-jurisdictional	Downtown DC	Partnership of DDOT, WMATA, and DC Surface Transit	Public Transportation Improvements	Demand	DC Circulator	A public bus system serving the District.	https://www.dccirculator.com/
State/Multi-jurisdictional	Virginia-statewide	VDRPT, VDOT	Telecommuting	Demand	Telework!VA	Primary resource for Virginia's employers to start a telework program in VA, promotes teleworking.	https://www.dhrm.virginia.gov/teleworking
State/Multi-jurisdictional	Northern Virginia	VDOT	Variably Priced HOT Lanes	Demand/ Operational	495 Express Lanes	High occupancy toll (HOT) lanes that use congestion pricing to manage congestion on the Beltway in Virginia	https://expresslanes.com

Geography	Location	Local Jurisdiction / Organization	Strategy Name	Operational or Demand Mngt. Strategy	Project/Program Name	Description	Website
State/Multi-jurisdictional	Northern Virginia	VDOT	Variably Priced HOT Lanes	Demand/ Operational	95 Express Lanes	Construction of high occupancy toll (HOT) lanes that use congestion pricing to manage congestion on the Beltway in Virginia	https://expresslanes.com
State/Multi-jurisdictional	Northern Virginia	VDOT	Variably Priced HOT Lanes	Demand/ Operational	395 Express Lanes	Construction of high occupancy toll (HOT) lanes that use congestion pricing to manage congestion on the Beltway in Virginia	https://expresslanes.com
State/Multi-jurisdictional	Northern Virginia	VDOT and VDRPT	Transportation Demand Management Program	Demand/ operational	Virginia Megaprojects Regional, Dulles Rail, and 495 and 95 Express Lanes TMP's	Various targeted TDM and transit improvements to mitigate impacts and delays caused by construction of large scale projects in Northern Virginia	http://www.virginiadot.org/projects/northern%20virginia/default.asp
State/Multi-jurisdictional	Northern Virginia	NVRC	Laws and Safety Tips Booklet	Demand	Safety/Outreach	Pocket Booklet	https://novaregion.org/1236/Bicycle-and-Pedestrian-Safety
State/Multi-jurisdictional	Fairfax and Loudoun Co. VA	VDRPT and MWAA	Public Transportation Improvements	Demand	Dulles Corridor Metrorail Project	In cooperation with WMATA and local governments. Construct an extension of Metrorail to Dulles Airport	http://www.dullesmetro.com
State/Multi-jurisdictional	Virginia Statewide	VDRPT and AMTRAK	Public Outreach	Demand	AMTRAK Virginia	Promotes AMTRAK passenger rail service in Virginia	http://www.amtrakvirginia.com

Geography	Location	Local Jurisdiction / Organization	Strategy Name	Operational or Demand Mngt. Strategy	Project/Program Name	Description	Website
State/Multi-jurisdictional	Virginia Statewide	VDOT	Traffic Management	Operational	I-66 ATM	Promote safety and congestion management	none
State/Multi-jurisdictional	Virginia Statewide	VDOT	TDM and Traffic management	Operational	I-95 ICM	Promote safety and congestion management	none
State/Multi-jurisdictional	Loudoun, Fairfax, Arlington, and Prince William Counties	Northern Virginia Transportation Authority	Public Transportation Improvements	Demand	NVTA's TransAction Regional Transportation Plan	Identifies a number of public transit, travel demand management, and other improvements, including new park-and-ride lots throughout Northern VA.	https://nvtatransaction.org/ /
State/Multi-jurisdictional	Loudoun, Fairfax, Arlington, and Prince William Counties	Northern Virginia Transportation Authority	Alternative Commute Programs	Demand	NVTA's Mission of the Authority	Responsibilities include a general oversight of regional congestion mitigation, including carpooling, vanpooling, and other commute programs	https://thenovaauthority.org/planning/long-range-transportation/
State/Multi-jurisdictional	Northern VA and the District of Columbia	VRE	Public Transportation Improvements	Demand	Virginia Railway Express (VRE) Train	Commuter rail serving Northern VA and two stations in the District. Connects to local transit.	http://www.vre.org/index. html

Geography	Location	Local Jurisdiction / Organization	Strategy Name	Operational or Demand Mngt. Strategy	Project/Program Name	Description	Website
State/Multi-jurisdictional	Prince William Co., Manassas, Manassas Park, and several locations in VA & DC	PRTC	Public Transportation Improvements	Demand	Potomac and Rappahannock Transportation Commission's (PRTC) OmniRide	Commuter and local bus services along I-95 and I-66 corridor and within Prince William Co., Manassas, and Manassas Park, and to several locations in VA & DC, including Metrorail stations.	http://omniride.com/about/
State/Multi-jurisdictional	Prince William Co. and Manassas	PRTC	Ridematching Services	Demand	PRTC's OmniRide Ridesharing	A free ridematching service for carpooler and vanpoolers originating in Prince William Co., Manassas, and Manassas Park.	http://omniride.com/ridesharing/
State/Multi-jurisdictional	Fairfax, Loudoun, and Prince William Counties	VDOT/NOVA	Park-and-Ride Lots	Demand/ operational	Commuter Park-and-Ride lots	Provides and maintains numerous free park-and-ride lots	http://www.virginiadot.org/travel/parkride/home.asp
State/Multi-jurisdictional	Fairfax, Loudoun, and Prince William Counties	VDOT/NOVA	Bicycle Lockers	Demand/ operational	Bicycle Locker Rental Program	Provides reserved bicycle lockers at several Park-and- Ride lots for an annual rental fee	http://www.virginiadot.org /travel/nova- mainBicycle.asp
State/Multi-jurisdictional	Northern Virginia	PRTC in cooperation with NVTC and GWRC	Vanpool Programs	Demand	Vanpool Alliance	Organizes private vanpool providers for NTD reporting. Provides support, ridematching, and general marketing for vanpools in the region.	www.vanpoolalliance.org

Geography	Location	Local Jurisdiction / Organization	Strategy Name	Operational or Demand Mngt. Strategy	Project/Program Name	Description	Website
State/Multi-jurisdictional	Prince William Co., Manassas, and Manassas Park	PRTC	Employer Outreach	Demand	Omni SmartCommute	Provides outreach and support to area employers seeking to implement employee commute assistance programs.	http://www.prtctransit.org/service/programs/
State/Local	NOVA	VDOT/Local	Bike Lanes	Demand	Road Diet	Improve safety and mobility	https://virginiadot.org/programs/bikeped/roadway_reconfiguration.asp
County	Throughout Montgomery County	Montgomery County, MD	Park-&-Ride lots: Provision, maintenance & improvements	Demand	Montgomery County Park-and-Ride Lots	Provide park-and-ride lot information in the County.	https://www.montgomerycountymd.gov/dot-dir/Resources/Files/commuter/ParkRideLotGuide-rev-Oct2014.pdf
County	Throughout Montgomery County	Montgomery County, MD	Public Transportation	Demand	Ride On (local bus)	Provides public bus service in Montgomery County. Connects to Metrorail and Metrobus	https://www.montgomerycountymd.gov/DOT/ride.html
County	Throughout Montgomery County MD	MCDOT/ Commuter Services Section	Alternative Commute Programs	Demand	MCDOT TDM Programs & Services - available throughout the County	Provides information on alternative commute options: carpooling, biking, employer incentives, all other TDM services & strategies	http://www.montgomerycountymd.gov/commute

Geography	Location	Local Jurisdiction / Organization	Strategy Name	Operational or Demand Mngt. Strategy	Project/Program Name	Description	Website
County	Throughout Montgomery County MD	MCDOT/ Commuter Services Section & other offices within MCDOT; M- NCPPC	Growth Management	Demand	TDM for Development Review	Coordinates TDM strategies required in new developments	http://www.montgomerycountymd.gov/commute
County	Throughout Montgomery County MD	MCDOT/ Commuter Services Section & Traffic Engineering Div./Bikeways	Alternative Commute Programs – Bicycling	Demand	Bicycling Resources	Bike/transit maps for County and individual service areas. Bike resources	http://www.montgomerycountymd.gov/commute http://www2.montgomerycountymd.gov/DOT-DTE/BikeWays/BWHome.aspx
County	Throughout Montgomery County MD	MCDOT/ Commuter Services Section	Telework Incentive Program	Demand	Telework Resources	Laptops and consulting services available to employers exploring or adopting telework	http://www.montgomerycountymd.gov/commute
County	Throughout Prince George's County	Prince George's County Dept. of Public Works and Trans.	Alternative Commute Programs	Demand	Prince George's County Ride Smart Commuter Solutions	Provides information on commuter services available in Prince George's County and works with employers to establish workplace commuter benefits programs.	http://www.ridesmartsolutions.com/
County	Throughout Prince George's County	Prince George's County Dept. of Public Works and Trans.	Park-and-ride lot improvements	Demand	Prince George's County Park-and-Ride Lots	There are a number of free park-and- ride lots available in Prince George's County.	https://www.princegeorgescountymd.gov/1134/Park-Ride

Geography	Location	Local Jurisdiction / Organization	Strategy Name	Operational or Demand Mngt. Strategy	Project/Program Name	Description	Website
County	Throughout Prince George's County	Prince George's County Dept. of Public Works and Transport.	Improving accessibility to multimodal options	Demand	Prince George's County Call-A-Bus and PGC Link	Bus service available to all residents of Prince George's County who are not served by existing bus or rail; PGC Link offers on-demand service in specific zones not well served by fixed-route service.	https://www.princegeorgescountymd.gov/1138/Call-a-Bus and https://www.princegeorgescountymd.gov/3391/Microtransit
County	Throughout Frederick County	Frederick County, MD	Public Transportation Improvements	Demand	TransIT Services of Frederick County	Public bus and paratransit services.	https://frederickcountymd.gov/105/TransIT
County	Throughout Frederick County	Frederick County, MD	Alternative Commute Programs	Demand	TransIT Rideshare (a program within TransIT Services of Frederick County)	TransIT offers information on alternative commute options including commuter connections, regional transit and vanpools.	https://www.frederickcountymd.gov/208/Commuter-Services-Regional-Transportatio
County	Throughout Frederick County	Frederick County, MD	Alternative Commute Programs	Demand	Employer Connection (a program of TransIT Services of Frederick County)	Help business and employees find best transportation solutions	https://frederickcountymd.gov/105/TransIT
County	Throughout Frederick County	Frederick County, MD	Alternative Commute Programs	Demand	Frederick County Rideshare and Employer Outreach	Provides information on alternative commute programs, and local and regional public transit. Work with Employers to develop commute strategies at their locations.	https://www.frederickcountymd.gov/208/Commuter-Services-Regional-Transportatio
County	Throughout Frederick County	Frederick County, MD	Alternative Commute Programs	Demand	Taxi Access Program	TAP is available to County TransIT-plus program users as a way to supplement their transportation options.	https://www.frederickcountymd.gov/6483/Taxi-Access-Program

Geography	Location	Local Jurisdiction / Organization	Strategy Name	Operational or Demand Mngt. Strategy	Project/Program Name	Description	Website
County	Throughout Fairfax County	Fairfax County, VA	Public Transportation Improvements	Demand	Fairfax Connector (local bus)	Public bus system in Fairfax County. Connects to Metrorail and bus.	http://www.fairfaxcounty.gov/connector/
County	Throughout Fairfax County	Fairfax County, VA	Alternative Commute Programs	Demand	Fairfax County Commuter Services Program	Provides information on alternative commute programs, and helps business and employees find best transportation solutions	https://www.fairfaxcounty.gov/transportation/commuter-services
County	Throughout Fairfax County	Fairfax County, VA	Alternative Commute Programs	Demand	Active Transportation Program	A comprehensive bicycle initiative and program committed to making Fairfax County bicycle and pedestrian friendly	https://www.fairfaxcounty.gov/transportation/bike-walk
County	Throughout Fairfax County	Fairfax County, VA	Employer Awards	Demand	Fairfax County Best Workplaces for Commuters Awards	National & local recognition awards for Fairfax County employers who have established level 3 or 4 TDM programs	https://www.fairfaxcounty.gov/transportation/bike-walk
County	Throughout Fairfax County	Fairfax County, VA	Transit	Demand	Fairfax Transit	Study countywide transit needs	https://www.fairfaxcounty.gov/transportation/sites/transportation/files/assets/documents/pdf/transportation%20projects,%20studies%20and%20plans/countywide%20transit%20network%20study/finalreport.pdf
County	Throughout Arlington County	Arlington County, VA	Public Transportation Improvements	Demand	Arlington Transit (ART)	Public bus service in Arlington. Connects to Metrorail and bus.	https://www.arlingtontransit.com/
County	Throughout Arlington County	Arlington County, VA	Alternative Commute Programs	Demand	Arlington County Commuter Services	Provides information on alternative commute programs, and public transit.	https://www.commuterpage.com/about/arlington-county-commuter-services/

Geography	Location	Local Jurisdiction / Organization	Strategy Name	Operational or Demand Mngt. Strategy	Project/Program Name	Description	Website
County	Throughout Arlington County	Arlington County, VA	Pedestrian, Bicycle and Multimodal Improvements	Demand	Arlington's BikeArlington	Initiative to encourage more people to bike often.	http://www.bikearlington.com/
County	Throughout Arlington County	Arlington County, VA	Alternative Commute Programs	Demand	Arlington's Car-Free Diet	Promotes alternative commute methods.	http://www.carfreediet.co m/
County	Throughout Arlington County	Arlington County, VA	Promote Alternate Modes	Demand	WALKArlington	Promotes walking as an alternative mode.	http://www.walkarlington.com/
County	Throughout Arlington County	Arlington County, VA	Alternative Commute Programs	Demand	Arlington County's CommuterPage.com	Provides information on transportation options in Arlington and the DC area.	http://www.commuterpag e.com/
County	Throughout Arlington County	Arlington County, VA	Growth Management	Demand	Arlington County's TDM Management for Site Plan Development	Coordinates site plan development (proposed land use) with commuter and transit services.	http://www.commuterpag e.com/TDM/
Throughout Loudoun and from Loudoun to DC	Loudoun County, VA	Public Transportatio n Improvement s	Demand	Loudoun County Transit	Commuter bus service from Loudoun Co. to Arlington and downtown DC.	https://www.loudoun.gov/transit	Throughout Loudoun and from Loudoun to DC
County	Throughout Loudoun County	Loudoun County, VA	Park-and-ride lot improvements	Demand	Loudoun's Free Park-and-Ride lots	Free park-and-ride lots are available throughout the County.	https://www.loudoun.gov/242/P ark-Ride-Lots
County	Throughout Loudoun County	Loudoun County, VA	Alternative Commute Programs	Demand	Loudoun's Commuting options	Provides information on alternative commute programs and transit options.	https://www.loudoun.gov/commu te

Geography	Location	Local Jurisdiction / Organization	Strategy Name	Operational or Demand Mngt. Strategy	Project/Program Name	Description	Website
County	Throughout Loudoun County	Loudoun County, VA	Employer Outreach/ Services	Demand	Loudoun's Employer Services	Helps businesses identify commuting solutions for employees in Loudoun County	https://www.loudoun.gov/283/Employer-Services
County	Throughout Southern Loudoun and in Northern Loudoun to Purcellville	Virginia Regional Transit (in cooperation with Loudoun Co.)	Local Fixed Route Bus Service	Demand	Loudoun County	Public bus service within Loudoun County.	https://www.loudoun.gov/bus
City	The length of College Park, MD	City of College Park, MD	Pedestrian, Bicycle and Multimodal Improvements	Demand	College Park Trolley Trail	Trail is to run the length of the City of College Park, in the old trolley right-of-way.	https://collegeparkmd.gov/trails
City	Throughout Greenbelt	City of Greenbelt, MD	Public Transportation Improvements	Demand	Greenbelt Connection	A local bus in Greenbelt; runs upon request.	https://greenbeltmd.gov/government/departments-con-t/public-works/greenbelt-connection
City	Throughout City of Frederick	City of Frederick, MD	Pedestrian, Bicycle and Multimodal Improvements	Demand	Frederick Shared use paths	Promotes the use of, and creates new shared use paths.	https://www.cityoffrederick.com/232/Transportation
City	Throughout Alexandria	City of Alexandria, VA	Alternative Commute Programs	Demand	GO Alex	Promotes use of alternative modes.	https://www.alexandriava.gov/GOAlex

Geography	Location	Local Jurisdiction / Organization	Strategy Name	Operational or Demand Mngt. Strategy	Project/Program Name	Description	Website
City	Throughout Alexandria	City of Alexandria, VA	Public Transportation Improvements	Demand	Alexandria DASH	Local bus system. Connects to Metrobus and Metrorail, VRE, and other local bus systems.	http://www.dashbus.com/
City	Throughout Alexandria	City of Alexandria, VA	Growth Management	Demand	Transportation Management Plans for Site Plan Developments	Coordinates site plan development (proposed land uses) with commuter and transit services.	www.Alexandriava.gov/6556
City	Throughout Alexandria	City of Alexandria, VA	Improving accessibility to multimodal options	Demand	Alexandria Transit Store	Provides resources and retail transactions for multimodal travel	https://www.alexandriava.gov/TransitStore
City	Throughout City of Fairfax	City of Fairfax, VA	Public Transportation Improvements	Demand	City of Fairfax's CUE	Public bus service within City of Fairfax. Also connects to Vienna Metrorail station.	https://www.fairfaxva.gov/government/public-works/transportation-division/cue-bus-system
Local / Corridor-based	Along the corridor between Baltimore and DC	BWI Business Partnership	Alternative Commute Programs	Demand	BWI Business Partnership Commuter Resources	Provides information on commuter programs available to the BWI area.	http://www.bwipartner.org/index.php?option=com_content&task=view&id=21&Itemid=59
Local / Corridor-based	Downtown Bethesda Transportation Management District (TMD)	MCDOT/ Commuter Services Section with contractor: Bethesda Transportation Solutions (BTS)	Alternative Commute Programs	Demand	Bethesda TMD	Provides information on alternative commute options: carpooling, biking, employer incentives	http://www.bethesdatransi t.org/
Local / Corridor-based	Downtown Bethesda Transportation Management District (TMD)	MCDOT with contractor: Bethesda Urban Partnership (BUP)	Public Transportation Improvements	Demand	Bethesda Circulator	Downtown Bethesda Circulator Bus	https://www.bethesda.org/bethesda/bethesda-circulator

Geography	Location	Local Jurisdiction / Organization	Strategy Name	Operational or Demand Mngt. Strategy	Project/Program Name	Description	Website
Local / Corridor-based	North Bethesda TMD	MCDOT/ Commuter Services Section with contractor: North Bethesda Transportation Center	Alternative Commute Programs	Demand	N. Bethesda TMD	Provides information on alternative commute options: carpooling, biking, employer incentives	http://www.nbtc.org
Local / Corridor-based	Friendship Heights TMD	MCDOT/ Commuter Services Section (CSS)	Alternative Commute Programs	Demand	Friendship Heights TMD	Provides information on alternative commute options: carpooling, biking, employer incentives	http://www.montgomerycountymd.gov/DOT-DIR/commuter/tmd/index.html#FHTMDAC
Local / Corridor-based	Silver Spring TMD	MCDOT/ Commuter Services Section (CSS)	Alternative Commute Programs	Demand	Silver Spring TMD	Provides information on alternative commute options: carpooling, biking, employer incentives	http://www.montgomerycountymd.gov/DOT-DIR/commuter/tmd/index.html#DSS
Local / Corridor-based	Greater Shady Grove TMD	MCDOT/ Commuter Services Section (CSS)	Alternative Commute Programs	Demand	Greater Shady Grove TMD	Provides information on alternative commute options: carpooling, biking, employer incentives	http://www.montgomerycountymd.gov/DOT-DIR/commuter/tmd/index.html#GSG-TMD
Local/Corridor-based	Downtown Bethesda TMD	MCDOT/ Commuter Services Section (CSS)	Alternative Commute Programs	Demand	Downtown Bethesda TMD	Provides information on alternative commute options: carpooling, biking, employer incentives	http://www.montgomerycountymd.gov/DOT-DIR/commuter/tmd/index.html#GSG-TMD
Local/Corridor-based	North Bethesda TMD	MCDOT/ Commuter Services Section (CSS)	Alternative Commute Programs	Demand	North Bethesda TMD	Provides information on alternative commute options: carpooling, biking, employer incentives	http://www.montgomerycountymd.gov/DOT-DIR/commuter/tmd/index.html#GSG-TMD

Geography	Location	Local Jurisdiction / Organization	Strategy Name	Operational or Demand Mngt. Strategy	Project/Program Name	Description	Website
Local/Corridor-based	White Oak TMD	MCDOT/ Commuter Services Section (CSS)	Alternative Commute Programs	Demand	White Oak TMD	Provides information on alternative commute options: carpooling, biking, employer incentives	http://www.montgomerycountymd.gov/DOT-DIR/commuter/tmd/index.html#GSG-TMD
Local / Corridor-based	Loudoun, Fairfax, and Prince William Counties	Dulles Area Transportation Association (DATA)	Alternative Commute Programs	Demand	DATA Commuter Resources	Advocates for alternative commute programs, transit needs, and transit-oriented development.	http://www.datatrans.org/
Local / Corridor-based	Reston	LINK	Alternative Commute Programs	Demand	Reston's LINK Commuter Resources	Provides information on carpooling, vanpooling, and regional bus schedules.	http://www.linkinfo.org/index.cfm
Local / Corridor-based	Tyson's Corner area	Tyson's Transportation Association (TYTRAN)	Alternative Commute Programs	Demand	TYTRAN's Commuter Resources	Provides information on carpooling, vanpooling, park- and-ride lots, and telework locations.	https://www.tysonspartnership.org/experience/transportation
Local / Corridor-based	Northern VA - Loudoun, Fairfax, Prince William	Northern Virginia Transportation Commission (NVTC)	Public Transportation Improvements	Demand	NVTC Programs	NVTC has innovative programs supporting transit	http://www.novatransit.org/programs/
Local / Corridor-based	Eastern Arlington's Potomac Yard neighborhood	Full Access Solutions in Transportation (FAST) for Potomac Yard	Growth Management	Demand	Non-profit, developer-initiated FAST	Aims at reducing single- occupant trips to the growing Potomac Yard area. Promotes transit, biking, walking. Offers discounted Metrobus shuttle.	https://fastpotomacyard.com/

3.2.3 Transit Systems

Transit systems can improve the operation of existing roadways and systems by carrying more passengers than a single-occupant vehicle. They can also be considered demand management strategies in that they can influence a person's traveling behavior and convince them to leave their car at home. Many of the transit systems in the region are operated by transit agencies or local government agencies, including:

- *Alexandria DASH*, the local bus service in Alexandria, Virginia.
- *Arlington Transit (ART)*, the local bus service in Arlington County, Virginia.
- *Bethesda Circulator*, a downtown Bethesda bus service.
- *City-University Energysaver (CUE)*, the local bus service in City of Fairfax, Virginia.
- *DC Circulator* bus, serving downtown District of Columbia.
- *Fairfax Connector*, the local bus service in Fairfax County, Virginia.
- *Frederick County TransIT*, the local bus service in Frederick County, Maryland.
- *Greenbelt Connection*, bus serving Greenbelt upon request.
- *Loudoun County Transit* operates local and commuter bus services in the County, with commuter services between the County and West Falls Church Metro, Rosslyn, the Pentagon, and Washington, D.C.
- *Maryland Transit Administration (MTA) MARC* train commuter rail, serving the District of Columbia and Maryland, as well as West Virginia.
- *Montgomery County Ride On*, the local bus service in Montgomery County, Maryland.
- *MTA Commuter Bus* operates contracted bus services throughout the Maryland suburbs including service from Howard, Anne Arundel, Queen Anne's, and Charles Counties to locations in Washington, D.C., Montgomery County, and Prince George's County.
- *Potomac and Rappahannock Transportation Commission (PRTC)*, providing *OmniRide* commuter and local bus services throughout Prince William County, Manassas, and Manassas Park with commuter services to several Metrorail stations, the Pentagon, Crystal City, Rosslyn/Ballston, downtown Washington, D.C., Capitol Hill, and the Washington Navy Yard.
- *Prince George's County Call-A-Bus*, serving those in Prince George's County not served by existing bus or rail.
- *Prince George's County TheBus*, the local bus service in Prince George's County, Maryland.
- *Regional Transportation Agency (RTA) of Central Maryland*, a public transportation service providing fixed route and paratransit services within Howard County, Anne Arundel County, Northern Prince George's County and the City of Laurel.
- *Virginia Railway Express (VRE)* commuter rail serving Virginia and District of Columbia.
- *Virginia Regional Transit* (in cooperation with Loudoun County Transit), a bus service that operates into Loudoun County, Virginia.
- *Washington Metropolitan Area Transit Authority (WMATA) Metrobus*, serving the entire Washington metropolitan area.
- *Washington Metropolitan Area Transit Authority (WMATA) Metrorail*, serving the entire Washington metropolitan area.

While these transit systems are individually very important strategies, it is important to note that they work together to form an entire transit network important to our congestion management system. They work well with other strategies as well, such as VPLs and HOV lanes. In addition, with the help of Intelligent Transportation System (ITS) technologies, Advanced Traveler Information Systems and providing buses with bicycle racks, transit can be even more appealing to travelers.

The 2017/2018 regional household travel survey revealed that commuting transit modal share increased from 15.1% in 1994 to 19.8%. This increase reflects the positive effect of the region's longstanding efforts to promote transit usage. However, overall daily transit modal share has been essentially static, at 5.5% in 1994 and 5.6% in 2017/2018[67].

3.2.3.1 Significant Transit Construction and Capacity Increases

The second phase of Metrorail's Silver Line with service to Dulles Airport is anticipated to open in 2022.[68] The Potomac Yard Metrorail station in Alexandria, Virginia is also expected to open in late 2022. Beyond the completion of these two projects no further Metrorail expansion is funded.

DDOT is still evaluating a planned extension of the H Street NE Streetcar to the Benning Road Metrorail station. DDOT is also working on engineering for the K Street NW Transitway, which long-term could be converted to streetcar operation though the plan currently calls for it to be built as a busway.

Other significant public transportation projects include the expansion of commuter rail services for Northern Virginia. These are part of a wider statewide rail effort in Virginia, the Transforming Rail Initiative.[69] Fundamental to this effort is the construction of a second span to the Long Bridge railroad bridge across the Potomac River. The Long Bridge project will add two tracks for commuter and intercity rail efforts, and the state also plans to construct a fourth track from the bridge south on land right-of-way purchased from CSX. Eventually, this should enable frequent commuter rail service in Virginia, as well as through running service from Maryland via the District of Columbia into Northern Virginia.

In Maryland there are also plans for commuter rail expansion, as detailed in the MARC Cornerstone Plan.[70] However, beyond short-term investments in state of good repair much of this plan has not been programmed for funding.

Section 3.4.2 discusses technology-related transit projects such as bus priority systems.

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[67] A presentation of the 2017/2018 Regional Travel Survey, January 20, 2021.
https://www.mwcog.org/file.aspx?D=Dw%2fgnMYLOCdyKXzDtqFr5zupoggDaIxTusmHeFT279s%3d&A=1jtAjBORzA7h3tDBYvudqLXCbQeynNuAP7ySU4tLGKI%3d
[68] http://www.dullesmetro.com/silver-line-stations/
[69] https://transformingrailva.com/
[70] https://s3.amazonaws.com/mta-website-staging/mta-website-staging/files/Transit%20Projects/Cornerstone/MCP_MARC.pdf

3.2.3.2 Future Transit Planning

While there are no current projects for expanding the WMATA Metrorail network after 2022, there are several studies and plans examining possible expansion, including a Blue Orange Silver (BOS) study by WMATA to add capacity through the downtown core. In addition, there have been several conceptual studies which included looking at extending the Yellow Line to Hybla Valley in Fairfax County, Virginia, extending Metrorail to Prince William County, Virginia[71] and extending Metrorail to Germantown, Maryland.

3.2.3.3 University Transit Systems

Many area universities have their own transit systems for students, faculty, staff, and in some cases, visitors. These shuttle systems increase transit options for the university community and help reduce congestion on campus roads. Two examples of university transit systems are the Shuttle-UM system at the University of Maryland, College Park and the Mason Shuttle at George Mason University. The Shuttle-UM system is one of the nation's largest University transit services[72] with a fleet of over 75 vehicles, including hybrid and clean diesel vehicles, and a ridership of about 3.3 million during FY 2019.[73] Mason Shuttles has five routes including connections to the Vienna Metrorail Station and the Burke VRE station. Both universities provide riders with real-time bus arrival information.

3.2.4 Pedestrian and Bicycle Transportation

Walking and bicycling are garnering attention as having positive environmental and health benefits. As a part of the region's transportation network, these activities impact congestion management as well. There are a number of things the Washington region is doing to enhance the area of bicycle and pedestrian transportation to encourage non-motorized transportation.

- The TPB adopted Visualize 2045, the region's long range transportation plan, in October 2018. Two of the seven "aspirational" initiatives in Visualize 2045, "Improve Walk and Bike Access to Transit" and "Complete the National Capital Trail" relate to enhancing walk and bike access.

- In July 2020, the TPB passed a resolution adopting the National Capital Trail Network, a regional trails plan.[74] The National Capital Trail Network will provide a continuous pedestrian and bicycle network of over 1,400 miles of trails and other low-stress facilities, of which over 600 miles already exist and almost 800 miles are planned.

- Projects that help complete the TPB's Aspirational Initiatives, such as by improving walk and bike connections to transit, or completing the National Capital Trail Network, are prioritized for funding through the TPB's Transportation-Land Use Connections, Transit within Reach, Roadway Safety, and Transportation Alternatives programs.[75]

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[71] http://www.drpt.virginia.gov/transit/springfield-to-quantico/
[72] http://www.transportation.umd.edu/shuttle.html (Accessed April 301, 2016)
[73] University of Maryland Department of Transportation Services 2019 Annual Report https://transportation.umd.edu/sites/default/files/Annual%20Report_2019.pdf
[74] https://www.mwcog.org/events/2020/7/22/transportation-planning-board/
[75] https://www.mwcog.org/transportation/programs/

- The TPB adopted an updated "Bicycle and Pedestrian Plan for the National Capital Region" in January 2015,[76] with a revised plan anticipated in 2022. Both the TPB and COG recognize the congestion reduction benefits of bicycling and walking.

- Most of the area's local governments have adopted bicycle, pedestrian, and/or trail plans and/or policies. Bicycle or pedestrian coordinators and trail planners are now found at most levels of government.

- On May 16, 2012, the TPB approved the "Complete Streets Policy for the National Capital Region" which is a directive to all of the TPB member jurisdictions to ensure safe and adequate accommodation, in all phases of project planning, development, and operations, of all users of the transportation network in a manner appropriate to the function and context of the relevant facility.[77]

- Most of the region's transit agencies have bike racks on their buses. WMATA allows bikes on rail at all times.[78]

- Full-size and collapsible/folding bicycles are permitted on all MARC trains on all three lines - Penn Line, Camden Line, and Brunswick Line. Non-collapsible bikes may only be transported on railcars with bike racks, indicated by green lights on the exterior of the car.[79]

- VRE allows collapsible bicycles on all trains. VRE allows up to two full size bicycles on the last three northbound trains, the midday train, and the last three southbound trains on each line.[80]

- WMATA has three secure Bike & Ride facilities at historically high bike-to-rail stations: College Park, East Falls Church, and Vienna. Together, Metro's Bike & Rides offer secure parking for about 270 bikes, with space for expansion to meet future demand.

- A number of local governments require bicycle parking, as well as provide free on-street racks. DC requires bike parking in all buildings that offer car parking.

- In accordance with federal guidance and state policies, pedestrian and bicycle facilities are increasingly being provided as part of larger transportation projects. A number of local jurisdictions have implemented transit-oriented developments (TODs) and other walkable communities.

- VDOT has included in its secondary street acceptance requirements the mandate that streets built by private developers connect with adjacent streets and future developments in a manner that enhances pedestrian and bicycle access, and that adds to the capacity of the transportation system. Residential streets may be narrower and incorporate traffic calming features.

- Employers are investing in bike facilities at work sites, and developers are including paths in new construction.

- Specific bicycle/pedestrian campaigns encourage biking/walking, such as WALKArlington, GoAlex, and GoDCGo.

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[76] https://www.mwcog.org/documents/bicycle-and-pedestrian-plan/
[77] http://www.mwcog.org/uploads/committee-documents/mV1dXl9e20120510092939.pdf
[78] https://www.wmata.com/service/bikes/
[79] https://www.mta.maryland.gov/bike
[80] http://www.vre.org/service/rider/policies/

- Thanks in part to the TPB's policies, plans, and grant programs, bicycle and pedestrian plans and projects are now widespread throughout the Washington region. For example, DC has built 94 miles of bike lanes since 2001. Beginning in 2009, the DDOT began installing protected bike lanes, also known as Cycle Tracks or separated bike lanes, and there were, as of 2020, 16.6 miles of these facilities. Other jurisdictions are following the District's example, adding bike lanes and trails. Maps of existing bike facilities can be found at dcbikemap.com and at BikeArlington.com.

- More and better on line bike and walk routing resources have also become available. Google Maps offers both walk and bike routing features. Other bike routing resources for the Washington region include dcbikemap.com and Map My Ride,

Results

- Better bike and walk infrastructure has led to more bicycling and walking. The 2017-2018 COG household travel survey shows that bicycle commuting in the DC metropolitan area has nearly tripled since the 2007-2008 household travel survey, from 0.9% to 2.8%, while walk commutes jumped from 2.2% to 3.1%. Drive alone trips fell sharply.

- Growth in bicycling and walking is concentrated in the urban core jurisdictions that have done the most to enhance facilities and increase densities around transit. The urban core (DC. Arlington, and Alexandria) saw bike commuting triple, from 2.4% to 8.9%. Walking increased from 7.2% to 8.7%, and transit ridership increased.[81]

- The inner suburbs also tripled their bike commute share, from a low base of 0.5% to 1.5%,

Potential for the Future

Bicycling and walking have an even greater potential to grow as modes of transportation. Many trips taken by automobile could potentially be taken by bicycle. This is especially true in areas such as Activity Centers where a number of trips are more easily switched from motorized transportation to walking. Many people who live far from their jobs, but closer to transit or a carpool location could walk or bike to transit or the carpool instead of driving. When considering the following statistics, switching from a motor vehicle or bicycling or walking is feasible[82]:

- The median work trip length for solo drivers in the TPB Planning area is 9.3 miles.
- Twenty-five percent of commute trips are less than 4.8 miles, a distance most people can cover by bicycle.
- The median auto driver trip (for all purposes) is only 4.3 miles, and 25% of all auto driver trips are less than 1.7 miles.
- Auto passenger trips, often children being taken to school, are even shorter, with a median trip distance of 3.1 miles, and 25% of trips less than 1.3 miles.

Supporting bicycle and pedestrian planning is important to congestion management. Each additional person walking or biking for a trip is one less person on the road, thus easing congestion. Pedestrian and bicycle facility planning is something that will continue to be considered in the realm of congestion

[82] https://www.mwcog.org/documents/2020/01/21/regional-travel-survey-presentations-regional-travel-survey-tpb-travel-surveys/

management, not only as a stand-alone area, but in conjunction with transit projects and land use planning.

Bikesharing

Capital Bikeshare opened in September 2010 with 1,100 bikes at 110 stations. The public-private partnership has since expanded, with more than 5,000 bikes available at 600 stations across six jurisdictions: Washington, DC; Arlington, VA; Alexandria, VA; Montgomery County, MD; Prince George's County, MD; Fairfax County, VA; and the City of Falls Church, VA.[83] The Capital Bikeshare smartphone app allows users to see bicycle and dock availability.

The results of a survey[84] of Capital Bikeshare members conducted in 2016 provided information on travel changes made in response to Capital Bikeshare availability. According to the survey report, bikeshare provides an additional transportation option to members to make trips that they may not have made in the past because it was too far to walk. More than half of Capital Bikeshare members do not have access to a car or personal vehicle. The survey found that bikeshare plays a role in multimodal transportation. When asked about their travel, seven in ten (71%) of respondents used Capital Bikeshare at least occasionally to access a bus, Metrorail, or commuter rail; 18% used bikeshare six or more times per month for this purpose. The availability of bikeshare allows its members to switch trips to bike from other modes.

3.2.5 Dockless Micromobility

The term 'dockless' originally referred to bikeshare programs that allowed people to pick up and drop off a rented bicycle at any place away from a designated docking station within a certain jurisdiction. In a short time (since mid-2018), however, dockless bikes have been replaced with electric scooters and e-bikes. They are typically rented using a smartphone app. Dockless bikes, e-scooters, and e-bikes are collectively referred to as "dockless micromobility" vehicles.

Table 3-2 Dockless Micromobility Services in the Washington Region (As of August 2020)

Jurisdiction	E-Scooters and E-Bikes Permitted*	Service Area	Number of Operators
District of Columbia	10,000	All	4
Alexandria	1500	All	4
Arlington	3500	All	8
City of Fairfax	750	All	3
Fairfax County	300 per operator	All	2
Loudoun County	1000	Within 3 miles of Metrorail	None yet
City of Manassas	N/A	All	None yet
College Park	300	All	1
Montgomery County	1500	Rockville & Silver Spring	3

[83] https://www.capitalbikeshare.com/about (Accessed December 2, 2021).
[84] 2016 Capital Bikeshare Member Survey Report prepared by LDA Consulting. https://www.capitalbikeshare.com/system-data

*Actual availability is typically significantly less than the maximum number permitted, often less than half the permitted level. E-scooters account for most shared mobility devices.

Dockless e-scooter trips are mostly replacing ride-hailing and personal vehicle trips, rather than transit or walk trips. In Alexandria, when asked "If there were no scooters in the City, how would you have taken most of these trips?", almost 70% of users (980) responded that they would have either used a personal vehicle, used a rideshare app (such as Uber or Lyft), or taken a taxi as one of their top two choices.[85]

Regional Dockless Workshops

TPB hosts a series of regional workshops on dockless electric scooter and bicycle sharing. Representatives from member jurisdictions present on their programs, to an audience of planners, consultants, public officials, and members of the general public.

These multi-purpose workshops provide a forum for staff from various agencies in the region, working or exploring dockless services within their jurisdictions, to hear about the experience and approaches taken by agencies currently providing these services. The workshops are also a forum for all agency staffs to hear from the various stakeholders, including members of the public, about their expectations from and opportunities for improving these services.

Workshops were held on May 31 and October 31, 2018, May 30 and December 9, 2019, and August 13, 2020. Documents from the workshops are posted on the Bicycle and Pedestrian Subcommittee website.[86]

Conclusions

- Electric scooters are likely to be a growing part of the transportation scene for the immediate future. Established permit programs are being renewed, and additional jurisdictions have pilot programs under development.

- E-scooters serve short trips in urban areas, replacing walking, driving, and taxi/ride-hailing trips. They often provide a last-mile solution of access to transit.

Scooter Corral. Photo Credit: DDOT

- Major concerns with e-scooters include dangers to pedestrians from sidewalk-riding, rider safety, and obstruction of the sidewalk by improperly parked vehicles.

- Covid-19 slowed deployment of new dockless micromobility programs, and many e-scooter companies modified or reduced operations.

[85] *Alexandria Dockless Mobility Pilot Evaluation,* page 31. City of Alexandria, November 2019.
[86] https://www.mwcog.org/events/2022/?F_committee=22.

3.2.6 Car Sharing and Ride Hailing

Car sharing is short-term car rental, often by the hour. Using smartphone apps and unstaffed parking spaces, it makes renting a car fast and convenient. This supports residents, especially in densely populated urban environments, who make only occasional use of a vehicle.

Car share companies follow one of two basic models. The first has designated parking spaces for each vehicle, and the vehicle must be returned to that location at the end of the rental. The second, has a home area defined where users can park the vehicle in any legal public parking space at the end of the rental, allowing for one-way or point-to-point trips.

The point-to-point model has come under competitive pressure from ride hailing and from shared e-scooters, which serve the same kind of short trips within the city, often for a lower price. The round trip model has proven more stable.[87]

Ride-hailing car services, such as Uber and Lyft (also called transportation network companies or TNCs), operate much like a taxi service. However, these app-based services are often cheaper and easier to use, more reliable, and more secure than traditional street-hailed taxicabs. Ride hailing has grown rapidly, especially in the urban core.[88] In Washington, DC (in the pre-Covid period) ride-hailing was reported to account for 7% of VMT, versus 2% for the region as a whole.[89]

Ride hail users own fewer cars, use more shared modes, and spend less on transportation overall than their neighbors. However, in many locations ride hailing appears to be more a substitute for transit than a complement, resulting in increased motorized traffic and congestion. Operating characteristics of ride hailing, such as driving without a passenger, and stopping in the travel lane to load and unload, have also been shown to increase congestion.[90] Improved curbside management may mitigate some of these issues.

Major ride-hailing companies acknowledge that they have contributed to congestion in the urban core, and support congestion pricing so long as it is applied to all private motorized users.[91]

Covid-19 was devastating for the ride hail business.[92] Recovery has been complicated by a shortage of drivers, which has led to increased wait times and fares.[93]

3.2.7 Land Use Strategies in the Washington Region

The relationship of land use and transportation often has an important influence on a person's willingness to commute by transit, ridesharing, bicycling, or walking; modes other than driving alone.

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[87] https://dcist.com/story/20/03/03/the-future-of-carsharing-in-d-c-now-that-car2go-has-gone/

[88] "Ride-hailing, travel behaviour and sustainable mobility: an international review" Alejandro Tirachini, November 2019.
https://link.springer.com/article/10.1007/s11116-019-10070-2

[89] https://www.bloomberg.com/news/articles/2019-08-05/uber-and-lyft-admit-they-re-making-traffic-worse

[90] "The New Automobility: Lyft, Uber and the Future of American Cities" Schaller Consulting, July 25, 2018.
http://www.schallerconsult.com/rideservices/automobility.pdf

[91] https://medium.com/sharing-the-ride-with-lyft/the-new-frontier-congestion-pricing-in-america-ba99c3721c98

[92] https://www.theverge.com/2021/2/11/22277043/uber-lyft-earnings-q4-2020-profit-loss-covid

[93] https://www.theverge.com/2021/4/7/22371850/uber-lyft-driver-shortage-covid-bonus-stimulus

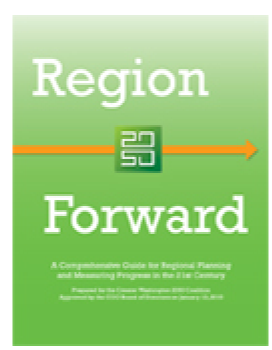
The TPB and its staff collaborate with COG's Department of Community Planning and Services (DCPS) staff to support regional land-use and transportation coordination. Through staff support, local jurisdictions are provided with opportunities to inform the TPB about market conditions, real estate development, land-use plans, and growth forecasts for employment, population, and households. Staff also coordinates closely with the National Capital Planning Commission (NCPC) and General Services Administration (GSA) in planning for the optimal locations for federal facilities throughout the National Capital Region. At the policy level, the TPB, COG Board, and Region Forward Coalition work to develop long-range regional planning goals and to integrate planning policies around land-use, transportation, housing, and the environment.

3.2.7.1 Cooperative Forecast

The Cooperative Forecasts are the official employment, population and household projections for COG member local governments, based on common assumptions about future growth. The Forecasts are widely used as technical inputs for local and regional planning and to guide capital investment decisions. The forecasts are based on national economic trends, local demographic factors, and are closely coordinated with regional travel forecasts.

The Cooperative Forecasting program is a multi-stage, "top-down/bottom-up" technical process led by the Planning Directors Technical Advisory Committee (PDTAC) and the Cooperative Forecasting and Data Subcommittee (CFDS). The Program employs a regional econometric model and local jurisdictional forecasts. The regional econometric model, IHS Markit, projects employment, population, and heads of households for the metropolitan Washington region based on national economic trends. Concurrently, local government planners develop short-term benchmark projections (5 to 10 years) based upon current development activity (rezonings, construction and permitting, etc.) and long-term benchmark forecasts (15 to 25 years) guided by local comprehensive, land use, and small area plans. COG staff, PDTAC members and CFDS members work to reconcile the regional econometric model and local jurisdictional benchmark projections. COG staff also coordinates with adjacent MPOs (the Baltimore Metropolitan Council, the Fredericksburg Area MPO, and other jurisdictions within the TPB "Model Region" footprint to obtain similar growth assumptions for those areas. If there is a major change in planned transportation facilities (such as an addition or removal of a planned major facility) the cooperative forecasts are updated to reflect this change. Overall, Metropolitan Washington has strong, well-established processes to ensure that transportation planning and land use planning are well-coordinated. The current draft Forecasts are Round 9.2.

3.2.7.2 Region Forward and Regional Activity Centers



Region Forward is a vision for a more accessible, sustainable, prosperous, and livable National Capital Region. It was developed by the Greater Washington 2050 Coalition, a group of public, private, and civic leaders convened by COG in 2008 to help the region meet future challenges like accommodating two million more people by 2050, maintaining aging infrastructure, growing more sustainably, and including all residents in future prosperity.

The Region Forward Compact seeks effective coordination of land use and transportation planning resulting in an integration of land use, transportation, environmental, and energy decisions. Specifically in the transportation sector, Region Forward:

- Seeks a broad range of public and private transportation choices for our Region which maximizes accessibility and affordability to everyone and minimizes reliance upon single occupancy use of the automobile.
- Seeks a transportation system that maximizes community connectivity and walkability, and minimizes ecological harm to the Region and world beyond.[94]

First called for by the TPB in the 1998 "Vision Plan", Regional Activity Centers are a framework used to coordinate transportation and land use planning in specific areas in the Washington region experiencing and anticipating growth. Concentrating residential and commercial development in dense, mixed-use Activity Centers is a strategy that the TPB has encouraged jurisdictions throughout the region to pursue to reduce the reliance on people driving alone for their daily needs. The Activity Centers include existing urban centers, priority development areas, transit hubs, suburban town centers, and traditional towns throughout the region. Connecting Activity Centers with high-capacity transit[95] options and making it easier for people to move around within these areas can also help reduce reliance on driving alone which is key to congestion management.

The first map of Regional Activity Centers was adopted in 2002, and since that time it has been updated twice, based upon current local comprehensive plans and zoning. The most recent map of Activity Centers, again developed by the COG PDTAC, was adopted by the COG Board in January 2013.[96] The development of the 2013 map used more targeted and specific criteria than in previous versions (2003, 2007) to designate 141 Activity Centers (Figure 3-2). The criteria are a mix of 'core' or required local planning goals or attributes, and a mix of several additional measures.[97]

According to the latest forecast, Round 9.2 (draft), 33 percent of the region's households are within Activity Centers, and 65 percent of jobs are located within them. In the future, growth will be even more concentrated in Activity Centers. By 2045, 39 percent of the region's households and 67 percent of the region's jobs will be located in Activity Centers. Regarding growth, 62 percent of all new households and 74 percent of all new jobs will be located in Activity Centers between 2020 and 2045.

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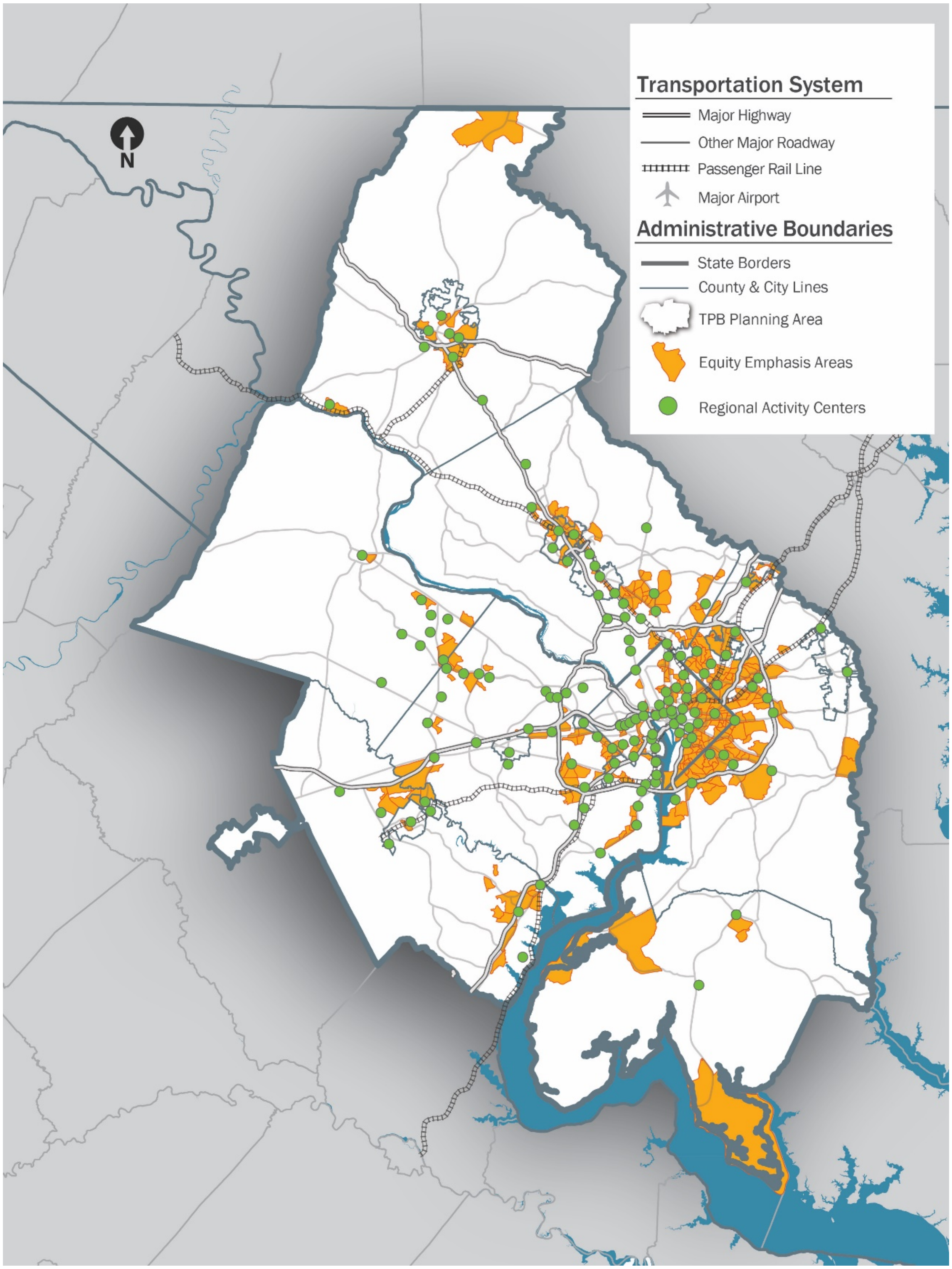
[94] https://www.mwcog.org/regionforward/
[95] High-capacity transit includes Metrorail, commuter rail, light rail, streetcar, and bus rapid transit.
[96] Regional Activity Centers Map, January 2013
http://www.mwcog.org/uploads/pub-documents/oV5cXVc20130813171550.pdf

Figure 3-2 2013 Regional Activity Center Map



3.2.7.3 Aspirational Initiative to "bring Jobs and Housing Closer Together"

In endorsing an Aspirational Initiative to "bring jobs and housing closer together," the TPB is calling upon regional leaders to promote policies encouraging more housing in general and more housing near transit and in Activity Centers. The TPB has prioritized growth around high capacity transit stations. A recent analysis by the TPB determined that additional housing in the region would improve transportation system performance, particularly if those units were strategically located in Activity Centers and near High-Capacity Transit Stations. Learn more about planning for focused growth around high capacity transit stations at: https://www.mwcog.org/maps/map-listing/high-capacity-transit-hct-station-areas/

To address the regional housing shortfall and affordability challenges documented in COG's report, the Future of Housing in Greater Washington, in September 2019, the COG Board of Directors approved three Housing Targets:

1. The Region needs 320,000 housing units in the next 10 years – 75,000 more than currently anticipated;
2. At least 75 percent of all new housing – or 240,000 total units – should be located in Activity Centers or near High Capacity Transit; and
3. At least 75 percent of new housing should be affordable to low and middle-income households.

In October 2021, the COG Board took action on two resolutions to optimize land use around High-Capacity Transit Station Areas and elevate Equity Emphasis Areas throughout all of COG's planning. High-Capacity Transit Station Areas (HCTs) are a regional planning concept adopted in 2021 by the COG Board of Directors and Transportation Planning Board to guide future growth and investment decisions. HCTs are the 225 locations around Metrorail, commuter rail, light rail, bus rapid transit, and streetcar stations that are in place or will be by 2030. By optimizing land use around these station areas, enhancing transportation connections, and creating transit-oriented communities, the region can accommodate future growth and also ensure quality places where all residents can thrive.

The TPB and COG are responding to the day-to-day challenges of people who are struggling with high costs of housing and transportation by focusing on more housing, including more affordable housing options, in places where people will have better access to transit, biking and walking.

3.2.7.4 Transportation-Land Use Connection (TLC) Program

The TPB's Transportation/Land Use Connections (TLC) program helps local jurisdictions work through the challenges of integrating transportation and land use planning to create vibrant communities. TLC is designed to support local planning and design projects as well as share success stories and proven tools with governments and agencies across the region.

Since 2007, the TPB has worked with its member jurisdictions on the three components of the TLC Program: TLC Technical Assistance, the Peer Exchange Network (TLC PeerX), and the Transportation Alternatives Set Aside (TA Set Aside).

The TLC program allows for flexibility to study a wide variety of transportation – land use issues. Some projects are more demand management focused, focusing on pedestrian improvements, growth management, and transit-oriented development. Other projects address operational issues, including pedestrian safety improvements and roadway design. The goals among each may be different, but each project is applicable to congestion management.

3.2.7.5 Local Jurisdictional Land Use Planning Activities

Following are some of the major examples of activities going on at the local level that are important to congestion management. Activities range from having a strong comprehensive plan that guides local development, to the implementation of projects that include transportation options and pedestrian and bicycle facilities. Examples of local jurisdictional recent or ongoing planning activities (please note: this is not a comprehensive list) include:

- Silver Spring Downtown and Adjacent Communities Plan[98]
- Prince George's County Zoning Rewrite[99]
- Loudoun County 2019 Comprehensive Plan[100]
- Alexandria Old Town North Urban Design Standards & Guidelines[101]
- Prince William County Small Area Plans[102]

3.3 Operational Management Strategies

3.3.1 Managed Lanes/Facilities/Systems

Managed lanes have their origin in the Washington Area with the I-95 Busway/Shirley Express[103] project of the early 1970's. These lanes were converted to allow car-pools and van-pools (initially HOV-4 then HOV-3), and the network was expanded to include a new section of I-66 (HOV restricted in peak-flow directions between I-495 and the Rosslyn area of Arlington County), VA-267 (Dulles Toll Road), I-270 and U.S. 50 in Prince George's County.

Since 2010, several of these former HOV corridors have been converted to HOV/Toll lanes, including in the I-395, I-95, and I-66 corridors. New managed lanes were added to I-495 in Fairfax County, and an entirely new priced highway, MD-200, was constructed and opened to traffic in Montgomery County and Prince George's County in Maryland[104]. A study in Maryland (as of this writing) is examining the extension of the 495Express lanes in Virginia north on I-495, I-270 Spur and I-270 as a public-private partnership project.

3.3.1.1 High-Occupancy Vehicle (HOV), High-Occupancy Vehicle/Toll and Variable Tolling Overview

High Occupancy Vehicle (HOV) lanes are defined as roadways or roadway segments that are restricted to use by vehicles (cars, buses, vanpools) carrying the driver and one or more additional passengers.

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[98] https://montgomeryplanning.org/planning/communities/downcounty/silver-spring/silver-spring-downtown-plan/
[99] https://montgomeryplanning.org/planning/communities/downcounty/silver-spring/silver-spring-downtown-plan/
[100] https://www.loudoun.gov/4957/Loudoun-County-2019-Comprehensive-Plan
[101]https://www.alexandriava.gov/planning/info/default.aspx?id=86032
[102] https://www.pwcva.gov/department/planning-office/small-area-plans; http://eservice.pwcgov.org/planning/documents/NorthWoodbridgeSAP/NorthWoodbridgeSAP_DRAFT.pdf

[103] Now 395Express and 95Express HOV/Toll lanes.
[104] Differing from the Virginia examples cited, MD-200 does not exempt HOVs from tolls (though tolls charged vary according to anticipated demand on the highway).

HOV facilities offer several advantages over conventional lanes and roads. They increase the number of persons per motor vehicle using a highway over conventional (non-HOV) roadways, they preserve the person-moving capacity of a lane or roadway as demands for transportation capacity increase, and enhance bus transit operations. All advantages are important to effectively managing the operations of existing and new capacity on roadways.

However, HOV facilities can also be considered demand management strategies as well, providing predictable travel times even during peak periods of high demand for highway capacity. HOV lanes can help influence travelers' behavior and provide them with additional choices of how, or if, to travel a certain route.

High-Occupancy Vehicle/Toll lanes are an adaptation of HOV lanes and allow vehicles not meeting the HOV requirement to use the faster lanes in exchange for electronic payment of a toll, usually variable according to demand or sometimes time-of-day.

Variable-pricing of road capacity can be used with HOV lanes or alone to manage traffic and demand so that traffic is flowing freely, even in peak demand times, as on MD-200.

The TPB has had active interest in variably priced lanes (VPLs) since June 2003 when the TPB, together with the Federal Highway Administration and the Maryland, Virginia, and District Departments of Transportation, sponsored a successful one-day conference on value pricing in the Washington region. After the conference, in Fall 2003, the TPB created a Task Force on Value Pricing to further examine and consider the subject. Under a grant from the Federal Highway Administration's Value Pricing Program, the TPB Value Pricing Task Force evaluated a regional network of variably priced lanes in the region producing a final report in February 2008.

Currently there are six HOV or HOV/Toll or variable toll facilities in the Washington region on highways functionally classified as freeways:

- I-95/I-395 in the Northern Virginia counties of Stafford, Prince William, Fairfax and Arlington and the City of Alexandria (HOV/Toll);
- I-66 in the counties of Prince William, Fairfax and Arlington (concurrent-flow HOV and HOV/Toll);
- Virginia Route 267 (Dulles Toll Road) in Fairfax County (concurrent-flow HOV);
- I-270 and the I-270 Spur in Montgomery County, Maryland (concurrent-flow HOV);
- U.S. 50 (John Hanson Highway) in Prince George's County, Maryland (concurrent-flow HOV);
- MD-200 (InterCounty Connector) in Montgomery County and Prince George's County, Maryland (variable-priced tolling); and
- I-495 between Springfield and a point north of the VA-267 (Dulles Toll Road) interchange (HOV/Toll).

3.3.1.2 I-95/I-395

Managed lanes have their origin in the Washington area with the I-95 Busway/Shirley Express reversible lane project which began operation in 1969 and continued into the 1970's, running from the D.C. approaches to the 14th Street Bridge to a point south of VA-644 (Franconia Road) in the Springfield area of Fairfax County, Virginia. These reversible lanes were eventually converted to allow car-pools and van-pools (initially HOV-4 then HOV-3), and the lanes were extended south to VA-234 at Dumfries, Prince William County in the 1990's. In 2014 the reversible lanes from the southern terminus (at VA-610 in Garrisonville, Stafford County, an extension from VA-234) to a point north of VA-648 (Edsall Road) at Turkeycock Run on I-395 were converted from HOV-3 to the 95Express HOV/toll lanes, with vehicles not meeting the HOV-3 requirement permitted to use them in exchange for payment of tolls (HOV-3 vehicles may use them at no charge if equipped with E-ZPass Flex transponder set appropriately). North of Turkeycock Run, on I-395, the HOV-3 operation remained unchanged at the time of the conversion to 95Express. In 2019 the 95Express HOV/toll operation was extended north from Turkeycock Run along I-395 and called 395Express to the Virginia shoreline of the Potomac River, with the same operating characteristics as the original 95Express lanes. The combined length of the 95Express and 395Express managed lanes is currently about 37 miles.

A ten-mile southern extension of 95Express to near U.S. 17 in southern Stafford County was expected to open by 2022.

3.3.1.3 I-66

In 1982, the network was expanded to include a new section of I-66 (all lanes HOV restricted (initially HOV-4 now HOV-2) in peak-flow directions between I-495 and U.S. 29 in the Rosslyn area of Arlington County).

This section of I-66, about 9.5 miles in length, was converted to HOV/Toll operation in December 2017 (currently HOV-2 traffic may use the lanes at no charge).

In 1994, the I-66 HOV lanes were extended west beyond I-495 as single concurrent-flow HOV lanes, initially to U.S. 50 near Fair Oaks and eventually west to U.S. 15 at Haymarket. A project to convert the concurrent-flow HOV lanes to two lanes each way separate (from conventional lanes) HOV/toll lanes as part of the Transform 66 Outside the Beltway Project from I-495 to U.S. 29 at Gainesville will deliver about 22.5 miles of managed lanes when completed in 2022.

3.3.1.4 I-270

I-270 had the first HOV lanes on an Interstate highway in Maryland. All HOV lanes in Maryland are currently HOV-2. The first section of I-270 HOV was opened in 1993 along northbound lanes (P.M.) from the I-495/MD-355 interchange to the I-270 Spur. By 1999, the P.M. HOV system had expanded to include HOV lanes along I-270 Spur (about 2 miles) and along I-270 as far north as MD-121 (about 18.2 miles). Southbound the A.M. HOV system runs from the I-370 interchange to a point south of MD-187 (about 8.8 miles) and along the I-270 Spur (also about 2 miles). The I-270 corridor HOV lanes may be converted to HOV/Toll lanes in the coming years under a P3 partnership agreement between the state and a private-sector partner.

3.3.1.5 VA-267 (Dulles Toll Road)

Concurrent-flow HOV lanes began operation in December 1998 in peak-flow directions (eastbound in A.M. and westbound in P.M.) and are little changed since opening except at the far eastern connection to I-66. These HOV-2 lanes provide a direct connection to the HOV/Toll (in peak hours) section of I-66 (eastbound in A.M. and westbound in P.M.) but there is a gap in the HOV lanes between the main toll barrier at VA-684 (Spring Hill Road) and east of VA-123 (Dolley Madison Boulevard). The western terminus of the HOV lanes is between VA-657 and VA-28. HOV traffic is not granted an exception from tolls, but approved buses may use the un-tolled Dulles Airport Access Road (otherwise reserved for airport users only – violators can be stopped and ticketed by police) through restricted and gated ramps east of VA-674 (Hunter Mill Road). The distance from the western terminus of the VA-267 HOV lanes to I-66 (includes a section between VA-7 and VA-123 without marked HOV lanes) is about 14.5 miles.

3.3.1.6 U.S. 50 in Prince George's County

HOV lanes have been open along U.S. 50 between U.S. 301/MD-3 and I-95/I-495 since October 2002, a distance of about 9 miles. Unlike other HOV lanes in the region, HOV restrictions are in effect 24 hours per day and 7 days per week in both directions.

3.3.1.7 MD-200 in Montgomery County and Prince George's County

The Intercounty Connector (MD 200) – a 6-lane, 18-mile east-west highway in Montgomery County and Prince George's County Maryland that runs between I-370 at Shady Grove and U.S. 1 (Baltimore Avenue) in Beltsville. Most of the facility, from I-370 to I-95 was open by November 2011 and the road was fully open by 2014. Toll rates vary by time of day. MDOT/MTA operates three bus routes on the ICC: Gaithersburg to BWI Business District, Columbia to Bethesda, and Frederick to College Park and Montgomery County Ride-On provides service between Shady Grove and Glenmont. There is no HOV requirement to use MD-200 and discounts for HOV traffic are not offered.

3.3.1.8 I-495 in Fairfax County

There were never HOV lanes on this section of I-495. The roadway was widened to add 4 new HOV/Toll lanes (called 495Express) consisting of about 11 miles of managed lanes opened to traffic in November 2012. As with the I-95/I-395 lanes, HOV-3 traffic may use the lanes at no charge. PRTC OmniRide provides express bus service using these lanes between Woodbridge in eastern Prince William County and the Tysons employment area.

An extension of these lanes north across the Potomac River via the American Legion Bridge into Montgomery County, Maryland is in various stages of planning and engineering, including extension of the lanes to the American Legion Bridge, adding managed lanes to the bridge itself, and on I-495 in Maryland to the I-270 spur and I-270.

3.3.2 Traffic Management

The topic of Traffic Management, including Incident Management and Intelligent Transportation Systems (ITS) is considered under the Systems Performance , Operations, and Technology Planning program and Subcommittee (SPOTS). SPOTS advises the TPB on management and operations matters and provides a regional forum for coordination among TPB member agencies and other stakeholders on these topics.

Investments in operations-oriented strategies have time and again shown good benefit-cost ratios and best enable transportation agencies (for both highways and transit) to provide effective incident management and good customer service, through operations centers and staffs, motorist/safety service patrols, traffic signal optimization, and supporting technologies. Particularly, intersection improvements (signalization timing / geometrics) can provide cost efficient congestion reduction. Also, the Metropolitan Transportation Operations Coordination (MATOC) program, comprising DDOT, MDOT, VDOT, WMATA, and TPB, is a regional program to enhance the availability of real-time transportation information and strengthen coordination among transportation agencies.

3.3.3.1 Active Traffic Management (ATM)

As defined by FHWA, active traffic management is the "ability to dynamically manage recurrent and non-recurrent congestion based on prevailing and predicted traffic conditions." [105]

- VDOT's I-66 Active Traffic Management Project from the District of Columbia to Gainesville in Prince William County was brought online on September 16, 2015.[106] ATM components in the corridor included expanded use of shoulder lanes, lane control signals, expanded camera and dynamic message sign coverage, and upgrades to the ramp metering system. VDOT's I-66 Active Traffic Management Project was removed from service in 2019 in conjunction with the managed lane upgrade to the I-66 facility.

- Montgomery County has an ATM system which includes strategies such a vehicle detection, video and aerial monitoring, and information outreach including broadcast media, internet, variable message signs, and Travelers Advisory Radio System (TARS). Future strategies will include variable speed limit signs, monitoring parking and weather/pavement sensors, and in-vehicle paging services.[107]

3.3.3.2 Incident Management

A significant portion of congestion is associated with incidents such as crashes, disabled vehicles, and traffic associated with special events. If an incident disrupts traffic, it is important for congestion that normal flow resumes quickly.

Many successful incident management activities are part of the robust activities undertaken by the Washington region's transportation agencies. The region's state DOTs all pursue strategies for managing their transportation systems, including operation of 24/7 traffic management centers, roadway monitoring, service patrols, and communications interconnections among personnel and systems. All three focus on getting timely word out to the media and public on incidents. Local-level agencies also play an important role in transportation management, particularly on local roads and traffic signal optimization.

Specific state-wide and regional incident management strategies include:

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[105] http://ops.fhwa.dot.gov/atdm/approaches/atm.htm (Accessed June 7, 2016)

[107] http://www.montgomerycountymd.gov/DOT-TMC/ATMS/gettmc.html (Accessed April 30, 2016)

- ***Imaging / video for traffic monitoring and detection*** – help detect incidents and allow emergency vehicles to arrive quickly. Also helps travelers negotiate around incidents.
  - State and local DOTs have cameras for traffic monitoring and detection throughout the region. The Regional Integrated Transportation Information System (RITIS) provides a platform for participating agencies to share real-time data feeds and other pertinent information related to real-time situational awareness and incident management.[108]

- ***Service patrols*** – These specially equipped motor vehicles and trained staff help in clearing incidents off a roadway and navigating traffic safely around an incident.
  - MDOT/CHART is now providing 24/7 safety patrols for the Washington region.
  - VDOT and DDOT also provide service patrols.
  - Montgomery County became the region's first local jurisdiction to deploy patrols in 2006, concentrating on major arterials rather than freeways.

- ***Road Weather Management*** – Can take the forms of information dissemination, response and treatment, monitoring, prediction, and traffic control.
  - All three state DOTs implement road weather management systems that disseminate information, treat roadways, and monitor conditions, especially during winter snow and ice events.

- ***Traffic Management Centers (TMCs)*** – These centers collect and analyze traffic data, then disseminate data to the public. Data collection includes CCTVs, cameras, and detectors.
  - All three state DOTs have TMCs:
    - *VDOT's McConnell Public Safety Transportation Operation Center (MPSTOC)* operates the Northern Region Transportation Operations Center (TOC) and Signal System. The TOC monitors traffic and incidents by using cameras and other information-gathering mechanisms to better manage day-to-day traffic flow and large incidents.
    - *DDOT's Transportation Management Center* gathers and disseminates information to the public using a network of cameras and other devices.
    - *MDOT's Coordinated Highway Action Response Team (CHART)* collects traffic data, disseminates information to the public, and provides emergency motorist assistance.

- ***Curve Speed Warning Systems*** - use roadside detectors and electronic warning signs to warn drivers, typically those in commercial trucks and other heavy vehicles, of potentially dangerous speeds in approach to curves on highways, with the intention of preventing incidents.
  - Curve speed warning systems have been used on the Capital Beltway.

- ***Work Zone Management*** - uses traffic workers, signs, and temporary road blockers to direct and control traffic during construction activities.
  - All three state DOTs have work zone management programs to temporarily implement traffic management and direct traffic. The goal is to reduce incidents by controlling the flow, speed, and direction of traffic.

- ***Automated Truck Rollover Systems*** - detectors deployed on ramps to warn truck drivers if they are about to exceed their rollover threshold, thus helping to reduce incidents.

[108] http://i95coalition.org/projects/regional-integrated-transportation-information-system-ritis/

  - Automated truck rollover systems, similar to the curve speed warning systems, were implemented at the same locations on the Capital Beltway in Virginia and Maryland. This was in response to a high number of truck rollovers on the Beltway in the 1980's.

- ***Maryland State Police Traffic Incident Management Unit*** – in 2021 the MSP created their new TIM units to respond to incidents in the state of Maryland. The unit in our region is mostly tasked with responding to incidents on the I-495 Beltway. More information regarding the success of the effectiveness of this unit will be included in the next CMP update when there are results to report.

Studies have shown the impact incident management activities have on reducing congestion, in particular reducing duration of incidents and reducing chances for secondary incidents. An example of this type of study is the yearly analysis of impacts of the Coordinated Highway Action Response Team (CHART) on incident management in Maryland. The focus of the report is to gauge effectiveness of CHART's availability to detect and manage incidents on major freeways and highways.

The *Performance Evaluation and Benefit Analysis for CHART*[109] includes statistics and analysis such as:

- Distribution of incidents and disabled vehicles
  - By day and time
  - By road and location
  - By lane blockage type
  - By blockage duration
  - By nature of incident (accident, disabled vehicle, etc.)
- Comparison of current year's data with that of previous years
- Benefits from CHART's incident management
  - Assistance to drivers
  - Potential reduction in secondary incidents
  - Estimated benefits due to efficient removal of stationary vehicles
  - Direct benefits to highway users

Analysis and studies such as those conducted by CHART indicate that incident management activities do have a positive impact on congestion. Each minute of reduced duration of incidents, for example, reduces the chances of secondary incidents and has a concomitant reduction in the severity and duration of non-recurring congestion.

Continuing enhancement of and investment in incident management activities will support congestion management.

Traffic Incident Management Enhancement (TIME) Task Force

In January 2018, the Metropolitan Washington Council of Governments (COG) Board of Directors, tasked COG with identifying recommendations and actions to enhance traffic incident management in the region. TPB and COG Department of Homeland Security and Public Safety (DHSPS) staff convened a multi-disciplinary task force of transportation, law enforcement, fire and emergency medical services subject matter experts. The Traffic Incident Management Enhancement (TIME) Task Force met seven

[109] http://chartinput.umd.edu/.

times from February to October 2018 and hosted a May 22 regional workshop with expanded participation.

Traffic Incident Management (TIM) encompasses a wide range of topics. Staff's review of national literature and initiatives found dozens of notable TIM strategies and practices in place.
Although many of these initiatives are already being pursued in the region, there were many other new, innovative practices to consider. The region's high traffic volumes and continually growing population and economy mean the area's roadway system has little spare capacity to absorb traffic incidents when they do occur.

The TIME Task Force forwarded the COG board seven items that were approved in a resolution. The seven approved items are as follows:

1. Update regional agreements and improve consistency of TIM laws and policies. COG should lead an effort to develop a transportation incident management mutual aid operations plan. Jurisdictions should review and update, as necessary, their laws to ensure the concepts of "move over," "move it," and "hold harmless" are included consistently.
2. Coordinate regional annual TIM self-assessments. Convene state and local transportation agencies, public safety agencies, and private sector TIM stakeholders annually for a regional Traffic Incident Management Self-Assessment.
3. Encourage and coordinate TIM trainings to promote best practices. Member agencies should require those who have a role in responding to traffic incidents to attend TIM trainings, particularly through the Federal Highway Administration's National TIM Responder Training Program. COG should share information with its members about available TIM training opportunities and host its own regional sessions.
4. Launch outreach initiatives that better engage the public and officials on TIM. Identify funding for and develop a regional public outreach campaign that promotes educational messages on moving over for sirens, slowing down near incident scenes, and other TIM-related driver safety messages. Elected officials should also request periodic briefings from transportation and public safety agencies on TIM-related activities and data to inform future decision-making.
5. Create a regional TIM program. Identify resources to create and sustain a regional program and stakeholder committee that can coordinate training and exercises, compile and review data, track emerging technologies, and promote best practices. Practitioners are eager to collaborate but must be given a forum.
6. Designate transportation incident responders as emergency responders regionwide. As has been done in Maryland, jurisdictions must review and update legislation and policies to ensure transportation emergency responders can get to incident scenes quickly, using flashing lights and audible sirens.
7. Expand roadway service patrols to federal parkways and other critical major roads not currently covered. Convene the federal government, District, Maryland, and Virginia public safety agencies, and state and local jurisdictions to negotiate an agreement allowing for the funding and deployment of roadway service patrols on federal parkways and other key highways.

TPB Staff along with DHSPS staff have continued to work together to incorporate TIM into the respective work programs where appropriate. Most TIM work is currently housed in the Transportation Emergency Preparedness (Regional Emergency Support Function 1/R-ESF 1) Committee since many of the region's TIM practitioners are also members of the committee.

3.3.3.3 Traffic Signal Operations

Traffic Signal Optimization

There are at least 21 different agencies that have ownership and/or maintenance responsibilities for the approximately 5,900 signals on public roads in the region. The most recent TPB survey of these agencies (2018) found that an estimated 73% of the eligible traffic signals had been retimed within the past three years, which is a generally accepted guideline. The signals in the region use a variety of retiming methods including computer optimization, engineering judgment, and active management.[110]

DDOT undertook a comprehensive 5-year plan to improve the flow of traffic in the region, including signal timing, and impacts all 1600 traffic signals in the District of Columbia.[111] The project was completed in 2016 and funding secured to continue another round of signal timing optimization. For example, in Anacostia, one of the completed areas, DDOT reported a 13% network-wide travel time savings over all peak periods, a 34% reduction in delays, and a 23% reduction in stops. In the downtown area, DDOT reported travel time savings for motorized vehicles during all periods, and reduced stopping for bicycles in the Pennsylvania Avenue separated bike lanes.[112]

Advanced Traffic Signal Systems

Advanced Traffic Signal Systems are used for coordination of traffic signal operations in a jurisdiction, or between jurisdictions using detectors to monitor real-time traffic conditions. This is important to congestion, as it reduces delay and improves travel time. It can include active traffic signal management – where traffic signals are managed through a control center, where technicians adjust the length of signal phases based on prevailing traffic conditions – or adaptive signal control – in which the controller automatically adjusts the timing of signals to accommodate changing traffic patterns.

- VDOT actively optimizes traffic signal timing plans and launched a signal/arterial traffic management control center located adjacent to the MPSTOC operating floor to proactively manage the arterial traffic.

- The City of Alexandria has implemented an adaptive traffic signal control system along Duke Street. The system can adapt to real-time traffic situations by changing cycle lengths as traffic flows change while keeping the corridor synchronized.

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.

3.3.3.4 Regional Operations Coordination

Metropolitan Area Transportation Operations Coordination (MATOC)

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[110] http://www.mwcog.org/uploads/committee-documents/aI1ZXFpb20140212133426.pdf

The Metropolitan Area Transportation Operations Coordination (MATOC) Program is a coordinated partnership between transportation agencies in D.C., Maryland, and Virginia that aims to improve safety and mobility in the region through information sharing, planning, and coordination. Current agencies include the District of Columbia, Maryland, and Virginia Departments of Transportation along with County and City transportation departments and transit providers like WMATA and other local providers. For example, a review of the MATOC program showed that coordination between the MATOC family of agencies during a bus crash on I-66 resulted in a savings of over $382,000 for area commuters. This savings was a result of decreased emissions, fuel consumption and lost time. [113]

A benefit-cost study of the MATOC program was undertaken and the results were based on three incidents that were handled by MATOC. The benefit-cost study looked at travelers "modified trips" - trips made at a later time, on another route, by another mode, or not made due to regionally significant incidents. Benefits were estimated from reduced delay, fuel consumption, emissions (including greenhouse gases), and secondary incidents. Three case studies were conducted, two for freeway incidents and one for arterial incident. The study found an overall benefit/cost ratio conservatively estimated at 10 to 1. A summary report of this study called the MATOC Benefit Cost Analysis dated June 2010 is available. MATOC also maintains a public use website called Traffic View which can be accessed at https://matoc.org/travel-info/ which uses the RITIS traffic information to inform the public about regional traffic incidents and roadway conditions.

MATOC has undertaken several initiatives. The Severe Weather Mobilization Coordination Effort began during the winter of 2012-2013. This effort has led to "the development of consistent terminology to describe roadway and transit conditions throughout the region, protocols for sharing weather information from different agency-specific sources and detection systems, testing of coordinated messaging systems, and better ways to advise the overall regional winter storm decision-making process." [114] MATOC's Regional Construction and Work Zone Coordination effort was initiated in 2014 to develop a framework for regional coordination around major construction projects as well as regional work zone-related lane closures and special events. In the Spring of 2016, MATOC hosted its first Regional Traffic Incident Management (TIM) Conference in an effort to bring together its partner Departments of Transportation and area first responders to highlight, discuss, and demonstrate advancements in TIM best practices, technologies, and policies affecting agencies and jurisdictions in and around the National Capital Region. MATOC followed up with its June 2018 Regional Traffic Incident Management Tabletop Exercise to bring together its partner transportation agencies and first responders to evaluate and discuss communications and coordination efforts. The MATOC program is committed to hosting similar regional TIM related events in the future to support its member Departments of Transportation and their regional partners.

3.3.3.5 Intelligent Transportation Systems (ITS)

ITS 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.

[113] www.matoc.org

- ***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.
  - SmarTrip cards are used for rail and bus fares (both WMATA and local buses) and for WMATA parking facilities. WMATA discontinued use of paper farecards on March 6, 2016.[115]
  - The region's roadway toll agencies are part of the E-ZPass consortium electronic payment system. The ICC and the 495 and 95 Express Lanes are E-ZPass-only facilities (no toll booths).
  - TransIT (Frederick County) released phone app for payment of TransIT fares.[116].

- ***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.
  - Ramp meters are used inside the Capital Beltway (I-495) in Virginia on I-66 and I-395.

- ***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. Any help provided preventing non-recurring and incident related congestion will bolster safety.
  - In the Washington region, the legal ability to deploy these systems is in place in the District of Columbia, Maryland, and Virginia.

- ***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. Examples of reversible lanes include Rock Creek Parkway in the District and Colesville Rd./US29 in Maryland.

3.3.3.6 Connected and Autonomous Vehicles

The shift from today's automobiles to connected and autonomous vehicles (CAVs) is anticipated to have broad and significant impacts on various facets of mobility and society, such as traffic safety; personal and freight mobility; changing models of vehicle ownership and use; public transit services; and where people choose to live and travel. Given the sheer number of factors that will influence CAV deployment, much uncertainty surrounds how CAVs will function on the highways and local roads and in our communities. However, CAVs are likely to impact regional transportation planning goals, priorities, and activities in significant ways.

In 2021, TPB received an expert consulting firm white paper[117] to assist in planning for CAVs on the region's transportation system. Specifically, it looked to inform regional conversations on CAVs and TPB's role related to this topic by examining:

- Areas where TPB goals, policies, and activities may substantially interact with CAVs.
- Potential CAV deployment impacts (issues, challenges, opportunities) as they relate to corresponding jurisdictional authorities and roles (primary, secondary, collaborative).

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115 http://www.wmata.com/fares/paperless.cfm
116 https://frederickcountymd.gov/5906/Mobile-App
117 https://www.mwcog.org/file.aspx?&A=7WMjEy2ZhM8YzERTQVVII3PKAQ0m42ApjSq%2fGenZ2N0%3d.

- Opportunities to enhance CAV considerations within TPB's planning products/activities including processes for developing regional CAV principles.

CAVs may impact transportation management and operations in the future, on a variety of factors such as traffic flow and data availability. However, the exact nature and timing of these impacts remains uncertain. TPB will monitor this topic and any impacts on the CMP.

3.4 Integrative/Multi-Modal Strategies

3.4.1 Advanced Traveler Information Systems (ATIS)

ATIS are technology-based means of compiling and disseminating transportation systems information on a real-time or near-real-time basis prior to or during trip making. The prevalence of smartphones and other mobile internet-capable devices make real-time information more accessible to travelers.

- Virginia operates under a statewide 511 system via telephone, internet (http://www.511virginia.org/), and mobile app.
- The District of Columbia makes traffic information, including live traffic cameras, traffic alerts, and street closures, available on the DDOT website.
- Maryland provides live traffic information on traffic and incidents via the CHART website.
- Dynamic Message Signs (DMS) are used throughout the region including permanently installed signs on freeways and portable signs used on both freeways and arterials.
- WMATA provides real-time transit information (both bus and rail) on the web and on informational screens in the Metrorail stations.
- Real-time bus information is available for many of the region's bus systems (including Montgomery, Arlington, and Prince George's Counties and the City of Fairfax).
- The MATOC website has links to all three state's traffic information. In addition, there is a link provided to the Traffic View website (https://matoc.org/travel-info/) which aggregates traveler information including incidents, traffic camera feeds, construction activity and schedules, and variable message sign information for the region.

3.4.2 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 more reliable arrival times for buses, makes public transit a more appealing option for travelers.

- As of this writing, the District of Columbia is installing bus priority systems on 16th Street NW. Bus routes along 16th Street currently serve more than 20,000 riders each weekday, making the corridor one of the busiest in the region in terms of ridership; more than half of the people traveling on 16th Street in the peak are bus riders. The plans include implementing peak period bus lanes, ADA accessible bus stops, enhanced passenger bus stop passenger amenities (off-board fare payment kiosks, bus shelters, etc.), signage, and pedestrian improvements.[118]

[118] https://www.16thstreetnwbus.com/

3.4.3 Regional ITS Architecture

The TPB has developed a regional ITS architecture, the Metropolitan Washington Regional Intelligent Transportation Systems Architecture (MWRITSA)[119]. The Regional Architecture is intended to provide a regional ITS framework for the foreseeable future, to define and validate ITS operations of regional significance, and to address national and statewide conformity in accordance with federal law and guidance. The architecture aims to ensure knowledge of ITS operations across the region, encouraging appropriate systems integration and enhanced technical systems interoperability. In addition to describing the interrelationships among existing transportation technology systems, the MWRITSA can provide a starting point for identifying responsibility for ITS Projects and applicable standards. It can inform business cases for state and federal ITS investment in transportation improvement programs as well as other plans, programs, and projects. The three DOTs have worked collaboratively to bring consistency among their regional ITS architectures. The Regional Architecture is updated periodically to reflect changes in the region.[120]

3.4.4 Integrated Corridor Management (ICM)

New technologies and concepts have been tested nationally or internationally to integrate operations to manage total corridor capacity including freeways, arterials, bus, rail, and parking systems. The purposes of the initiative include identifying innovative technologies to facilitate multi-modal local, regional, and national corridor travel, and identifying tools to provide information to travelers related to travel times and parking.

- A Regional Multimodal Mobility Program (RM3P) in Northern Virginia is managed by the Virginia Department of Transportation (VDOT) in partnership with the Virginia Department of Rail and Public Transportation (DRPT) and the Northern Virginia Transportation Authority (NVTA).[121] This is a data-driven program built on integrated corridor management activities (ICM) already underway in NOVA.[122]. Aspects include:
  - Enhanced Commuter Parking Data
  - Mobility as a Service (MaaS)
  - Dynamic Service Gap Dashboard
  - AI-Based Decision Support System with Prediction
  - Data-Driven Tool to Incentivize Customer Mode and Route Choice.

- MDOT/SHA I-270 Innovative Congestion Management Project – MDOT's FY 2020-2025 Consolidated Transportation Program (CTP) includes the $131 million I-270 Innovative Congestion Management (ICM) project to implement a series of roadway and technology-based improvements on I-270.. The project would contain both roadway improvements and innovative technology and techniques to achieve the goal.[123]

3.4.5 Evaluating Significant Transportation Projects

[119] The Metropolitan Washington Regional Intelligent Transportation Systems Architecture. http://www.mwcog.org/itsarch/Home.htm
[120] http://www.mwcog.org/itsarch/
[121] See presentation V in this document: https://thenovaauthority.org/wp-content/uploads/2019/07/Authority-Meeting-Packet-7-11-2019.pdf
[122] https://ops.fhwa.dot.gov/fastact/atcmtd/2017/applications/virginiadot/project.htm
[123] https://roads.maryland.gov/ohd2/MO695172-SOQ-CORMAN.pdf

Both the Virginia Department of Transportation and the Maryland Department of Transportation utilize performance-data-driven project programming prioritization processes that consider, in part, congestion management impacts of proposed projects.

Virginia's SMART SCALE (§33.2-214.1) is the method of scoring planned transportation projects included in VTrans (Virginia's Transportation Plan). SMART SCALE stands for System for the Management and Allocation of Resources for Transportation, and the key factors used in evaluating a project's merits: improvements to Safety, Congestion reduction, Accessibility, Land use, Economic development and the Environment.[124] Virginia uses this process to prioritize transportation projects in the state's transportation budget for certain funding categories. Each cycle is on a biennial schedule. There are five steps to the process used to rate projects: Determination of Eligibility for Program Funding, Project Application, Project Screening, Evaluation/Scoring, and Prioritization and Programming. As implied in SCALE, transportation projects are scored and prioritized using several metrics: Safety, Congestion Mitigation, Accessibility, Environmental Quality, Economic Development, and Land Use. Once projects are scored and prioritized, the Commonwealth Transportation Board (CTB) selects the projects that will receive funding, advised by the scoring.

Maryland's Chapter 30 Scoring Model is a project–based scoring system for proposed major transportation projects using goals and measures established under Transportation Article 2-103.7(c), for potential inclusion in the Maryland Department of Transportation's Consolidated Transportation Program (CTP). The law, as amended in 2017, defines a "major transportation project" as a highway or transit capacity project that exceeds $5,000,000 in cost, and excludes any projects solely intended for system preservation. The Chapter 30 scoring model evaluates projects across nine goals and twenty-three measures established in statute, using project data, modeling analysis, and qualitative questionnaires. A project application process has been established requiring county and municipalities to request major transportation projects to ensure the necessary project information and priorities is provided to conduct the scoring. Counties and municipalities submit projects via a web portal, in an annual process with submissions due March 1 of each year. One of the key evaluation criteria of the Chapter 30 Scoring Model is "reducing congestion and commute times".[125]

3.4.6 Mobile Devices and Social Media

3.4.6.1 Mobile Devices

The increasing number of people with mobile internet-capable devices, such as smartphones and tablets, combined with the availability of real-time travel data, is changing the way travelers receive information and make decisions on their choice of mode, route, and/or departure time. Most travelers now carry a mobile device with maps and GPS allowing for information to be tailored to their location. DOTs, transit agencies, private transportation providers, and other third parties have developed mobile versions of websites and mobile applications (apps) to make it easier for travelers to receive information on their devices.

- WMATA provides real-time rail arrivals on the mobile version of its website.

[124] Commonwealth Transportation Board SMART SCALE page, http://www.ctb.virginia.gov/planning/smart_scale/default.asp.
[125] Maryland Department of Transportation Chapter 30 information page, https://mdot.maryland.gov/tso/pages/Index.aspx?PageId=83.

- Many bus operators make real-time arrival information and/or static schedules available on their mobile websites and/or make data available to third party websites and applications. NextBus is one of the most popular bus information apps.
- MARC provides real time incident and delay alerts through text, and email to commuters. The MARCTracker website provides live GPS train locations.
- Capital Bikeshare, carshare, and ridehailing (Uber, Lyft) companies have mobile apps which allow users to make travel decision on the spot.
- Traffic information, based on data sources such as INRIX, is available through a number of apps (INRIX, Google Maps, and WAZE being among some of the most popular. See Section 3.4.6.2 for more information about WAZE.)
- Wireless Emergency Alerts (WEA) are sent by authorized government alerting authorities. These alerts can contain information that is valuable to the traveling public such as extreme weather warnings and local emergencies requiring evacuation or other immediate action.[126]
- Commuter Connections has developed a mobile version of its website and mobile apps for a number of services. See Section 3.2.1.3.

Safety while using the devices while traveling remains a concern; all three states have laws against distracted driving and texting while driving.

3.4.6.2 Social Media

The traveling public is now oriented toward the use of social media for many aspects of their lives. The social media landscape is constantly evolving and it is causing the transportation sector to rethink its model for providing information. Transportation agencies in the region have adopted social media as a means of sharing information with a large segment of the public. Instead of providing information only on a central website that the user has to visit, social media provides a way to deliver that information to users through a forum to which they already subscribe, such as Twitter which is one of the most popular social media sites for the transportation sector. In addition, social media can provide a means for agencies to receive information from users in order to better manage the system.

- MDOT, VDOT, DDOT, and many other transportation agencies use Twitter to share information.
- Local police departments user Twitter to provide preliminary information and updates on active incidents.
- WMATA uses different Twitter accounts to share general information, Metrorail information, Metrobus information, and crime prevention tips. Supplemental two-way customer support has been provided on the Metrorail and Metrobus feeds.[127]
- WAZE[128] is a community-based traffic and navigation app. WAZE goes beyond other apps that provide traffic data by providing a crowdsourcing component. Users can passively contribute to providing traffic information by having the mobile app open while driving. They can also contribute by sharing information about incidents and other travel conditions.
- MATOC users its own Twitter account to provide updates on incidents. It follows other twitter feeds (including police departments, local jurisdictions, transit agencies, news organizations, etc.) and crowdsourcing websites like WAZE to obtain more timely and accurate information about incidents.

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[126] https://www.weather.gov/wrn/wea
[127] https://www.wmata.com/service/bus/bus_youtube_facebook_metroalerts.cfm
[128] https://www.waze.com/about (Accessed May 10, 2016).

3.5 TPB Aspirational Initiatives and the CMP

In 2017, while developing Visualize 2045, the Transportation Planning Board (TPB) looked at more than 80 projects, programs, and policies that were not currently funded, but could potentially address key challenges the region is facing. Some of these ideas were packaged into "initiatives" that were analyzed for their impacts on future transportation conditions, known as the TPB "Aspirational Initiatives"[129].

Based upon analysis and discussion, the TPB endorsed seven initiatives in early 2018 for future concerted action and inclusion in the aspirational element of Visualize 2045. The TPB noted that these ideas, if funded and enacted, would have the potential to significantly improve the region's transportation system performance compared to current plans and programs.

The seven Aspirational Initiatives are:

- Bring Jobs and Housing Closer Together
- Expand Bus Rapid Transit and Transitways
- Move More People on Metrorail
- Provide More Telecommuting and Other Options for Commuting
- Expand Express Highway Network
- Improve Walk and Bike Access to Transit
- Complete the National Capital Trail

These seven initiatives are also referenced in related sections throughout this CMP Technical Report. The following sections provide more detail on each Aspirational Initiative.

3.5.1 Bring Jobs and Housing Closer Together

The region's 141 Activity Centers (red dots on the map) are intended to be walkable places for concentrated housing and job growth. If more housing and jobs were placed in the region's Activity Centers, it would facilitate walking, bicycling, or taking public transit in lieu of driving. Local planning efforts would encourage housing and job growth close to Metrorail stations that have available space nearby for new construction. More housing close to Metro and in Activity Centers would let more people walk to work and transit. That means there would be fewer cars on the region's roads. And that would significantly reduce congestion, making driving more reliable for those who commute by car. For more information, see Section 3.2.7.3.

3.5.2 Expand Bus Rapid Transit and Transitways

Bus-rapid transit (BRT) in the region would provide high-quality transit services that approach the speed of rail, but at a fraction of the cost to build. Express bus, streetcar, and light rail systems would be available for more people in more places throughout the region. Streetcar and light rail routes would provide targeted connections within the regionwide system, serving high-density locations, promoting economic development, and offering viable alternatives to driving.

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[129] https://www.mwcog.org/documents/2019/09/20/visualize-2045-aspirational-initiatives-visualize-2045/.

3.5.3 Move More People on Metrorail

To move more people on Metrorail was also identified as a TPB Aspirational Initiative, including expanding the number of trains and expanding stations. The focus would be on the downtown core of the region to accommodate more riders where stations and trains are overcrowded. This would include running eight-car trains (instead of six-car trains) on all lines at all times, and expanding stations at the heart of the system to handle new riders with less crowding, such as with expanded mezzanines and new fare gates and escalators. Also importation will be ensuring that transit systems are in a state of good repair, for reliability.

3.5.4 Provide More Telecommuting and Other Options for Commuting

This initiative aims to expand programs to increase the number of people who telework, find carpools, or use transit. These programs can be implemented by employers, government programs, or both. This initiative is exemplified by the region's Commuter Connections program and the many activities it undertakes. See Section 3.2.1 for more information.

3.5.5 Expand Express Highway Network

Variably priced or managed lanes added to existing highways throughout the region would avoid congestion because of dynamic pricing – toll rates increase during the most congested times of day. And higher tolls would reduce demand on the lanes, keeping traffic free-flowing. Managed lanes exist today on new facilities in Maryland and Virginia. Toll lanes are the most likely way that the region will be able to fund needed road projects in our growing region, even as we seek to reduce our dependence on driving alone.

Managed lanes encourage carpooling, and provide opportunities for transit via networks of express buses would travel in those lanes, connecting people and jobs throughout the region. Revenues generated from the tolls can be used to operate the new extensive regional network of high-quality bus services. For more information, see Section 3.3.1.

3.5.6 Improve Walk and Bike Access to Transit

The region needs safe options for walking or bicycling to transit stations. Often, there are barriers in the way, such as a lack of safe sidewalks or crosswalks, or a major road that cannot be crossed.
To remove barriers for walkers and bicyclists, sidewalks would be built or repaired, crosswalks and crossing signals would be installed, and new trails would be constructed. Walking or biking would be comfortable and convenient.

At its July 2020 meeting, the TPB adopted Resolution R4-2021 to approve a regional list of Transit Access Focus Areas (TAFAs).[130]

The TAFAs work is rooted in the Improve Walk and Bike Access to Transit Aspirational Initiative. Based on this direction, TPB staff launched the Transit Within Reach project which prioritized locations with the greatest need for improvements. The list approved in July 2020 identified 49 TAFAs in 17 jurisdictions around the region. Improving walk and bike access to transit helps transit better fulfill its ridership potential, and could take cars off the road.

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130 https://www.mwcog.org/maps/map-listing/tafa/.

3.5.7 Complete the National Capital Trail Network

At its July 2020 meeting, the Transportation Planning Board approved the National Capital Trail Network, a 1,400-mile, continuous network of long-distance, off-street trails, serving the entire region. The COG Board of Directors endorsed the network at its August 2020 meeting.[131]

The network will be used to prioritize funding for the Transportation Alternatives Program and the Transportation – Land Use Connections Program. There will be periodic updates to the network (likely annually) to reflect new facilities and new information. The network is currently about 1/3 complete.

The network will provide healthy, low-stress access to open space and reliable transportation for people of all ages and abilities, and an environmentally friendly alternative to motorized travel. Also see Section 3.2.4.

3.6 Additional System Capacity

3.6.1 Documentation of Congestion Management for Additional System Capacity

Federal regulations state that any project proposing an increase in Single-Occupant Vehicle Capacity should show that congestion management strategies have been considered. The specific language from the Federal Rule states that Transportation Management Areas (TMAs) shall provide for:

"an appropriate analysis of reasonable (including multimodal) travel demand reduction and operational management strategies for the corridor in which a project that will result in a significant increase in SOVs is proposed to be advanced with Federal Funds. If the analysis demonstrates that travel demand reduction and operational management strategies cannot fully satisfy the need for additional capacity in the corridor, and additional SOV capacity is warranted, then the congestion management process shall identify all reasonable strategies to managed the SOV facility safely and effectively."

In the Washington region, the TPB is ensuring that all proposed SOV capacity increasing projects (except those which are exempt) show that congestion management strategies have been considered to effectively manage the additional capacity. This is being done with agencies completing a "CMP Documentation Form" when submitting a proposal for projects in the long-range plan and Transportation Improvement Program (TIP).

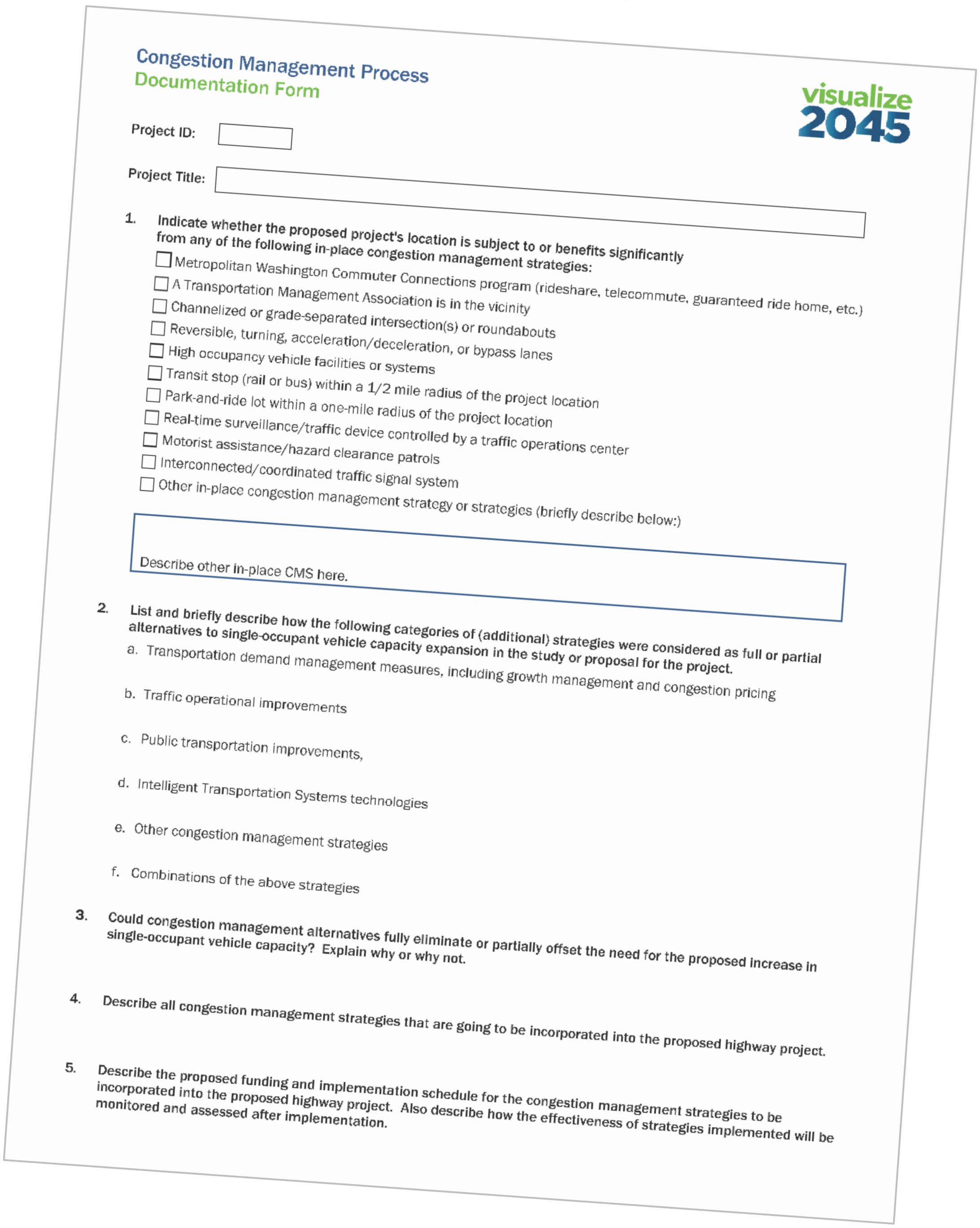
The TPB collects from project sponsors a CMP Documentation Form for projects that require them. The requirement is that SOV capacity-increasing projects are only supposed to be implemented if non-SOV-capacity strategies were also considered. The forms document that such consideration has occurred.

The TPB also compiles information pertinent to specific projects in its CMP documentation process form. These forms provide documentation that the planning of federally-funded SOV projects has included considerations of CMP strategy alternatives, and integrate such components where feasible. In the "Technical Inputs Solicitation" for the update to Visualize 2045 and the Transportation Improvement Program, for any project providing a significant increase to SOV capacity, it must be documented that the implementing agency considered all appropriate systems and demand management alternatives to the SOV capacity. A Congestion Management Documentation Form (see

[131] https://www.mwcog.org/maps/map-listing/national-capital-trail-network/.

Figure 3-3) is distributed along with the Technical Inputs Solicitation and a special set of SOV congestion management documentation questions must be answered for any project to be included in the Plan or TIP that significantly increases the single occupant vehicle carrying capacity of a highway.

Figure 3-3 Visualize 2045 Technical Inputs Solicitation Congestion Management Process Documentation Form Sample



Congestion Management Process
Documentation Form

visualize 2045

Project ID:

Project Title:

1. 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 (rideshare, telecommute, guaranteed ride home, etc.)
   - ☐ 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:)

   Describe other in-place CMS here.

2. 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
   e. Other congestion management strategies
   f. Combinations of the above strategies
3. 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.
4. Describe all congestion management strategies that are going to be incorporated into the proposed highway project.
5. 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.

3.6.2 Where Additional System Capacity Is Needed and How the Additional System Capacity Will be Managed Efficiently

The long-range transportation plan, updated regularly, identifies where major roadway capacity expansions are planned. The TPB, through the long-range transportation plan, asks that congestion management strategies be considered for these capacity increases. In the Washington region, all proposed SOV capacity increasing projects (except those which are exempt), show that congestion management strategies have been considered to effectively manage the additional capacity. These types of strategies could be of demand or operational management, or both, as outlined in this report. Many of these strategies are considered before any capacity-increasing project is adopted.

Visualize 2045, through the CMP, strongly encourages consideration and implementation of strategies such as the following to manage both existing and future additional roadway capacity:

- Transportation Demand Management (TDM) strategies, such as Commuter Connections programs.
- Traffic Operational Improvements
- Public Transportation Improvements
- Intelligent Transportation Systems technologies
- Combinations of the above strategies.

Roadway capacity increases may be needed in specific locations for a number of reasons including bottleneck removal, safety improvements, economic development, and other reasons. Managing this capacity through the CMP is key.

3.7 Project-Related Congestion Management

There have been examples in the Washington region of successfully implemented project-related congestion management for major construction projects. Strategies include providing incentives for commuters to give up driving alone and try transit, carpooling, vanpooling, and other alternatives, disseminating more information about construction projects and congestion, improving alternative routes, providing fire and rescue equipment and staff for emergency services along with additional police services, adding additional spaces to park-and-ride lots, providing additional shuttle bus services, etc.

Some successful examples of implementing project-related congestion management during construction include the Woodrow Wilson Bridge project, the I-95/I-495 Springfield Interchange project, the DDOT South Capitol Street and 11th Street Bridge projects, and Northern Virginia Megaprojects.

11th Street Bridges Project

During the construction phases of the DDOT 11th Street Bridge project, which was completed in September 2015, [132] several congestion management approaches were considered and the following was implemented to mitigate congestion and keep traffic moving:

- Maintain three lanes of traffic in each direction across the river;
- Provide additional transit enhancements during peak traffic periods;

- Provide traveler information systems, including low power highway advisory radio, and Intelligent Transportation Systems, including real-time message signs with alternate route suggestions;
- Provide updated freeway guide signing within the immediate project area that reflects temporary access routes during the various phases of construction. Also provide way-finding signage for freeway access points on local roads in the project study area; and event management systems, such as roving tow services.

Northern Virginia Megaprojects

Northern Virginia Megaprojects[133] were a series of large-scale and simultaneous transportation improvements aimed to ease congestion and provide alternatives to travelers. The projects currently underway include 95 Express Lanes, I-95 Auxiliary and Shoulder Improvements, Dulles Metrorail and BRAC Projects.

VIRGINIA MEGAPROJECTS

In 2007, the Virginia Department of Transportation (VDOT) began a new program of congestion management during the construction of megaprojects. The megaproject-related congestion management provides both "Commuter Solutions" and "Employer Solutions".

"Commuter Solutions" included resources on teleworking, vanpooling, carpooling, Guaranteed Ride Home, and walking/bicycling.

"Employer Solutions" provided assistance to employers to help them create new approaches or enhance existing services to keep their employees moving during construction.

SafeTrack

WMATA's SafeTrack was an accelerated track work plan to address safety recommendations and rehabilitate the Metrorail system to improve safety and reliability. The plan condensed approximately three years' worth of work into one year and is doing so by extending maintenance time by expanding maintenance time on weeknights, weekends, and middays periods as well as 15 "Safety Surges", long duration track outages for major projects in key parts of the system.

SafeTrack was completed with minimal impact on the road system.[134]

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[134] https://www.mwcog.org/about-us/newsroom/2016/07/19/how-safetrack-has-impacted-traffic-on-area-roadways-so-far-metro-traffic-monitoring/

4. STUDIES OF CONGESTION MANAGEMENT STRATEGIES

Defining, analyzing and assessing congestion management strategies are important components of the CMP. This chapter reviews performance measures adopted by the TPB and its subcommittees and the effectiveness of demand and operational management strategies. Several important studies of strategies are also documented in this chapter as examples.

4.1 Review of Performance Measures

4.1.1 Introduction to Performance Measures

A performance measure, or indicator, is a means to gauge and understand the usage of a transportation facility, or the characteristics of particular travelers and their trips. The performance measure/indicator may refer to a particular location or "link" of the transportation system.

Performance measures can be either quantitative or qualitative. It may refer to the experience of a traveler on a trip between a particular origin and a particular destination. It may summarize all trips or trip makers between a particular origin and destination pair. Or, it may describe the operation of one mode of transportation versus another.

Federal regulations[135] state that the CMP should include:

"Definition of <u>congestion management objectives and performance measures</u> to assess the extent of congestion and support the evaluation of the effectiveness of congestion reduction and mobility enhancement strategies for the movement of people and goods."

The fields of transportation planning have typically used mode-specific performance measures or indicators to gauge conditions on the system. These include motor-vehicle specific performance measures such as traffic volumes, capacities, and level-of-service.

The TPB adopted a set of performance measures in the 1994 Congestion Management System (CMS) Work Plan. Since then, there has been an evolution towards more traveler-oriented metrics in conveying congestion and related information to the general public. Some of the measures are leveraged by emerging highway performance monitoring activities such as the Eastern Transportation Corridor Coalition Vehicle Probe Project that provides probe-based continuous monitoring.

In the Final Rule on "National Performance Management Measures; Assessing Performance of the National Highway System, Freight Movement on the Interstate System, and Congestion Mitigation and Air Quality Improvement Program" which became effective on May 20, 2017 [82 FR 22879][136], FHWA established a set of performance measures for State departments of transportation (State DOTs) and Metropolitan Planning Organizations (MPOs) to use as required by Moving Ahead for Progress in the 21st Century Act (MAP-21) and the Fixing America's Surface Transportation (FAST) Act.

The highway system performance measures are used by State DOTs and MPOs to assess the performance of the Interstate and non-Interstate National Highway System (NHS) for the purpose of carrying out the National Highway Performance Program (NHPP); to assess freight movement on the Interstate System; and to assess traffic congestion and on-road mobile source emissions for the purpose of carrying out the Congestion Mitigation and Air Quality Improvement (CMAQ) Program.

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[135] Federal Register, Vol. 81, No.103, May 27, 2016.
[136] Docket No. FHWA-2013-0054, RIN 2125-AF54, Federal Register - Vol. 82, No. 11, Pg. 5970 - January 18, 2017: https://www.gpo.gov/fdsys/pkg/FR-2017-01-18/pdf/2017-00681.pdf.

Targets for the highway system performance measures are set for a four-year period, with the initial, first performance period starting with 2018 and ending at the end of 2021. All targets are set for calendar years, with the exception of on-road mobile source emissions reductions achieved by CMAQ projects which are set for federal fiscal years. In addition to four-year targets, targets are also set for the mid-point of the period, or the two year mark; the four-year targets can then be revised. Following State DOT adoption of the first period targets, the TPB set targets for the highway system performance measures for 2018 through 2021 during 2018, with these targets and background data included in the Visualize 2045 long-range transportation plan adopted in October 2018. The TPB developed targets in coordination with the three State DOTs, taking the lead in coordinating the forecasting and setting of the targets that apply to the urbanized area and the air quality maintenance area. The TPB contributed to the State DOT Baseline Performance Reports submitted in September 2018 as well as the State DOT Mid Period Performance Reports submitted in September 2020.

In 2022, the TPB will be evaluating performance for the first period of performance targets as well as setting targets for the second four year period, from 2022 through 2025 in close coordination with the State DOTs. TPB will again take the lead for those performance targets established for the urbanized area and the air quality maintenance area. The TPB expects to contribute to the State DOT Final Period Performance Reports for the years 2018 through 2021, as well as the new round of Baseline Performance Reports for years 2022 through 2025 that the State DOTs will need to submit in September 2022.

4.1.2 MAP-21/FAST Act Performance Measures

The MAP-21 and FAST Acts transformed the Federal-aid highway program by establishing new requirements for performance management to ensure the most efficient investment of Federal transportation funds. Performance management increases the accountability and transparency of the Federal-aid highway program and provides a framework to support improved investment decision-making through a focus on performance outcomes for key national transportation goals. State DOTs and MPOs will be expected to use the information and data generated as a result of these regulations to inform their transportation planning and programming decisions.

Performance measures in four areas, relevant to the congestion management process, were defined in the final rule on "National Performance Management Measures; Assessing Performance of the National Highway System, Freight Movement on the Interstate System, and Congestion Mitigation and Air Quality Improvement Program" are summarized in Table 4-1, including:

- percent of reliable person-miles traveled on the Interstate.
- percent of reliable person-miles traveled on the non-Interstate NHS.
- percentage of Interstate system mileage providing for reliable truck travel time (Truck Travel Time Reliability Index)
- annual hours of peak hour excessive delay per capita

TPB, in conjunction with state DOTs, works to analyze these measures and set associated targets.

Table 4-1 Performance Measures in the final rule on "National Performance Management Measures; Assessing Performance of the National Highway System, Freight Movement on the Interstate System, and Congestion Mitigation and Air Quality Improvement Program

Areas	Measures	Metrics	Equations	Thresholds	Time Periods (in a Calendar Year)	Geographic Areas	Data	Target Scope
Performance of the Interstate	Percent of the Interstate System providing for Reliable Travel	Level of Travel Time Reliability (LOTTR)	80^{th} TT / 50^{th} TT	Reliable: LOTTR < 1.50	6:00 am-10:00 am, M-F 10:00 am-4:00 pm, M-F 4:00 pm-8:00 pm, M-F 6:00 am-8:00 pm, S-S	Interstate	1) Travel Time Data Set; 2) Reporting segments	Statewide target; MPO-wide target
	Percent of the Interstate System where peak hour travel times meet expectations	Peak Hour Travel Time Ratio (PHTTR)	Longest PHTT / Desired PHTT in that hour the longest PHTT occurred	Meet expectation: PHTTR < 1.50	Could be any one of the 6 peak hours: 6:00 am-9:00 am, 4:00 pm-7:00pm in non-Federal holiday weekdays	Interstate in urbanized area with population over 1 million	1) Travel Time Data Set; 2) Reporting segments; 3) Desired Peak Period Travel Time	A single urbanized area target
Performance of the Non-Interstate NHS	Percent of the non-Interstate NHS providing for Reliable Travel	Level of Travel Time Reliability (LOTTR)	80^{th} TT / 50^{th} TT	Reliable: LOTTR < 1.50	6:00 am-10:00 am, M-F 10:00 am-4:00 pm, M-F 4:00 pm-8:00 pm, M-F 6:00 am-8:00 pm, S-S	Non-Interstate NHS	1) Travel Time Data Set; 2) Reporting segments	Statewide target; MPO-wide target
	Percent of the non-Interstate NHS where peak hour travel times meet expectations	Peak Hour Travel Time Ratio (PHTTR)	Longest PHTT / Desired PHTT in that hour the longest PHTT occurred	Meet expectation: PHTTR < 1.50	Could be any one of the 6 peak hours: 6:00 am-9:00 am, 4:00 pm-7:00pm in non-Federal holiday weekdays	Non-Interstate NHS in urbanized area with population over 1 million	1) Travel Time Data Set; 2) Reporting segments; 3) Desired Peak Period Travel Time	A single urbanized area target
Freight movement on the Interstate System	Percent of the Interstate System Mileage providing for Reliable Truck Travel Time	Truck Travel Time Reliability	95^{th} Truck TT / 50^{th} Truck TT	Reliable: Annual Average Truck Travel Time Reliability < 1.50	24/7/365	Interstate	1) Travel Time Data Set; 2) Reporting segments	Statewide target; MPO-wide target
	Percent of the Interstate System Mileage Uncongested	Average Truck Speed	Arithmetic mean of Truck Speeds **(leading to inconsistency between average speed and average travel time)**	Uncongested: Truck Speed > 50 mph	24/7/365	Interstate	1) Travel Time Data Set; 2) Reporting segments	Statewide target; MPO-wide target
Traffic Congestion	Annual Hours of Excessive Delay per Capita	Vehicle-hours of delay per capita	Delay * volume	Delay occurs if speed < 35 mph on Interstate (FC1), freeways and expressways (FC2); and < 15 mph on principal arterials (FC3) and all other NHS	24/7/365	NHS in nonattainment or maintenance urbanized area with population over 1 million	1) Travel Time Data Set; 2) Reporting segments; 3) **Hourly traffic volume**	A single urbanized area target

4.1.3 Traveler-oriented CMP Performance Measures

Since the TPB development of the CMP performance measures in 1994 (see Section 4.1.4), there has been an evolution towards more traveler-oriented metrics in conveying congestion and related information to the general public. Some of the measures are leveraged by emerging highway performance monitoring activities such as the Eastern Transportation Corridor Coalition's Vehicle Probe Project that provides probe-based continuous monitoring. Earlier in this report, the following four measures were used, with the first two quantifying congestion and the latter two travel time reliability. The 2010 Strategic Plan for the Management, Operations and Intelligent Transportation Systems (MOITS) Program[137] adopted Travel Time Index, Buffer Time Index and Planning Time Index as three regional indices of travel conditions and traveler's experience.

4.1.3.1 Travel Time Index (TTI)

TTI is defined as the ratio of actual travel time to free-flow travel time, measures the intensity of congestion. The higher the index, the more congested traffic conditions it represents, e.g., TTI = 1.00 means free flow conditions, while TTI = 1.30 indicates the actual travel time is 30% longer than the free-flow travel time. For more information, please refer to Travel Time Reliability: Making It There On Time, All The Time, a report published by the Federal Highway Administration and produced by the Texas Transportation Institute with Cambridge Systematics, Inc. This report uses the following method to calculate TTI:

1) Download INRIX 5-minute raw data from the RITIS Probe Data Analytics Suite website (https://pda.ritis.org/suite/).

2) Aggregate the raw data to monthly average data by day of the week and hour of the day. Harmonic Mean was used to average the speeds and reference speeds (Harmonic Mean is only used here; other averages used are all Arithmetic Mean). For each segment (TMC), the monthly data have 168 observations (7 days in a week * 24 hours a day) in a month.

3) Calculate TTI = reference speed / speed in the monthly data. If TTI < 1 then make TTI = 1. If constraint TTI >= 1 was not imposed, some congestion could be cancelled by conditions with TTI < 1.

4) Calculate regional average TTI for the Interstate system, non-Interstate NHS, non-NHS, and all roads for AM peak (6:00-10:00 am) and PM Peak (3:00-7:00 pm) respectively, using segment length as the weight.

5) Calculate the average TTI of the AM Peak and PM Peak to obtain an overall congestion indicator.

4.1.3.2 Planning Time Index (PTI)

PTI is defined as the ratio of 95th percentile travel time to free flow travel time, measures travel time reliability. The higher the index, the less reliable traffic conditions it represents, e.g., PTI = 1.30 means a traveler has to budget 30% longer than the uncongested travel time to arrive on time 95% of the times (i.e., 19 out of 20 trips), while TTI = 1.60 indicates that one has to budget 60% longer than the uncongested travel time to arrive on time most of the times. For more information, please refer to

[137] COG/TPB, http://www1.mwcog.org/transportation/activities/operations/plan/MOITS-Strategic-Plan-Executive-Summary-2010-06-16.pdf

Travel Time Reliability: Making It There On Time, All The Time, a report published by the Federal Highway Administration and produced by the Texas Transportation Institute with Cambridge Systematics, Inc. This report uses the following method to calculate PTI:

1) Calculate TTI = reference speed / speed in the monthly data obtained in step 2 of the above TTI methodology. Do not impose constraint TTI >= 1, since the purpose of this calculation is to rank the TTIs to find the 95th percentile, not to average the TTIs.

2) Calculate monthly average PTI: including sorting the data obtained in step 1 by segment, peak period, and month, finding the 95th percentile TTI and this TTI is PTI by definition, and averaging the PTIs using segment length as the weight to get regional summaries (for the Interstate system, non-Interstate NHS, non-NHS, and all roads for AM peak (6:00-10:00 am) and PM Peak (3:00-7:00 pm) respectively).

3) Calculate yearly average PTI: including sorting the data obtained in step 1 by segment and peak period, finding the 95th percentile TTI and this TTI is PTI by definition, and averaging the PTIs using segment length as the weight to get regional summaries.

4) Calculate the average PTI of the AM Peak and PM Peak to obtain an overall travel time reliability indicator.

4.2 Review of Congestion Management Strategies

4.2.1 Introduction

Federal regulations state that the CMP should include:

"Identification and evaluation of the anticipated performance and expected benefits of appropriate congestion management strategies that will contribute to the more effective use and improved safety of existing and future transportation systems based on the established performance measures. The following categories of strategies, or combinations of strategies, are some examples of what should be appropriately considered for each area:

(i) Demand Management measures, including growth management and congestion pricing;
(ii) Traffic operational improvements;
(iii) Public transportation improvements;
(iv) ITS technologies as related to the regional ITS architecture; and
(v) Where, necessary, additional system capacity."[138]

To address this point, strategy lists have been developed as a way of categorizing congestion management strategies and characterizing the current impact, or potential impact, these strategies have throughout our region.

These lists are modeled after the longstanding Transportation Emission Reduction Measure (TERM) process for air quality in the region. The TERM list was formed as a way of developing additional plan and program elements which could be utilized to mitigate emission increases.

[138] §450.322(d), Metropolitan Transportation Planning, Final Rule, Federal Register, May 27, 2016 – emphasis added.

Similarly, lists have been developed for strategies under consideration for Congestion Management. At this time the effort is proposed to be qualitative, as the congestion information is not tied to one specific location. In addition, some strategies are regional while others are local , and a qualitative effort better characterizes the impact they have on the region as a whole.

The following section contains background and summary information of how the Strategy Lists were developed.

4.2.2 DESCRIPTIONS OF STRATEGIES

The general characteristics of strategies are provided in Table 4-2 and Table 4-3; one for operational management strategies (those strategies contributing to a more effective use of existing systems) and one for demand management strategies (those that influence travel behavior). The qualitative criteria across the top of the lists, and the methodology used to categorize each strategy as “some impact (x)”, “significant impact (xx)”, and “high impact (xxx)” are the same for both tables. The separate tables are simply for the purpose of distinguishing the two types of strategies. A more detailed review of the strategies is provided in Appendix F.

Table 4- 2 Congestion Management Process (CMP) Demand Management Strategies Criteria

1. Low (x)
2. Medium (xx)
3. High (xxx)

STRATEGY		QUALITATIVE CRITERIA									
		Congestion Related			Others						
		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
C.5.0	***Alternative Commute Programs***										
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 Workw eeks	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	xxx	xx	xx
C.5.9	Alternative Commute Subsidy Program	xx	x	xxx	xxx	xx	xx	x	x	xxx	xxx
C.5.10	App-based Incentives (e.g. incenTrip)	xx	xxx	xxx	xxx	xx	xx	xx	x	xxx	xxx
C.6.0	***Managed Facilities***										
C.6.1	High-Occupancy Vehicle (HOV) Facilities	xx	x	xxx	xxx	xx	xx	xx	xxx	xxx	xxx
C.6.2	Variably Priced Lanes (VPL)	xxx	x	xx	xxx	xx	xx	xx	xxx	xxx	xx
C.6.3	Cordon Pricing	xxx	x	xxx	xxx	xx	x	x	xx	xxx	xx
C.7.0	***Public Transportation Improvements***										
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
C.8.0	***Pedestrian, bicycle, and multi-modal improvements***										
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 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	Bikesharing/Micromobility Programs	xx	x	xxx	xxx	xxx	xx	xxx	xx	xx	xxx
C.9.0	***Growth Management***										
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 w ith 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	xx	x	xx

Table 4- 3 Congestion Management Process (CMP) Operational Management Strategies Criteria

1. Low (x)
2. Medium (xx)
3. High (xxx)

		QUALITATIVE CRITERIA									
		Congestion Related			Others						
STRATEGY		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
C.1.0	***Incident Mngt./Non-recurring***										
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 Management Systems	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 Management Centers	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
C.1.10	Regional Incident Coordination	xxx	xxx	x	xxx	xx	xxx	xx	x	xxx	xxx
C.2.0	***ITS Technologies***										
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	xx	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	xx	x	xx	xx	xx
C.2.12	Probe Traffic Monitoring	xx	xxx	x	xxx	xx	xxx	xxx	x	xxx	xxx
C.3.0	***Advanced Traveler Information Systems***										
C.3.1	Traffic Information Systems (e.g. 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
C.3.5	Information Sharing with Private Sector Apps	xx	xxx	x	xxx	xxx	xx	xx	x	xxx	xx
C.4.0	***Traffic Engineering Improvements***										
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

4.3 Examples of Strategies Studies

4.3.1 Analysis of Transportation Emissions Reduction Measures (TERMs)

4.3.1.1 Overview

Transportation Emission Reduction Measures (TERMs) are strategies or actions employed to offset increases in nitrogen oxide (NOx) and volatile organic compound (VOC) emissions from mobile sources. The TPB first adopted TERMs in FY 1995.

The Clean Air Act Amendments of 1990 (CAAA) and SAFETEA-LU require metropolitan planning organizations and DOTs to perform air quality analyses, to ensure that the transportation plan and program conform to mobile emission budget established in the State Implementation Plans (SIP). Consequently MPOs and DOTs are required to identify TERMs that would provide emission-reduction benefits and other measures intended to modify motor vehicle use.

Selection of the TERMs requires quantitative as well as qualitative assessment. The quantitative assessment includes specific information on the benefits, costs, and expected air-quality benefits. Qualitative criteria includes ranking based on the subjective criteria's such as ease of implementation, how to implement, and synergy with other measures.

The effects of TERMs on GHG reduction in the Washington region were analyzed in the "What Would It Take" Scenario Study (see Section 4.3.3).

4.3.1.2 Findings and Applications to Congestion Management

Most TERMs are intended to reduce either the number of vehicle trips (VT), vehicle miles traveled (VMT), or both. These strategies may include ridesharing and telecommuting programs, improved transit and bicycling facilities, clean fuel vehicle programs or other possible actions. These TERMs are not only important to offsetting increases in NOx and VOC, but many are important in congestion management by reducing trips and miles of travel.

The Washington region has adopted and implemented several TERMs with the sole aim of reducing emissions, such as the addition of clean diesel bus service, taxicabs with Compressed Natural Gas (CNG) cabs, and CNG buses. However, many TERMs also have an impact on congestion management. Examples of some of these congestion-mitigating TERMs that have been implemented included upgrading traffic signal systems, telecommuting programs, park-and-ride lots, and pedestrian facilities.

4.3.2 Scenario Planning

4.3.2.1 "CLRP Aspirations" Scenario

Presented in 2013, the "CLRP Aspirations" scenario was an integrated future land use and transportation scenario for building on the key results of previous TPB scenario studies. It included concentrated land use growth in Regional Activity Centers, a regional network of variably priced lanes, and a high quality bus rapid transit network operating on the VPL network for the current planning horizon year 2040. Relative to the 2012 CLRP baseline for 2040, the full CLRP Aspirations Scenario showed increases in trips of all modes (auto person trips, transit trips, and non-motorized trips) due to the increase in population, both auto and transit capacity, and shifts in land use that enable more non-motorized trips. The Scenario showed a slight decrease in VMT, a decrease in VMT per capita, and a significant decrease in regional vehicle-hours of delay.[139]

4.3.2.2 "What Would It Take?" Scenario

Completed in May 2010, the "What Would It Take?" scenario started with the adopted COG non-sector specific goals for reducing mobile source greenhouse gas emissions for 2030 and beyond. It assesses how such goals might be achieved in the transportation sector through different combinations of interventions that include increasing fuel efficiency, reducing the carbon-intensity of fuel, and improving travel efficiency. The study found that:

- Strategies analyzed to date do not achieve regional goals of reducing greenhouse gas emissions, and additional strategies can and should be analyzed.
- Goals are difficult to meet and will require emission reductions in all three categories: Vehicle efficiency (CAFE improvement), alternative fuel (cellulosic ethanol), and travel efficiency (strategies aimed at reducing VMT, congestion, and delays).
- While major reductions can come from federal energy policies, local governments can make significant reductions quickly.
- Some strategies may not have major greenhouse gas (GHG) reduction potential, but have multiple benefits worth exploring through benefit-cost analysis (e.g. the MATOC program).

The study also recommended nine potential local actions that can be implemented quickly to reduce GHG.

4.3.2.3. Multi-Sector Working Group

This group comprised senior staff from transportation, planning, and environment sectors of COG member agencies including state departments of transportation. A consultant studied effective strategies to reduce greenhouse gases from the transportation, land use and built environment sectors. Many of the strategies studied had the added benefit of reducing vehicle trips and vehicle miles of travel affecting congestion positively. This was a study under the direction of the COG Board of Directors and the January 2016 Technical Report on Multi-Sector Approach to Reducing Greenhouse Gas Emissions in the Metropolitan Washington Region was published.[140]

4.3.2.4. Long-Range Plan Task Force

In 2016 and 2017, TPB formed this task force to identify a limited set of regionally significant projects, programs, and policies above and beyond what is in the region's current long-range transportation plan. The Task Force and supporting consultants identified and analyzed a number of long-range planning strategies, many of which could address congestion. Following the Task Force's work, Seven Endorsed Initiatives were included in Visualize 2045 planning.[141]

4.3.2.5. Climate Change Mitigation Study

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[140] https://www.mwcog.org/documents/2016/08/01/multi-sector-approach-to-reducing-greenhouse-gas-emissions-in-the-metropolitan-washington-region-final-technical-report/

[141] http://mwcog.maps.arcgis.com/apps/Cascade/index.html?appid=debc2550777b4cc2bae2364c7712a151

The TPB Climate Change Mitigation Study of 2021[142] (CCMS) was a scenario study whose goal was to identify potential pathways for the region to reduce on-road, transportation sector greenhouse gas emissions to meet COG's regional greenhouse gas (GHG) reduction goals associated with 2030 and 2050. The analysis phase of the study included three "top-down" scenarios and 10 "bottom-up" scenarios that explore single and combination pathways to reduce on-road, transportation-sector greenhouse gas emissions. Among scenarios analyzed were strategies that could also have congestion management benefits, including:

- *Mode Shift and Travel Behavior (MSTB):* Strategies to reduce motor vehicle travel, typically measured as vehicle miles of travel, by shifting travel from driving alone to more efficient modes, such as transit, ridesharing, bicycling, and walking; reducing vehicle trip lengths, such as through land use strategies; or reducing trip-making entirely, such as through telework.
- *Transportation Systems Management and Operations (TSMO):* Strategies to optimize the efficiency of travel by reducing vehicle travel delay and/or encourage more eco-friendly driving patterns.

The study estimated reduction of vehicle miles of travel from combinations of analyzed strategies, and brought strategies and scenarios once again to the attention of member agencies.

4.3.3 MATOC Benefit-Cost Analysis

The Metropolitan Area Transportation Operations Coordination (MATOC) Program is a joint program of VDOT, MDOT, DDOT, WMATA and TPB. It aims to provide real-time situational awareness of transportation operations in the National Capital Region (NCR), especially during emergencies and other incidents with significant impacts on travelers and on the transportation systems of the region.

A benefit-cost study has been carried out to quantify the effectiveness of this program which shows a $ 10 benefit for every $ 1 spent on the program.

4.3.4 MOITS Strategic Plan

The Management, Operations, and Intelligent Transportation Systems program (MOITS – since renamed Systems Performance, Operations, and Technology [SPOT] program) of the TPB developed a strategic plan for the program dated June 16, 2010 and the plan is available on MWCOG website.[143] The Strategic Plan defined and promoted potential regional projects or activities for the management, operations, and application of advanced technology for the region's transportation systems, as well as to advise member agencies on management, operations, and transportation technology deployments for meeting common regional goals and objectives.

The MOITS Strategic Plan built upon the TPB Vision by identifying four key tactical actions toward achieving and building upon the goals, objectives, and strategies of the Vision. It identifies nine emphasis areas derived from the National ITS Architecture, seven proposed projects out of which three have been implemented, and two are in the planning stage three strategic efforts out of which two are being considered for implementation, and a number of "best practices" for consideration by the member agencies and jurisdictions. The Plan also recommended use of a few key performance

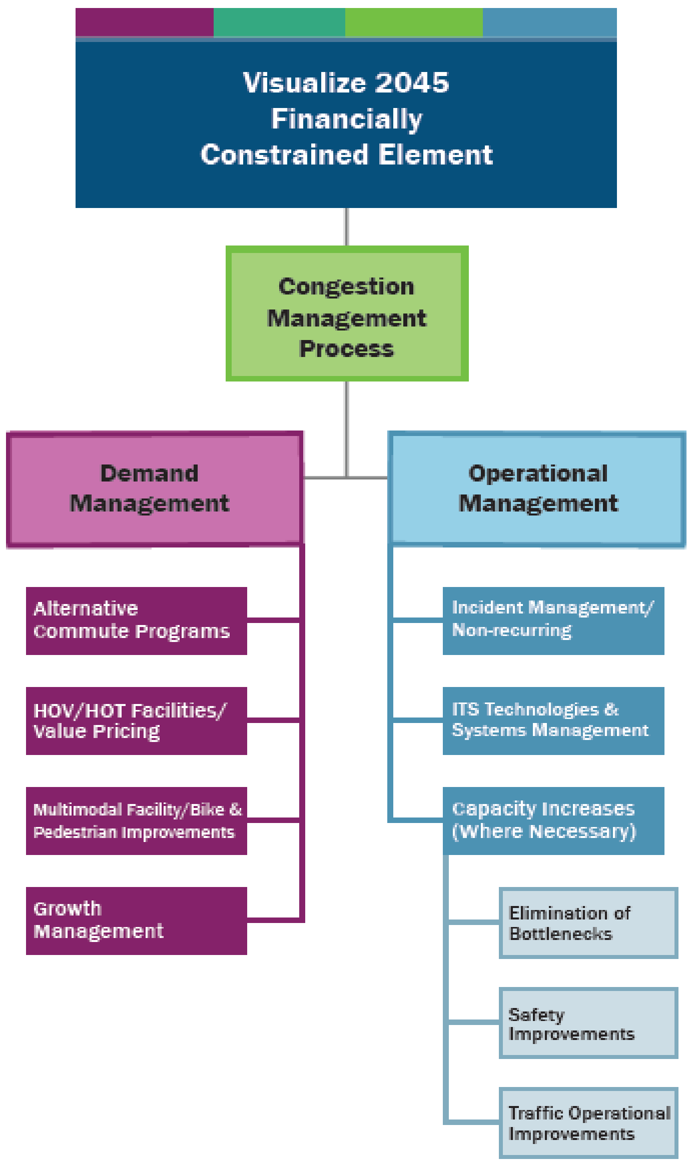
[142] https://www.mwcog.org/tpb-climate-change-mitigation-study-of-2021/.
[143] http://www1.mwcog.org/transportation/activities/operations/plan/MOITS-Strategic-Plan-Executive-Summary-2010-06-16.pdf

measures, including travel time index, buffer time index and planning time index, which are already used in this CMP Technical Report. The Strategic Plan concluded with seven key recommendations for the MOITS Technical Subcommittee and Program.

5. HOW RESULTS OF THE CMP ARE INTEGRATED INTO THE LONG-RANGE TRANSPORTATION PLAN, VISUALIZE 2045

According to federal regulations, the CMP should be an integrated process informing the planning, strategies and ultimately the projects, programs and policies documented in Visualize 2045 rather than a standalone product of the regional transportation planning process. This chapter clarifies this integration by reviewing the components of the CMP and how they inform and are integrated into Visualize 2045. See Figure 5-1 for a visual reference to CMP and Visualize 2045 integration.

Figure 5-1 Visualize 2045 and the CMP



5.1 Components of the CMP are Integrated in Visualize 2045

There are four major components of the CMP as described in Visualize 2045:

- Monitor and evaluate transportation system performance
- Define and analyze strategies
- Compile project-specific congestion management information
- Implement strategies and assess

In monitoring and evaluating transportation system performance, the TPB uses probe vehicle data to support both the CMP and travel demand forecast model calibration, complementing operating agencies' own information, and illustrating locations of existing congestion. Travel demand modeling forecasts, in turn, provide information on future congestion locations. This provides an overall picture of current and future congestion in the region, and helps set the stage for agencies to consider and implement CMP strategies, including those integrated into capacity-increasing roadway projects.

The CMP component of Visualize 2045 defines and analyzes a wide range of potential demand management and operations management strategies for consideration. The TPB, through its Technical Committee, Travel Management Subcommittee, Travel Forecasting Subcommittee, and other committees, reviews and considers both the locations of congestion and the potential strategies when developing Visualize 2045.

For planned (Visualize 2045) or programmed (TIP) projects, cross-referencing the locations of planned or programmed improvements with the locations of congestion helps guide decision makers to prioritize areas for current and future projects and associated CMP strategies. Maps can show correlations between the locations of planned or programmed projects and locations where congestion is being experienced or is expected to occur.

The TPB also compiles information pertinent to specific projects in its CMP documentation process (form) within the quadrennial long-range transportation plan Technical Inputs Solicitation. This further assures and documents that the planning of federally-funded SOV projects has included considerations of CMP strategy alternatives and integrated components.

The fiscally constrained list of projects in Visualize 2045 and TIP project selection is informed by the CMP, and implementation of CMP strategies is encouraged through committee discussions and consensus building around priority strategies at the TPB, such as the TPB endorsement of the Aspirational Initiatives as priority strategies for the region. The region relies particularly on non-capital congestion strategies in the Commuter Connections program of demand management activities, and the Systems Performance, Operations, and Technology (SPOTS) program of operations management strategies. The Commuter Connections staff conduct regular evaluations of its programs, and the TPB conducts regular travel monitoring updates and studies to look at trends and impacts. This activities provide feedback to inform future long-range transportation plan cycles.

Visualize 2045 documents the TPB's focus on CMP and PBPP information in plan development. Specifically, Appendix E of Visualize 2045 documents the compliance of Visualize 2045 with federal CMP law and regulations, and to provides information on how the CMP impacted plan development.[144]

[144] www.visualize2045.org/resources. As of this writing, the 2022 Update of Visualize 2045 was still ongoing; a link to Appendix E will be available at a later date.

Table 5-1 Visualize 2045 CMP Components

Component	TPB Role	CMP Documentation
1. Monitoring and evaluating transportation system performance	The TPB monitors the performance of the region's transportation system and identifies and evaluates the benefits that various congestion management strategies may have.	The TPB travel monitoring activities associated with the CMP are communicated to inform decision makers on the region's congestion through numerous documents, graphics and text compiled on the TPB website including an ongoing series of reports: National Capital Region Congestion Report.
2. Defining and analyzing strategies	With accurate and reliable data, the TPB and regional partners work to establish potential strategies and initiatives to help alleviate congestion, such as the seven Aspirational Initiatives that the TPB endorsed in 2018. Strategies include both demand management and operational management strategies as described in the additional CMP documentation.	The TPB's congestion management strategies can be found online at: Major CMP Strategies. The TPB's Congestion Management Technical Report provides updated congestion information and congestion management strategies on the region's transportation systems, as well as the process integrating the CMP into the update to Visualize 2045.
3. Compiling project-specific congestion management information	The TPB collects from project sponsors a CMP Documentation Form for projects that require them. The requirement is that SOV capacity-increasing projects are only supposed to be implemented if non-SOV-capacity strategies were also considered. The forms document that such consideration has occurred.	CMP Forms are provided by implementing agencies as part of TPB's Technical Inputs Solicitation for LRTP and TIP projects that have significant CMP impacts. See an example of a blank form in **Error! Reference source not found.**.
4. Implementing strategies	The TPB manages the Commuter Connections program to promote and implement regional demand management. TPB members implement the strategies and submit projects, programs and policies to the TPB for inclusion in the LRTP and TIP.	As TPB members implement regionally significant projects, programs and policies that reflect the CMP strategies, they are included in the LRTP and TIP. Notable strategies include the region's incenTrip app and overall Commuter Connections programs, more information is available at: commuterconnections.org.

5.2 Demand Management in Visualize 2045

Demand Management aims at influencing travelers' behavior for the purpose of redistributing or reducing travel demand. Existing demand management strategies contribute to a more effective use and improved safety of existing and future transportation systems. Visualize 2045 takes a number of demand management strategies into consideration when planning for the region's transportation infrastructure. Such strategies include alternative commute programs, managed facilities (such as HOV facilities and variably priced lanes), public transportation improvements, pedestrian and bicycle facility improvements, and growth management (implementing transportation and land use activities).

These strategies are outlined in detail in Section 3.2, including the board- endorsed TDM concepts represented by the Aspirational Initiatives.

In the “Technical Inputs Solicitation” for Visualize 2045 and the TIP, for any project providing a significant increase to SOV capacity, it must be documented that the implementing agency considered all appropriate systems and demand management alternatives to the SOV capacity. A Congestion Management Documentation Form is distributed along with the Technical Inputs Solicitation and a special set of SOV congestion management documentation questions must be answered for any project to be included in the Plan or TIP that significantly increases the single occupant vehicle carrying capacity of a highway.

Regional long-range transportation plans have reflected transportation demand management (TDM) programs, such as employer outreach, marketing, and the regional Guaranteed Ride Home program.

Some projects included in Visualize 2045 and TIP are revised as needed to reflect pertinent TDM study results. For example, the I-95/395 HOV-HOT-Bus Lanes project was revised to reflect the results of the Transit/Transportation Demand Management Study conducted by the Virginia Department of Rail and Public Transportation (DRPT) and the Technical Advisory Committee in the 2008 CLRP.

Finally, the TPB certifies demand management of the CMP in the overall certification of the transportation planning process in the National Capital Region. The Board finds the transportation planning process is addressing the major issues in the region and is being conducted in accordance with all applicable requirements.

5.3 Operational Management in Visualize 2045

Part of the CMP effort focuses on defining the existing operational management strategies that contribute to the more effective use and improved safety of existing and future transportation systems. Such strategies include incident management programs, ITS Technologies, Advanced Traveler Information Systems, and traffic engineering improvements. These strategies are outlined in detail in Section 3.3.

Along with demand management strategies, operational management alternatives must also be considered when SOV capacity expanding projects are submitted to the Technical Inputs Solicitation of Visualize 2045 and TIP. The considerations are documented in the Congestion Management Documentation Form.

The TPB also certifies operational management of the CMP in the overall certification of the transportation planning process in the National Capital Region.

5.4 Capacity Increases in Visualize 2045 and Their CMP Components

Federal law and regulations list capacity increases as another possible component of operational management strategies, for consideration in cases of:

- *Elimination of bottlenecks*, where a modest increase of capacity at a critical chokepoint can relieve congestion affecting a facility or facilities well beyond the chokepoint location. For example, widening the ramp from I-495 Capital Beltway Outer Loop to westbound VA 267 (Dulles Toll Road) relieved miles of regularly occurring backups on the Beltway and across the American Legion Bridge.

- *Safety improvements*, where safety issues may be worsening congestion, such as at high-crash locations, mitigating the safety issues may help alleviate congestion associated with those locations.

- *Traffic operational improvements*, including adding or lengthening left turn, right turn, or merge lanes or reconfiguring the engineering design of intersections to aid traffic flow while maintaining safety.

These considerations are included in the Congestion Management Documentation Form in Visualize 2045 and TIP project submissions.

6. CONCLUSIONS

The 2020 CMP Technical Report hereby concludes with a summary of key findings and important recommendations from throughout the report to improve the Congestion Management Process in the Washington region.

6.1 Key Findings of the 2020 CMP Technical Report

1. Congestion – Impacts of the COVID-19 pandemic dramatically decreased congestion in the Washington region, with the Travel Time Index being much lower/better (1.17 in 2020 and 1.28 in 2021, in weekday TTI) than at any time since vehicle probe data became available for analysis in 2010. Congestion in 2021 did increase versus 2020, but was still dramatically lower than historic norms. (Sections 2.2.1.1 and 2.2.1.3).

2. Reliability – Travel time reliability (as measured by Planning Time Index) in the region improved in 2020 and 2021 versus historic norms, reflecting significantly decreased congestion due to pandemic impacts (Section 2.2.1.2).

3. Bottlenecks – Bottleneck locations in the region did change somewhat due to pandemic impacts compared to the 2019 bottlenecks reported in the 2020 CMP Technical Report, though many of the region's historic bottlenecks remained in 2021. A segment of I-95 southbound between US-1/EXIT 161 and VA-123/EXIT 160 was ranked the top bottleneck in 2021, as it was in 2019. (Section 2.2.1.6).

4. Travel Demand Management – Travel demand management continues to be an important tool for day-to-day congestion management. The Commuter Connections program remains the centerpiece to assist and encourage people in the Washington region to use alternatives to the single-occupant automobile. The transit system in the Washington region serves as a major alternative to driving alone – transit mode share is among the highest several metropolitan areas in the country (Section 3.2.1).

5. Walking and Bicycling – Walking and bicycling continue to grow in the region in part due to bikesharing and increasing connectivity in the bicycle and pedestrian network (Sections 3.2.4 and 3.2.5).

6. Variably Priced Lanes (VPLs) - VPLs provide additional options to travelers in the region. Facilities include 95Express, 395Express, 495Express, I-66, and Maryland Route 200 (Intercounty Connector (ICC)) (Section 3.3.2).

7. Regional Transportation Operations Coordination – The Metropolitan Washington Area Transportation Operations Coordination (MATOC) program continues to play an important role in coordination and communicating incident information during both typical travel days and special events such as severe weather and construction work (Section 3.3.3.4).

8. Real-time Travel Information – The increasing availability of technology to monitor, detect, and evaluate travel conditions allows operators to make changes to the transportation network through active travel demand management, traffic signal timing, and integrative corridor management. For travelers, real-time traffic and transit information are available from a number of sources through mobile applications and mobile versions of websites. Social media provides a mutually beneficial direct connection between transportation providers and users.

Mobile applications related to non-auto modes, such as bikesharing and carsharing, allow travelers to be flexible with their mode choices (Section 3.4.6).

9. COVID-19 Pandemic Impacts – Beginning in March 2020, the COVID-19 pandemic had dramatic impacts on travel and transportation in the Washington region (as well as nationally). Among the transportation impacts reported were dramatic increases of telework, reduced transit ridership, increased freight movement, and increased home delivery of goods. It remains to be seen what these trends will be over the longer term, as recovery from the pandemic evolves. (Sections 2.2.1.1 and 2.2.1.2; Section 2.2.3; Section 2.3).

6.2 Recommendations for the Congestion Management Process

The 2022 CMP Technical Report documents the updates of the Congestion Management Process in the Washington region. Looking forward, the report leads to several important recommendations for future improvements.

1. **Continue the Commuter Connections program.** The Commuter Connections program is a primary key strategy for demand management in the National Capital Region and it is beneficial to have a regional approach. Meanwhile, this program in addition to reducing trips and vehicle miles of travel, reduces transportation emissions and improves air quality.

2. **Continue and enhance the MATOC program and support agency/jurisdictional transportation management activities.** The MATOC program/activities are key strategies of operational management in the National Capital Region. Future enhancements of the MATOC program should be considered when appropriate to expand the function and participation of the program.

3. **Continue to coordinate the region's Performance-Based Planning and Programming (PBPP) with the CMP.** Performance measurement and analysis are key components of both requirements, and can be accomplished synergistically.

4. **Continue to encourage integration of operations management and travel demand management components of congestion management for more efficient use of the existing transportation network.** State DOTs are encouraged to continue to explore management strategies along congested freeways and actively manage nearby arterials. Transportation agencies (including transit agencies) and stakeholders are encouraged to work collaboratively along congested corridors.

5. **Pursue sufficient investment in the existing transportation system, which is important for addressing congestion.** Prioritizing maintenance for the existing transportation system as called for in TPB's Regional Transportation Priorities Plan is critical to congestion management.

6. **Continue variable pricing and other management strategies in conjunction with capacity increasing projects.** Variably priced lanes (VPLs) provide an option to avoid congestion for travelers and an effective way to manage congestion for agencies.

7. **Continue to encourage transit in the Washington region and explore transit priority strategies.** The transit system in the Washington region serves as a major alternative to driving alone, and it is an important means of getting more out of existing infrastructure. Local jurisdictions are encouraged to work closely with transit agencies to explore appropriate transit priority strategies that could have positive impacts on travelers by all modes.

8. **Encourage implementation of congestion management for major construction projects.** The construction project-related congestion management has been very successful in the past such as for the 11th Street Bridge and Northern Virginia Megaprojects.

9. **Continue to encourage access to non-auto travel modes.** The success of the Capital Bikeshare program and increased mode share for bicycling in a number of jurisdictions indicate that improvements can engender shifts to non-automobile transportation.

10. **Continue and enhance providing real-time, historical, and multimodal traveler information.** Providing travelers with information before and during their trips can help them to make decisions to avoid congestion and delays and better utilize the existing road and transit infrastructure. Share travel/incident information and/or partner with private sector providers of travel and navigation information, including information on multi-modal alternatives to driving.

11. **Encourage implementation of projects, programs, and processes that support the TPB Aspirational Initiatives.** The TPB included seven Aspirational Initiatives in the aspirational element of Visualize 2045 for future concerted action. These initiatives, if funded and enacted, would have the potential to significantly improve the region's transportation system performance compared to current plans and programs, offering a broad range of congestion management benefits.

12. **Encourage connectivity within and between Regional Activity Centers.** The current Regional Activity Centers map, adopted in 2013, helps coordinate transportation and land use planning for future growth. Geographically-focused Household Travel Surveys can collect data which allows planners to see local level travel patterns and behaviors impacting mode shifts.

13. **Continue and enhance the regional congestion monitoring program with multiple data sources.** There are a wealth of sources, both public and private sector, for data related to congestion which have their individual strengths and shortcomings. Private sector probe-based monitoring provides unprecedented spatial and temporal coverage on roadways, but still needs to be supplemented with data from other sources including data on traffic volumes and traffic engineering considerations. There should be continual review of the quality and availability of data provided by different sources and the structuring of a monitoring program that is adaptable for potential future changes in data reporting and/or data sources.

14. **Monitor trends in freight, specifically truck travel.** Interrelationships between freight movement and congestion differ from interrelationships between passenger travel and congestion.

15. **Participate in collaborative planning connected and autonomous vehicle readiness.** These emerging technologies will dramatically alter future transportation planning. Standards and interoperability are critical issues and should be addressed through extensive collaboration with a variety of stakeholders.

16. **Monitor impacts of and interactions with shared mobility services.** Transportation Network Companies (TNCs) continue to have an evolving impact on a variety of aspects of congestion management, mode share, and transportation overall, but data for regional analysis remain scarce. Regulating agencies are encouraged to arrange for TNC data to be collected and

shared with the TPB and other official transportation planning and operating entities, to enable analysis of impacts.

17. **Encourage Traffic Incident Management (TIM).** COG's 2018 creation of its Traffic Incident Management Enhancement (TIME) initiative highlighted the importance of TIM within congestion management. Continued TIM efforts will be beneficial to the region.

APPENDICES

APPENDIX A – 2021 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://pda.ritis.org/suite/.

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, 2021

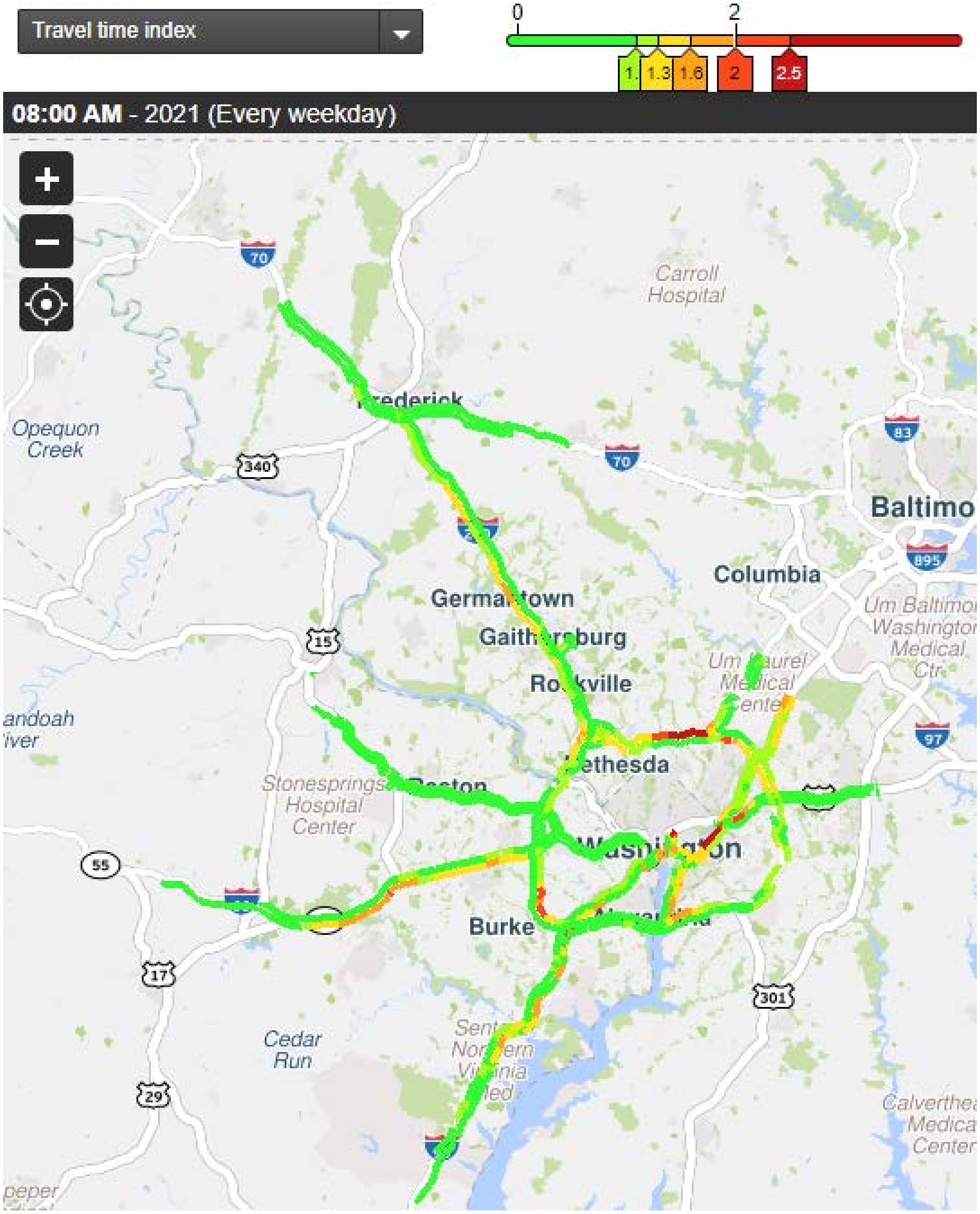


Figure A2: Travel Time Index on the Interstates and Freeways during Weekday 5:00-6:00 pm, 2021

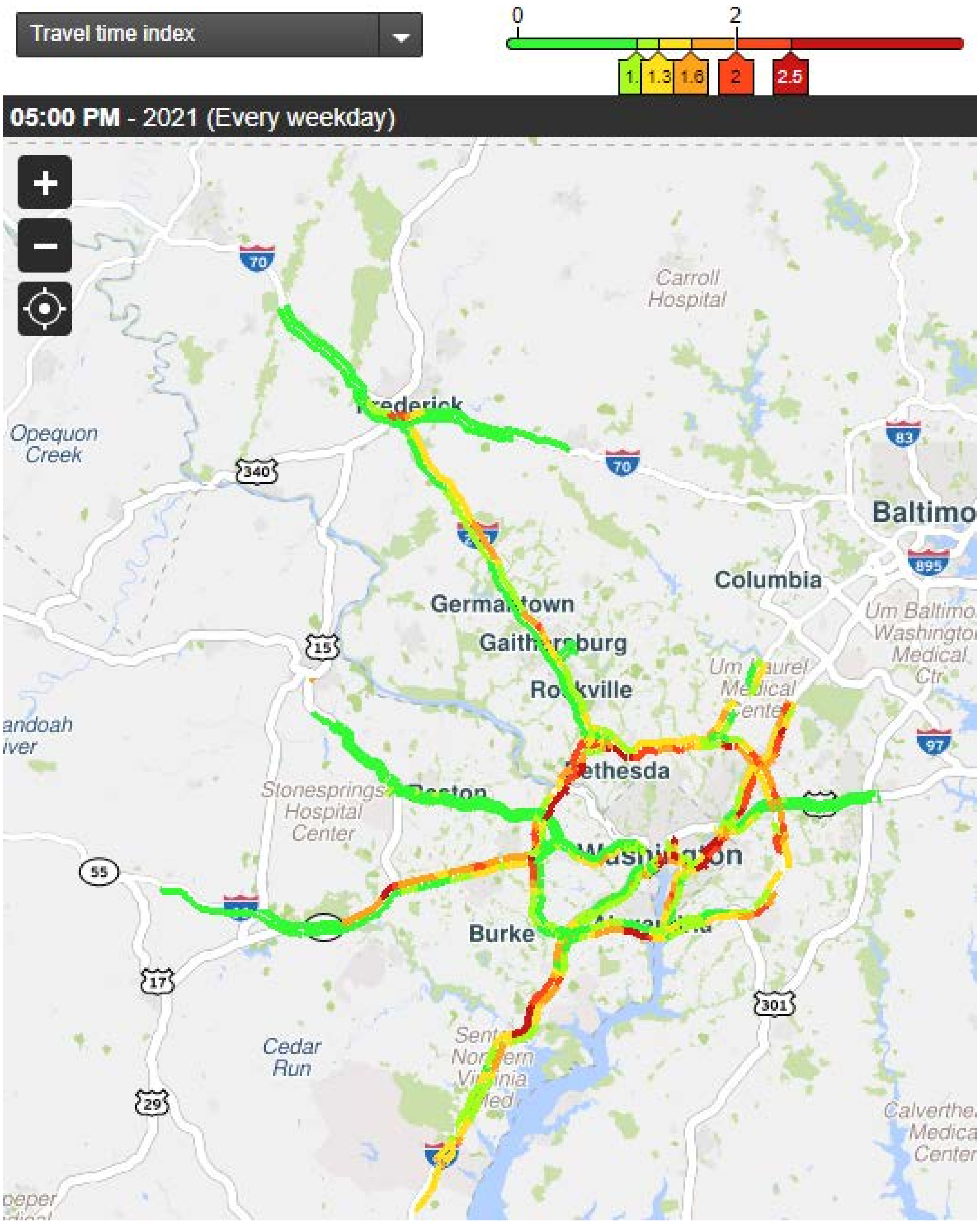


Figure A3: Travel Time Index in DC during Weekday 8:00-9:00 am, 2021

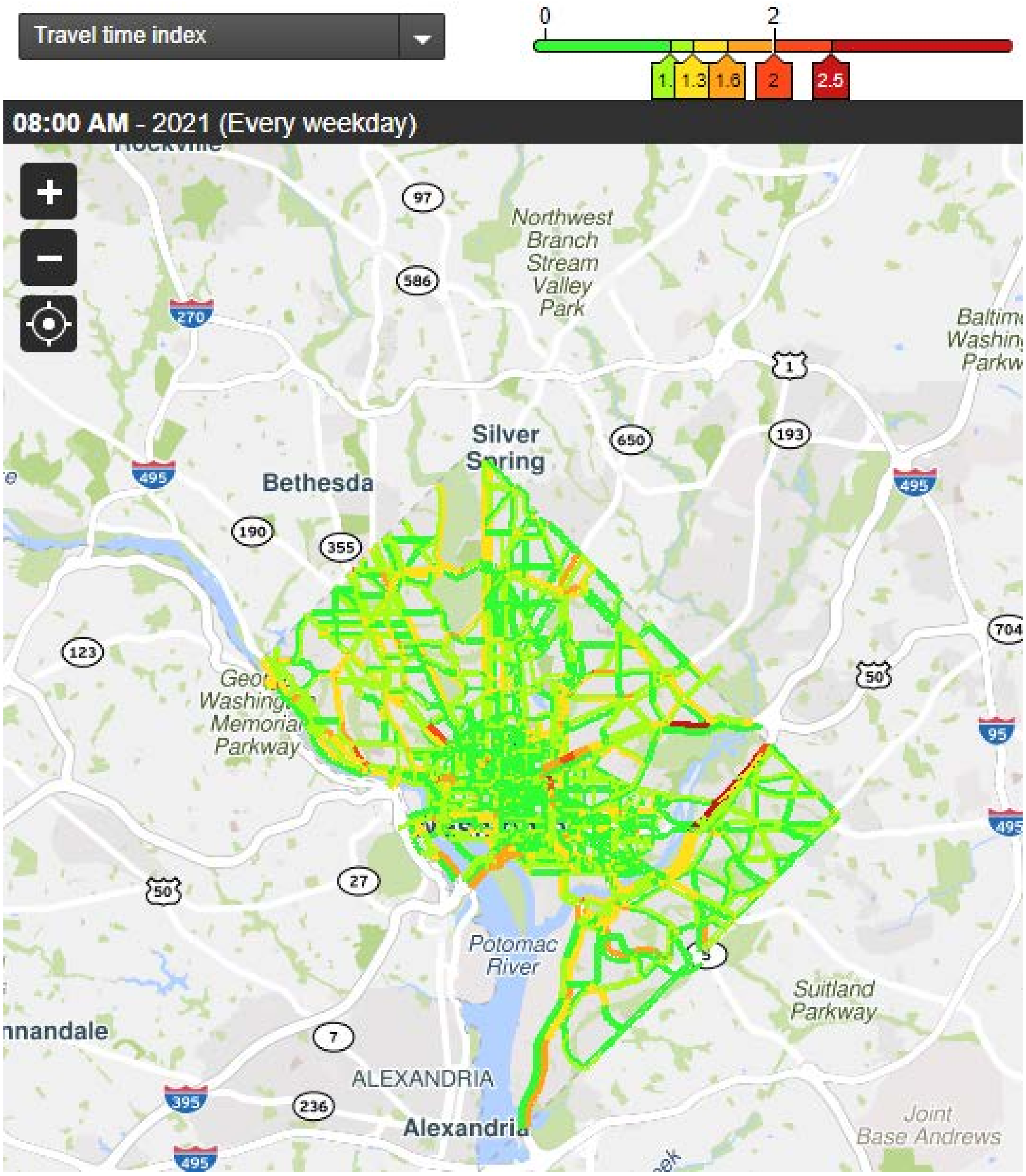


Figure A4: Travel Time Index in DC during Weekday 5:00-6:00 pm, 2021

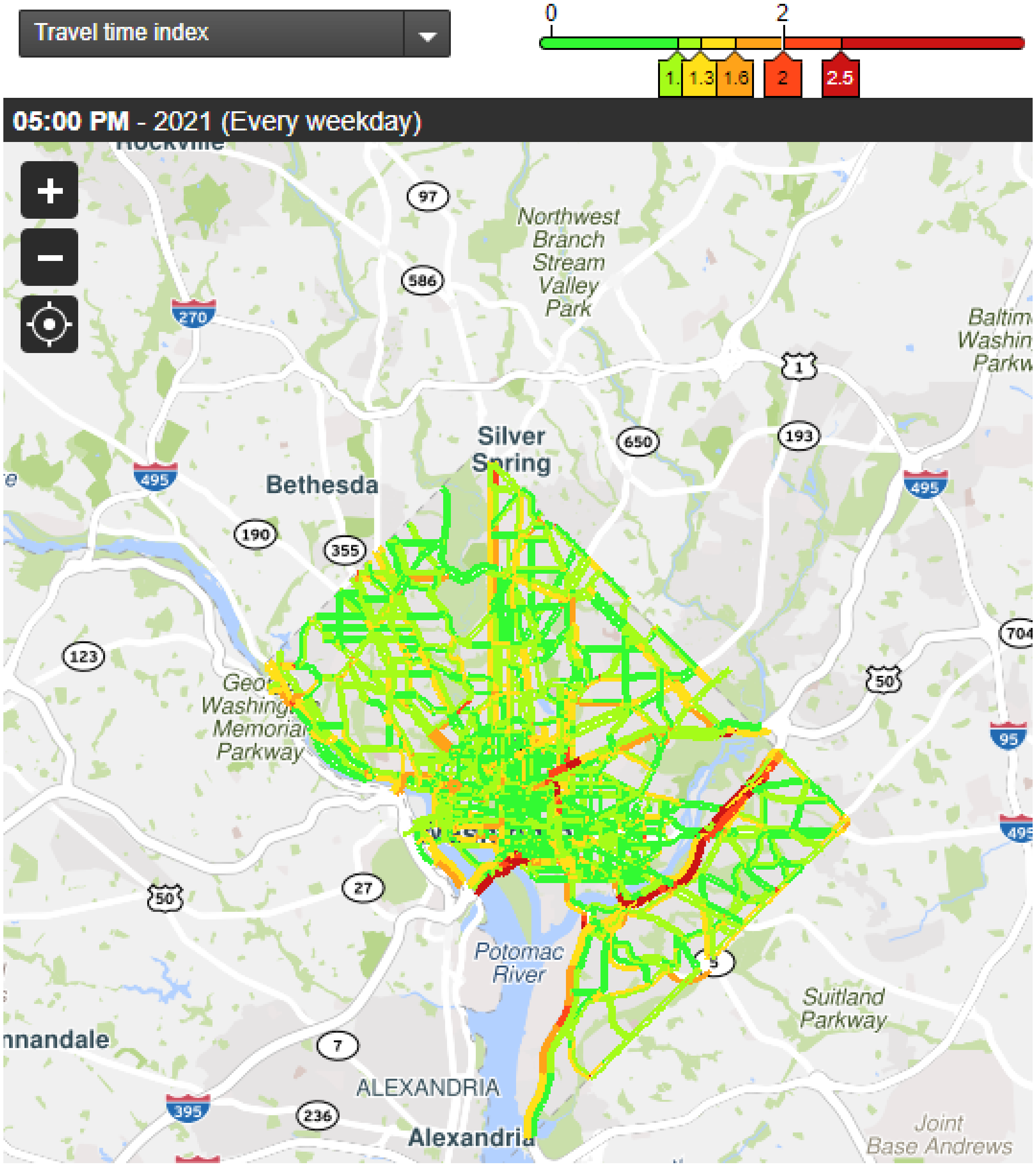


Figure A5: Travel Time Index in Frederick County, MD during Weekday 8:00-9:00 am, 2021

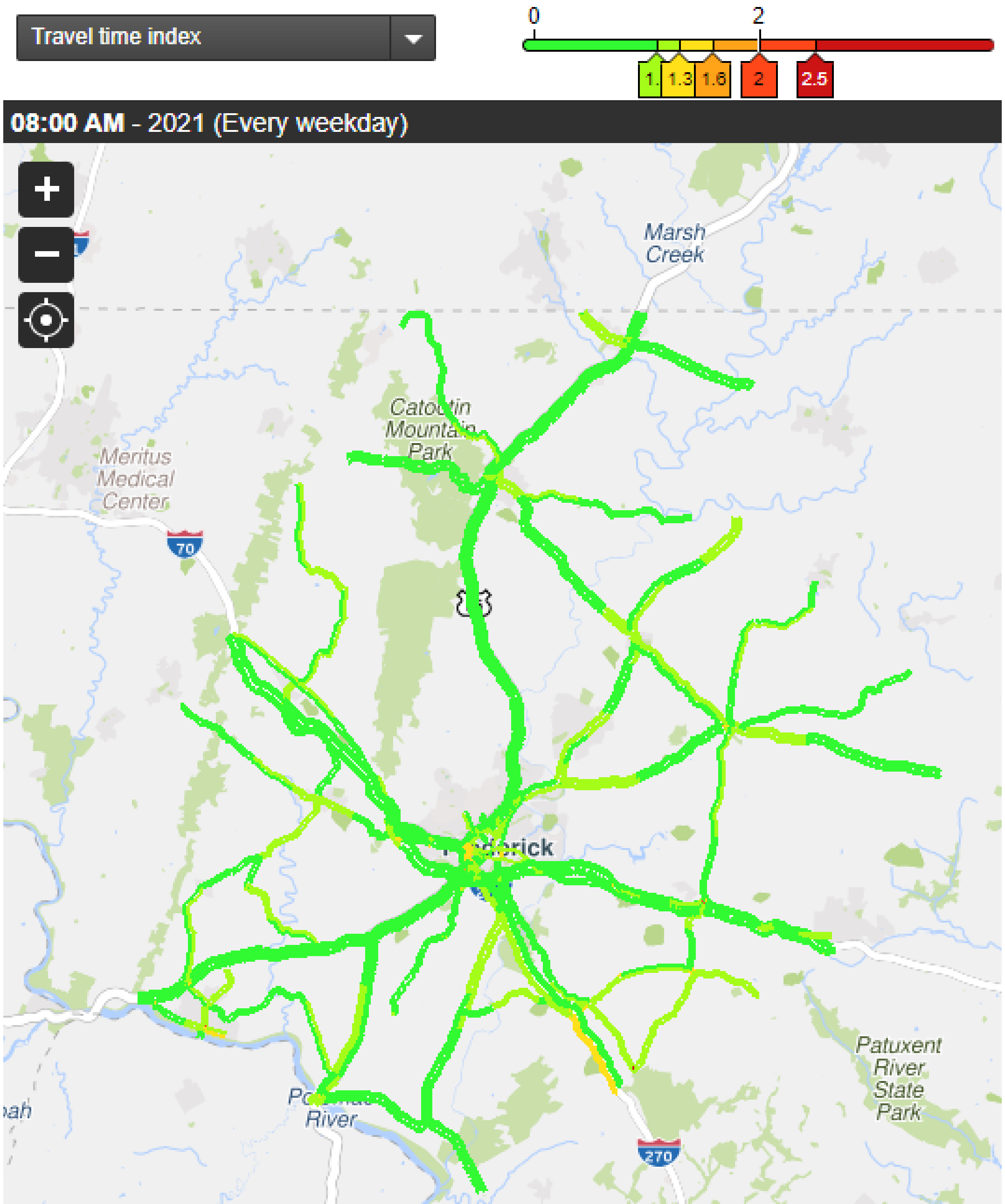


Figure A6: Travel Time Index in Frederick County, MD during Weekday 5:00-6:00 pm, 2021

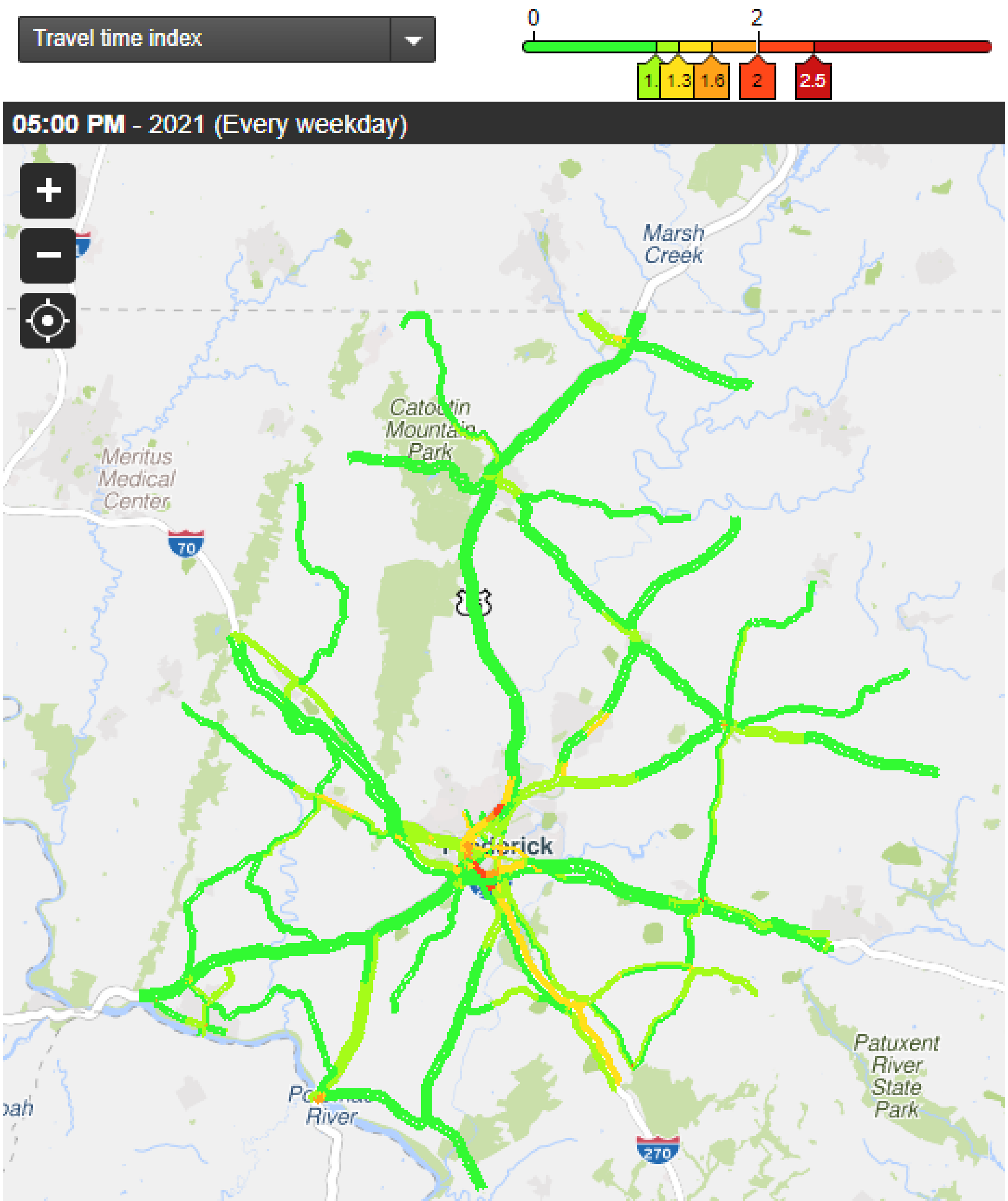


Figure A7: Travel Time Index in Montgomery County, MD during Weekday 8:00-9:00 am, 2021

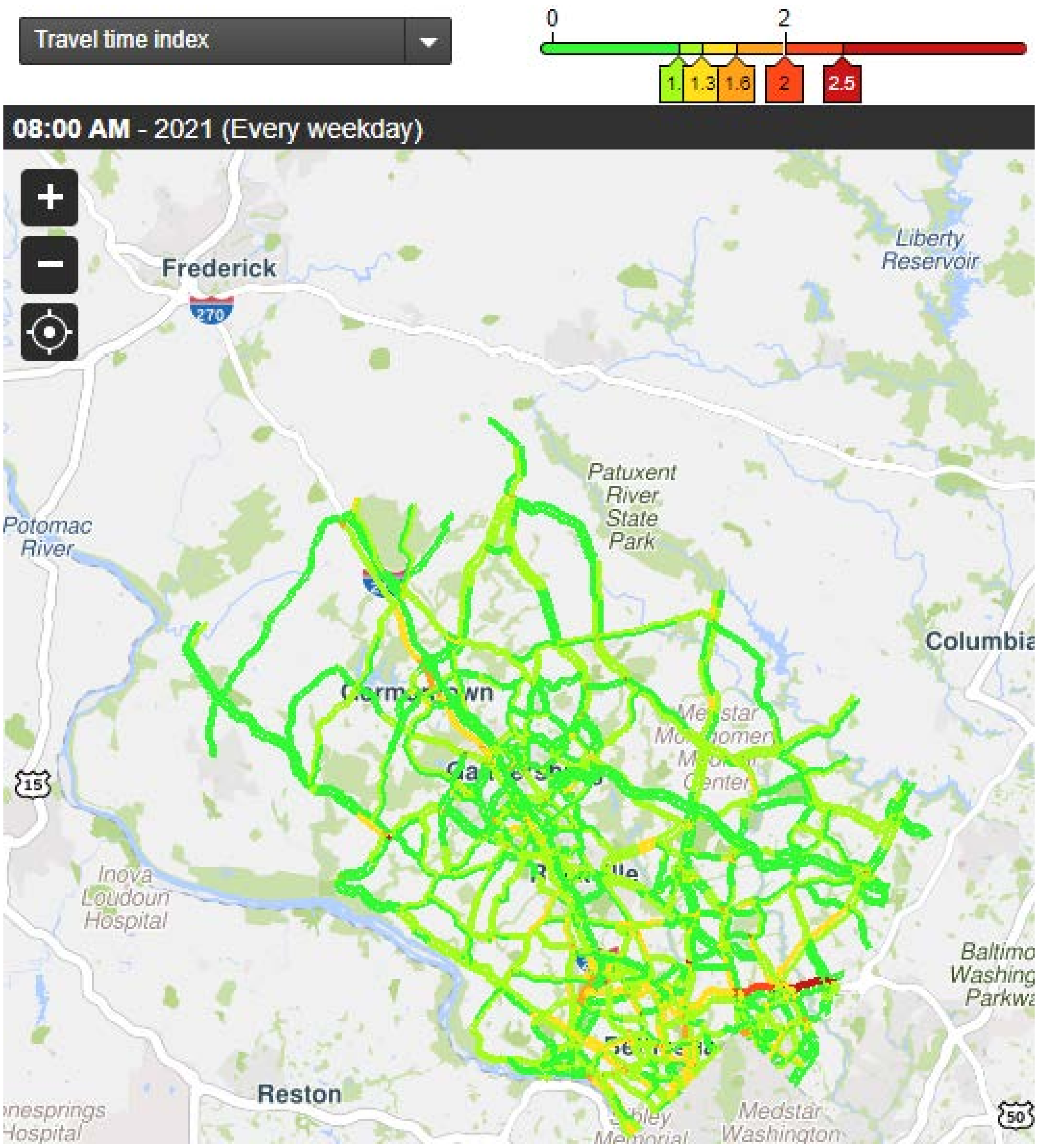


Figure A8: Travel Time Index in Montgomery County, MD during Weekday 5:00-6:00 pm, 2021

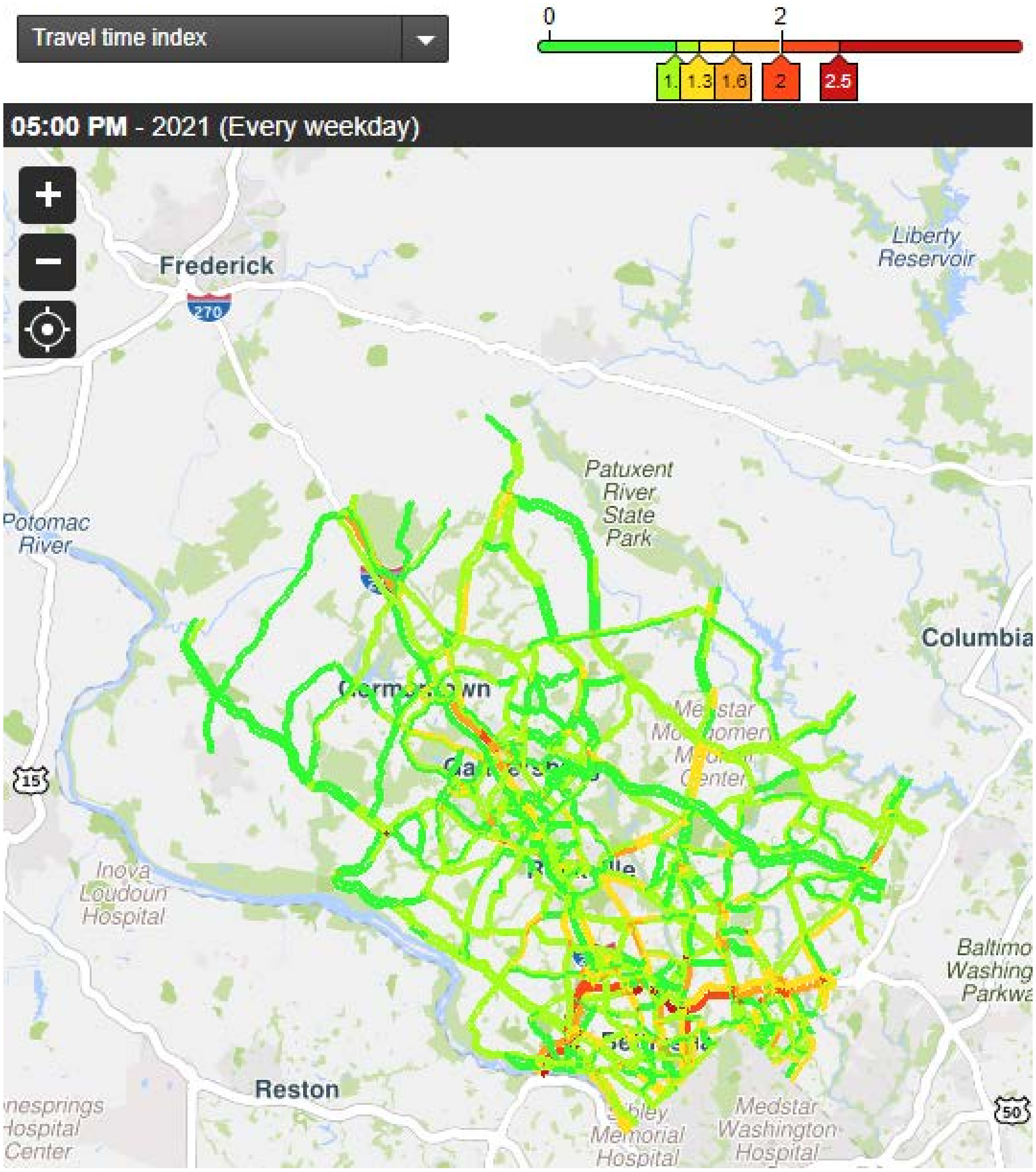


Figure A9: Travel Time Index in Prince George's County, MD during Weekday 8:00-9:00 am, 2021

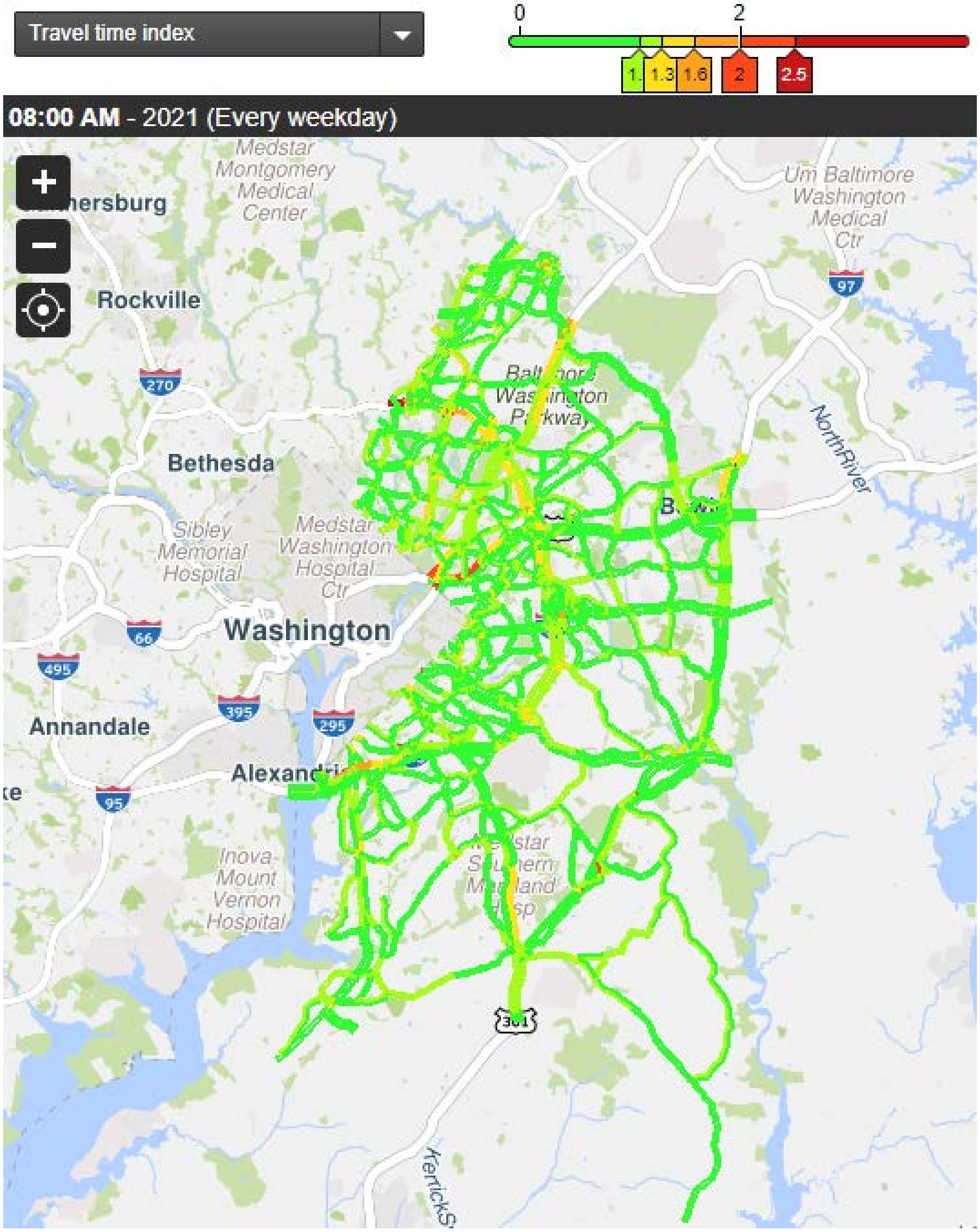


Figure A10: Travel Time Index in Prince George's County, MD during Weekday 5:00-6:00 pm, 2021

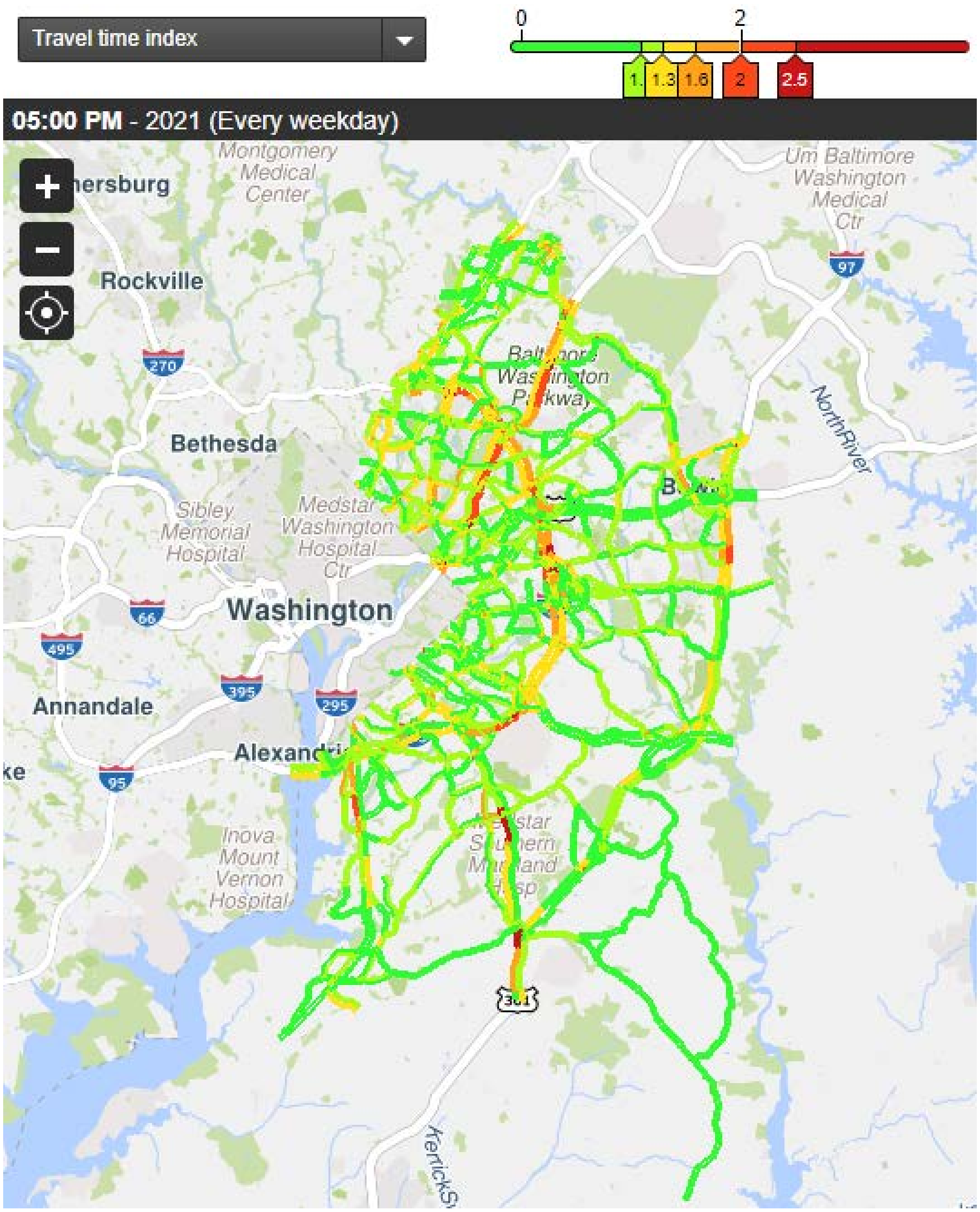


Figure A11: Travel Time Index in Charles County, MD during Weekday 8:00-9:00 am, 2021

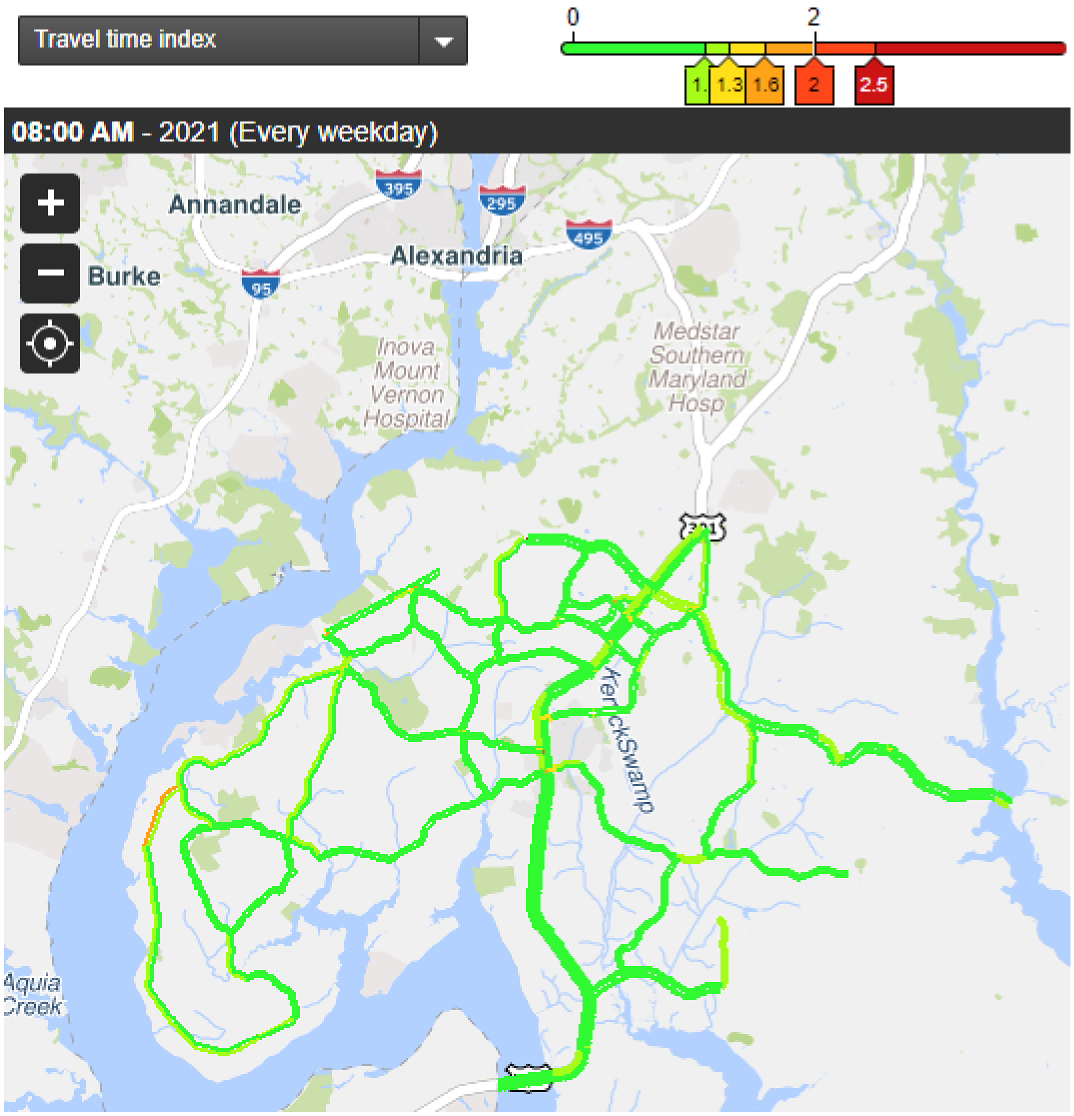


Figure A12: Travel Time Index in Charles County, MD during Weekday 5:00-6:00 pm, 2021

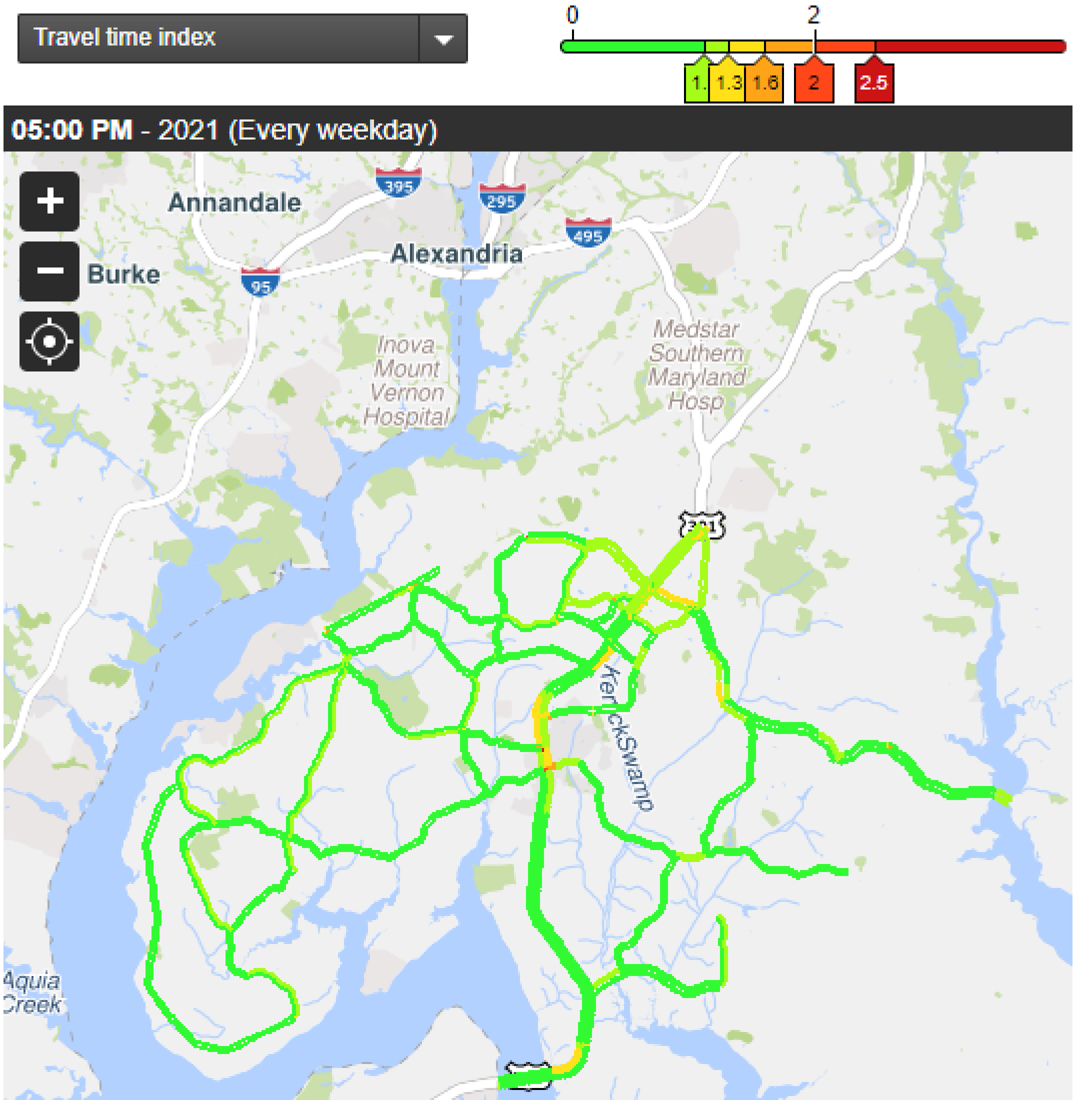


Figure A13: Travel Time Index in Loudoun County, VA during Weekday 8:00-9:00 am, 2021

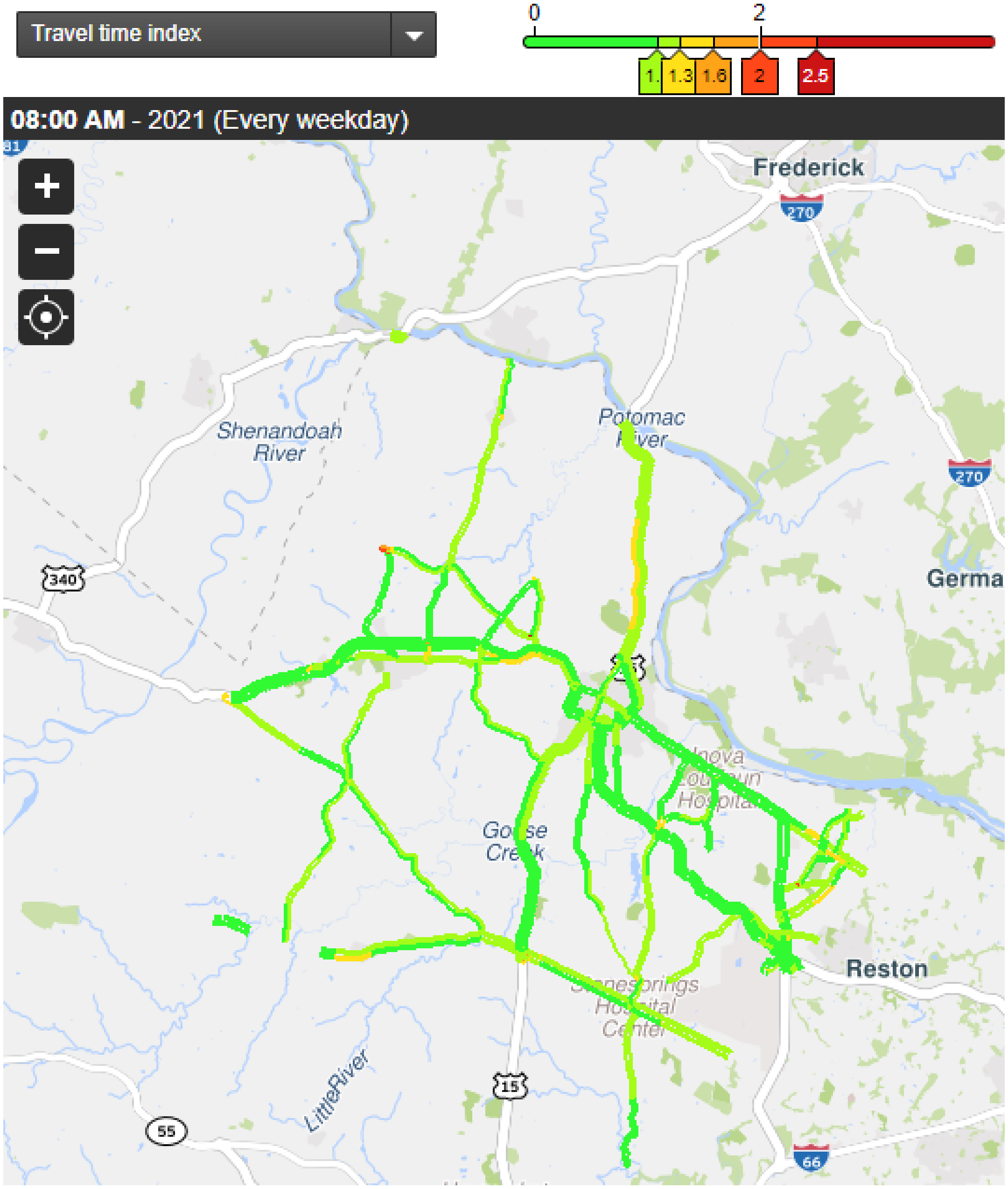


Figure A14: Travel Time Index in Loudoun County, VA during Weekday 5:00-6:00 pm, 2021

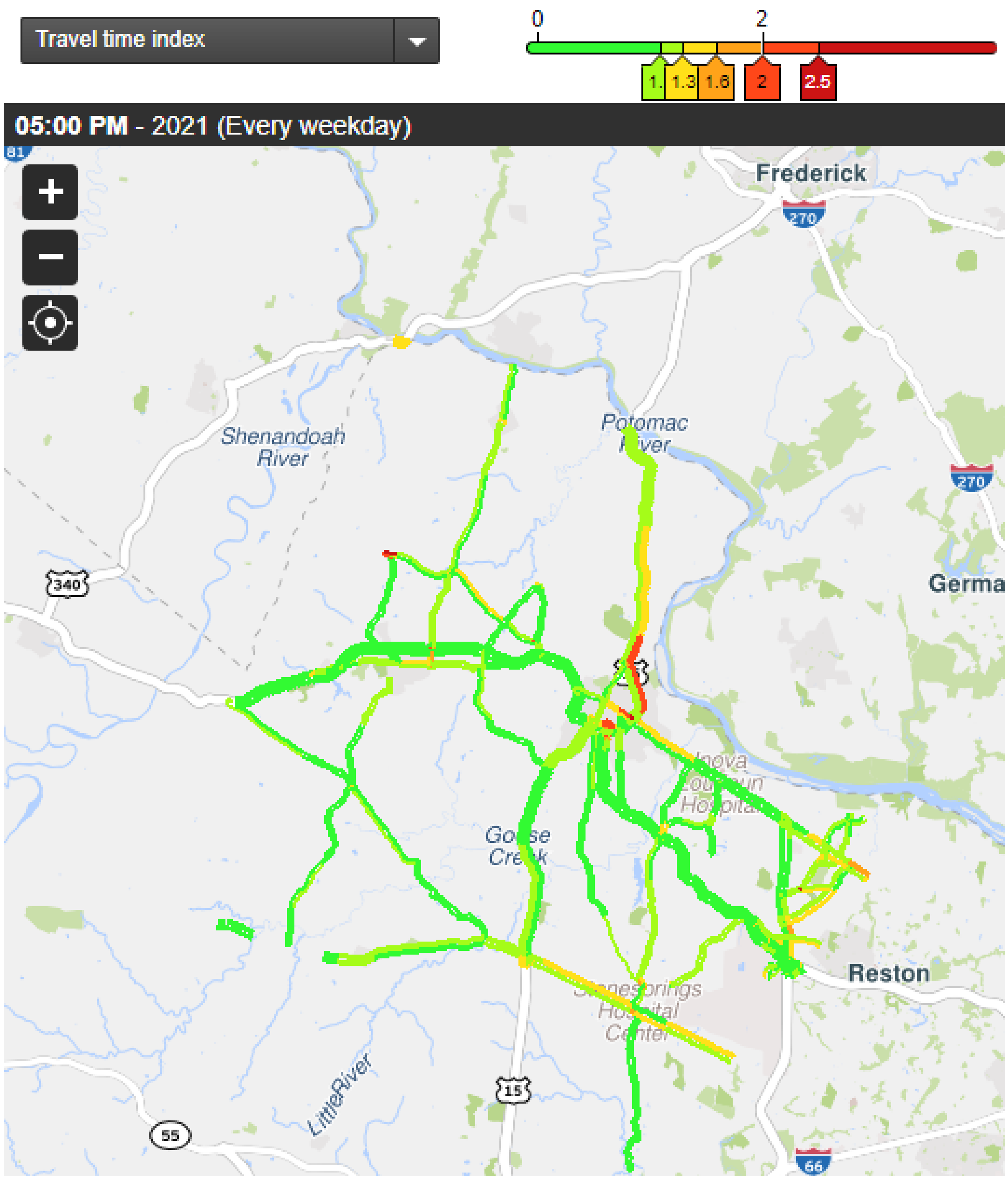


Figure A15: Travel Time Index in Fairfax, Prince William Counties and Cities of Fairfax, Manassas, and Manassas Park, VA during Weekday 8:00-9:00 am, 2021

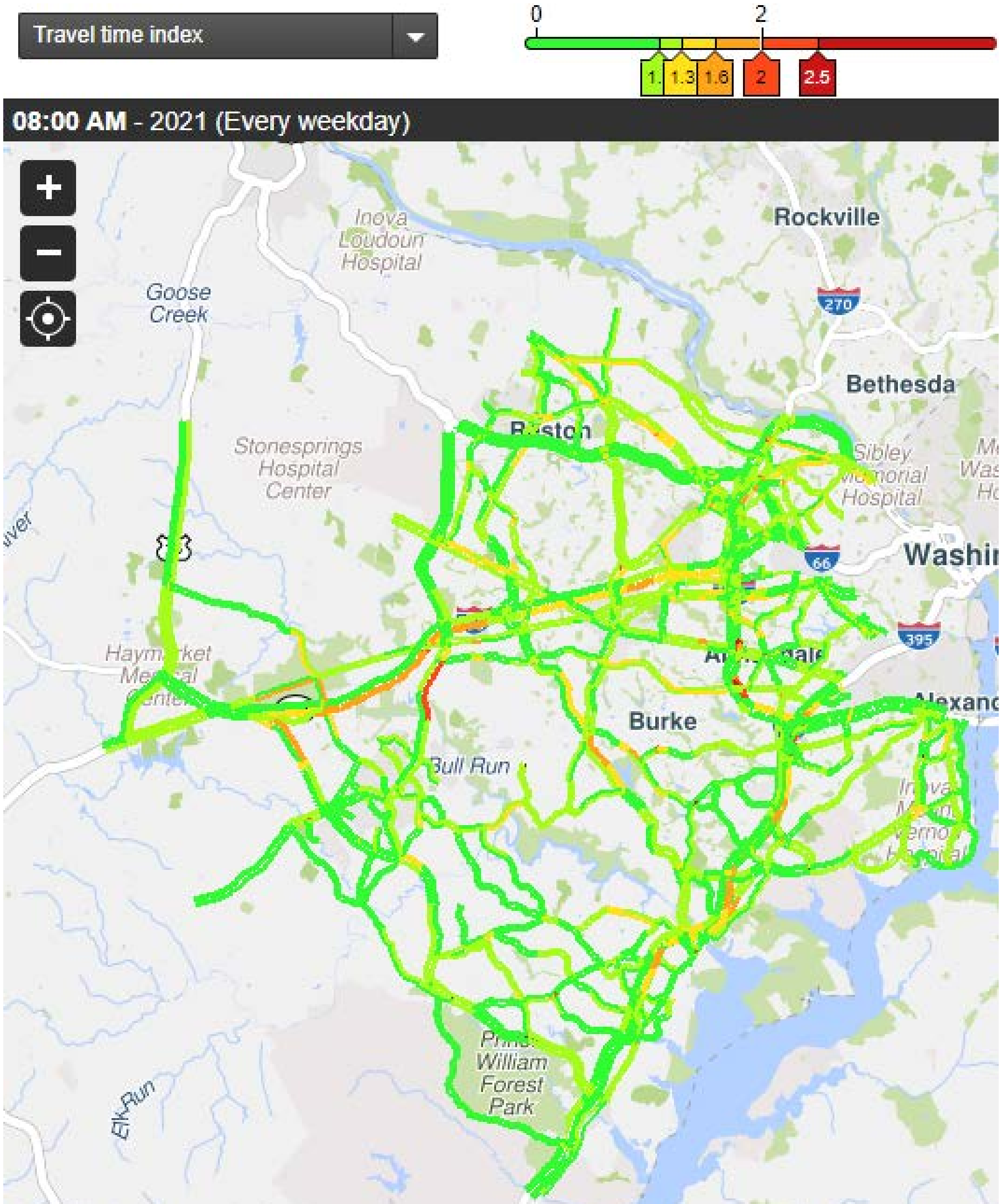


Figure A16: Travel Time Index in Fairfax, Prince William Counties and Cities of Fairfax, Manassas, and Manassas Park, VA during Weekday 5:00-6:00 pm, 2021

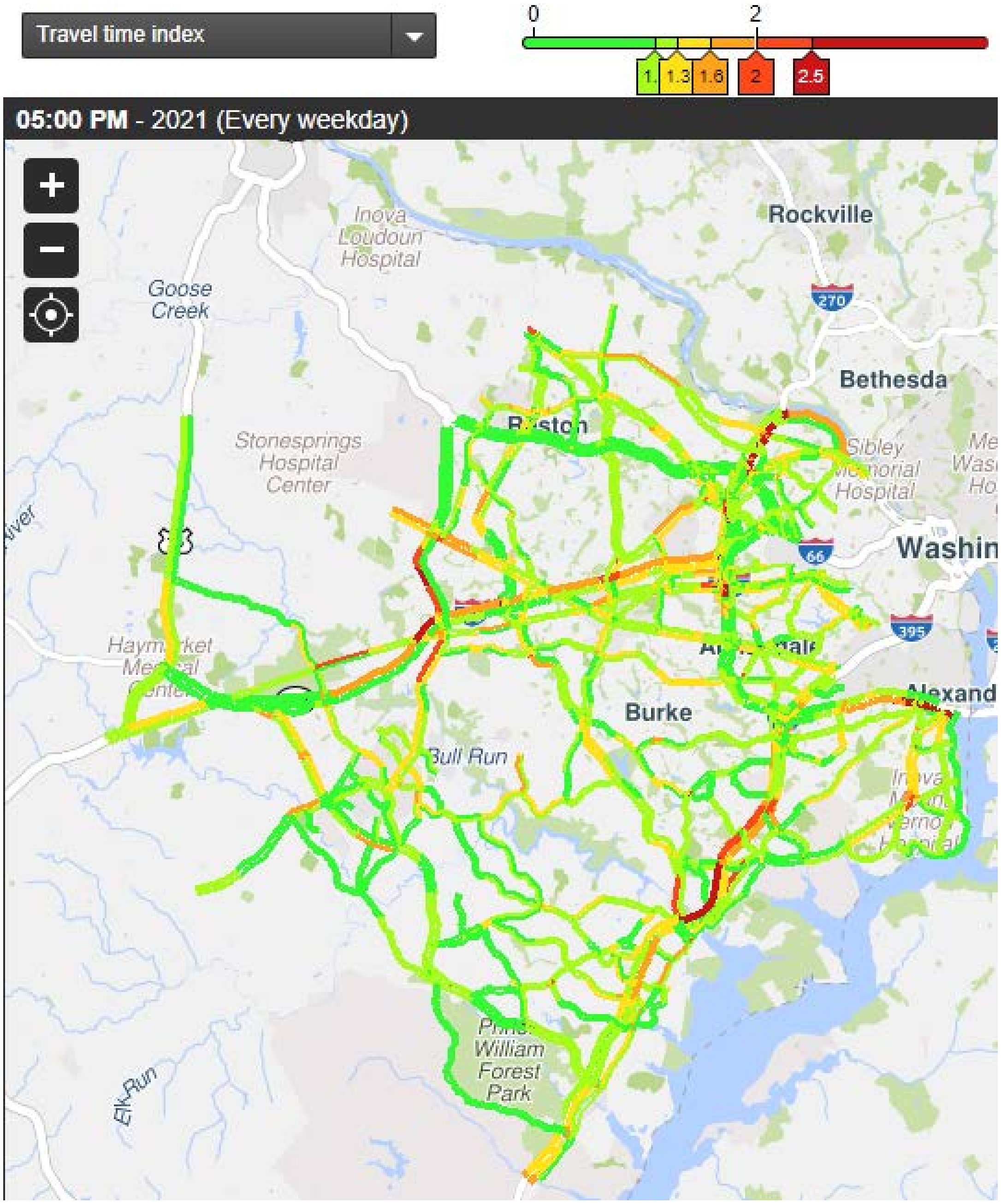


Figure A17: Travel Time Index in Cities of Alexandria, Arlington, and Falls Church, VA during Weekday 8:00-9:00 am, 2021

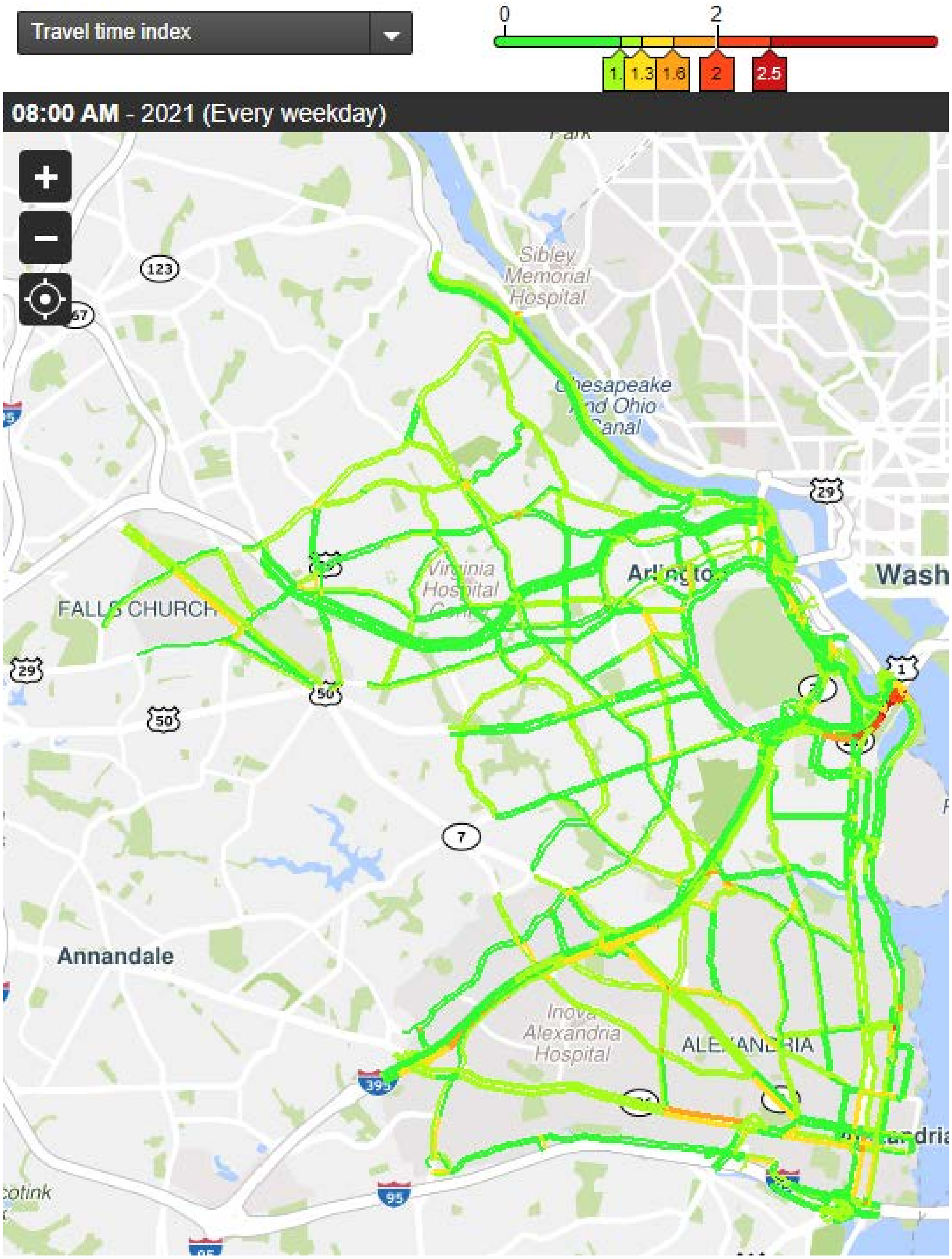
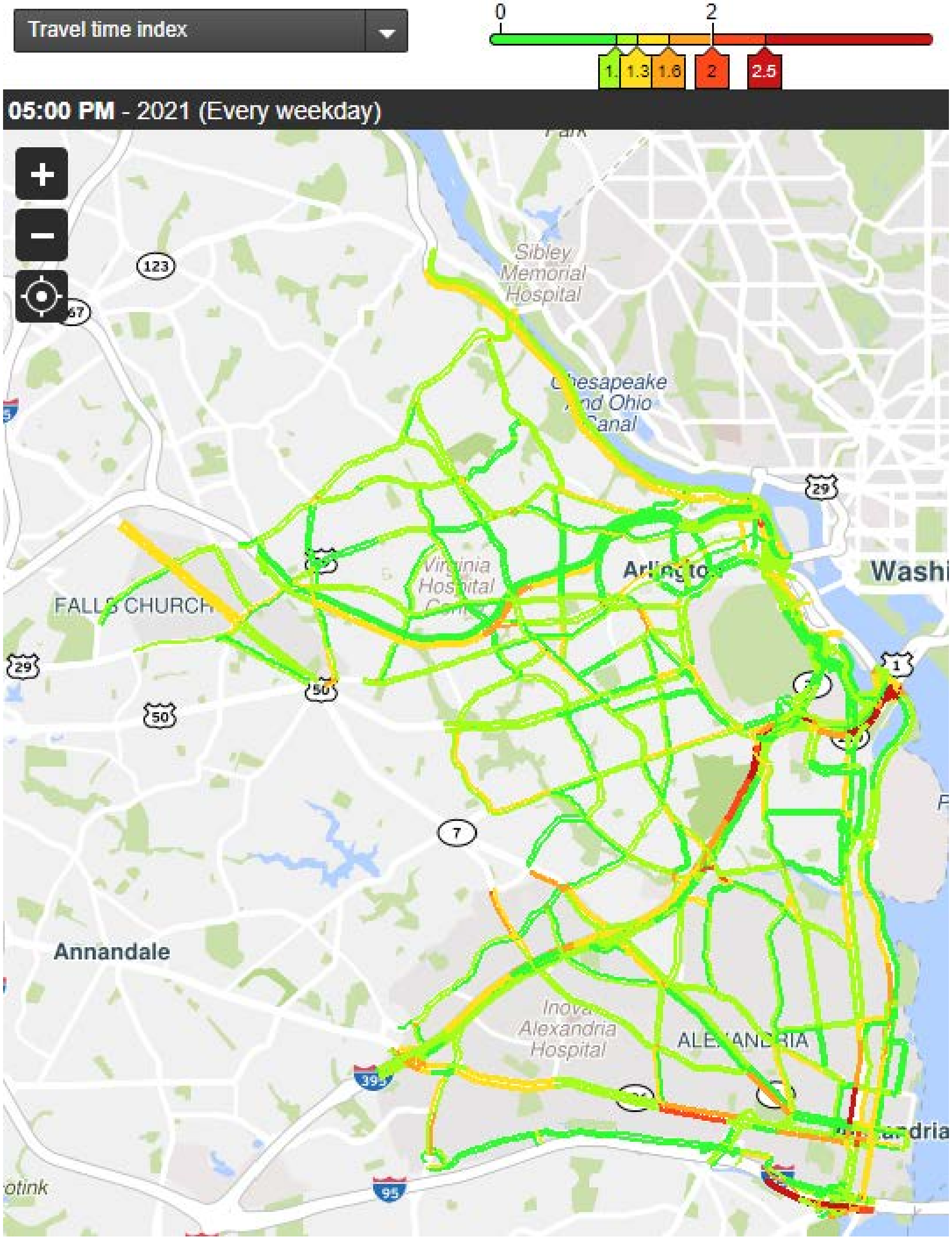


Figure A18: Travel Time Index in Cities of Alexandria, Arlington, and Falls Church, VA during Weekday 5:00-6:00 pm, 2021



APPENDIX B – 2021 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://pda.ritis.org/suite/.

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, 2021

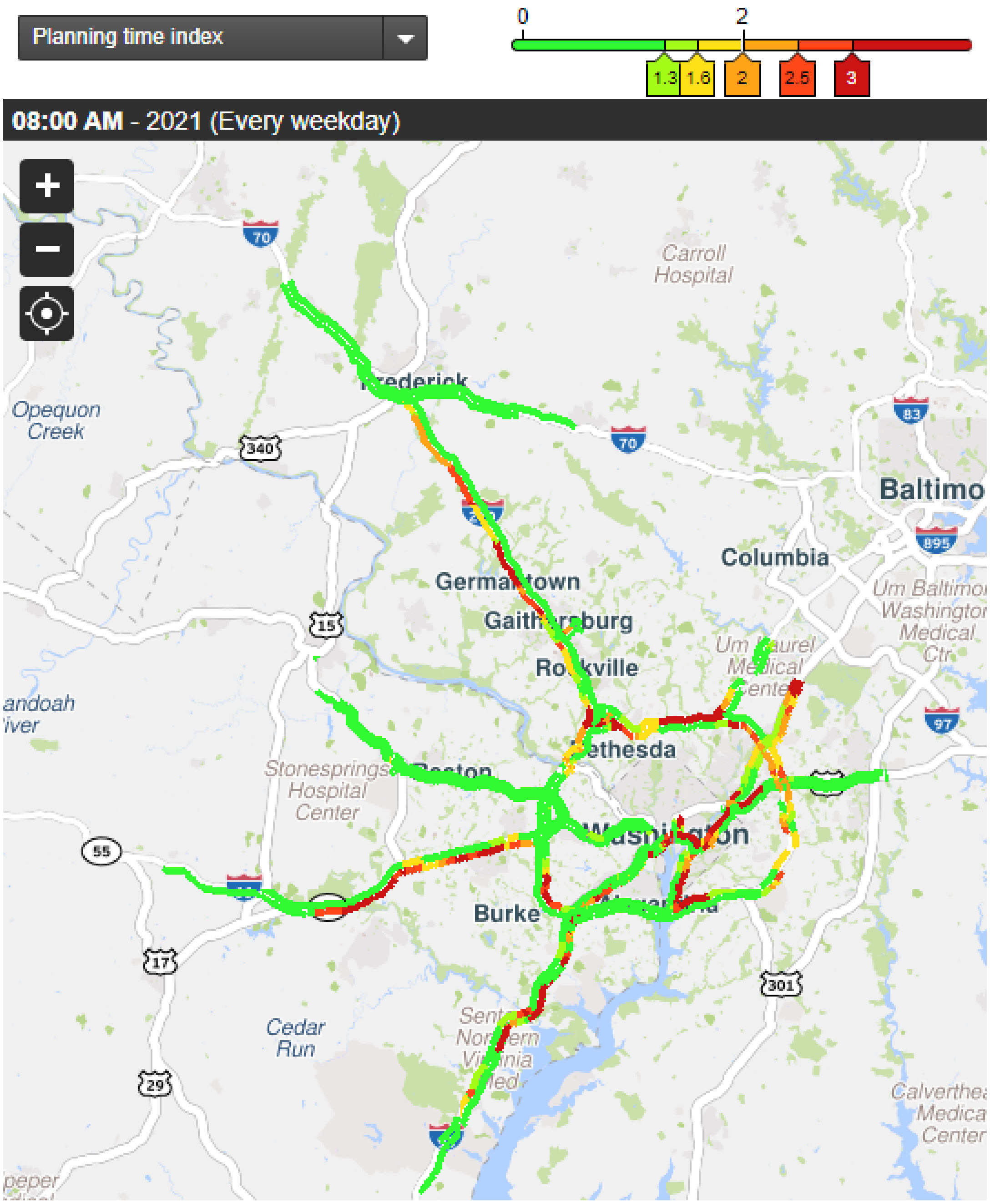


Figure B2: Planning Time Index on the Interstates and Freeways during Weekday 5:00-6:00 pm, 2021

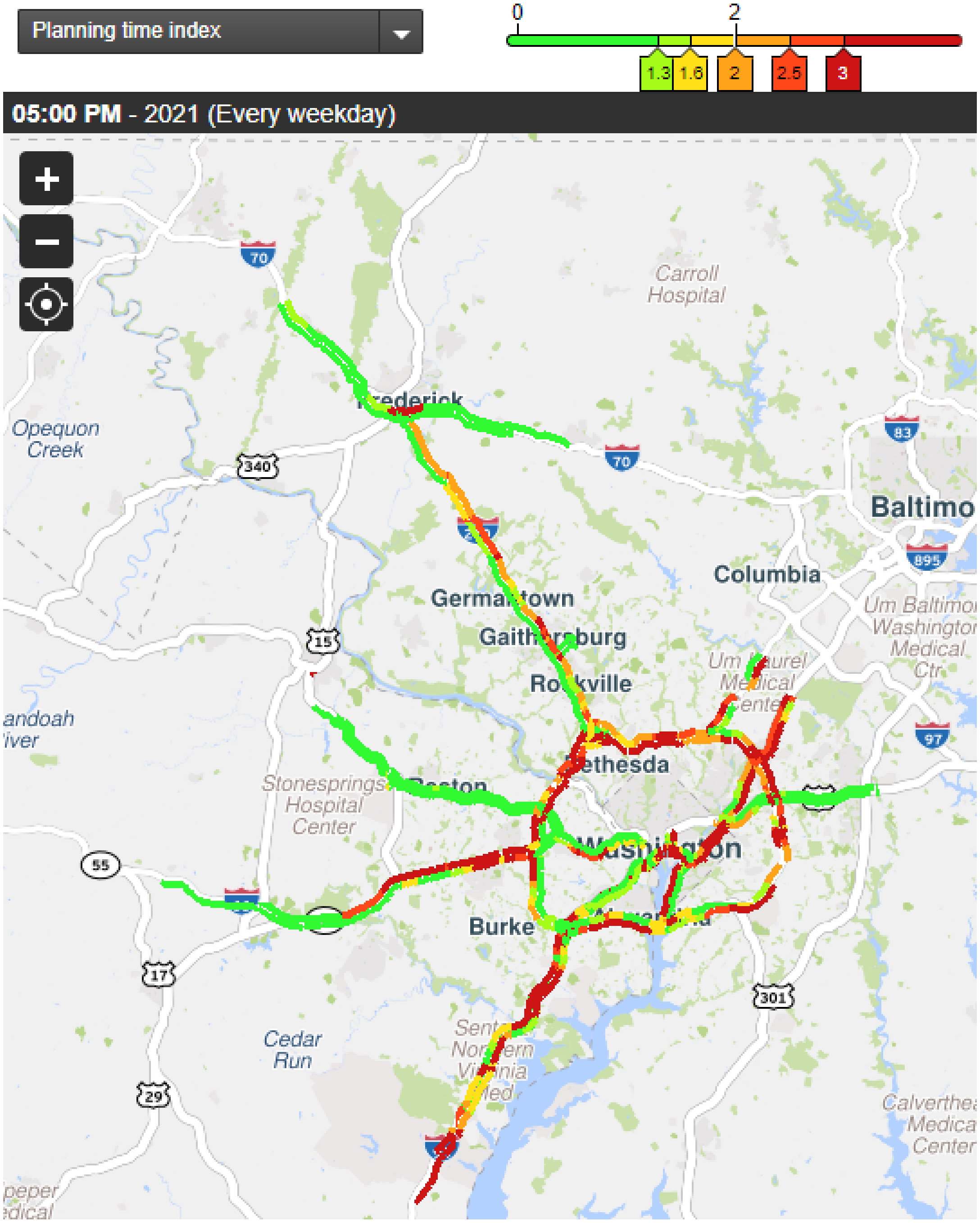


Figure B3: Planning Time Index in DC during Weekday 8:00-9:00 am, 2021

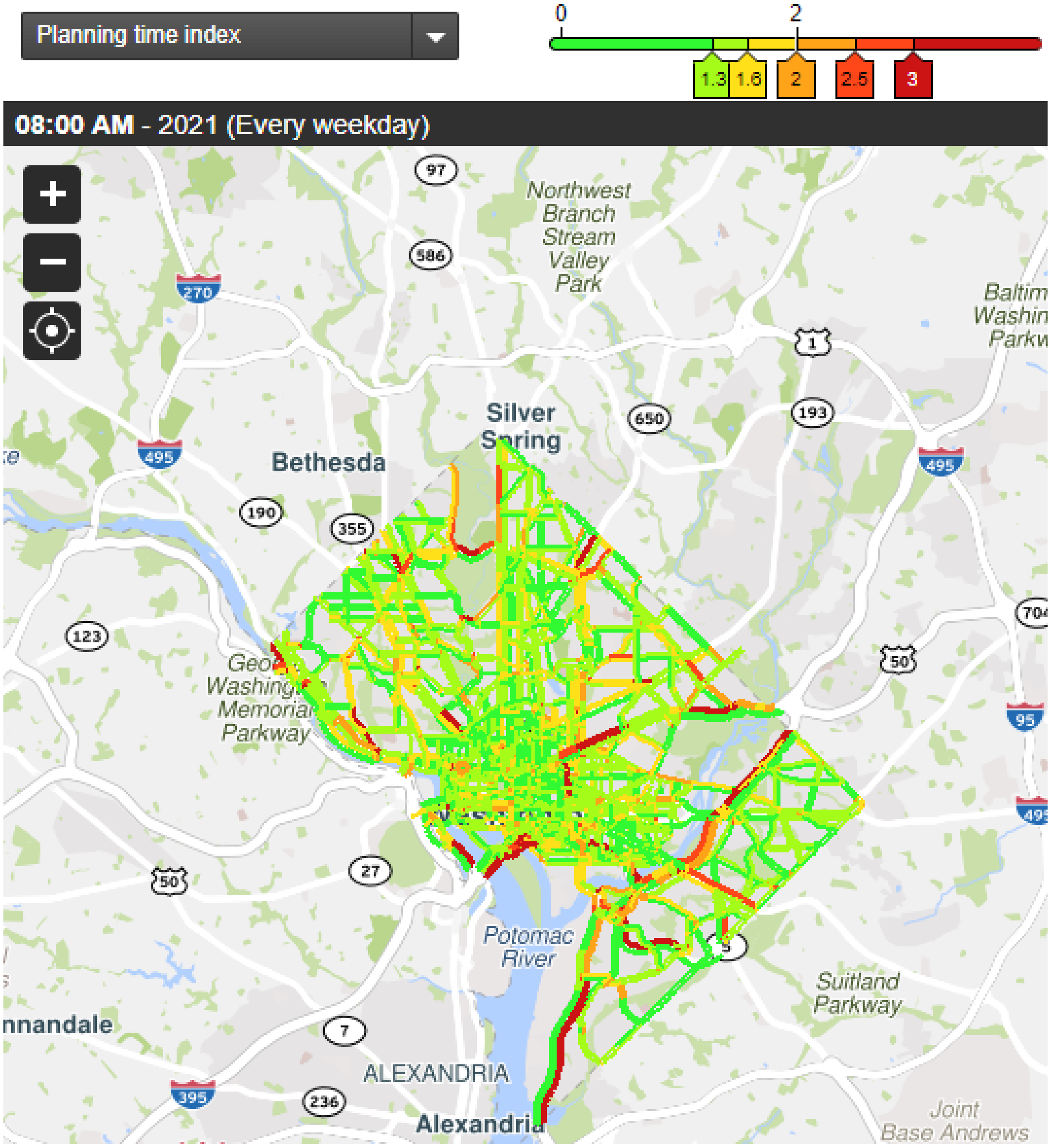


Figure B4: Planning Time Index in DC during Weekday 5:00-6:00 pm, 2021

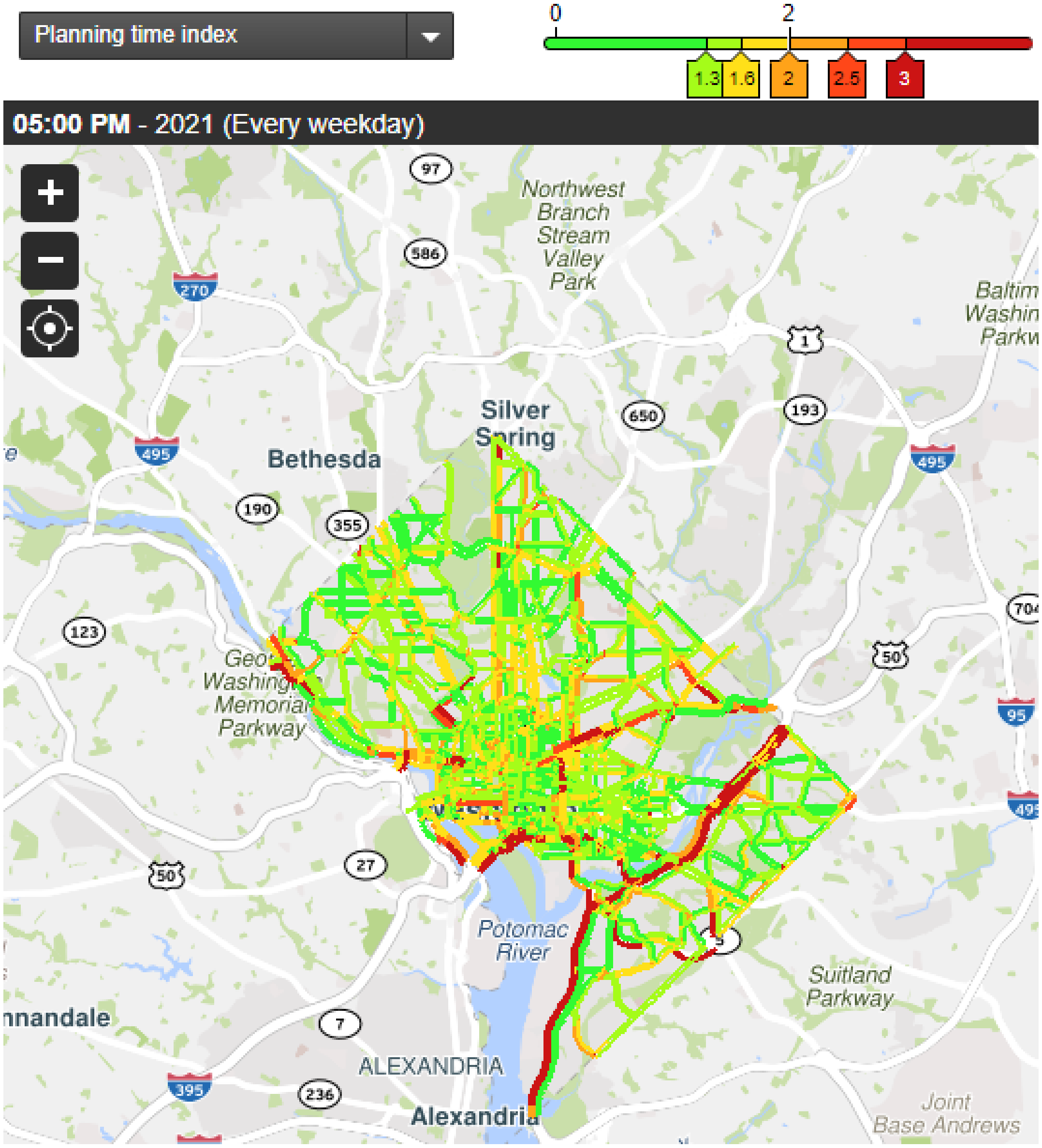


Figure B5: Planning Time in Frederick County, MD during Weekday 8:00-9:00 am, 2021

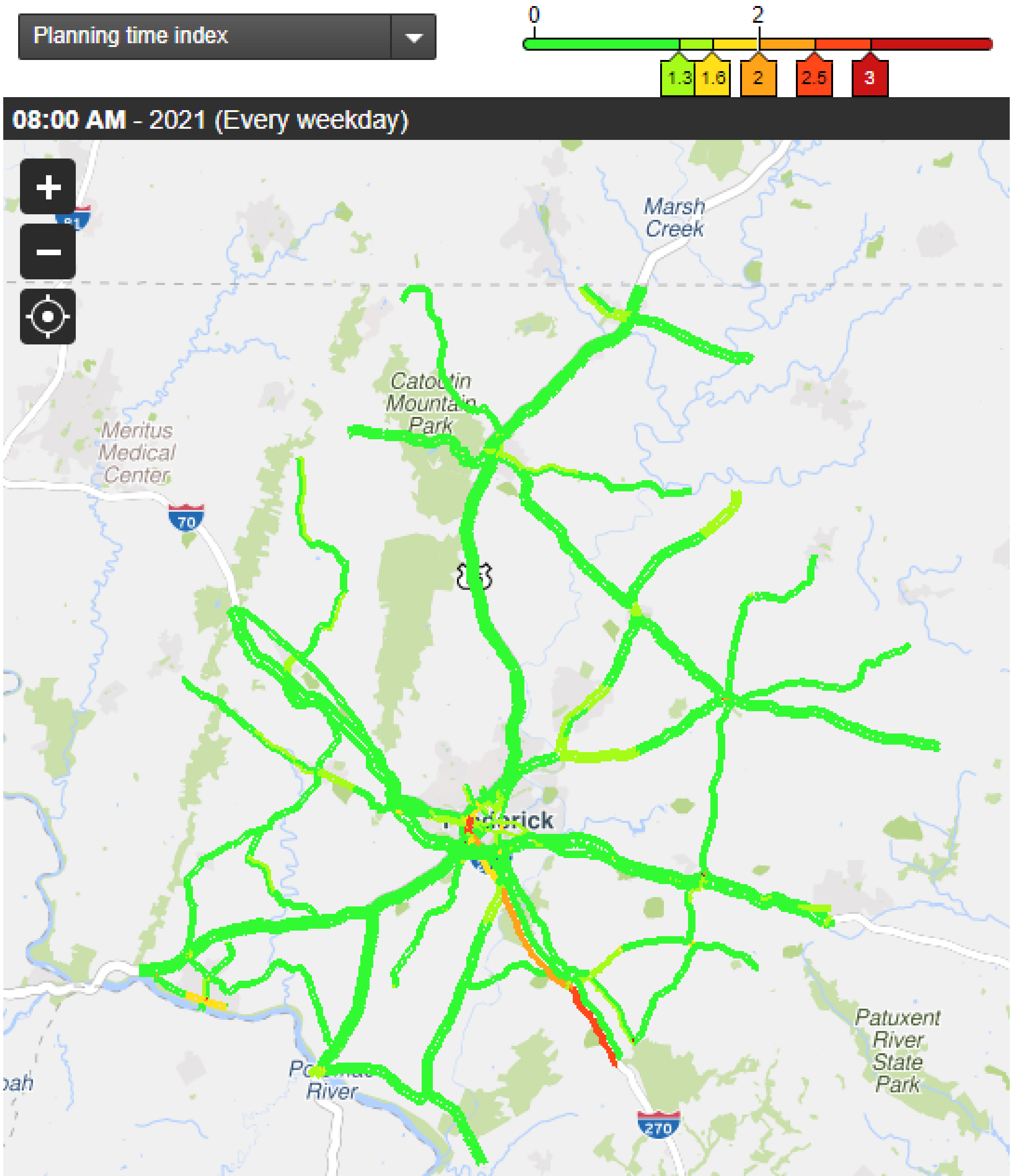


Figure B6: Planning Time Index in Frederick County, MD during Weekday 5:00-6:00 pm, 2021

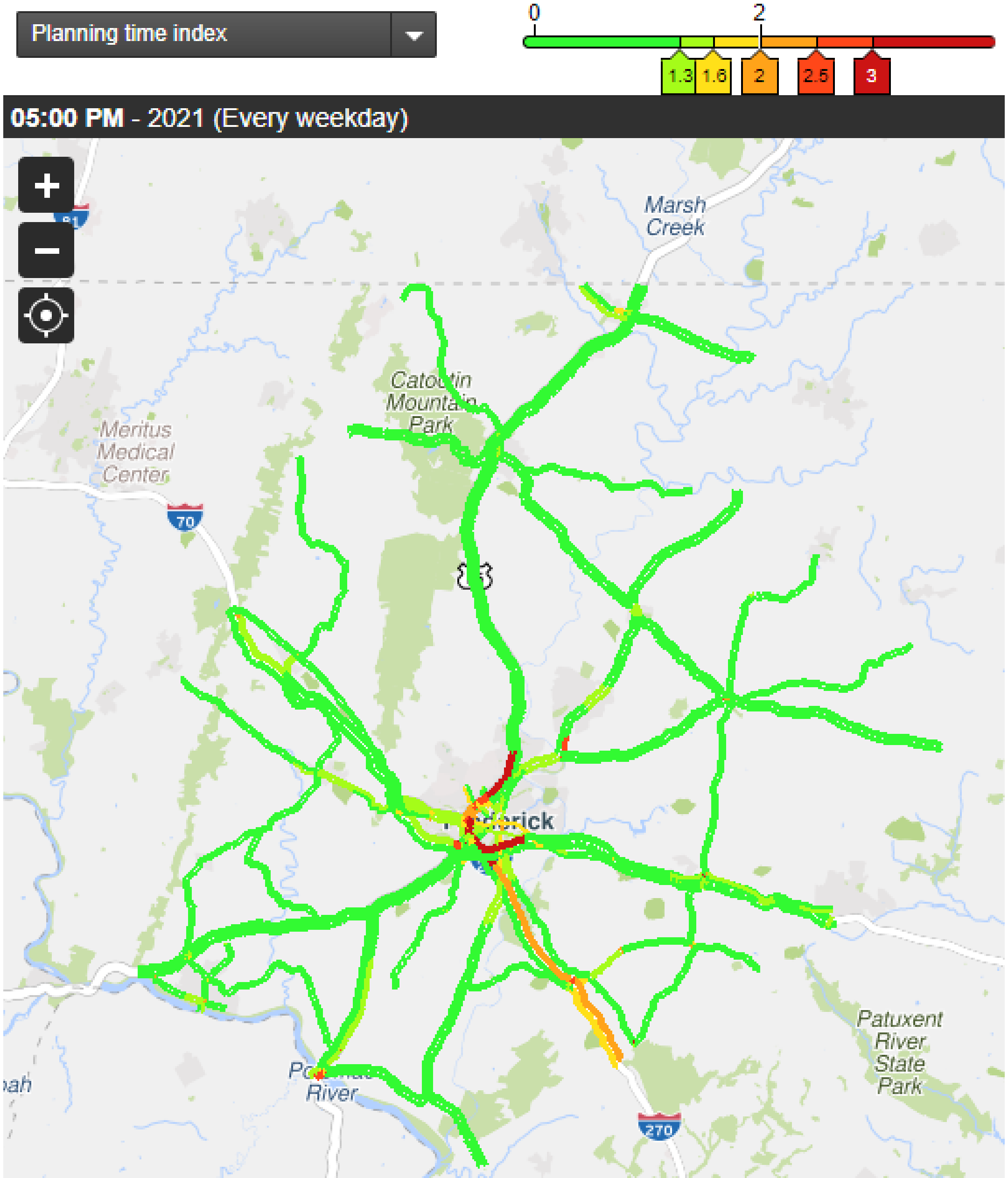


Figure B7: Planning Time Index in Montgomery County, MD during Weekday 8:00-9:00 am, 2021

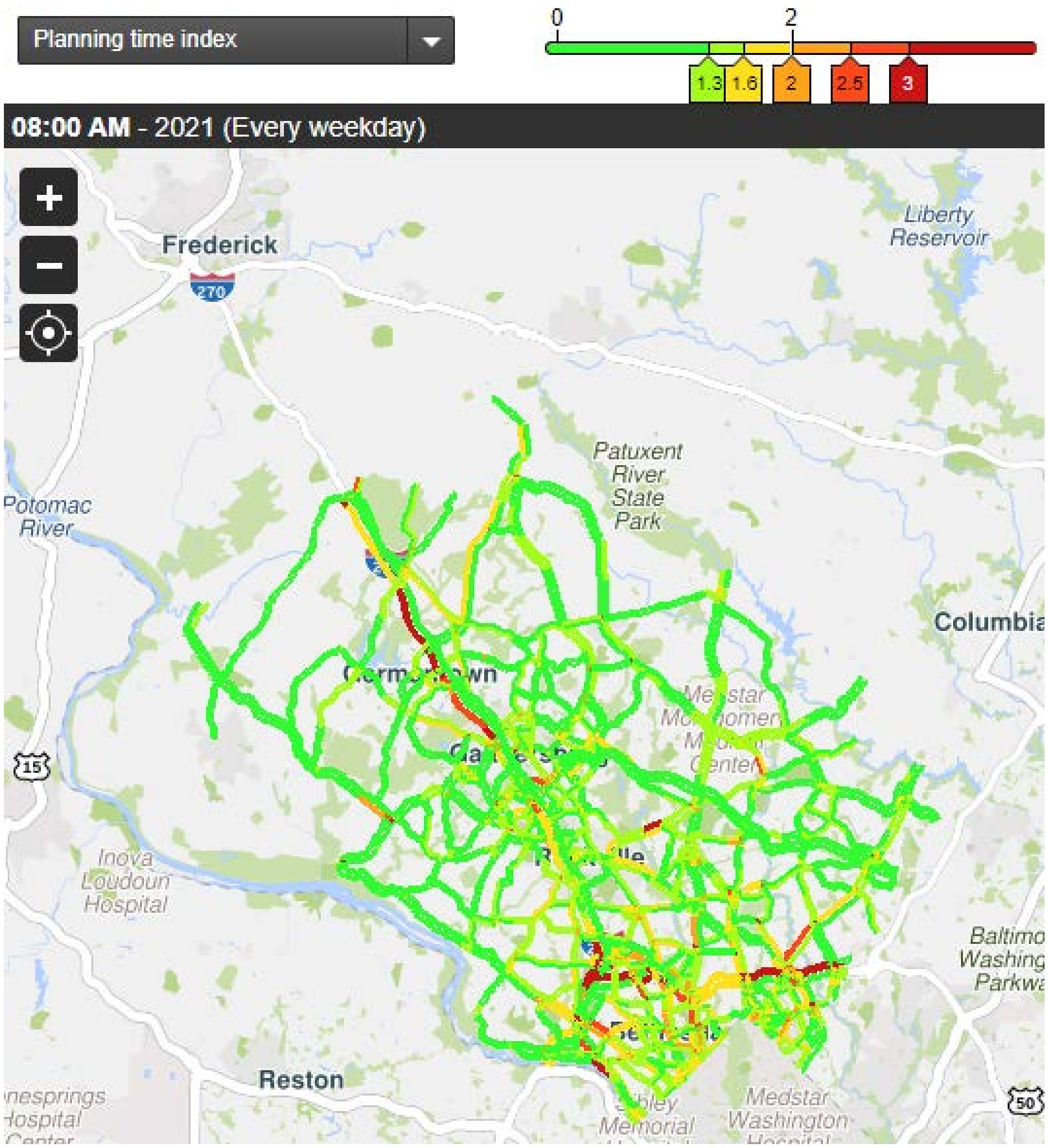


Figure B8: Planning Time Index in Montgomery County, MD during Weekday 5:00-6:00 pm, 2021

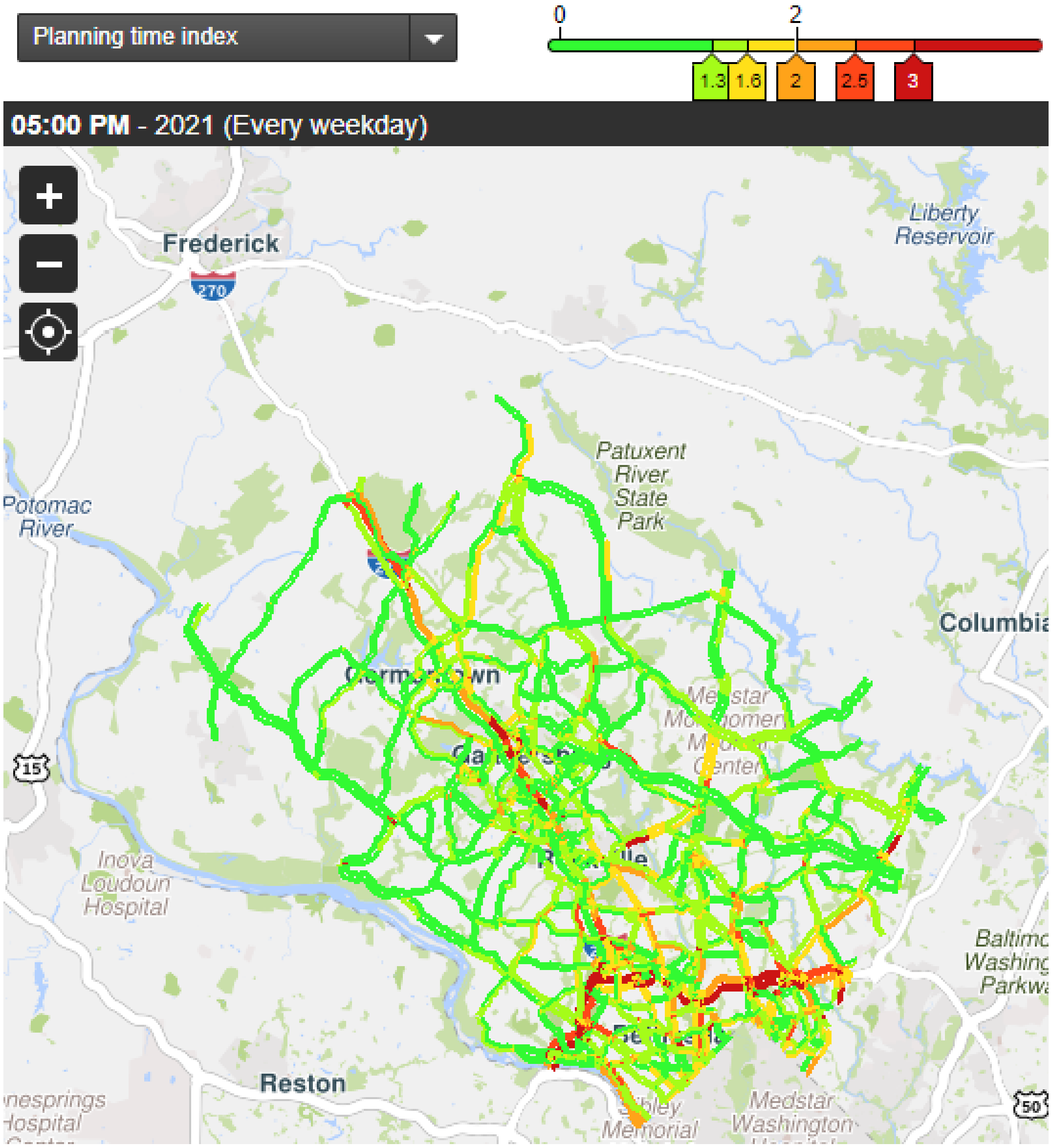


Figure B9: Planning Time Index in Prince George's County, MD during Weekday 8:00-9:00 am, 2021

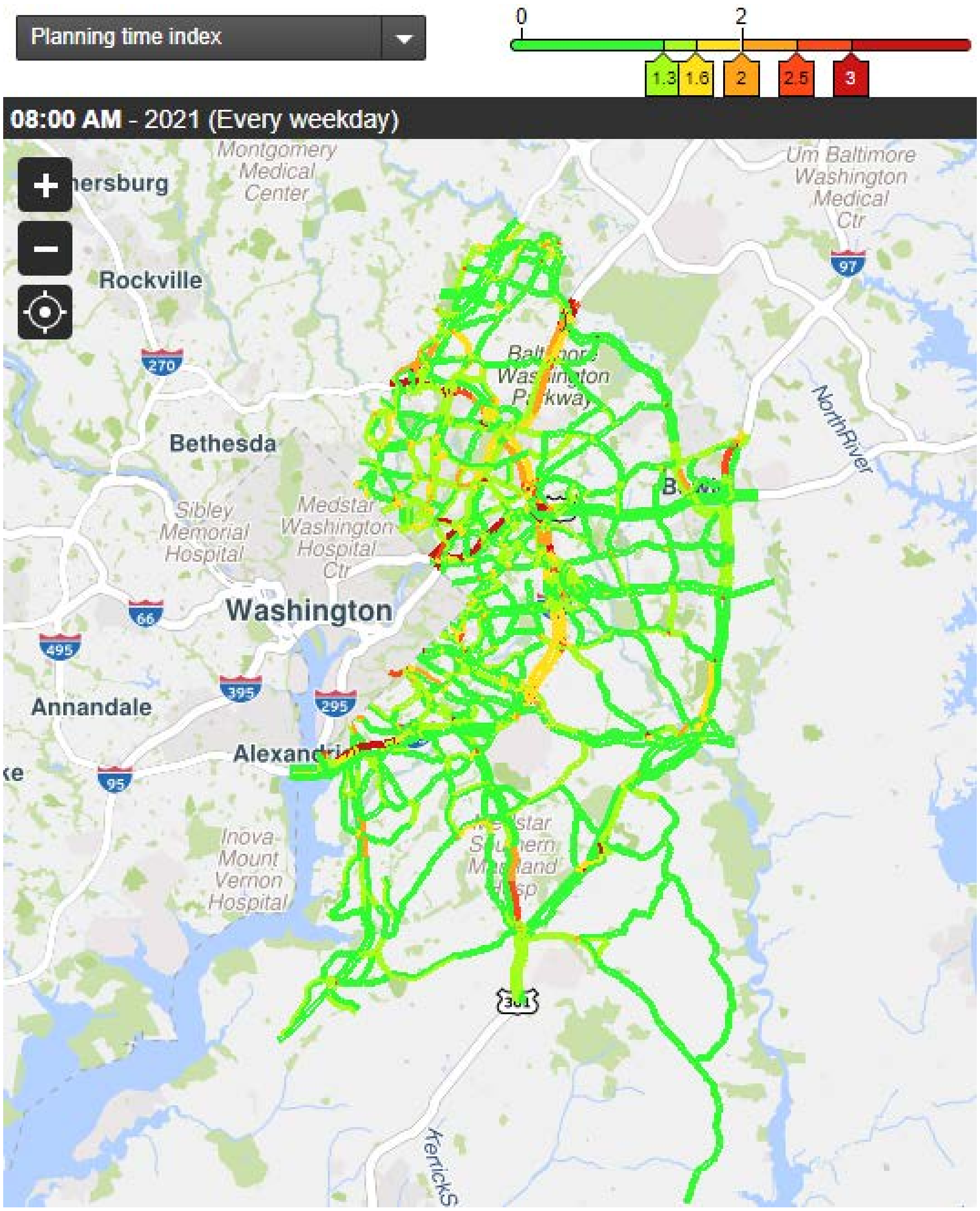


Figure B10: Planning Time Index in Prince George's County, MD during Weekday 5:00-6:00 pm, 2021

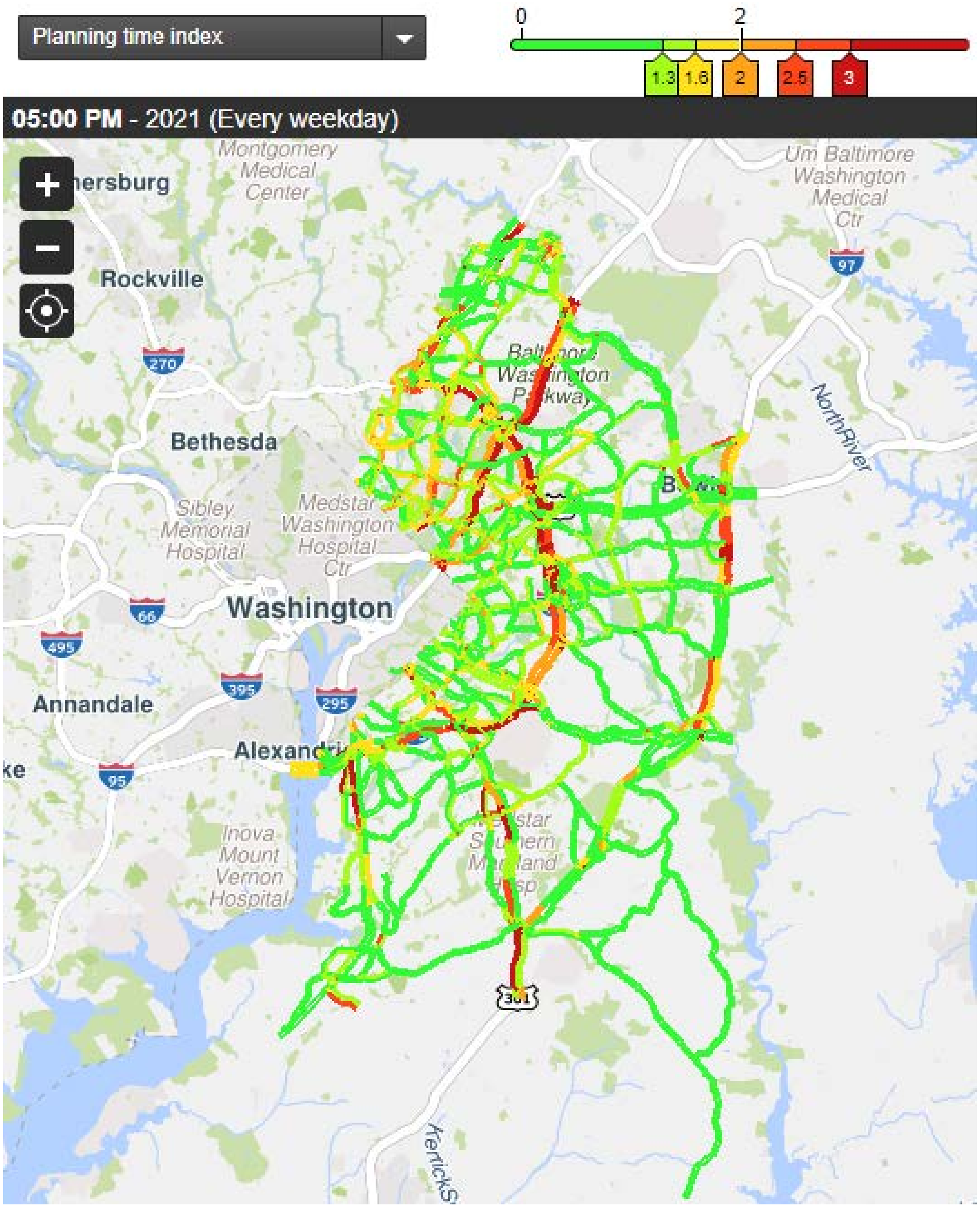


Figure B11: Planning Time Index in Charles County, MD during Weekday 8:00-9:00 am, 2021

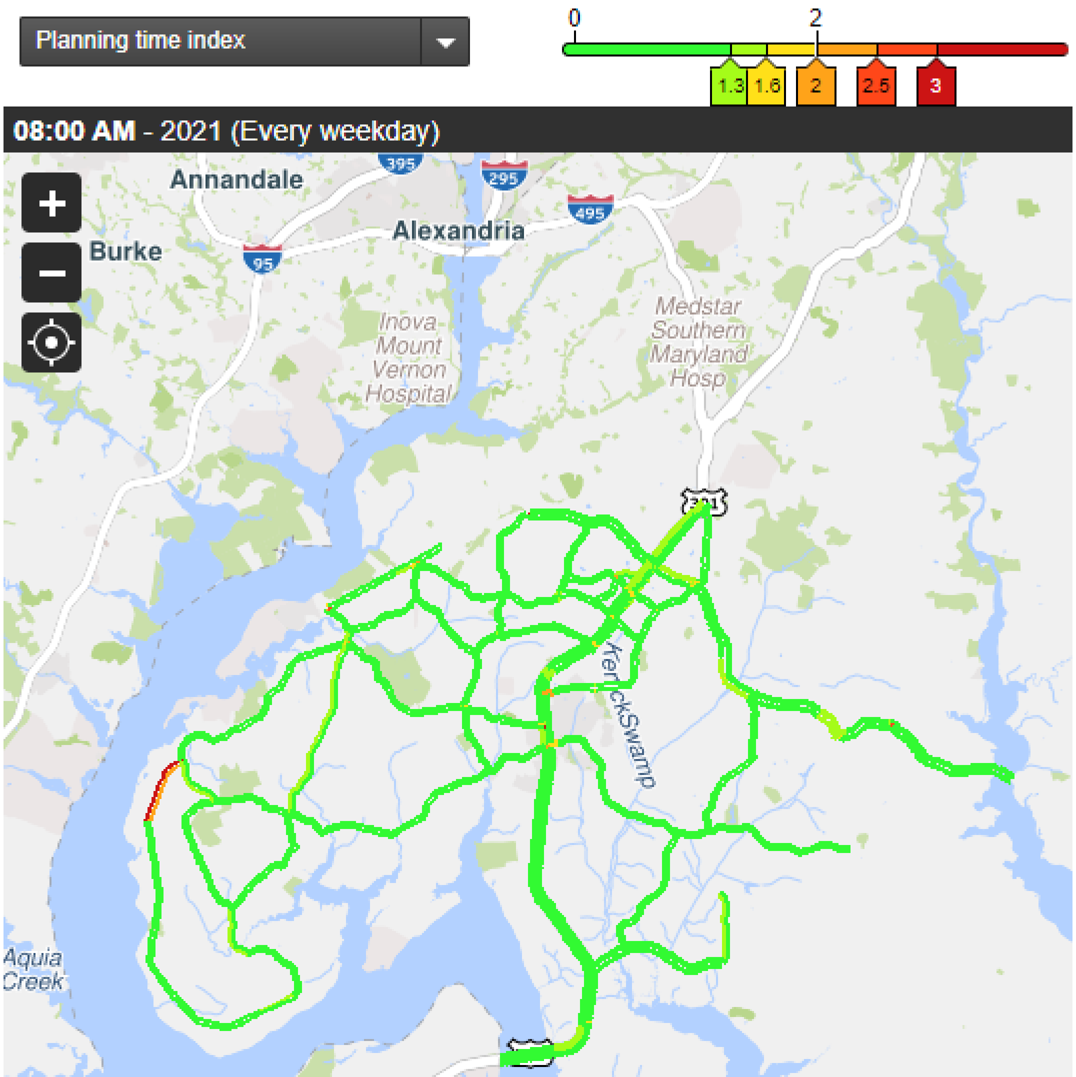


Figure B12: Planning Time Index in Prince Charles County, MD during Weekday 5:00-6:00 pm, 2021

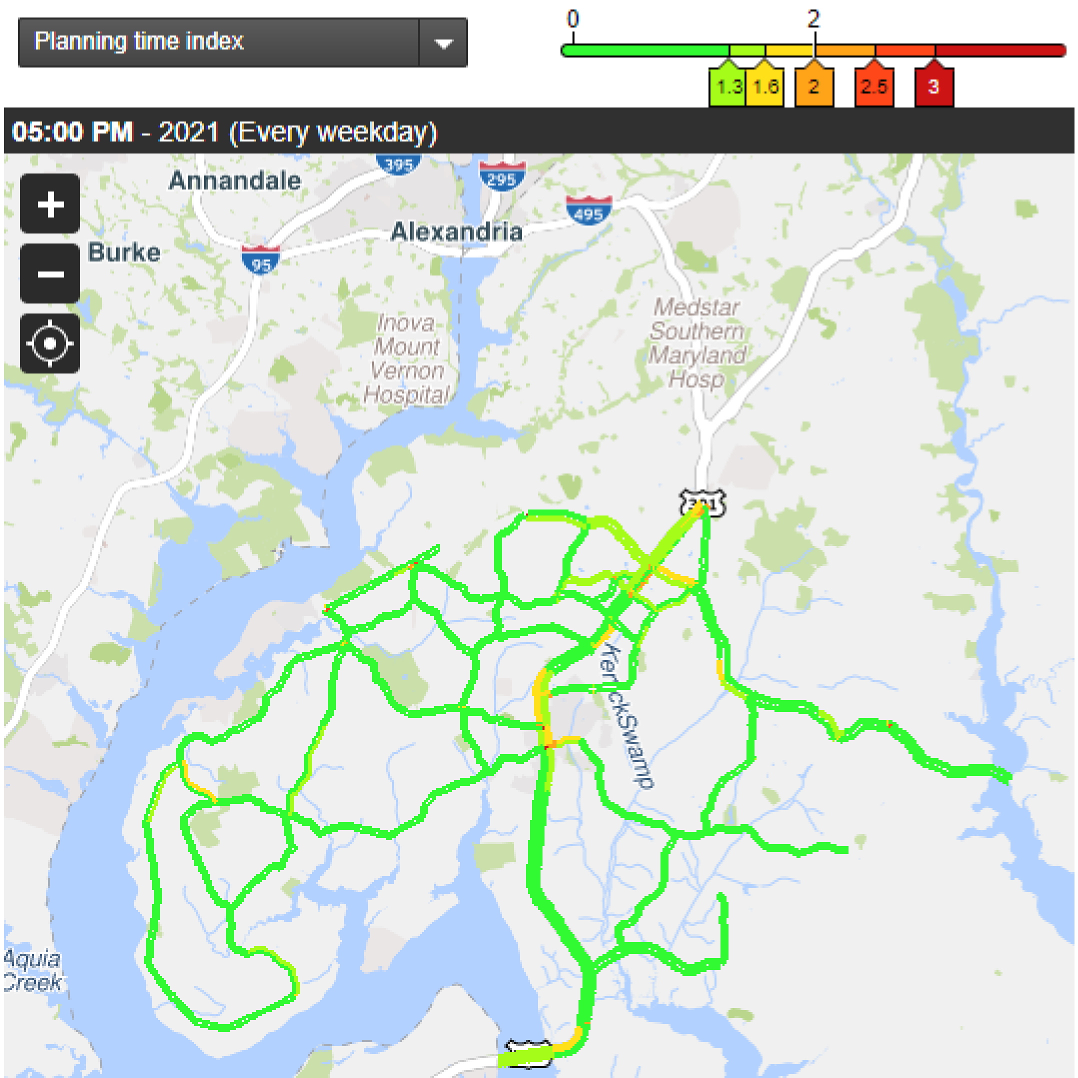


Figure B13: Planning Time Index in Loudoun County, VA during Weekday 8:00-9:00 am, 2021

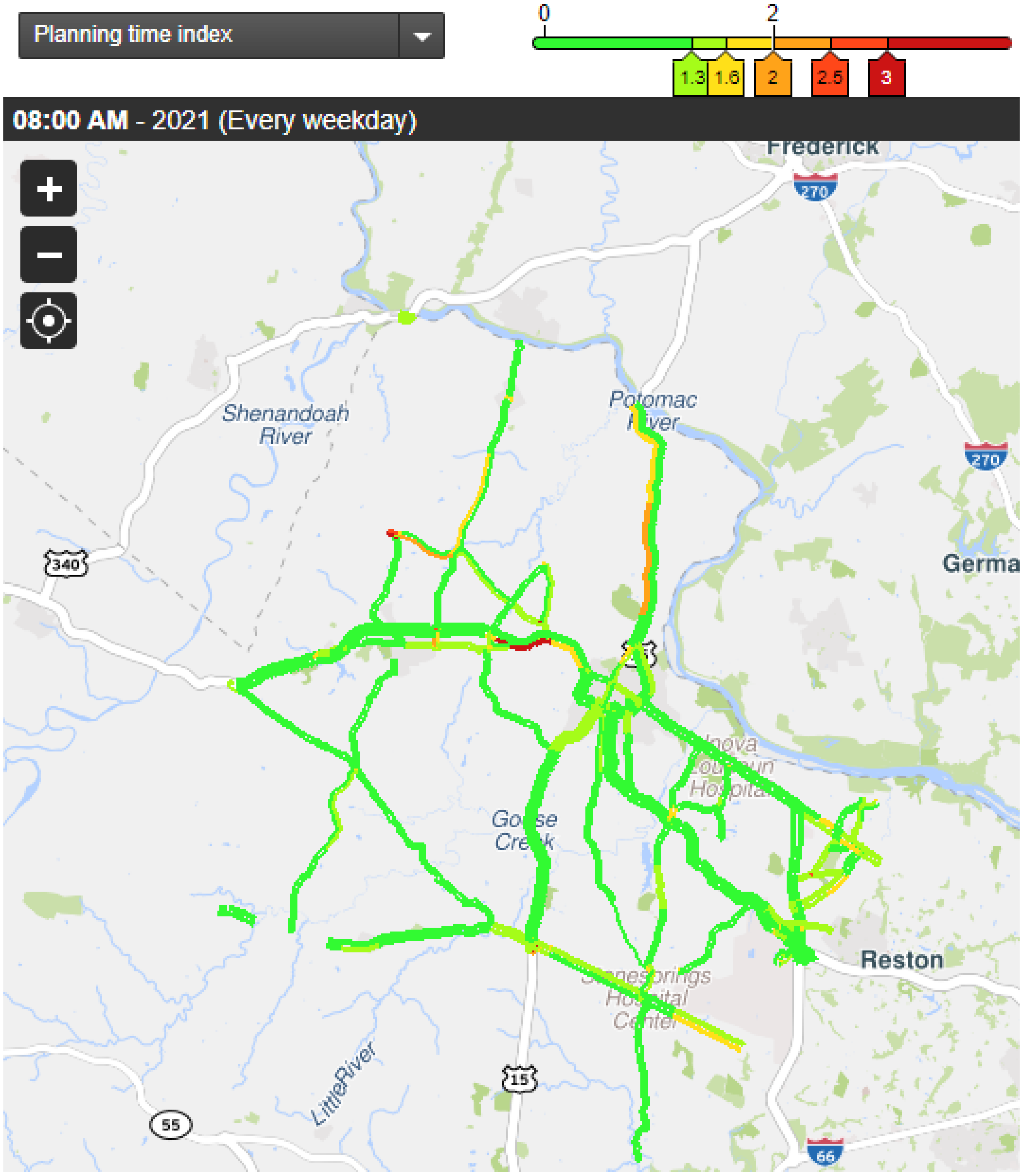


Figure B14: Planning Time Index in Loudoun County, VA during Weekday 5:00-6:00 pm, 2021

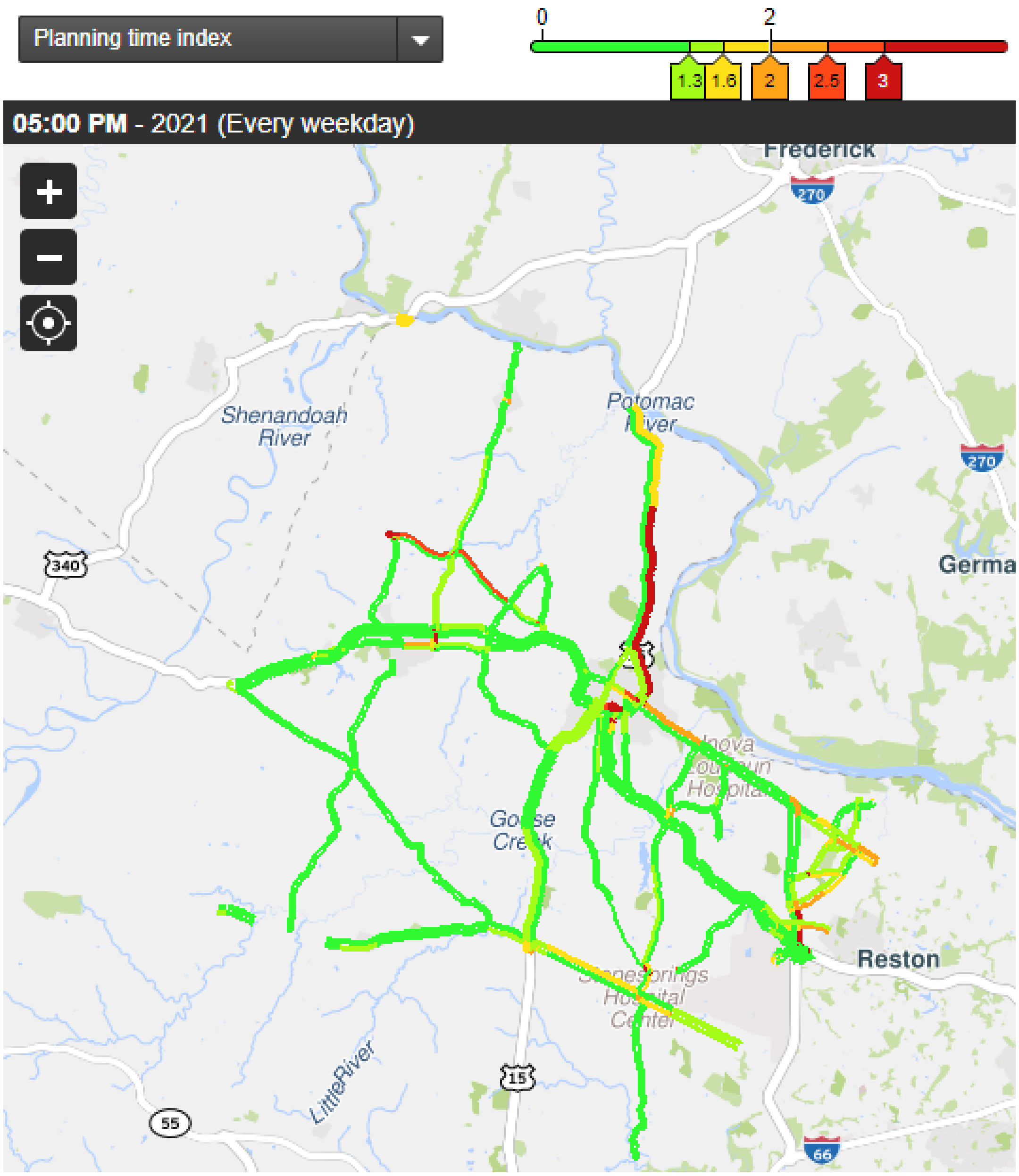


Figure B15: Planning Time Index in Fairfax, Prince William Counties and Cities of Fairfax, Manassas, and Manassas Park, VA during Weekday 8:00-9:00 am, 2021

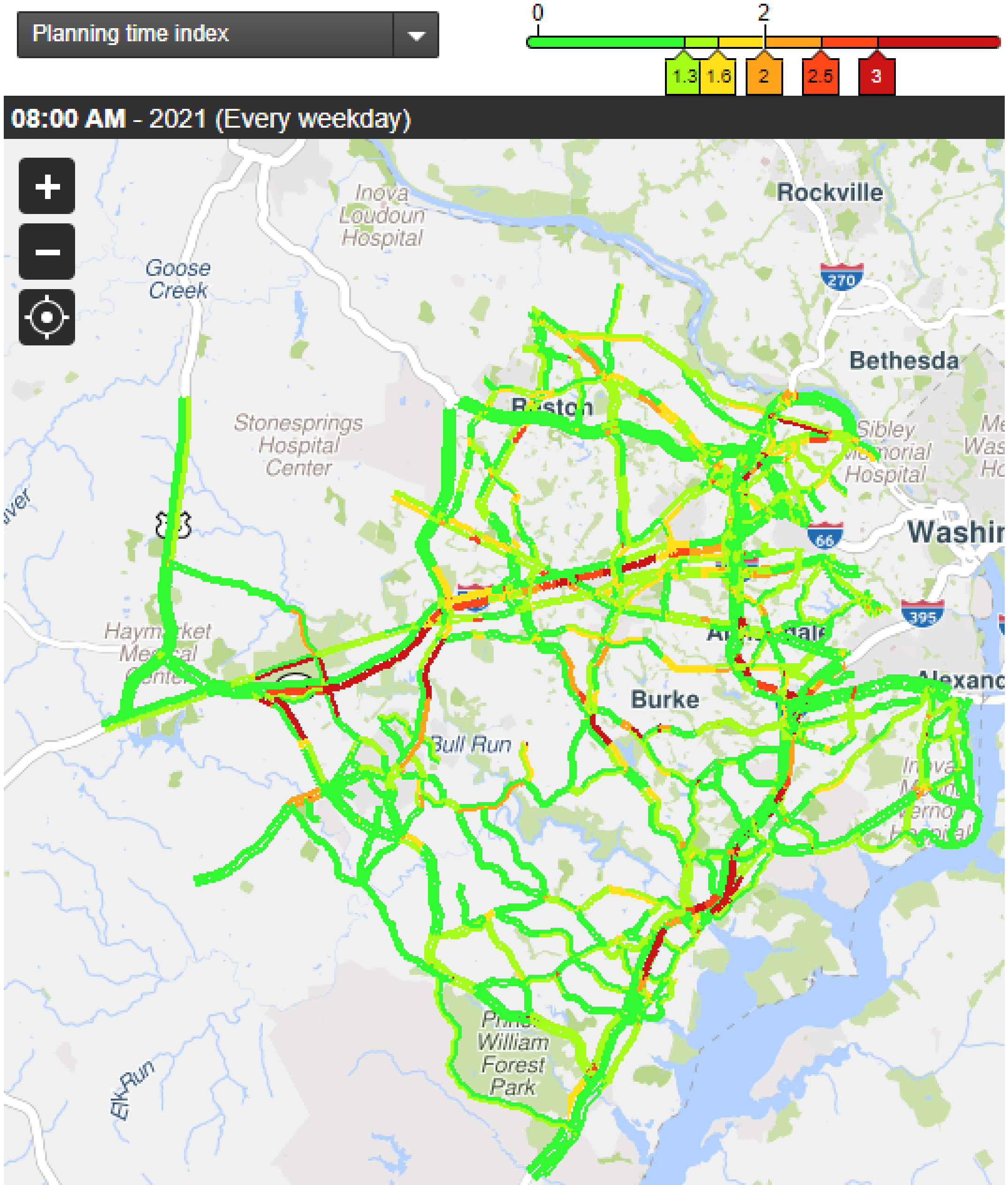


Figure B16: Planning Time Index in Fairfax, Prince William Counties and Cities of Fairfax, Manassas, and Manassas Park, VA during Weekday 5:00-6:00 pm, 2021

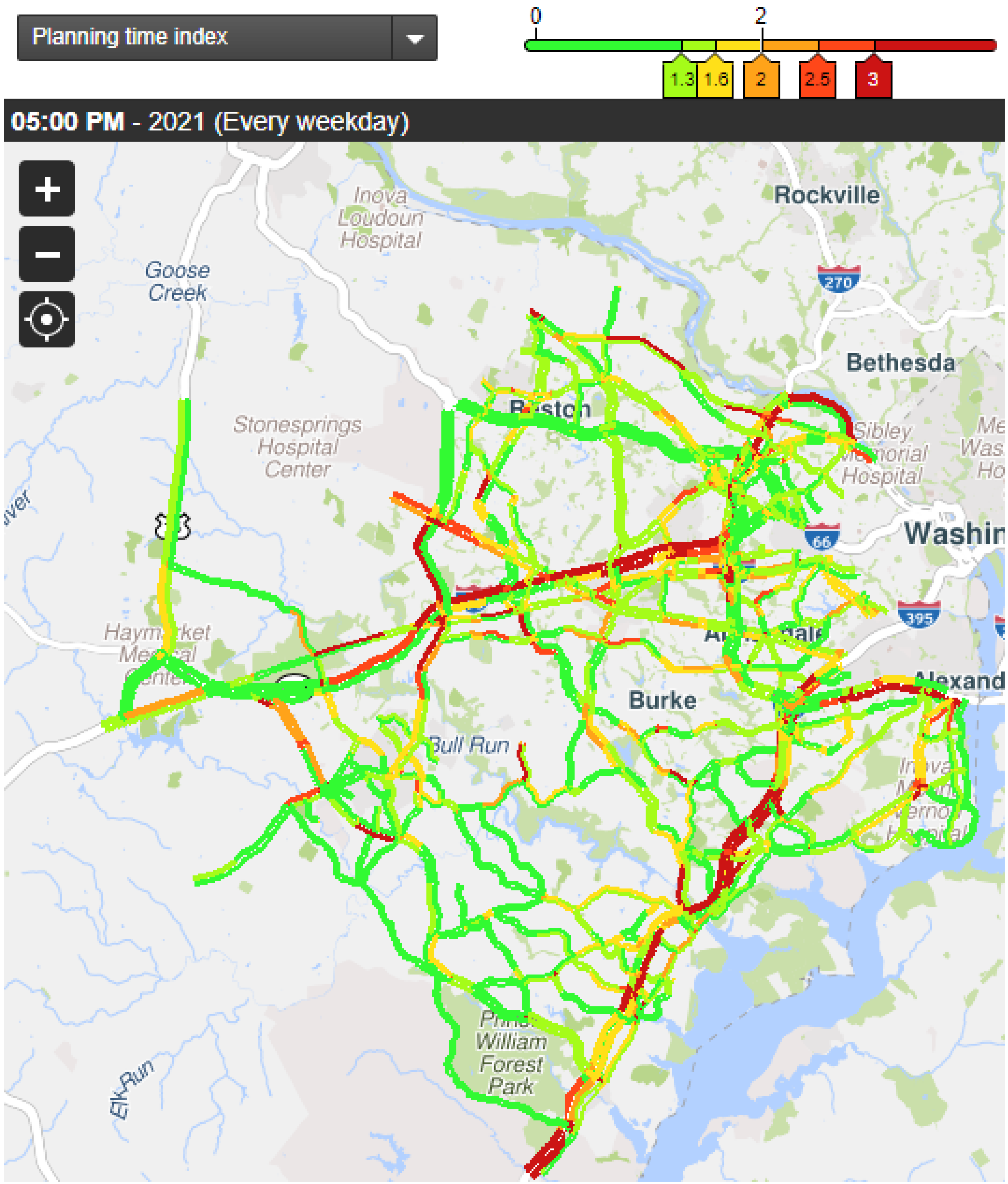


Figure B17: Planning Time Index in Cities of Alexandria, Arlington, and Falls Church, VA during Weekday 8:00-9:00 am, 2021

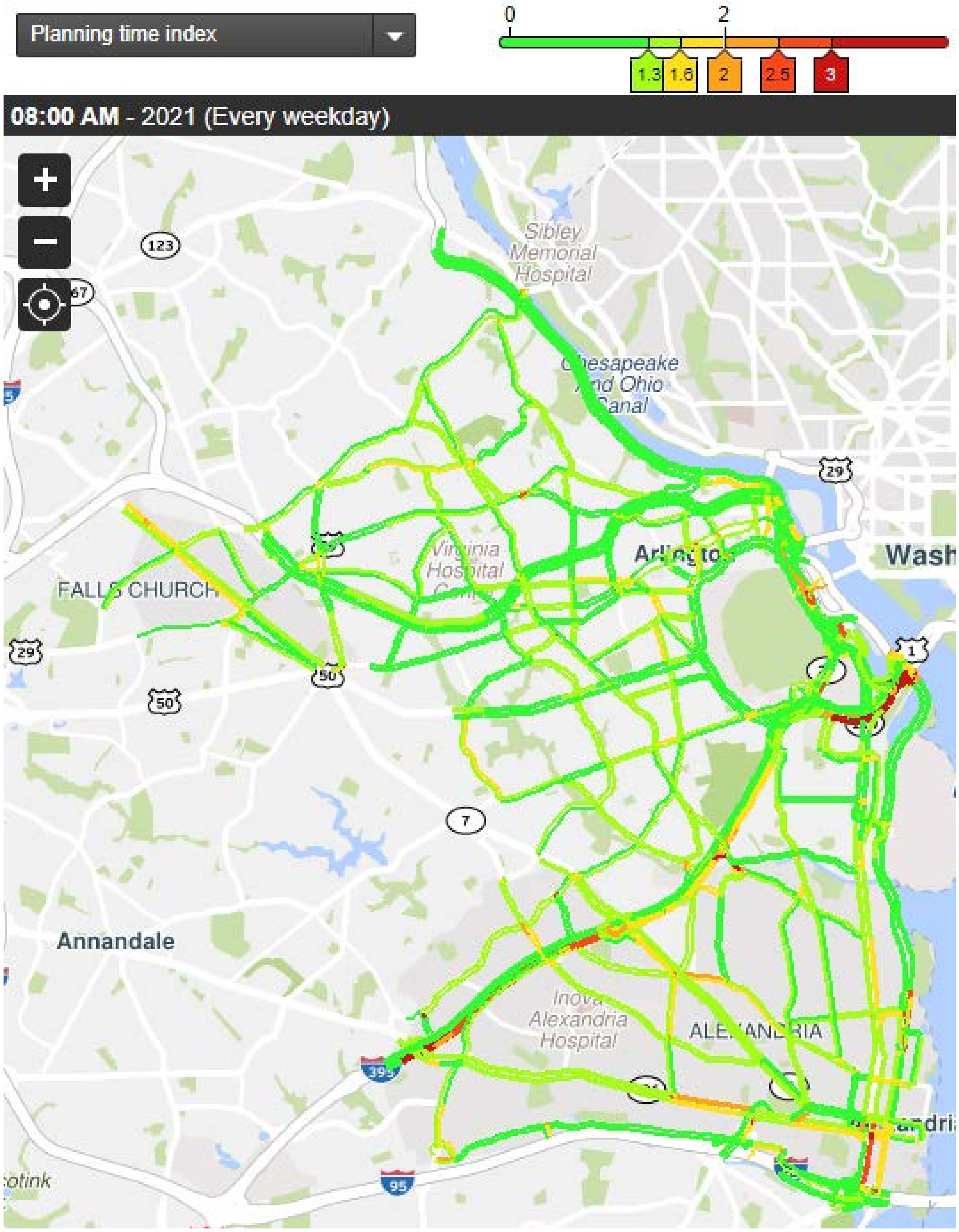
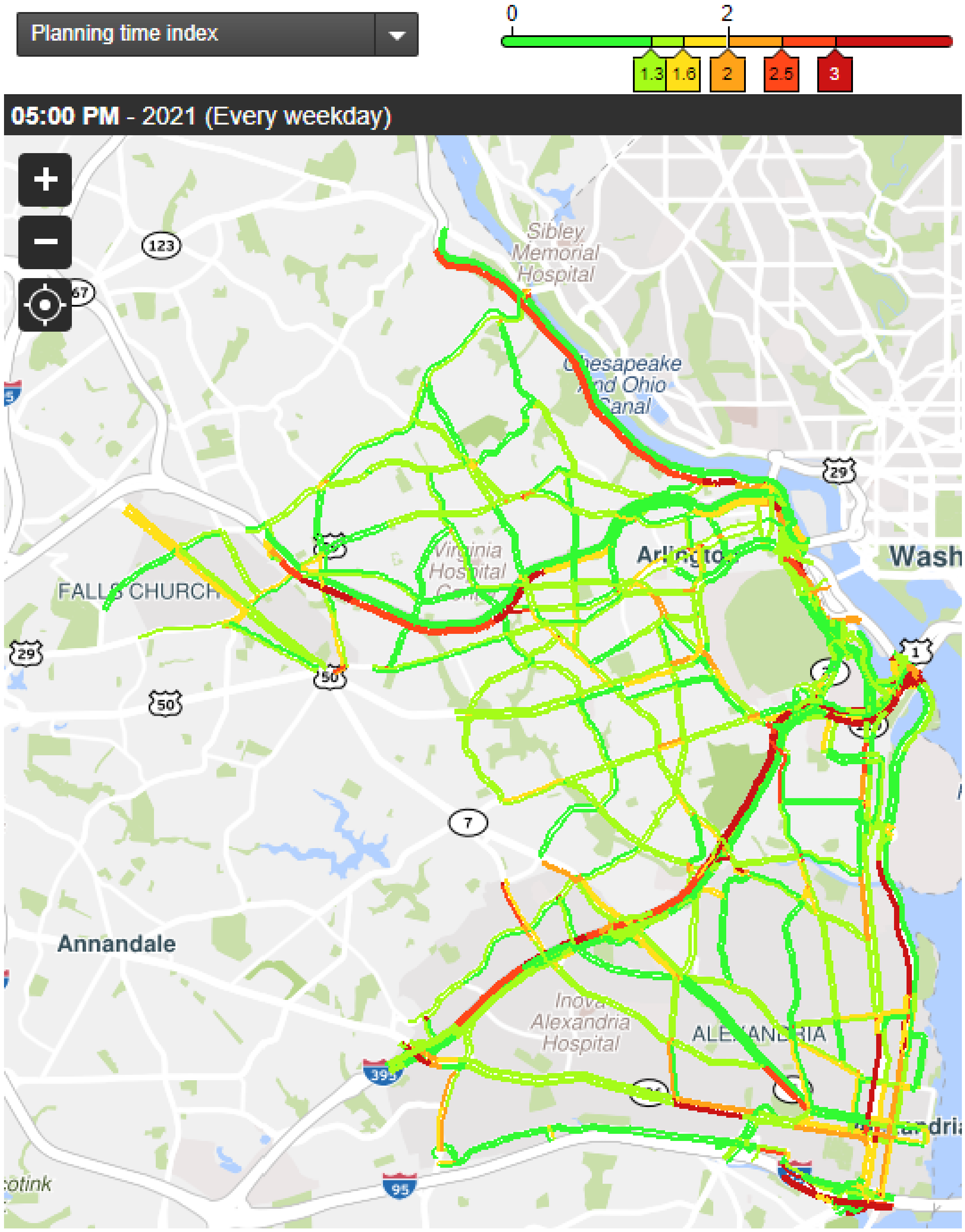


Figure B18: Planning Time Index in Cities of Alexandria, Arlington, and Falls Church, VA during Weekday 5:00-6:00 pm, 2021



APPENDIX C – 2010 AND 2019-2021 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://pda.ritis.org/suite/.

2. There are 18 major commuter corridors defined in this report:

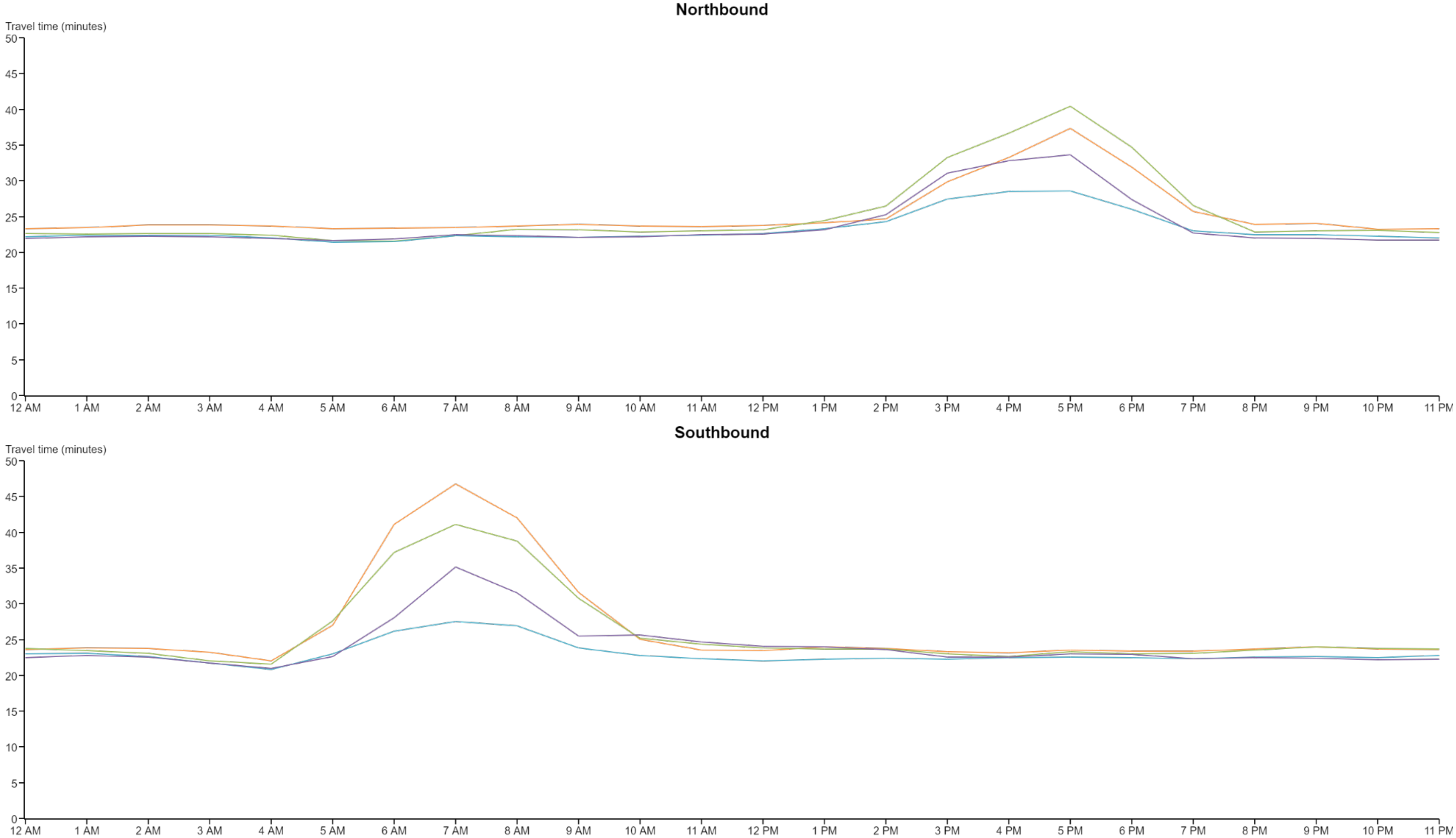
   C1 I-270 between I-370/Sam Eig Hwy/Exit 9 and I-70/US-40
   C2 I-270 between I-370/Sam Eig Hwy/Exit 9 and I-495/MD-355
   C3 VA-267 between VA-28/Exit 9a and VA-123/Exit 19
   C4 I-66 between VA-28/Exit 53 and I-495/Exit 64
   C5 I-66 between I-495/Exit 64 and Theodore Roosevelt Memorial Bridge
   C6 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 11th St. Bridge

3. Travel times were drawn for only normal weekdays – Tuesdays, Wednesdays and Thursdays.

Figure C1

I-270 between I-370/Sam Eig Hwy/Exit 9 and I-70/US-40

Averaged per hour for 2010 (Every Tuesday, Wednesday, and Thursday), 2019 (Every Tuesday, Wednesday, and Thursday), 2020 (Every Tuesday, Wednesday, and Thursday), and 2021 (Every Tuesday, Wednesday, and Thursday)



Travel time: Time it will take to drive along the roadway segment (Distance Traveled / Speed).

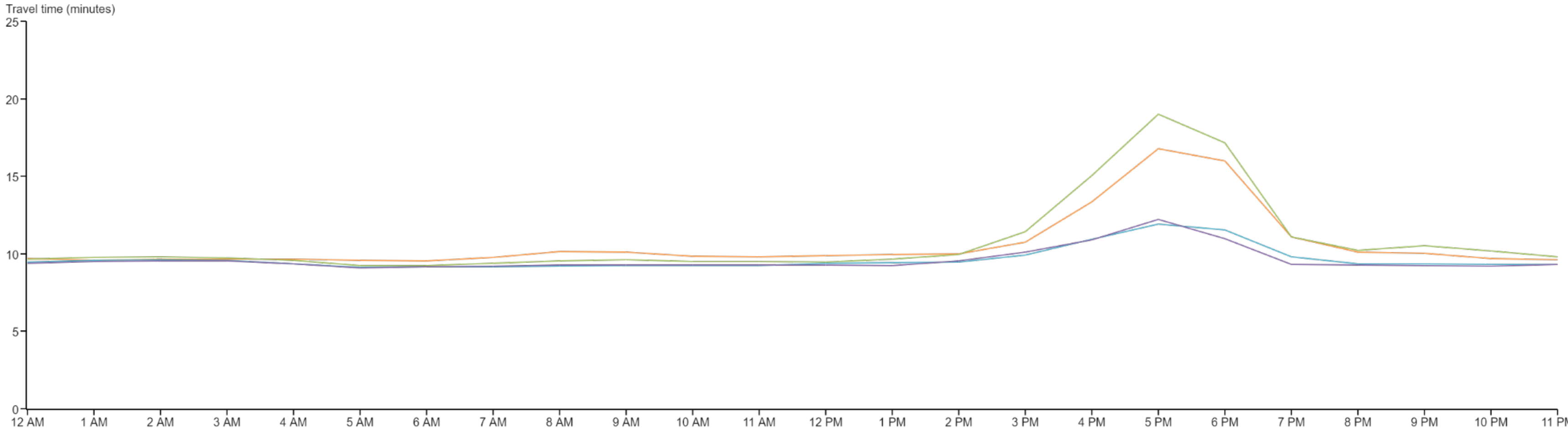
2010 (Every Tuesday, Wednesday, and Thursday) - INRIX
2019 (Every Tuesday, Wednesday, and Thursday) - INRIX
2020 (Every Tuesday, Wednesday, and Thursday) - INRIX
2021 (Every Tuesday, Wednesday, and Thursday) - INRIX

Figure C2

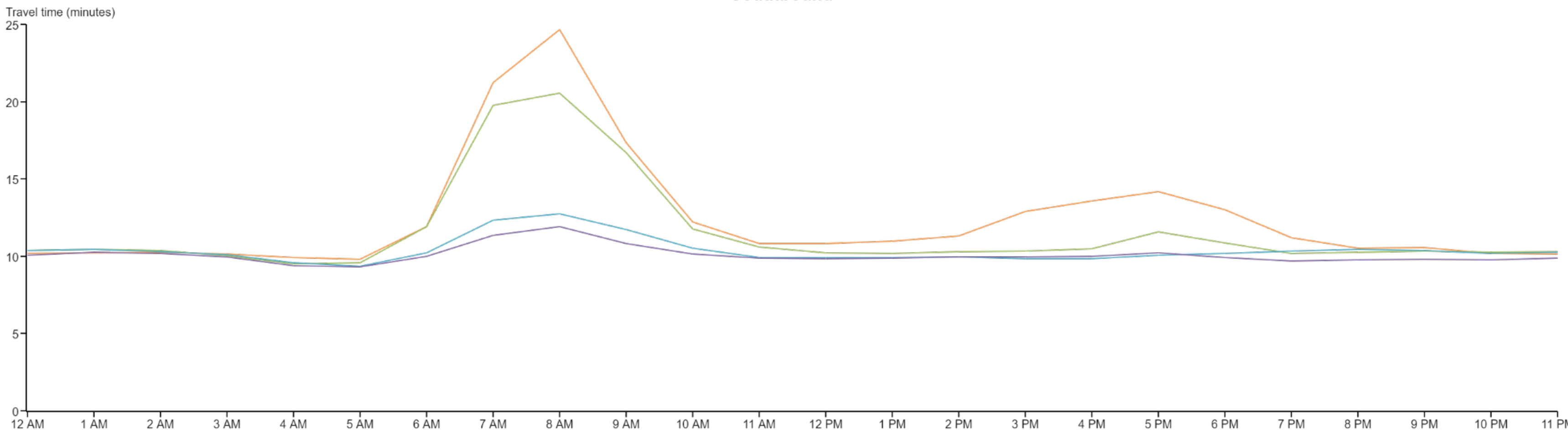
I-270 between I-370/Sam Eig Hwy/Exit 9 and I-495/MD-355

Averaged per hour for 2010 (Every Tuesday, Wednesday, and Thursday), 2019 (Every Tuesday, Wednesday, and Thursday), 2020 (Every Tuesday, Wednesday, and Thursday), and 2021 (Every Tuesday, Wednesday, and Thursday)

Northbound



Southbound



Travel time: Time it will take to drive along the roadway segment (Distance Traveled / Speed).

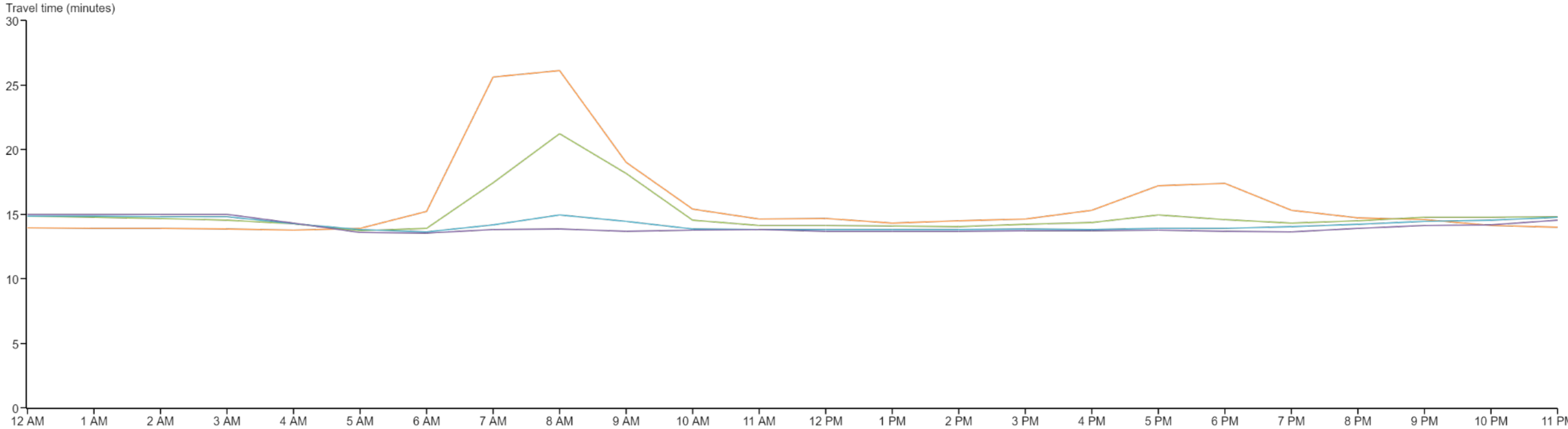
2010 (Every Tuesday, Wednesday, and Thursday) - INRIX
2019 (Every Tuesday, Wednesday, and Thursday) - INRIX
2020 (Every Tuesday, Wednesday, and Thursday) - INRIX
2021 (Every Tuesday, Wednesday, and Thursday) - INRIX

Figure C3

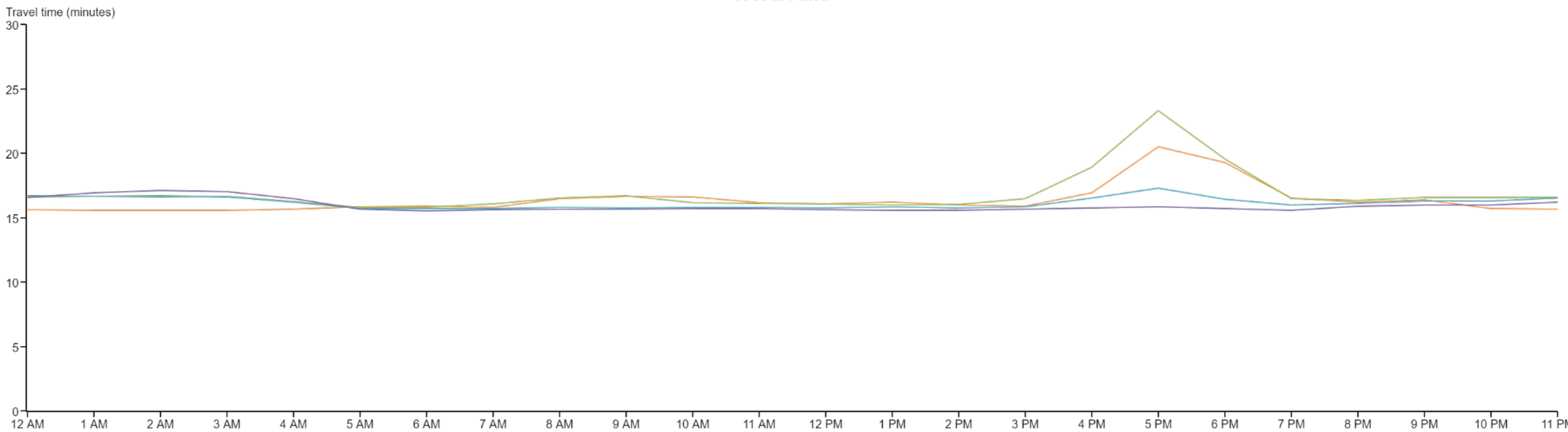
VA-267 between VA-28/Exit 9A and VA-123/Exit 19

Averaged per hour for 2010 (Every Tuesday, Wednesday, and Thursday), 2019 (Every Tuesday, Wednesday, and Thursday), 2020 (Every Tuesday, Wednesday, and Thursday), and 2021 (Every Tuesday, Wednesday, and Thursday)

Eastbound



Westbound



Travel time: Time it will take to drive along the roadway segment (Distance Traveled / Speed).

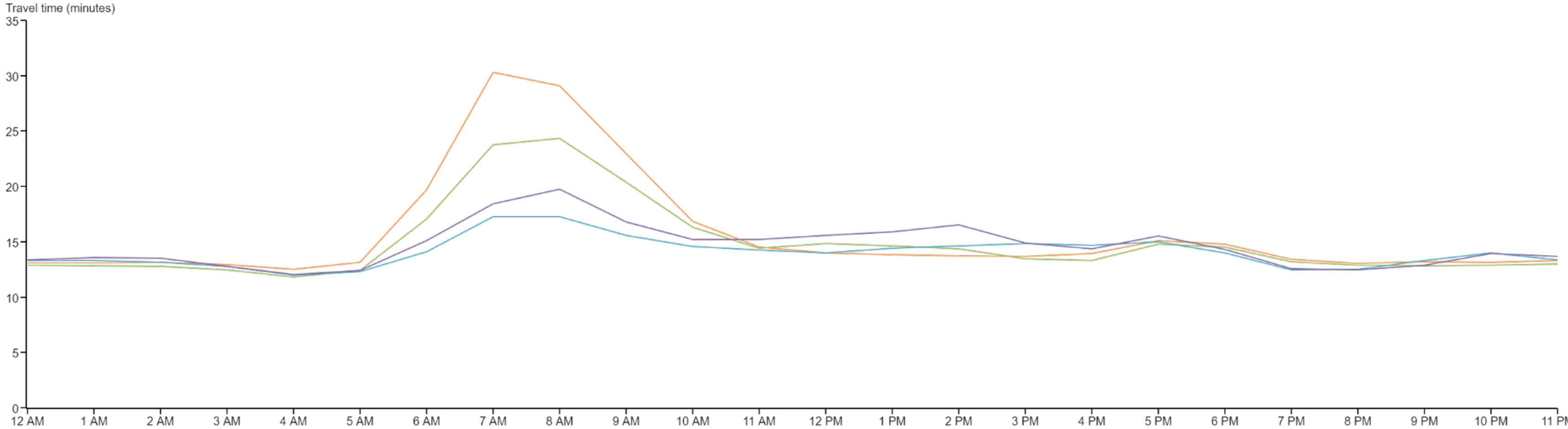
2010 (Every Tuesday, Wednesday, and Thursday) - INRIX
2019 (Every Tuesday, Wednesday, and Thursday) - INRIX
2020 (Every Tuesday, Wednesday, and Thursday) - INRIX
2021 (Every Tuesday, Wednesday, and Thursday) - INRIX

Figure C4

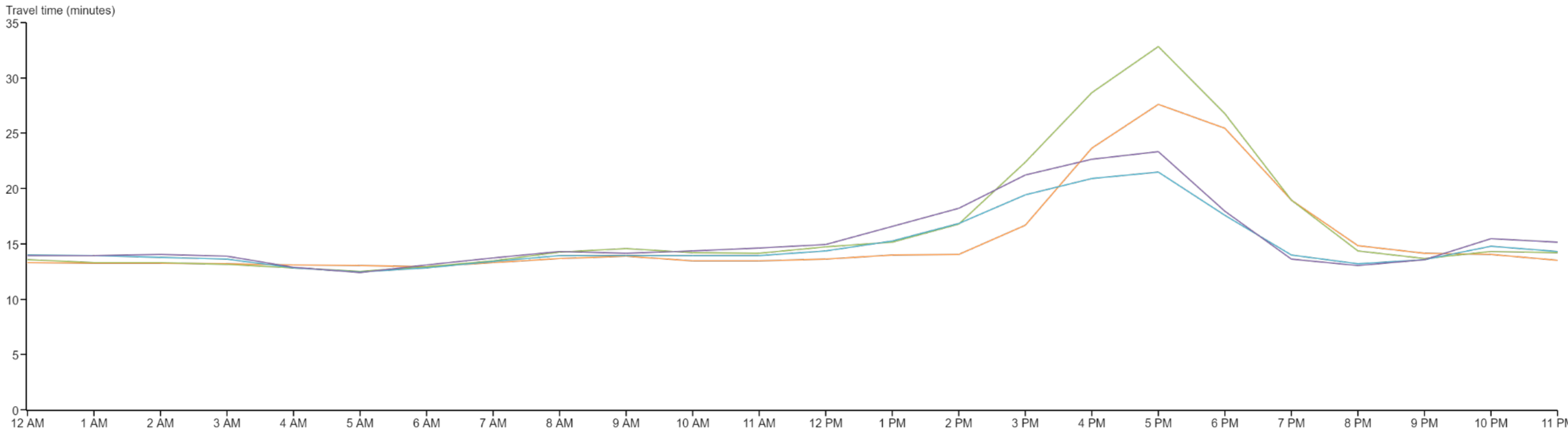
I-66 between VA-28/Exit 53 and I-495/Exit 64

Averaged per hour for 2010 (Every Tuesday, Wednesday, and Thursday), 2019 (Every Tuesday, Wednesday, and Thursday), 2020 (Every Tuesday, Wednesday, and Thursday), and 2021 (Every Tuesday, Wednesday, and Thursday)

Eastbound



Westbound



Travel time: Time it will take to drive along the roadway segment (Distance Traveled / Speed).

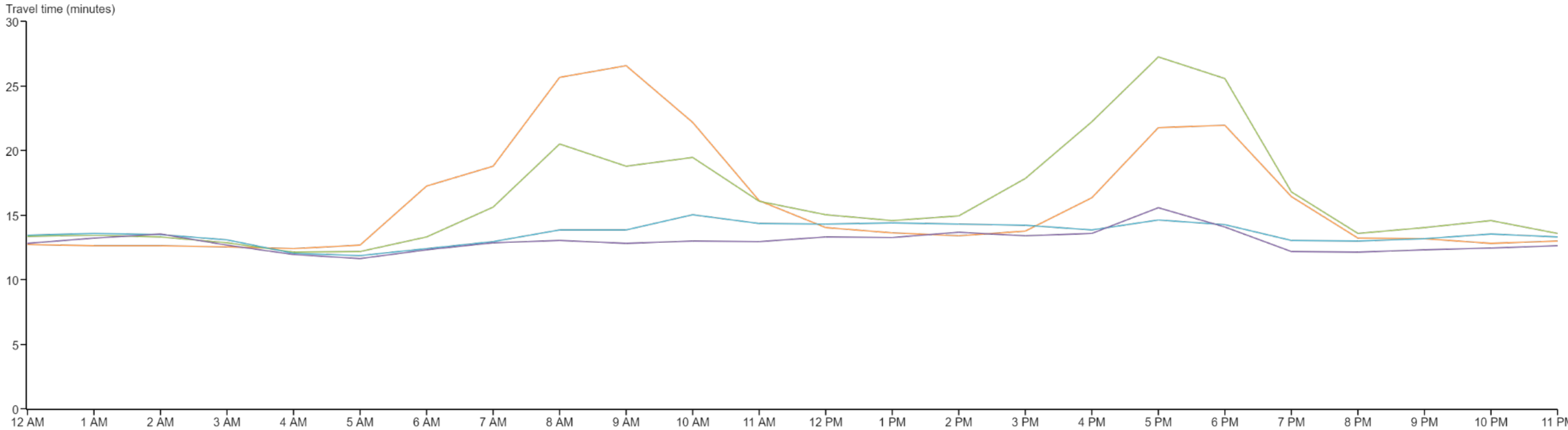
2010 (Every Tuesday, Wednesday, and Thursday) - INRIX
2019 (Every Tuesday, Wednesday, and Thursday) - INRIX
2020 (Every Tuesday, Wednesday, and Thursday) - INRIX
2021 (Every Tuesday, Wednesday, and Thursday) - INRIX

Figure C5

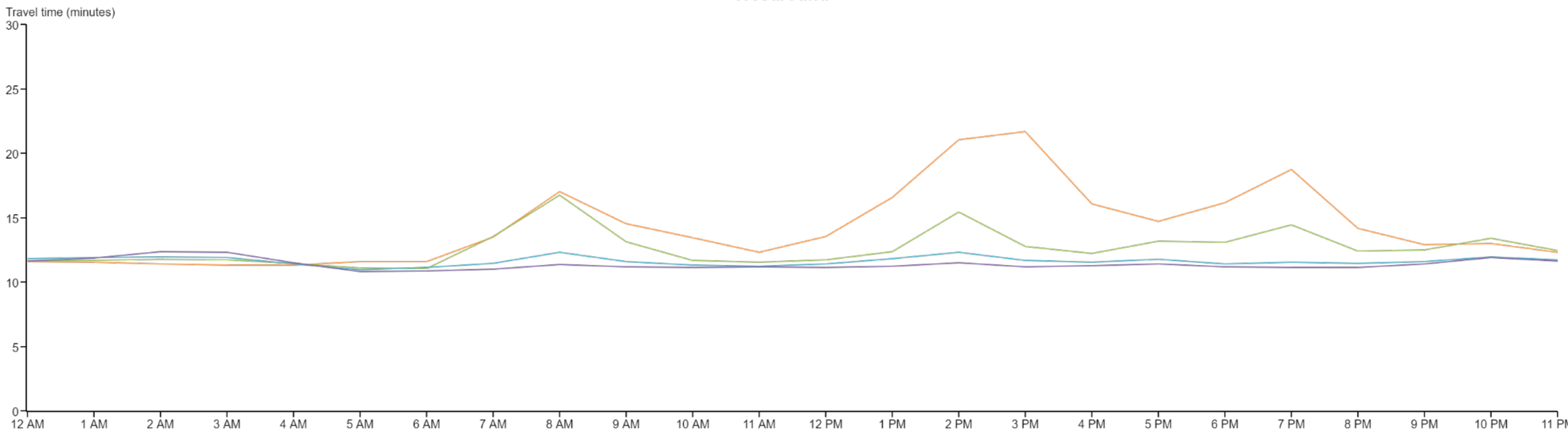
I-66 between I-495/Exit 64 and Theodore Roosevelt Memorial Bridge

Averaged per hour for 2010 (Every Tuesday, Wednesday, and Thursday), 2019 (Every Tuesday, Wednesday, and Thursday), 2020 (Every Tuesday, Wednesday, and Thursday), and 2021 (Every Tuesday, Wednesday, and Thursday)

Eastbound



Westbound



Travel time: Time it will take to drive along the roadway segment (Distance Traveled / Speed).

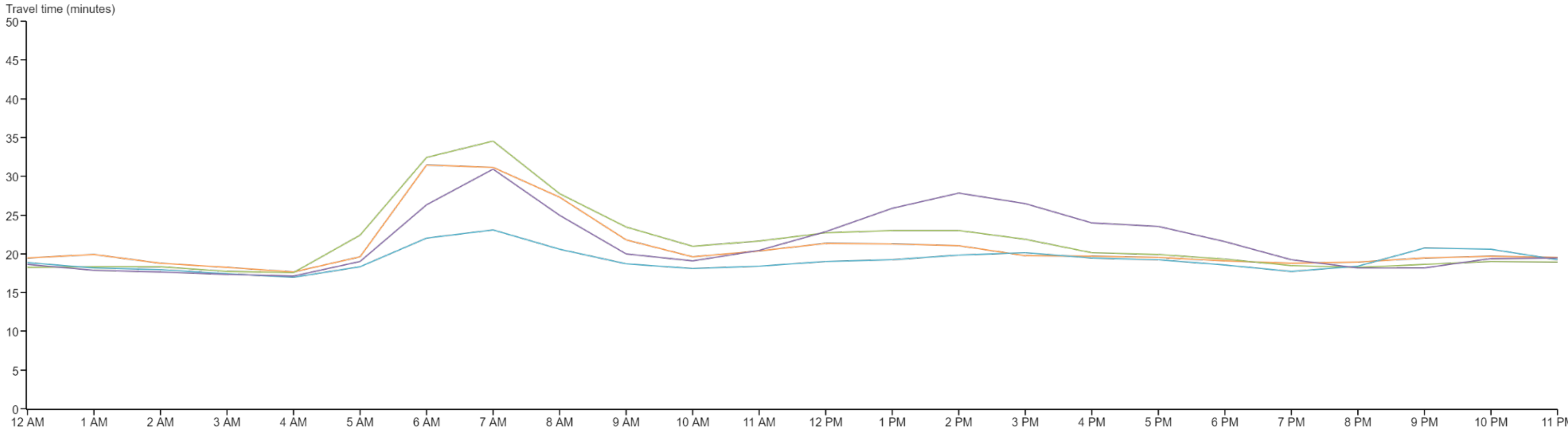
2010 (Every Tuesday, Wednesday, and Thursday) - INRIX
2019 (Every Tuesday, Wednesday, and Thursday) - INRIX
2020 (Every Tuesday, Wednesday, and Thursday) - INRIX
2021 (Every Tuesday, Wednesday, and Thursday) - INRIX

Figure C6

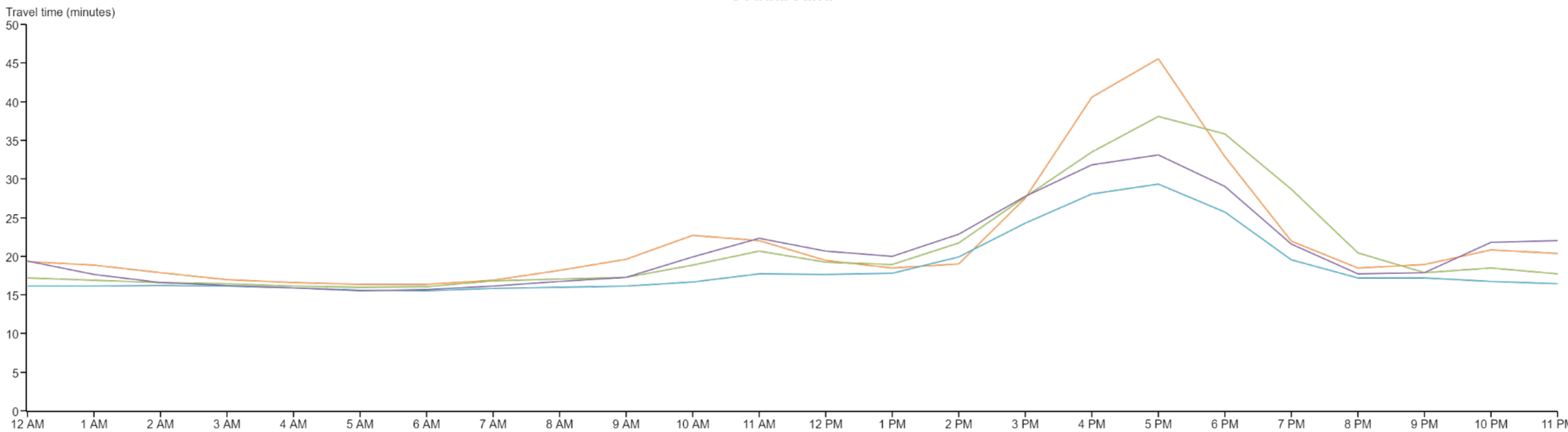
I-95 between VA-234/Exit 152 and Franconia Rd/Exit 169

Averaged per hour for 2010 (Every Tuesday, Wednesday, and Thursday), 2019 (Every Tuesday, Wednesday, and Thursday), 2020 (Every Tuesday, Wednesday, and Thursday), and 2021 (Every Tuesday, Wednesday, and Thursday)

Northbound



Southbound



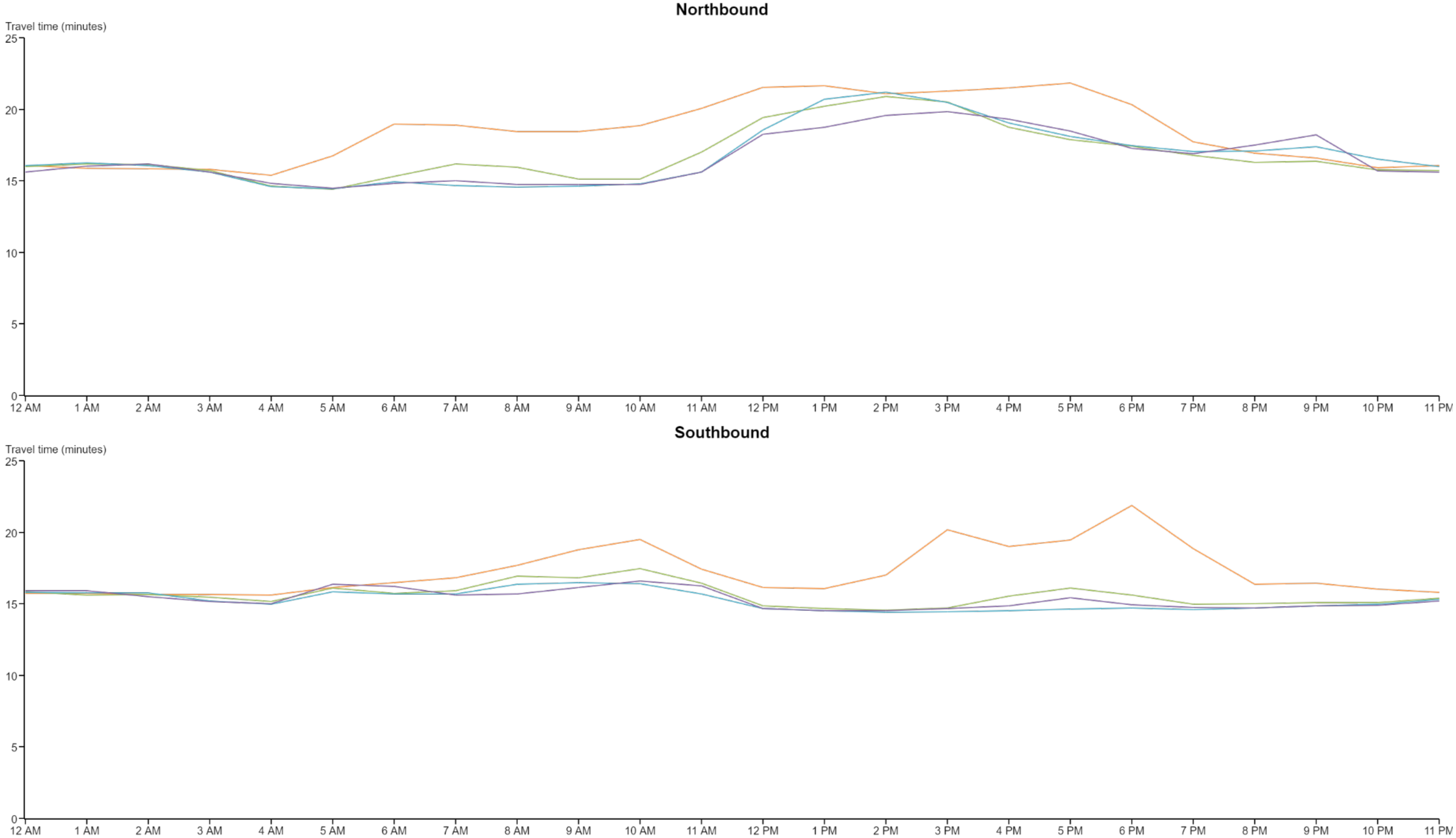
Travel time: Time it will take to drive along the roadway segment (Distance Traveled / Speed).

2010 (Every Tuesday, Wednesday, and Thursday) - INRIX
2019 (Every Tuesday, Wednesday, and Thursday) - INRIX
2020 (Every Tuesday, Wednesday, and Thursday) - INRIX
2021 (Every Tuesday, Wednesday, and Thursday) - INRIX

Figure C7

I-95 (HOV) between VA-234/Exit 152 and Franconia Rd/Exit 169

Averaged per hour for 2010 (Every Tuesday, Wednesday, and Thursday), 2019 (Every Tuesday, Wednesday, and Thursday), 2020 (Every Tuesday, Wednesday, and Thursday), and 2021 (Every Tuesday, Wednesday, and Thursday)



Travel time: Time it will take to drive along the roadway segment (Distance Traveled / Speed).

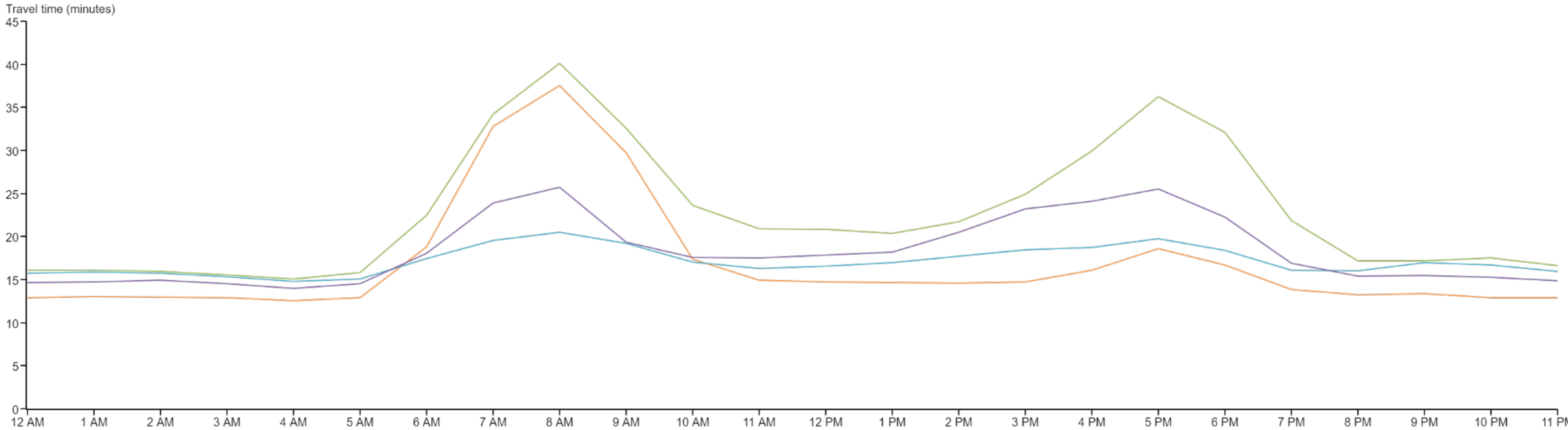
2010 (Every Tuesday, Wednesday, and Thursday) - INRIX
2019 (Every Tuesday, Wednesday, and Thursday) - INRIX
2020 (Every Tuesday, Wednesday, and Thursday) - INRIX
2021 (Every Tuesday, Wednesday, and Thursday) - INRIX

Figure C8

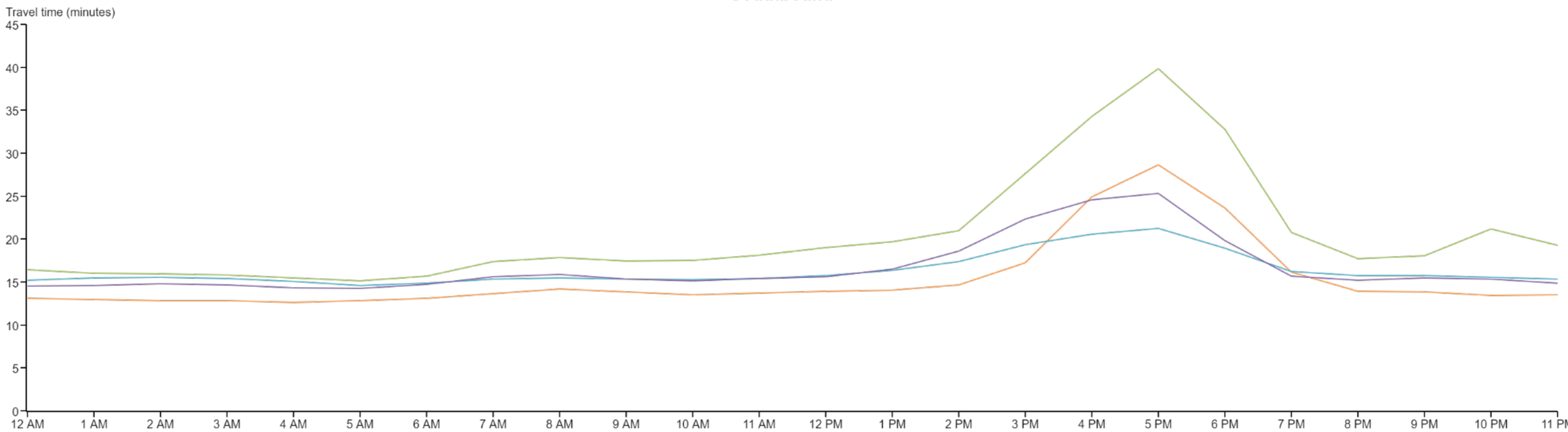
I-395 between I-95/I-495 and H St

Averaged per hour for 2010 (Every Tuesday, Wednesday, and Thursday), 2019 (Every Tuesday, Wednesday, and Thursday), 2020 (Every Tuesday, Wednesday, and Thursday), and 2021 (Every Tuesday, Wednesday, and Thursday)

Northbound



Southbound



Travel time: Time it will take to drive along the roadway segment (Distance Traveled / Speed).

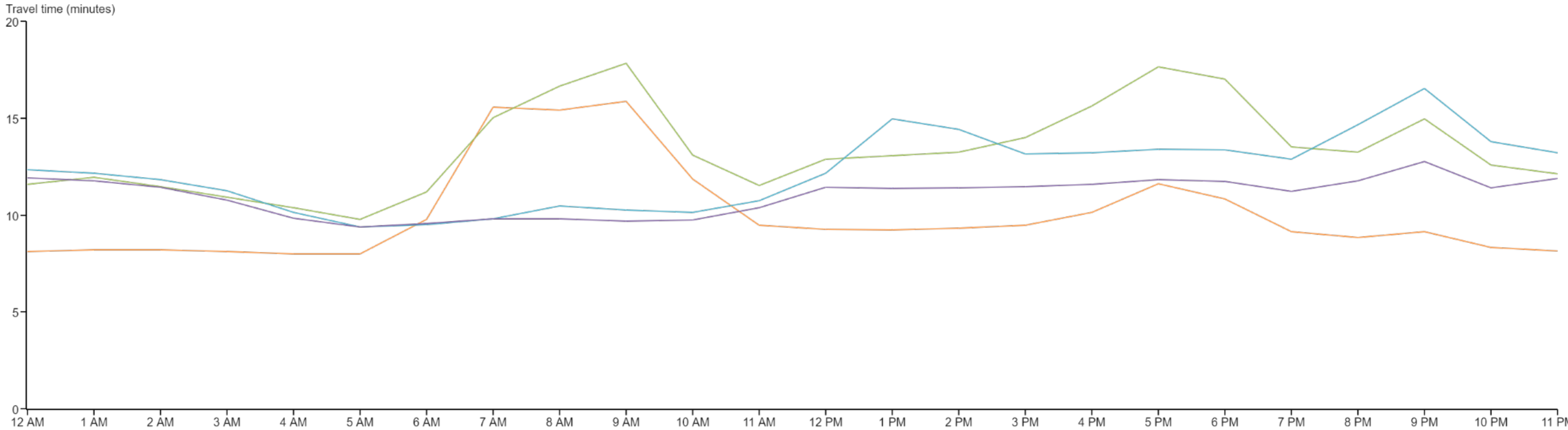
2010 (Every Tuesday, Wednesday, and Thursday) - INRIX
2019 (Every Tuesday, Wednesday, and Thursday) - INRIX
2020 (Every Tuesday, Wednesday, and Thursday) - INRIX
2021 (Every Tuesday, Wednesday, and Thursday) - INRIX

Figure C9

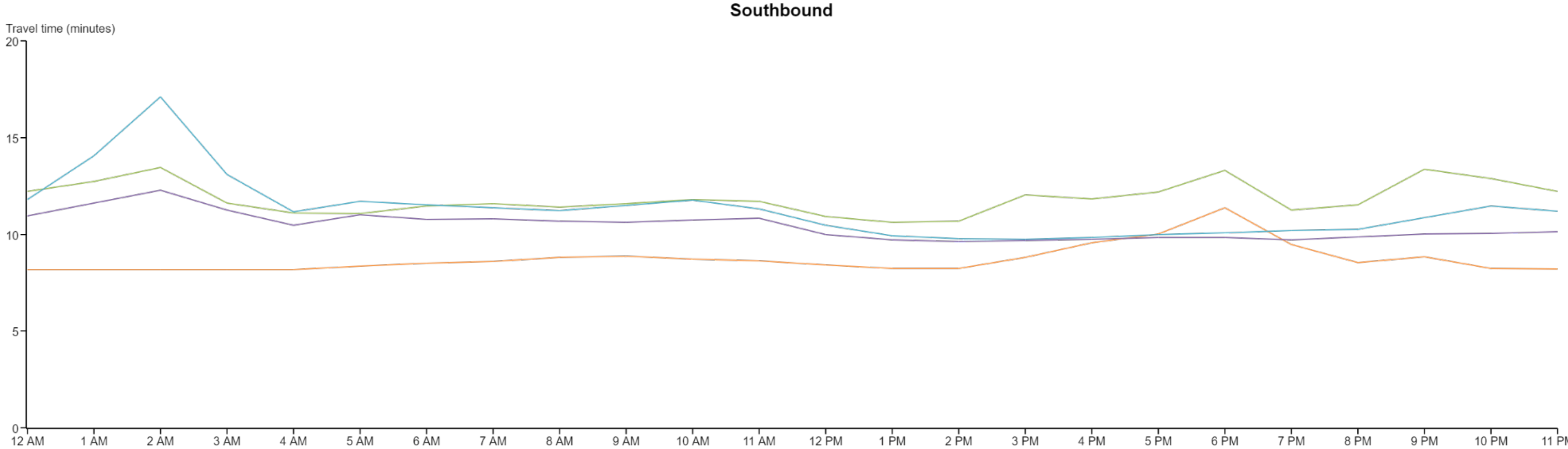
I-395 (HOV) between I-495/I-95 and US-1

Averaged per hour for 2010 (Every Tuesday, Wednesday, and Thursday), 2019 (Every Tuesday, Wednesday, and Thursday), 2020 (Every Tuesday, Wednesday, and Thursday), and 2021 (Every Tuesday, Wednesday, and Thursday)

Northbound



Southbound



Travel time: Time it will take to drive along the roadway segment (Distance Traveled / Speed).

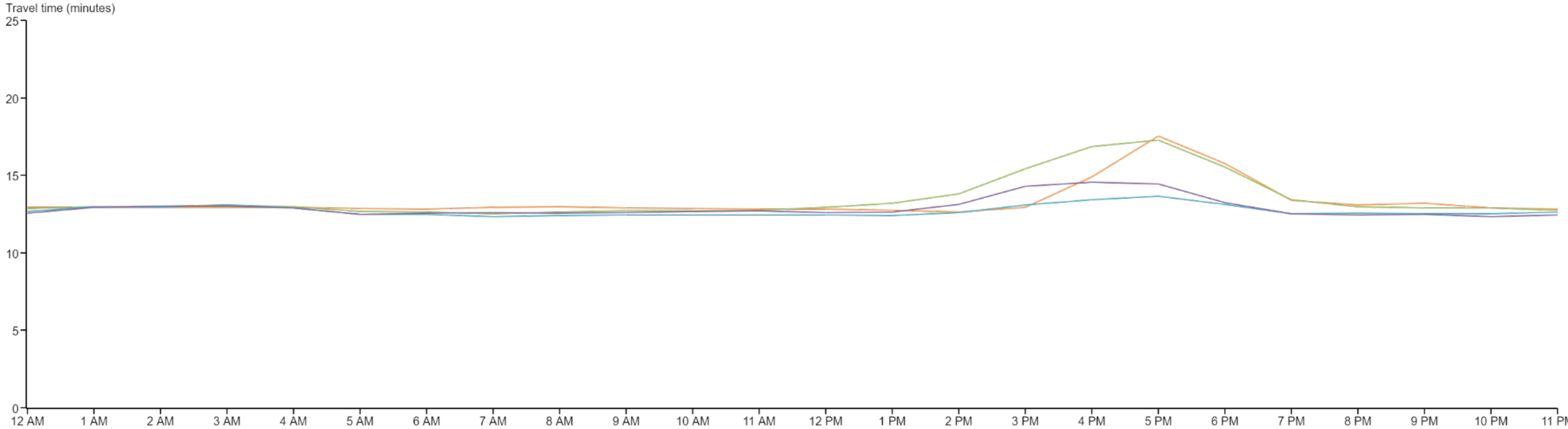
2010 (Every Tuesday, Wednesday, and Thursday) - INRIX 2019 (Every Tuesday, Wednesday, and Thursday) - INRIX 2020 (Every Tuesday, Wednesday, and Thursday) - INRIX
2021 (Every Tuesday, Wednesday, and Thursday) - INRIX

Figure C10

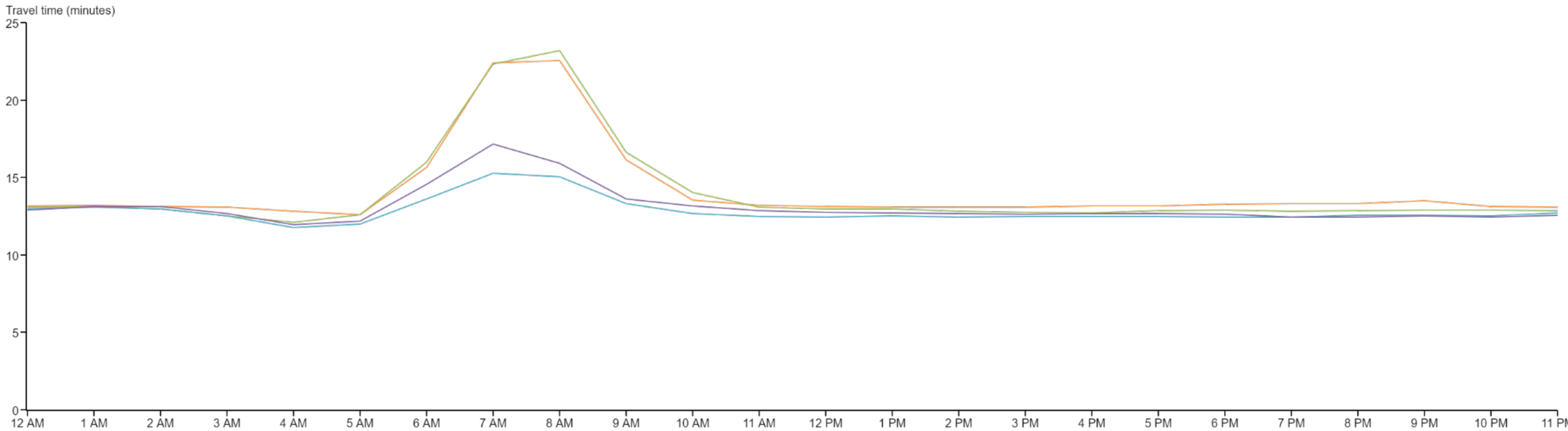
US-50 between MD-295/Kenilworth Ave and US-301/Exit 13

Averaged per hour for 2010 (Every Tuesday, Wednesday, and Thursday), 2019 (Every Tuesday, Wednesday, and Thursday), 2020 (Every Tuesday, Wednesday, and Thursday), and 2021 (Every Tuesday, Wednesday, and Thursday)

Eastbound



Westbound



Travel time: Time it will take to drive along the roadway segment (Distance Traveled / Speed).

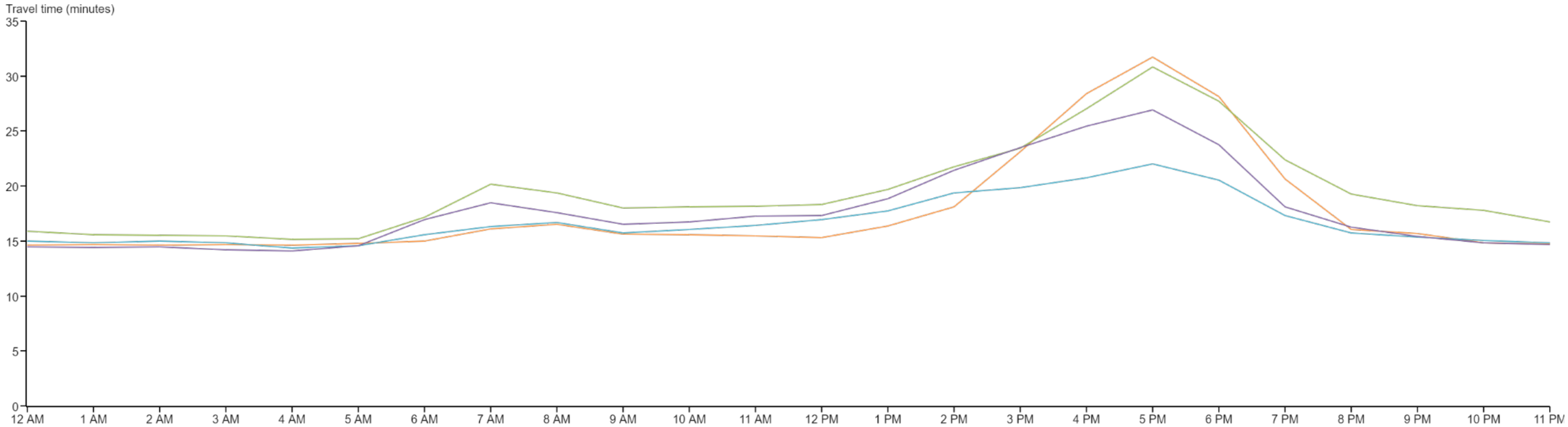
2010 (Every Tuesday, Wednesday, and Thursday) - INRIX
2019 (Every Tuesday, Wednesday, and Thursday) - INRIX
2020 (Every Tuesday, Wednesday, and Thursday) - INRIX
2021 (Every Tuesday, Wednesday, and Thursday) - INRIX

Figure C11

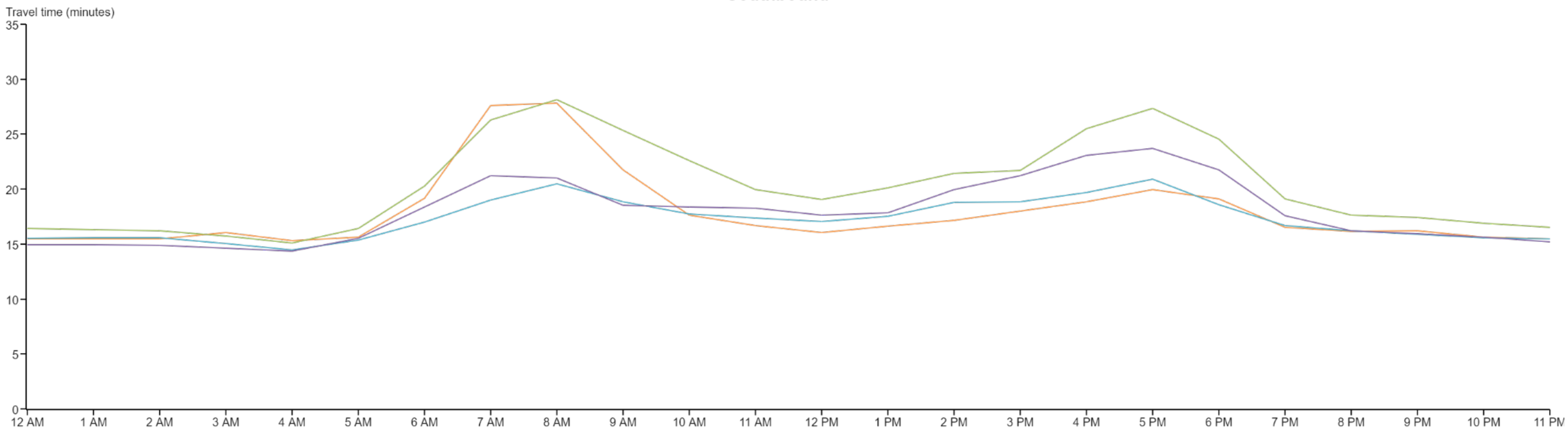
MD-295 between US-50/MD-201/Kenilworth Ave and MD-198

Averaged per hour for 2010 (Every Tuesday, Wednesday, and Thursday), 2019 (Every Tuesday, Wednesday, and Thursday), 2020 (Every Tuesday, Wednesday, and Thursday), and 2021 (Every Tuesday, Wednesday, and Thursday)

Northbound



Southbound



Travel time: Time it will take to drive along the roadway segment (Distance Traveled / Speed).

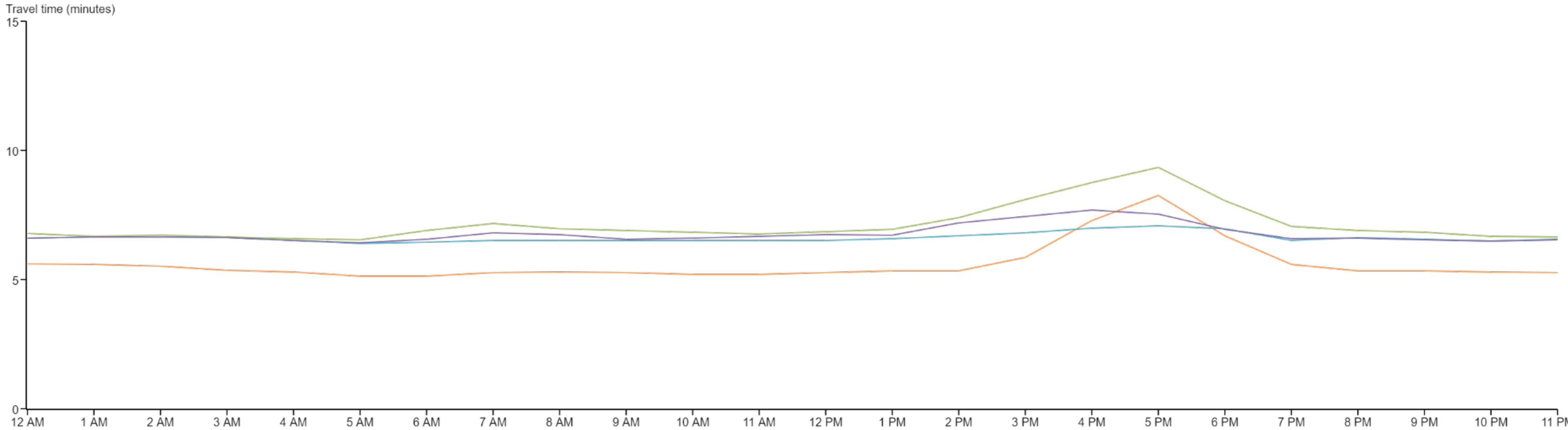
2010 (Every Tuesday, Wednesday, and Thursday) - INRIX
2019 (Every Tuesday, Wednesday, and Thursday) - INRIX
2020 (Every Tuesday, Wednesday, and Thursday) - INRIX
2021 (Every Tuesday, Wednesday, and Thursday) - INRIX

Figure C12

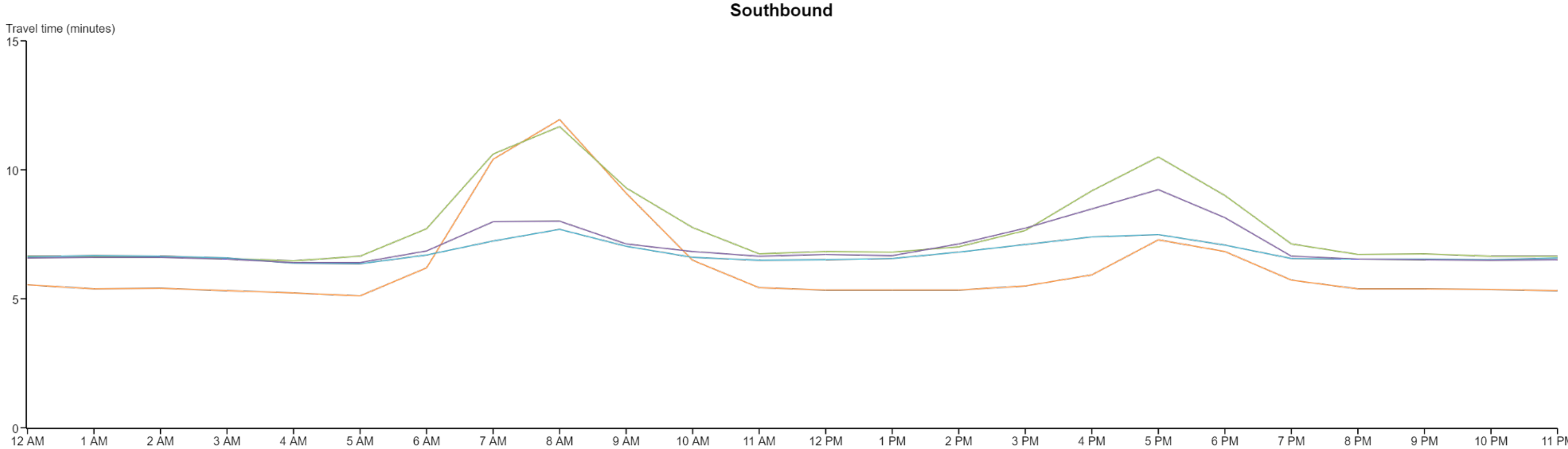
I-95 between I-495/EXIT 27-25 and MD-198/Exit 33

Averaged per hour for 2010 (Every Tuesday, Wednesday, and Thursday), 2019 (Every Tuesday, Wednesday, and Thursday), 2020 (Every Tuesday, Wednesday, and Thursday), and 2021 (Every Tuesday, Wednesday, and Thursday)

Northbound



Southbound



Travel time: Time it will take to drive along the roadway segment (Distance Traveled / Speed).

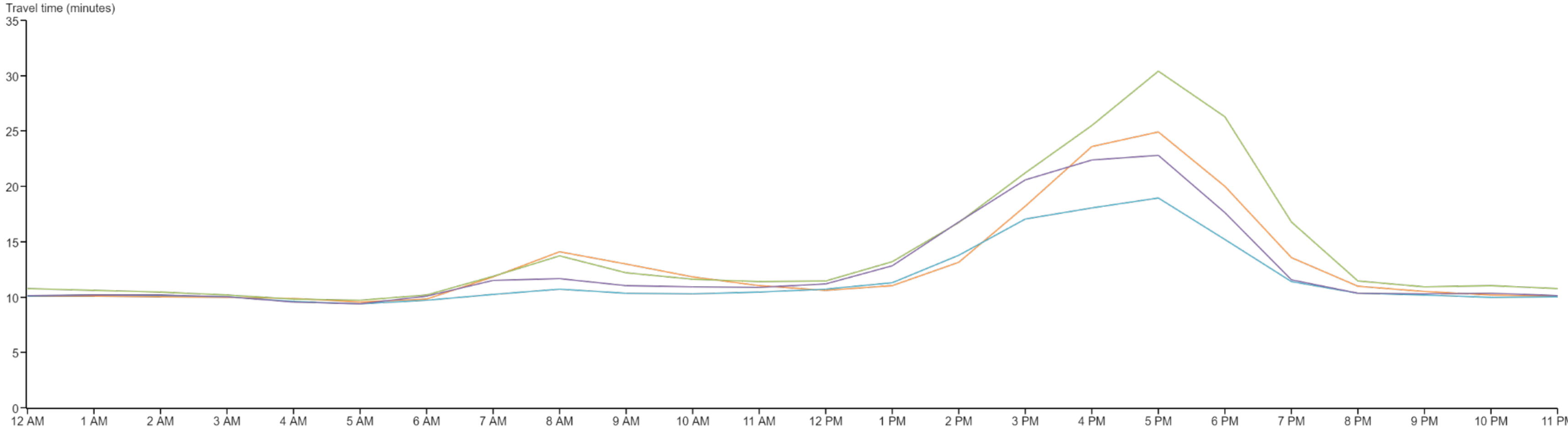
2010 (Every Tuesday, Wednesday, and Thursday) - INRIX
2019 (Every Tuesday, Wednesday, and Thursday) - INRIX
2020 (Every Tuesday, Wednesday, and Thursday) - INRIX
2021 (Every Tuesday, Wednesday, and Thursday) - INRIX

Figure C13

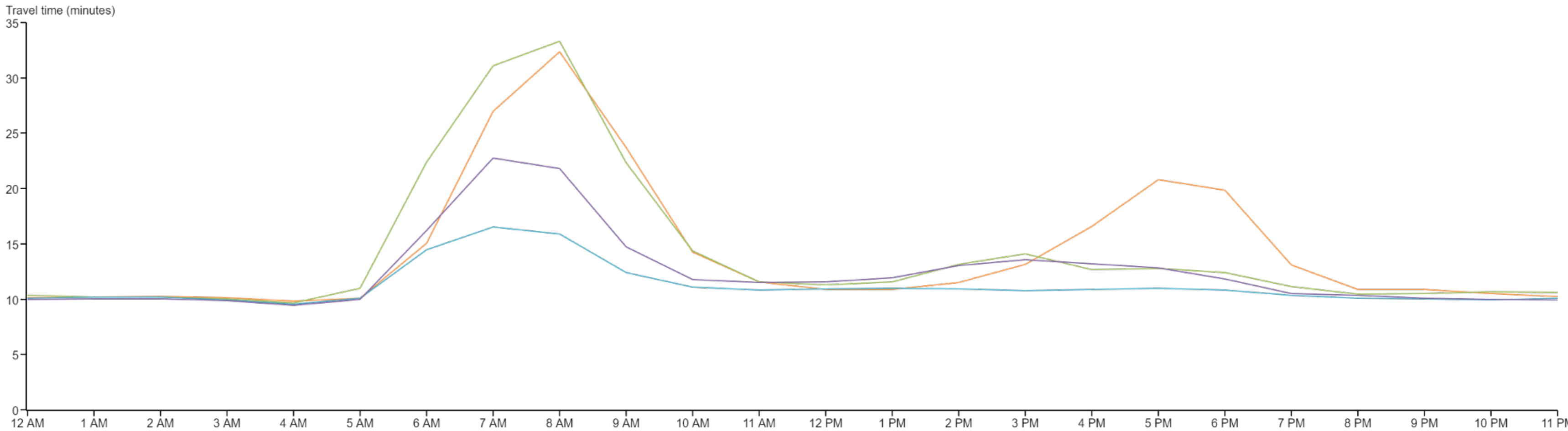
I-495 between I-270/Exit 35 and Exit 27

Averaged per hour for 2010 (Every Tuesday, Wednesday, and Thursday), 2019 (Every Tuesday, Wednesday, and Thursday), 2020 (Every Tuesday, Wednesday, and Thursday), and 2021 (Every Tuesday, Wednesday, and Thursday)

Clockwise



Counterclockwise



Travel time: Time it will take to drive along the roadway segment (Distance Traveled / Speed).

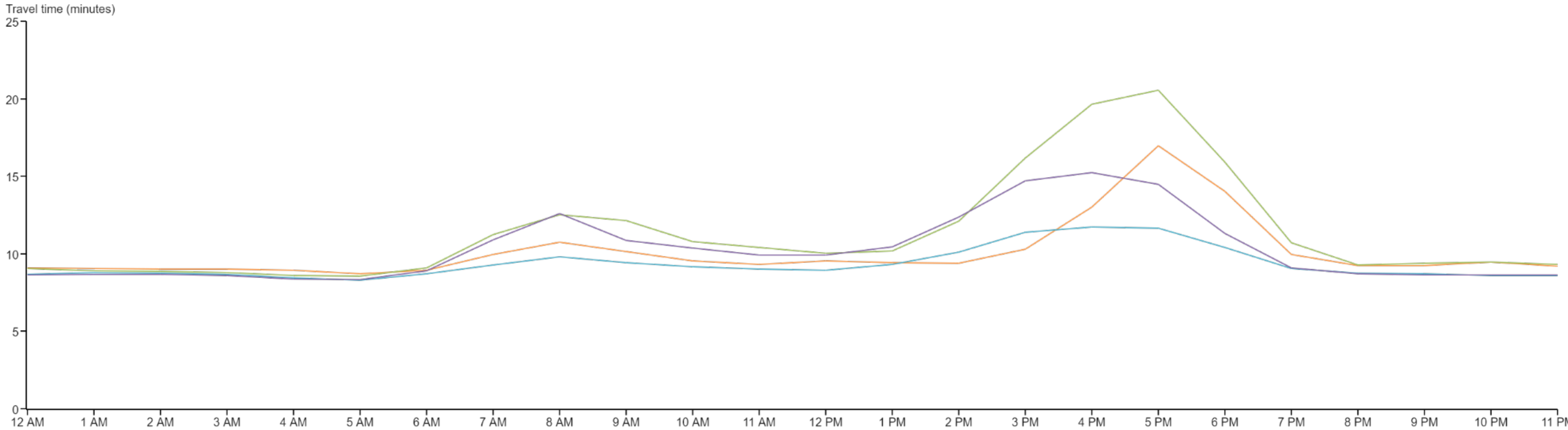
2010 (Every Tuesday, Wednesday, and Thursday) - INRIX
2019 (Every Tuesday, Wednesday, and Thursday) - INRIX
2020 (Every Tuesday, Wednesday, and Thursday) - INRIX
2021 (Every Tuesday, Wednesday, and Thursday) - INRIX

Figure C14

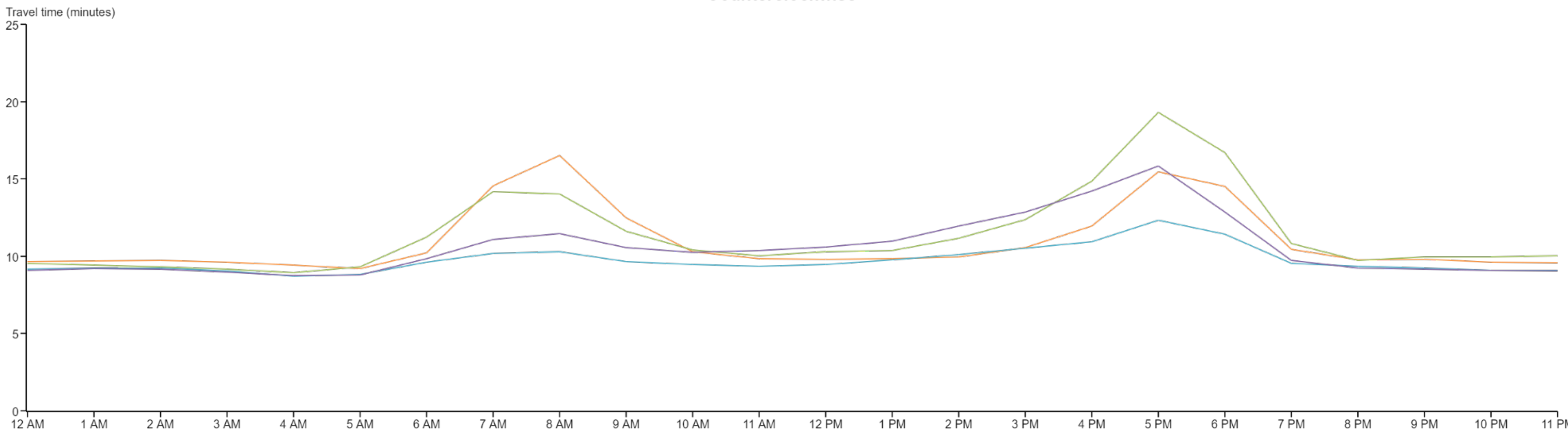
I-495 between Exit 27 and US-50/Exit 19

Averaged per hour for 2010 (Every Tuesday, Wednesday, and Thursday), 2019 (Every Tuesday, Wednesday, and Thursday), 2020 (Every Tuesday, Wednesday, and Thursday), and 2021 (Every Tuesday, Wednesday, and Thursday)

Clockwise



Counterclockwise



Travel time: Time it will take to drive along the roadway segment (Distance Traveled / Speed).

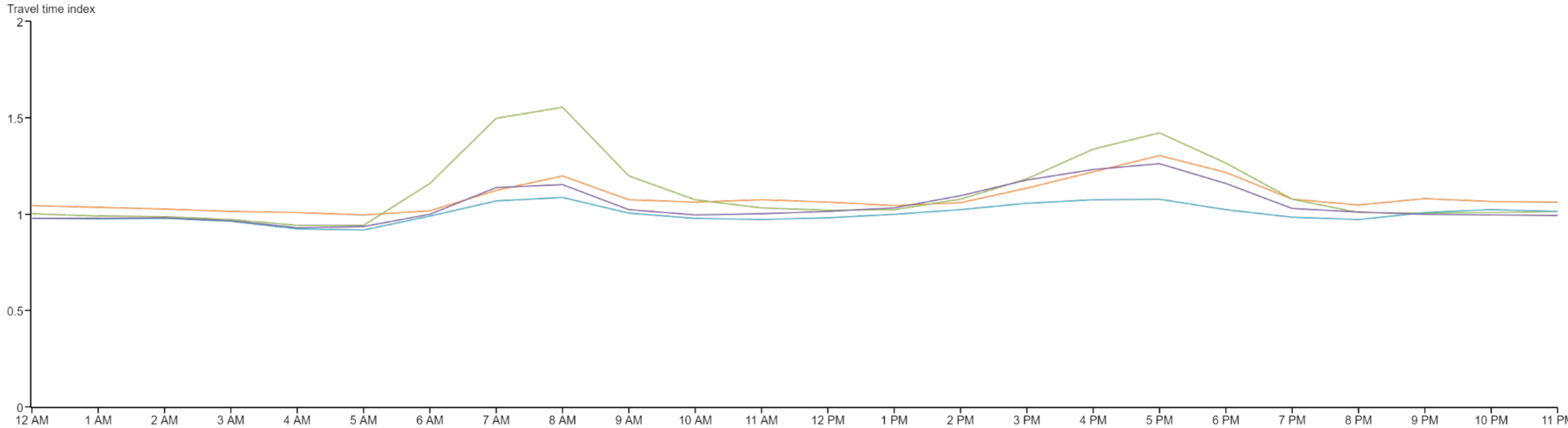
2010 (Every Tuesday, Wednesday, and Thursday) - INRIX
2019 (Every Tuesday, Wednesday, and Thursday) - INRIX
2020 (Every Tuesday, Wednesday, and Thursday) - INRIX
2021 (Every Tuesday, Wednesday, and Thursday) - INRIX

Figure C15

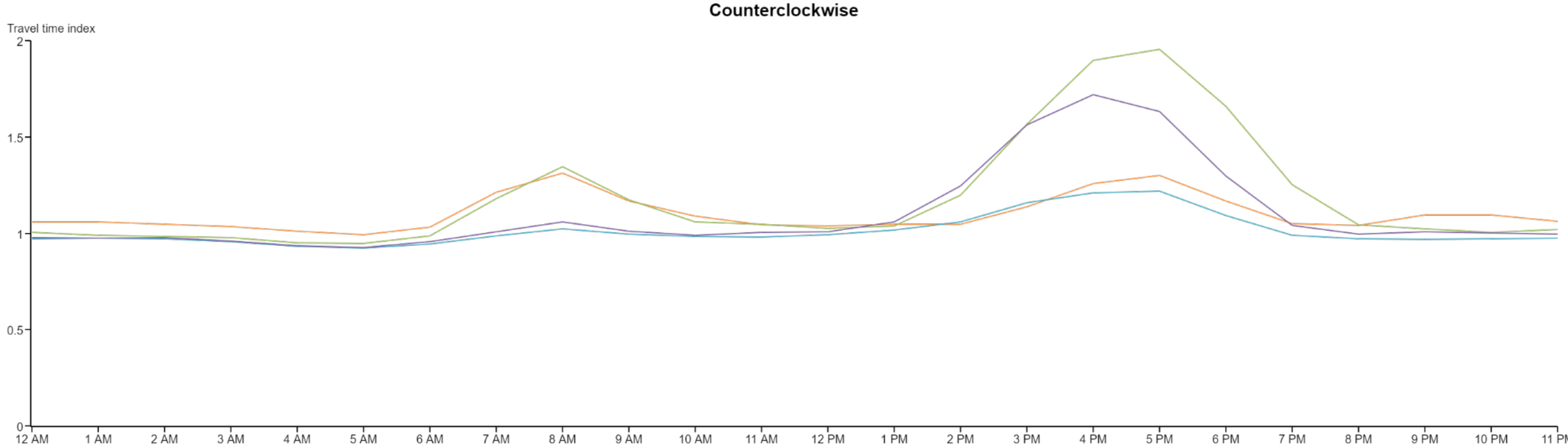
I-495 between US-50/Exit 19 and I-95/I-395/Exit 57

Averaged per hour for 2010 (Every Tuesday, Wednesday, and Thursday), 2019 (Every Tuesday, Wednesday, and Thursday), 2020 (Every Tuesday, Wednesday, and Thursday), and 2021 (Every Tuesday, Wednesday, and Thursday)

Clockwise



Counterclockwise



Travel time index: Travel time represented as a percentage of the ideal travel time (Travel Time / Free-flow Travel Time).

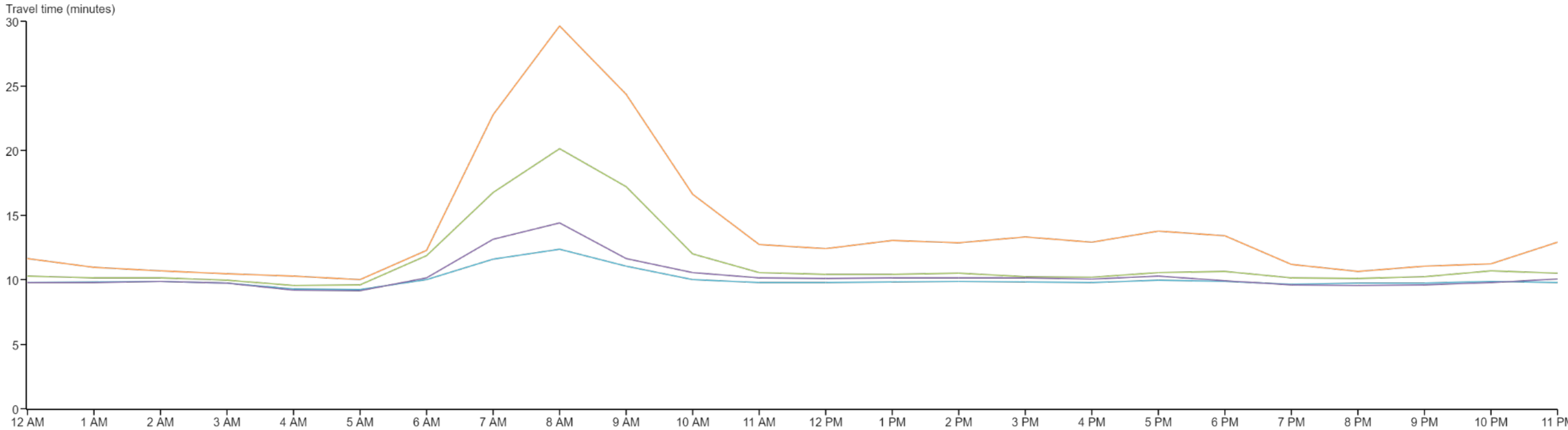
2010 (Every Tuesday, Wednesday, and Thursday) - INRIX
2019 (Every Tuesday, Wednesday, and Thursday) - INRIX
2020 (Every Tuesday, Wednesday, and Thursday) - INRIX
2021 (Every Tuesday, Wednesday, and Thursday) - INRIX

Figure C16

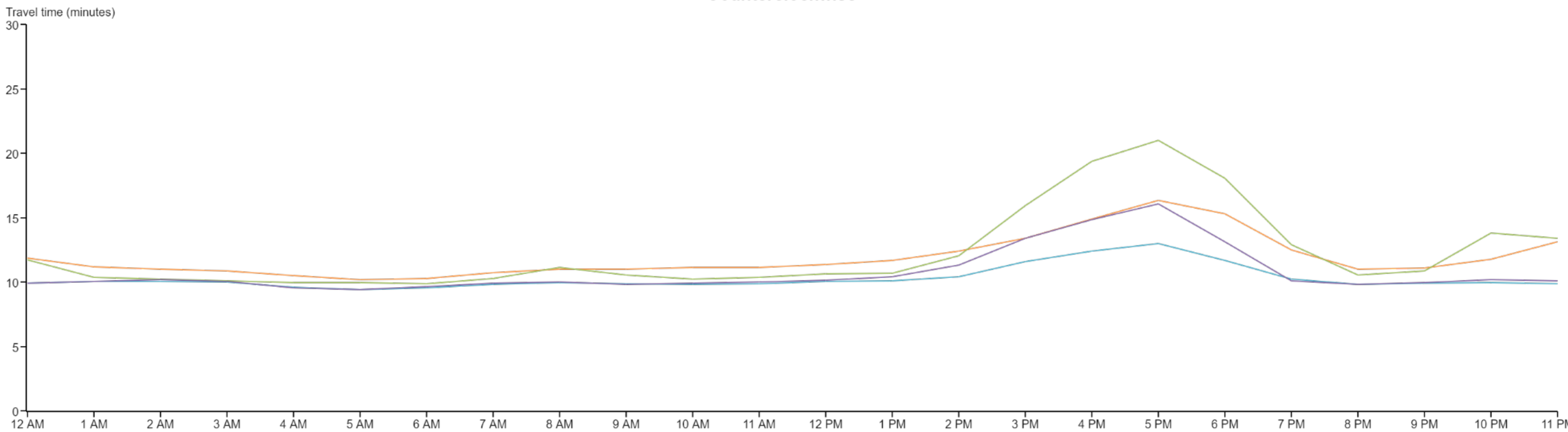
I-495 between I-95/I-395/Exit 57 and I-66/Exit 9

Averaged per hour for 2010 (Every Tuesday, Wednesday, and Thursday), 2019 (Every Tuesday, Wednesday, and Thursday), 2020 (Every Tuesday, Wednesday, and Thursday), and 2021 (Every Tuesday, Wednesday, and Thursday)

Clockwise



Counterclockwise



Travel time: Time it will take to drive along the roadway segment (Distance Traveled / Speed).

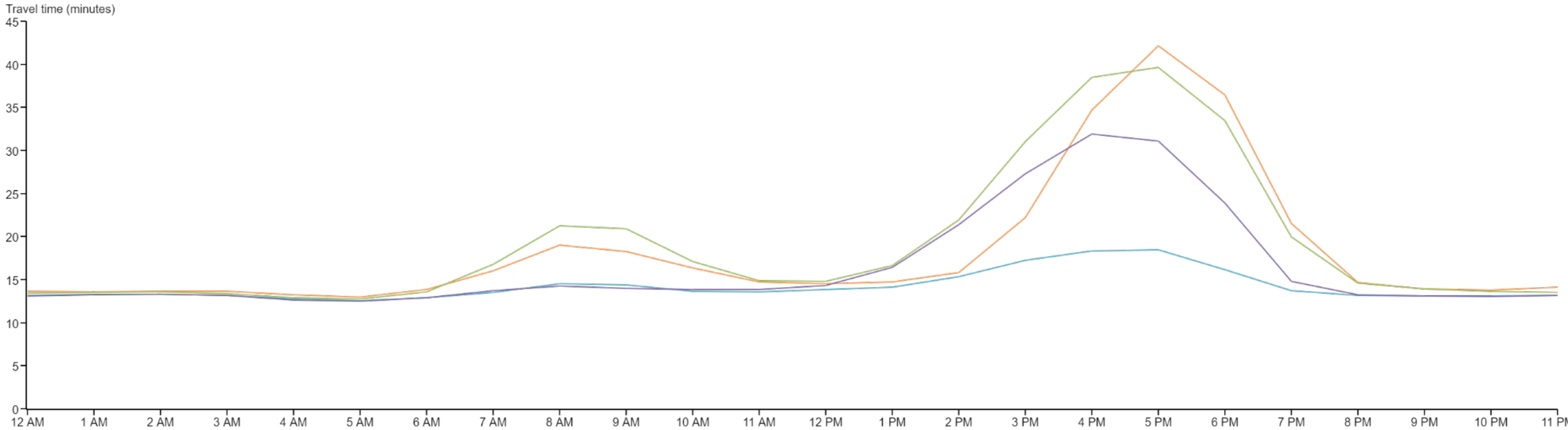
2010 (Every Tuesday, Wednesday, and Thursday) - INRIX
2019 (Every Tuesday, Wednesday, and Thursday) - INRIX
2020 (Every Tuesday, Wednesday, and Thursday) - INRIX
2021 (Every Tuesday, Wednesday, and Thursday) - INRIX

Figure C17

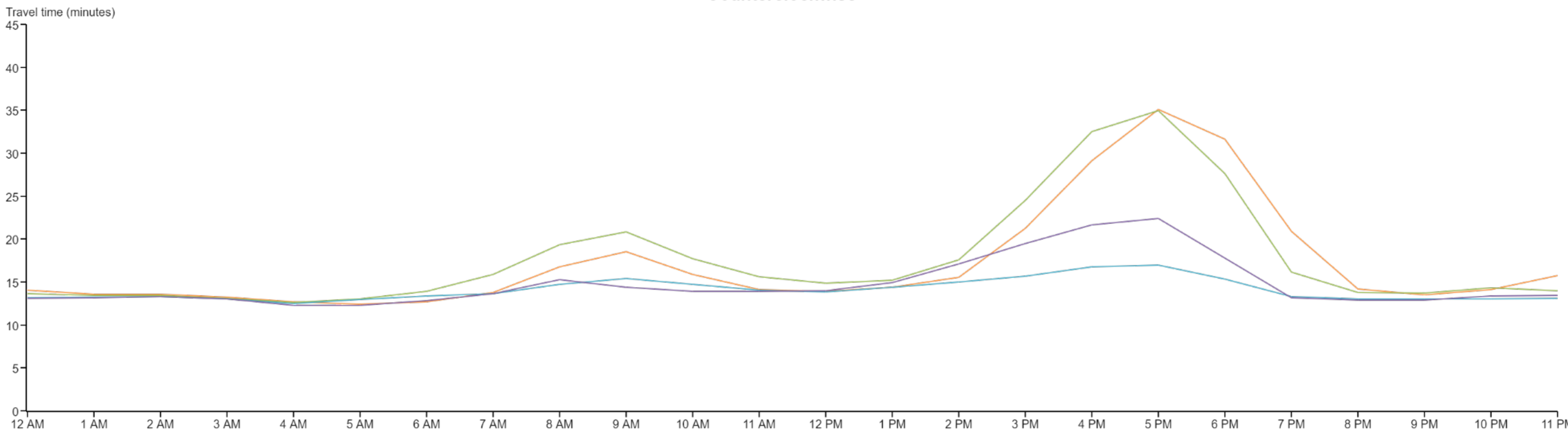
I-495 between I-66/Exit 9 and I-270/Exit 35

Averaged per hour for 2010 (Every Tuesday, Wednesday, and Thursday), 2019 (Every Tuesday, Wednesday, and Thursday), 2020 (Every Tuesday, Wednesday, and Thursday), and 2021 (Every Tuesday, Wednesday, and Thursday)

Clockwise



Counterclockwise



Travel time: Time it will take to drive along the roadway segment (Distance Traveled / Speed).

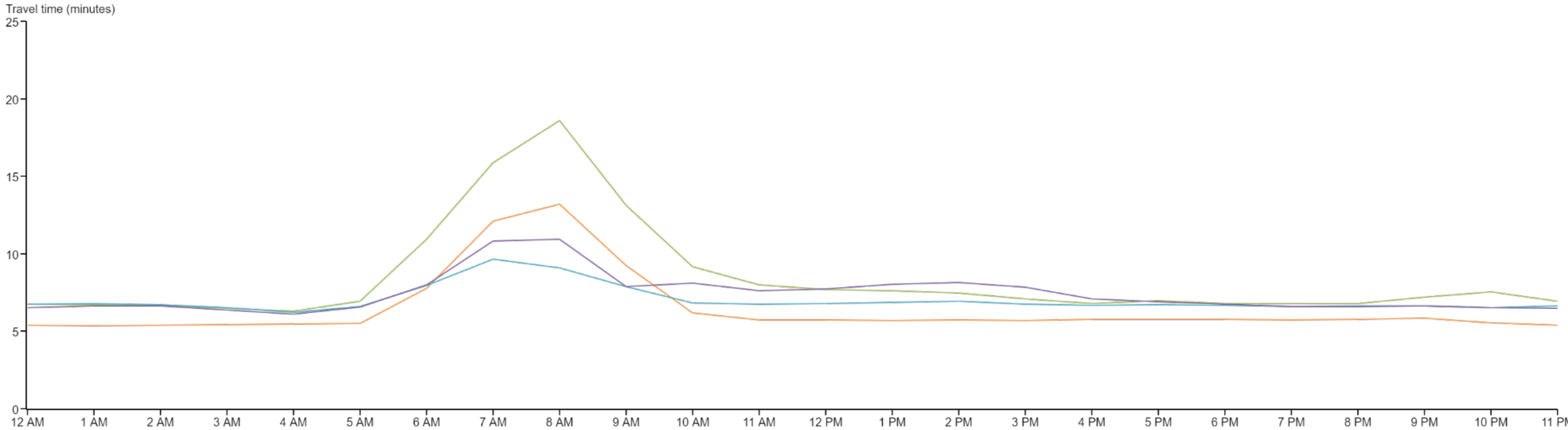
2010 (Every Tuesday, Wednesday, and Thursday) - INRIX
2019 (Every Tuesday, Wednesday, and Thursday) - INRIX
2020 (Every Tuesday, Wednesday, and Thursday) - INRIX
2021 (Every Tuesday, Wednesday, and Thursday) - INRIX

Figure C18

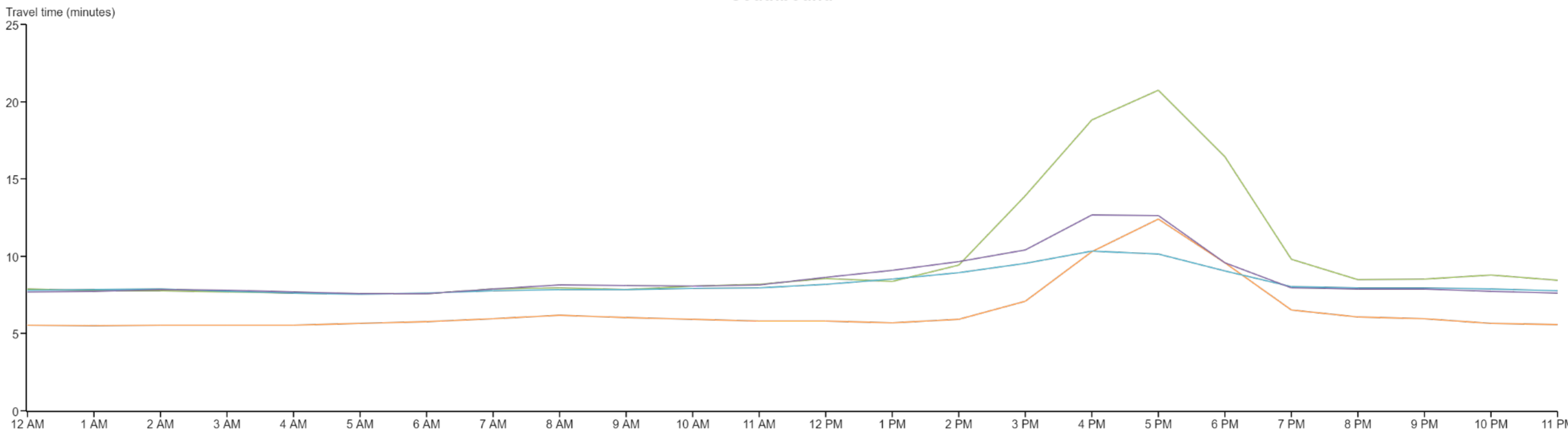
I-295 between I-495/I-95/EXIT 2A-B and 11Th St. Bridge

Averaged per hour for 2010 (Every Tuesday, Wednesday, and Thursday), 2019 (Every Tuesday, Wednesday, and Thursday), 2020 (Every Tuesday, Wednesday, and Thursday), and 2021 (Every Tuesday, Wednesday, and Thursday)

Northbound



Southbound



Travel time: Time it will take to drive along the roadway segment (Distance Traveled / Speed).

2010 (Every Tuesday, Wednesday, and Thursday) - INRIX
2019 (Every Tuesday, Wednesday, and Thursday) - INRIX
2020 (Every Tuesday, Wednesday, and Thursday) - INRIX
2021 (Every Tuesday, Wednesday, and Thursday) - INRIX

APPENDIX D – SUMMARY OF TRANSPORTATION DEMAND MANAGEMENT (TDM) ANALYSIS REPORT FY 2018-2020[145]

In addition to air quality benefits, the evaluation results of the Commuter Connections TDM program elements 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 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, 2018 and June 30, 2020, for the following:

- Maryland and Virginia Telework – The Maryland portion of this program element 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 program element 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 program element.

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 TDM program elements, among others, as part of the regional Transportation Improvement Program (TIP). The purpose of the Commuter Connections TDM programs 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 analysis.

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[145] Nicholas Ramfos, Lori Diggins, Eric Schreffler and Phillip Winters, National Capital Region Transportation Planning Board (TPB) Commuter Connections Program 2018-2020 Transportation Demand Management (TDM) Analysis Report, November 17, 2020.
https://www.commuterconnections.org/wp-content/uploads/2020-TDM-Analysis-Evaluation-FINAL-Report-111720-FOR-PUBLICATION.pdf

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

This evaluation is comprehensive for these programs; however, it should be noted 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. 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 Commuter Connections TDM program elements. 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 Commuter Connections TDM program elements themselves, and to refine future data collection methodologies and tools.

Summary of Commuter Connections TDM Program 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 (NOx), Volatile Organic Compounds (VOC), Particulate Matter (PM2.5), Particulate Matter NOx precursors (PM and NOx), and Carbon Dioxide (CO2)) resulting from implementation of each Commuter Connections TDM program element and compare the impacts against the goals established for the TDM program elements. The impact results for these measures are shown in Table A for each program element individually. Results for all Commuter Connections TDM program elements collectively and for the Commuter Operations Center (COC) are presented in Table B.

As shown in Table A, the TDM Program elements combined exceeded the collective goals for VMT reduced by 4% and fell under 1% shy of the goal for vehicle trips reduced. The Commuter Connections TDM Programs did not reach the emission goals; the impact for NOx was about 53% under the goal and VOC impact was 35% under the goal, but these deficits were due largely to changes in the emission factors. The goals were set in 2006, using 2006 emission factors. Goals for some program elements were re-set since the issuance of the FY2012 – 2014 Commuter Connections Transportation Emission Reduction Measure (TERM) Analysis Report. Emission factors used in the 2020 evaluation were considerably lower than the factors from 2017 and lower still than the factors used in 2014, reflecting a cleaner vehicle fleet.

When the COC results are added to the TDM program element impacts, as presented in Table B, the combined impact came within 2.7% of the VMT reduction goal. They fell 7% short of the goal for vehicle trips reduced. The combined program element – COC program impacts fell 55% short of the NOx goal and were 40% below the VOC goal. Again, the change in the emission factors affected the emission results.

Three program elements Telework – Maryland Assistance, the Virginia Telework program element, Telework!VA and Mass Marketing, easily met their individual goals for participation and travel impact.

Employer Outreach nearly achieved the travel goals, falling just 5% short of the goal for vehicle trips and 3% under the VMT goal. The Employer Outreach for Bicycling program element met the vehicle trip reduction goal but did not meet the VMT reduction goal, but the absolute deficit was small. The Virginia telework component (Telework!VA) also met the goals set for the program.

The impacts for the remaining program element, Guaranteed Ride Home, were 17% short of the goals for both vehicle trips and VMT, primarily due to declining registrations, compared with 2017 and previous years. The Commuter Operations Center and the Software Upgrades program element also were under their goals for vehicle trips and VMT reduced.

Additional details on the calculations for each Commuter Connections TDM program element 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
Daily Impacts for Individual Program Elements (Jul 2017 – Jun 2020) and Comparison to Goals

TDM Program Element	Participation [1]	Daily Vehicle Trips Reduced	Daily VMT Reduced	Daily Tons NOx Reduced	Daily Tons VOC Reduced
Maryland Telework Assistance [2]					
2020 Goal	31,854	11,830	241,209	0.1220	0.0720
Impacts (7/17 – 6/20)	46,254	13,636	308,001	0.0664	0.0522
Net Credit or (Deficit)	**14,400**	**1,806**	**66,792**	**(0.0556)**	**(0.0198)**
Virginia Telework Assistance – Telework! VA [2]					
2020 Goal	1,500	500	9,000	0.0027	0.0021
Impacts (7/17 – 6/20)	1,918	537	9,827	0.0022	0.0019
Net Credit or (Deficit)	**418**	**37**	**827**	**(0.0005)**	**(0.0002)**
Guaranteed Ride Home					
2020 Goal	18,496	6,296	177,568	0.0890	0.0480
Impacts (7/17 – 6/20)	12,944	5,200	147,371	0.0253	0.0154
Net Credit or (Deficit)	**(5,552)**	**(1,096)**	**(30,197)**	**(0.0637)**	**(0.0326)**
Employer Outreach – all employers participating [3]					
2020 Goal	2,031	90,776	1,533,161	0.6170	0.3850
Impacts (7/17 – 6/20)	1,962	85,845	1,489,165	0.2995	0.2297
Net Credit or (Deficit)	**(69)**	**(4,931)**	**(43,996)**	**(0.3175)**	**(0.1553)**
Employer Outreach – new / expanded employer services since July 2017 [3]					
2020 Goal	N/A	N/A	N/A	N/A	N/A
Impacts (7/17 – 6/20)	373	11,565	188,153	0.0383	0.0301
Net Credit or (Deficit)	N/A	N/A	N/A	N/A	N/A
Employer Outreach for Bicycling [3]					
2020 Goal	590	404	2,421	0.0016	0.0015
Impacts (7/17 – 6/20)	570	449	1,886	0.0008	0.0012
Net Credit or (Deficit)	**(20)**	**45**	**(535)**	**(0.0008)**	**(0.0003)**
Mass Marketing					
2020 Goal	23,168	10,809	181,932	0.0850	0.0250
Impacts (7/17 – 6/20)	38,273	14,031	277,511	0.0554	0.0415
Net Credit or (Deficit)	**15,105**	**3,222**	**95,579**	**(0.0296)**	**0.0165**
TDM Program Elements (all collectively)					
2020 Goal		120,211	2,142,870	0.9157	0.5321
Impacts (7/17 – 6/20)		119,249	2,231,875	0.4488	0.3407
Net Credit or (Deficit)		**(962)**	**89,005**	**(0.4669)**	**(0.1914)**

1) Participation refers to number of commuters participating, except for the Employer Outreach program element. For this element, participation equals the number of employers participating.

2) Maryland impacts represent portion of regional telework attributable to TW program 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 program element.

3) Impacts for Employer Outreach - all employers participating includes impacts for Employer Outreach – new / expanded employer services since July 2017 and for Employer Outreach for Bicycling.

Table B
Combined Program Element and COC Impacts (July 2017 – Jun 2020) and Comparison to Goals

TDM Program Element	Participation	Daily Vehicle Trips Reduced	Daily VMT Reduced	Daily Tons NOx Reduced	Daily Tons VOC Reduced
Program Elements (all collectively)					
2020 Goal		120,211	2,142,870	0.9157	0.5321
Impacts (7/17 – 6/20)		119,249	2,231,875	0.4488	0.3407
Net Credit or (Deficit)		**(962)**	**89,005**	**(0.4669)**	**(0.1914)**
Commuter Operations Center – Basic Services					
2020 Goal	91,609	24,425	512,637	0.2410	0.1150
Impacts (7/17 – 6/20)	75,651	16,281	375,135	0.0731	0.0523
Net Credit or (Deficit)	**(15,958)**	**(8,144)**	**(137,502)**	**(0.1679)**	**(0.0627)**
Commuter Operations Center – Software Upgrades [1]					
2020 Goal	4,681	2,379	66,442	0.0280	0.0110
Impacts (7/17 – 6/20)	3,536	1,363	40,541	0.0071	0.0044
Net Credit or (Deficit)	**(1,145)**	**(1,016)**	**(25,901)**	**(0.0209)**	**(0.0066)**

All Program Elements plus COC					
2020 Goal		147,015	2,721,949	1.1847	0.6581
Impacts (7/17 – 6/20)		136,893	2,647,551	0.5290	0.3974
Net Credit or (Deficit)		**(10,122)**	**(74,398)**	**(0.6557)**	**(0.2607)**

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 program element.

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

As shown, the program elements collectively reduce 7.5 annual tons of PM 2.5, 150 annual tons of PM 2.5 pre-cursor NOx, and 218,000 annual tons of CO2 (greenhouse gas emissions). When the Commuter Operations Center is included, these emissions impacts rise to 8.8 annual tons of PM 2.5, 177 annual tons of PM 2.5 pre-cursor NOx, and more than 258,000 annual tons of CO2 (greenhouse gas emissions)..

Table C
Annual PM 2.5 and CO2 (Greenhouse Gas) Emission Impacts for Individual Program Element

TDM Program Element	Annual Tons PM 2.5 Reduced	Annual Tons PM 2.5 Precursor NOx Reduced	Annual Tons CO2 Reduced
Maryland Telework Assistance [1]	1.100	22.225	31,602.5
Virginia Telework Assistance (TW!VA) [1]	0.025	0.750	1,015.0
Guaranteed Ride Home	0.451	8.485	13,523.9
Employer Outreach – all employers [2]	4.975	100.450	144,665.4
Employer Outreach – new/expanded employers [2]	0.650	12.850	18,242.4
Employer Outreach for Bicycling	0.000	0.275	214.9
Mass Marketing	0.940	18.617	27,104.8
Program Elements (all collectively)	7.491	150.527	217,911.6
Commuter Operations Center – basic services (not including Software Upgrades)	1.232	24.506	36,448.5
Commuter Operations Center – Software Upgrades	0.125	2.400	3,806.5
All Program Elements plus COC	8.848	177.432	258,166.6

1) Maryland impacts represent portion of regional telework attributable to TW program 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 program element.

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 TDM program element analysis (July 2017 through June 2020) to results of the 2017 analysis (July 2014 through June 2017). As noted before and as described in the footnotes to the table, the emission factors declined between 2017 and 2020, resulting in decreased emission reductions, even though some of the program elements achieved greater vehicle trip and VMT re-ductions in 2020 than in 2017.

The impacts for the Mass Marketing program element and for TW!VA were higher in 2020 than in 2017. Employer Outreach for Bicycling impacts also were higher in 2020 than in 2017, although the absolute values for the impacts in both years were relatively small, compared with the impacts for other TDM program elements.

The VMT impact for Maryland Telework Assistance was about 15% lower in the 2020 analysis than in 2017. Guaran-teed Ride Home and the Commuter Operations Center both had notably lower impacts. in 2020 than in 2017.

Table D
Impacts for Individual Program Elements 7/17– 6/20 Compared with 7/14 – 6/17

TDM Program Element	Daily Vehicle Trips Reduced	Daily VMT Reduced	Daily Tons NOx Reduced	Daily Tons VOC Reduced
Maryland Telework Assistance				
July 2017 – June 2020	13,636	308,001	0.066	0.052
July 2014 – June 2017	14,839	361,204	0.096	0.070
Change 1)	(1,203)	(53,203)	(0.029)	(0.018)
Virginia Telework Assistance – Telework! VA				
July 2017 – June 2020	537	9,827	0.002	0.002
July 2014 – June 2017	490	9,359	0.003	0.002
Change	47	468	(0.001)	0.000
Guaranteed Ride Home				
July 2017 – June 2020	5,200	147,371	0.025	0.015
July 2014 – June 2017	6,398	181,335	0.040	0.023
Change 1)	(1,198)	(33,964)	(0.015)	(0.008)
Employer Outreach – All services except Employer Outreach for Bicycling				
July 2017 – June 2020	85,396	1,487,279	0.299	0.229
July 2014 – June 2017	102,252	1,839,789	0.473	0.349
Change 1)	(16,856)	(352,510)	(0.174)	(0.120)
Employer Outreach for Bicycling				
July 2017 – June 2020	449	1,886	0.001	0.001
July 2014 – June 2017	373	1,640	0.001	0.001
Change 1)	76	246	0.000	0.000
Mass Marketing				
July 2017 – June 2020	14,031	277,511	0.055	0.042
July 2014 – June 2017	10,133	163,250	0.042	0.019
Change 1)	3,898	114,261	0.013	0.023
All TDM Program Elements (Excluding Commuter Operations Center)				
July 2017 – June 2020	119,249	2,231,875	0.449	0.341
July 2014 – June 2017	134,485	2,556,577	0.654	0.464
Change 1)	(15,236)	(324,702)	(0.206)	(0.123)

Commuter Operations Center (Basic Services + Software Upgrades)				
July 2017 – June 2020	17,644	415,676	0.080	0.057
July 2014 – June 2017	21,728	452,667	0.116	0.085
Change 1)	(4,084)	(36,991)	(0.036)	(0.029)

1) Change in emissions is due in part to reduction in emission factors from 2017 to 2020.

APPENDIX E – SAMPLE CMP DOCUMENTATION FORM

Congestion Management Process
Documentation Form

visualize2045
A LONG-RANGE TRANSPORTATION PLAN FOR THE NATIONAL CAPITAL REGION

1. **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 (rideshare, telecommute, guaranteed ride home, etc.)
   - ☐ 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:)

   Describe other in-place CMS here.

2. **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

   e. Other congestion management strategies

   f. Combinations of the above strategies

3. **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.**

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

5. **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 F – REVIEW OF CONGESTION MANAGEMENT STRATEGIES

This appendix references the Table 4-2 and Table 4-3, 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

1. Low (x)
2. Medium (xx)
3. High (xxx)

		QUALITATIVE CRITERIA									
		Congestion Related			Others						
STRATEGY		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
C.5.0	***Alternative Commute Programs***										
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 Workw eeks	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	xxx	xx	xx
C.5.9	Alternative Commute Subsidy Program	xx	x	xxx	xxx	xx	xx	x	x	xxx	xxx
C.5.10	App-based Incentives (e.g. incenTrip)	xx	xxx	xxx	xxx	xx	xx	xx	x	xxx	xxx
C.6.0	***Managed Facilities***										
C.6.1	High-Occupancy Vehicle (HOV) Facilities	xx	x	xxx	xxx	xx	xx	xx	xxx	xxx	xxx
C.6.2	Variably Priced Lanes (VPL)	xxx	x	xx	xxx	xx	xx	xx	xxx	xxx	xx
C.6.3	Cordon Pricing	xxx	x	xxx	xxx	xx	x	x	xx	xxx	xx
C.7.0	***Public Transportation Improvements***										
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
C.8.0	***Pedestrian, bicycle, and multi-modal improvements***										
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 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	Bikesharing/Micromobility Programs	xx	x	xxx	xxx	xxx	xx	xxx	xx	xx	xxx
C.9.0	***Growth Management***										
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 w ith 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	xx	x	xx

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

1. Low (x)
2. Medium (xx)
3. High (xxx)

		QUALITATIVE CRITERIA									
		Congestion Related		Others							
STRATEGY		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
C.1.0	***Incident Mngt./Non-recurring***										
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 Management Systems	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 Management Centers	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
C.1.10	Regional Incident Coordination	xxx	xxx	x	xxx	xx	xxx	xx	x	xxx	xxx
C.2.0	***ITS Technologies***										
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	Freew ay Ramp Metering	xx	x	x	xx	xx	xx	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	xx	x	xx	xx	xx
C.2.12	Probe Traffic Monitoring	xx	xxx	x	xxx	xx	xxx	xxx	x	xxx	xxx
C.3.0	***Advanced Traveler Information Systems***										
C.3.1	Traffic Information Systems (e.g. 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	Highw ay 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
C.3.5	Information Sharing w ith Private Sector Apps	xx	xxx	x	xxx	xxx	xx	xx	x	xxx	xx
C.4.0	***Traffic Engineering Improvements***										
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

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.

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*
  - Employers 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*
  - Employers 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.5.10 – App-based Incentives (e.g., incenTrip)*

    - Apps such as Commuter Connections' incenTrip combine information on multi-modal transportation choices available from a commuter's origin to their destination and the best times to travel, with gamification incentives to make tripmaking, trip timing, or mode choice changes that will be beneficial to congestion management.

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 – High-Occupancy Vehicle (HOV) Facilities*
    - High Occupancy Vehicle (HOV) facilities typically 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.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 Facilities*
  - Addition of new facilities 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 – Bikesharing/Micromobility Programs*
  - Bicycles, electronic scooters, and other devices can be rented from locations close to popular origins and destinations. This provides convenient and cost-effective mobility options for when other options such as transit or driving are not available or convenient.

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.

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 an 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 – Parking Management Systems*
  - Advanced parking management systems help people find parking spots quickly, thereby potentially reducing congestion in urban areas. Advanced parking management systems include elements from both traveler information systems and specialized parking management applications and technologies, including both detection and information sharing.
- *C.2.10 – 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 is 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 – Traffic Information Systems (e.g. 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.3.5 – Information Sharing with Private Sector Apps*
  - Widespread use of traffic/navigation smart phone apps among the traveling public has created opportunities for both obtaining and sharing traffic conditions or incident data. Roadway agencies can provide information feeds to such app operators, as well as entering into agreements with app operators to share real-time transportation information for mutual benefit.

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.

APPENDIX G – PREVIOUS TRAVEL MONITORING ACTIVITIES AND STUDIES

Previous editions of the CMP Technical Report included information in a series of appendices labeled Appendix D and Appendix H-1 through Appendix H-7. Information included was from a number of TPB or member involved travel monitoring activities or studies. These included six activities that in the past were conducted by field personnel under the direction of TPB staff:

- 2014 Performance of High-Occupancy Vehicle Facilities on Freeways in the Washington Region
- Freeway Aerial Photography Surveys
- Arterial Floating Car Travel Time Studies
- HOV Facility Studies
- Cordon Counts
- Park-and-Ride Facilities

However, in recent years, the above activities have not been repeated or otherwise undertaken by TPB, either by determination of evolving programmatic needs, or being superseded by emerging "big data" technologies such as vehicle probe data (the vehicle probe data-based analyses in Chapter 2 of this report specifically supersede the aerial photography and floating car activities).

Also included in the previous Appendix H series were:

- Traffic Management Activities Associated with Defense Base Closure and Realignment Commission (BRAC) Actions
- Performance Measures in the 1994 CMS Work Plan

Since none of the above information has been updated in recent years, nor is anticipated to be updated, these appendices have been removed from the 2022 CMP Technical Report. The information therein remains available in the 2020 CMP Technical Report posted on the TPB website[146].

[146] https://www.mwcog.org/documents/2016/09/09/congestion-management-process-cmp-technical-report-congestion-management-process/.