MDOT
MARYLAND DEPARTMENT OF TRANSPORTATION

STATE HIGHWAY ADMINISTRATION

MARYLAND STATE HIGHWAY MOBILITY REPORT 2020

2020

MARYLAND STATE HIGHWAY MOBILITY REPORT

Ninth Edition

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MESSAGE FROM THE ADMINISTRATOR

The Maryland Department of Transportation State Highway Administration (MDOT SHA) understands the essential nature of a safe and effective transportation environment, in relation to the economic vitality of the State and the overall wellbeing of its citizens. This is especially true now, as Marylanders everywhere feel the impact of the COVID-19 pandemic. From year to year, MDOT SHA faces evolving challenges and shifting mobility trends, creating the need for progressive and cost-effective operations, engineering, and context-sensitive design solutions for all of Maryland's roadway users. MDOT SHA ensures that whether you are traveling by car, bus, train, bicycle, or on foot, the safety and needs of all customers are prioritized with the goal to help create one cohesive network of travel. MDOT SHA collaborates with our customers, as well as state, regional, and local agencies to create statewide transportation solutions, and to develop transportation policies, programs, and investments to support this initiative.

In 2019, a record 60.1 billion vehicle miles of travel occurred on Maryland roadways. To address congestion issues related to these record volumes, MDOT SHA continues to use a data-driven decision-making approach to highlight and address some of these underlying patterns of travel. The 2020 Maryland Mobility Report plays an important role in this data-driven approach and utilizes 2019 data to conduct performance and mobility-trends analysis, vital to the decision-making process at MDOT SHA.

MDOT SHA utilizes these analyses to determine existing roadway performance trends with the overall goal to improve the customer experience for all MDOT roadway users. Some specific examples of this approach include pursuing capital projects as a result of the 2019 congestion management efforts, retiming traffic signals, providing incident management through CHART as well as other efforts; all of which provided over $1.5 billion in annual user cost savings.

MDOT SHA not only looks at the past to analyze performance, but also keeps the future in mind through continued investment and awareness of emerging technologies in the transportation industry. Through MDOT SHA's active collaboration with private partners and universities, our organization can contribute and provide input in relation to research and new technology. These collaborations are meant to foster improvement in safety and mobility, and enhance prosperity, connectivity, and the quality of life for those who utilize our roadways. One such example is our Transportation Systems Management and Operations (TSMO) effort which brought together multiple offices within MDOT SHA, the University of Maryland, and other pertinent stakeholders to develop a plan which has evolved into one of the nation's leading TSMO efforts. This strategic plan has completely shifted how the agency manages its roadways and promotes continued and reliable customer experience to Maryland's roadway users.

There are a multitude of other efforts that SHA collaborates on like our Connected and Automated Vehicles (CAV) efforts, as well as the implementation of SMART adaptive traffic signals along 13 corridors across the state as of 2019. Our organization is proud to be a part of the largest Transportation Private-Public Partnerships (P3) in Maryland's history. I-495 continues to be a bottleneck for trucks traveling along the I-95 corridor, and prioritizing this project is vital not only for Maryland, but our national economy and flow of goods and services.

Lastly, given all the difficulties and hardships we have faced in 2020, I am proud to say MDOT SHA continues to look to the future for innovative solutions to traffic and mobility issues and continues to lead by example in the realm of organizational excellence. Furthermore, MDOT SHA continues to take multi-faceted, long- and short-range approaches to manage the fiscal impact of COVID-19 through operating and capital budget adjustments—while striving to improve safety and service. Our operations, planning and capital programming ventures allow us to continue developing transportation systems which connect you—our customers—to life's opportunities.

Tim Smith, P.E.
MDOT SHA Administrator

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TABLE OF CONTENTS

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EXECUTIVE SUMMARY

The Maryland Department of Transportation State Highway Administration (MDOT SHA) meets the ever-changing and challenging needs of moving people and goods using a performance-based approach by addressing everyday congestion and non-recurring events such as crashes. A performance-based approach is critical to address shifting mobility trends each year. These shifts create a need for progressive and cost-effective operations, engineering, and context-sensitive design of the transportation system to ensure safe access for all users. To achieve this, MDOT SHA continuously monitors existing travel trends, accomplishments, and challenges. This helps establish short and long-term strategies for improvement, relevance, and organizational excellence. The following 2020 Maryland Mobility Report summarizes our performance, successes, opportunities, and future strategies based on the 2019 calendar year.

CONGESTION AND RELIABILITY TRENDS

Ease of mobility for people and freight movers using the Maryland highway system is directly related to roadway congestion. Higher traffic volumes usually means more congested and unreliable conditions. This negatively impacts travelers and freight movement in terms of cost, time, and efficiency. The following is a summary of mobility and reliability trends on the Maryland highway system in 2019.

Vehicle Miles Traveled (VMT)[1]:

- The number of miles traveled along Maryland roadways set an all-time record in 2019. This amounted to approximately 60.1 billion vehicle miles traveled (VMT), which is a 0.8% increase over 2018 from 59.6 billion miles. The growth occurred almost exclusively on MDOT managed roadways between 2018 and 2019.
- Approximately 72% of statewide total travel occurred on MDOT managed roadways.
- Baltimore, Montgomery, and Prince George's Counties experienced the largest increase in VMT, each growing by more than 80 million. Counties with a decrease in VMT experienced a reduction of less than 10 million, except Baltimore City, which decreased by 45 million.

Annual Average Daily Traffic (AADT)[2]:

The highest daily volume locations for freeway/expressway and arterial sections include:

HIGHEST ANNUAL AVERAGE DAILY TRAFFIC (AADT) FREEWAY/EXPRESSWAY SECTIONS		
ROUTE	LIMITS	2019 AADT (THOUSANDS)
I-270	I-270 Split to MD 117	230-267
I-495	Virginia State Line to I-270 West Spur	231-255
I-95/I-495	MD 4 to I-95	212-253
I-495	I-270 East Spur to I-95	213-240
I-695	MD 140 to MD 139	180-207

1 - See definition pg. 12
2 - See definition pg. 15

HIGHEST ANNUAL AVERAGE DAILY TRAFFIC (AADT) ARTERIAL SECTIONS		
ROUTE	LIMITS	2019 AADT (THOUSANDS)
US 301	Charles County Line to MD 5	105
MD 5	US 301 to MD 223	67-85
MD 3	US 50/301 to I-97/MD 32	70-84
MD 210	Ft Washington Rd to I-95/I-495	71-83
MD 650	MD 212 to Mahan Rd	52-80

Freeways

- Motorists on 11% (177 miles) of the network experienced heavy to severe congestion in the AM peak hour and 18% (286 miles) in the PM peak hour. This increased by 1% (22 miles) in the AM and 2% (24 miles) in the PM from 2018 to 2019.
- Roadway sections with higher volumes and greater VMT on the freeway/expressway system experience greater congestion. As such, 22% of the AM peak hour and 31% of the PM peak hour VMT occurred in congested conditions. This increased by 3% in the AM peak hour and 2% in the PM peak hour in 2019 compared to 2018.
- The worst AM peak hour congestion for any particular freeway/expressway was along I-695 Outer Loop (11 miles), and the worst PM peak hour congestion was along I-495 Inner Loop (15 miles).
- From 2018 to 2019, freeway/expressway congestion costs increased by $0.857 billion to a total annual cost of $3.58 billion.

Arterials

- Motorists on approximately 15% (88 miles) of the major arterial system experienced heavy to severe congested conditions in the AM peak hour and 29% (201 miles) in the PM peak hour. This is a 17-mile increase in the morning and a 46-mile increase in the afternoon in 2019 compared to 2018.
- Total congestion costs for freeway/expressways and arterials are estimated at $1.58 billion—an increase of $0.358 billion over 2018.

Intersections

- Analysis of the traffic count data from the last three years determined 36 state highway intersections operated at a failing level of service (LOS F), including six intersections which failed during both the AM and PM peak hours. On a summer weekend, two additional intersections on the Eastern Shore fail.

The most congested freeway/expressway (three to eight mile) and arterial (two to five mile) corridor sections for AM and PM peak hours (in descending order) are as follows.

2019 MOST CONGESTED FREEWAY/EXPRESSWAY SECTIONS (AVERAGE WEEKDAY)	
AM Peak Hour (8-9 AM)	**PM Peak Hour (5-6 PM)**
I-495 Outer Loop – I-95 to US 29	I-695 Inner Loop – MD 139 to Providence Rd
I-695 Outer Loop – MD 43 to Cromwell Bridge Rd	I-495 Inner Loop – I-270 East Spur to MD 193
I-695 Outer Loop – I-795 to Edmondson Ave	I-495 Inner Loop – Virginia State Line to I-270 West Spur
US 50 Westbound – MD 410 to Washington DC Line	I-95 Northbound – US 1 to Ft. McHenry Tunnel
I-270 (Local) Southbound – I-370 to MD 189	I-695 Outer Loop – I-95 to MD 295
I-895 Southbound – I-95 to Ponca St	I-95/I-495 Inner Loop – I-95 to MD 295
I-695 Inner Loop – MD 140 to I-83	I-695 Inner Loop – I-95 to MD 122
I-95/ I-495 (Local) Inner Loop – West of MD 414 to Washington DC Line	I-270 Northbound – I-370 to MD 124
MD 295 Southbound – MD 198 to MD 197	MD 295 Northbound – MD 410 to Powder Mill Rd
I-270 Southbound – I-370 to Montrose Rd	US 29 Northbound – North of Broken Land Pkwy to MD 103

2019 MOST CONGESTED ARTERIAL SECTIONS (AVERAGE WEEKDAY)	
AM Peak Hour (8-9 AM)	**PM Peak Hour (5-6 PM)**
US 29 Southbound – MD 650 to MD 193	MD 210 Southbound – Livingston Rd (North) to Kerby Hill Rd/ Livingston Rd (South)
MD 185 Southbound – I-495 Ramps to MD 191	MD 4 Northbound – MD 235 to Governor Thomas Johnson Bridge
MD 28 Westbound – Bel-Pre Rd to MD 586	MD 355 Northbound – MD 191 to Cedar Lane
MD 190 Eastbound – Luvie Lane to Piney Meetinghouse Rd	MD 3 Northbound – US 301 to MD 424
MD 210 Northbound – Fort Washington Rd to Livingston Rd/ Kerby Hill Rd	US 301 Southbound – MD 381 to McKendree Rd/ Cedarville Rd
MD 97 Southbound – Md 586 to Seminary Rd/Columbia Rd	MD 198 Eastbound – MD 295 to MD 32
MD 410 Westbound – MD 650 to US 29	US 29 Northbound – MD 650 to Cherry Hill Rd
MD 586 Westbound – Aspen Hill Rd to MD 355	MD 152 Northbound – I-95 Ramps to Old Joppa Rd
MD 355 Southbound – I-495 to MD 410	MD 2 Northbound – College Pkwy to Robinson Rd/Leelyn Rd
MD 2 Southbound – College Pkwy to US 50	MD 3 Southbound – I-97/MD 32 to St. Stephens Church Rd

In addition to congested AM/PM peak hours, summer-weekend traffic is substantial along roadways on the Eastern Shore/Northeastern Maryland. For the Friday 6–7 PM, Saturday 11–12 noon, and Sunday 5–6 PM hours, the following locations were identified as most congested (with the worst locations listed in bold):

Freeways

US 50 Eastbound – Buschs Frontage Rd to Chesapeake Bay Bridge: Friday/Saturday
US 50 Westbound – Piney Creek Rd to MD 8: Saturday
US 50 Westbound – Kent Narrows Rd to MD 8: Sunday
I-95 Southbound – MD 22 to MD 543: Sunday

Arterials

US 50 Eastbound – MD 611 to MD 378: Saturday
MD 404 Eastbound – MD 16 to MD 313: Saturday
US 50 Westbound – Del Rhodes Ave to US 301: Sunday
US 50 Westbound – Kelly Bridge Lane to MD 611: Sunday

CONGESTION REDUCTION ACCOMPLISHMENTS

To address congestion, MDOT implemented various policies, programs, and projects for passenger and freight traffic. These methods provide benefits for system users to yield a safe and modern transportation system. MDOT achieved user cost savings by reducing delays, fuel consumption, and emissions. These combined efforts resulted in more than $1.5 billion in annual user savings.

2019 USER SAVINGS DUE TO MDOT CONGESTION MANAGEMENT	
CHART	$1,393 Million
Signals	$36 Million
Capital Projects	$58 Million
Park and Ride Program	$59 Million
Total	**$ 1,546 Million**

A summary of accomplishments associated with MDOT mobility improvement efforts include:

CHART

- The Coordinated Highways Action Response Team (CHART) program cleared more than 31,000 incidents and assisted approximately 40,000 stranded motorists on Maryland roadways.
- CHART services reduced an estimated 32.6 million vehicle hours of delay, amounting to approximately $1,393 million in user savings.

TRAFFIC SIGNALS

- MDOT SHA has introduced an innovative method to provide for real time changes to signal timing. In 2019, MDOT implemented the SMART Traffic Signals systems in seven corridors: along MD 2 in Anne Arundel County, MD 3 in Anne Arundel and Prince George's Counties, MD 7 in Baltimore County, MD 22 in Harford County, MD 198 in Prince George's County, MD 202 in Prince George's County, and US 13 in Wicomico County. Previously, six systems were operational, reducing delay by 26% in the most congested conditions.
- One hundred and twenty-four traffic signal timings were reviewed in 19 systems, along with 31 other intersections. Traffic signal retiming resulted in $36 million in annual user savings and will continue to provide recurring benefits for years.

CAPITAL PROJECTS

- Improved mobility resulted from five intersection improvement projects at MD 26 at Oakland Mills Rd, MD 273 at Blue Ball Rd, MD 180 at Mt. Zion Rd, US 40 at MD7/MD 159, and MD 97 at MD 28.
- Five roadway widening projects also improved mobility along MD 175 from Mapes Rd to Reece Rd, MD 26 from Exchange Dr to Calvert Way, MD 97 from Airport Dr to Pleasant Valley Rd, MD 337 from the I-95/I-495 Northbound Ramp to Suitland Rd, and the MD 32 Dualization from Linden Church Rd to MD 108.
- MDOT completed a project to provide a two-lane road with direct access to MD 235 for the Woodland Acres community in California and made safety improvements along MD 4 at Oak Dr.
- These projects resulted in $58 million in annual user savings.
- Several mobility improvement projects are currently under construction including widening I-695 from US 40 to MD 144, widening MD 32 from Linden Church Rd to I-70, replacing MD 210 intersection at Kerby Hill Rd/Livingston Rd with an interchange, and the I-270 Innovative Congestion Management Plan which provides for active traffic management and includes such features as ramp metering.
- The I-495 and I-270 P3 Program is an on-going effort to design, build, finance, operate, and

maintain improvements along these roadways to reduce congestion in the region.

IMPROVED MOBILITY ACCOMPLISHMENTS

- MDOT SHA developed the "*Context Driven: Access and Mobility for All Users" guide* as a planning and design resource focused on creating safe facilities for all roadway users.
- Several pedestrian and bicycle projects were completed as part of other roadway or stand-alone projects. These included more than seven miles of new sidewalks and nearly 80 miles of marked bicycle lanes. Approximately 12 miles of marked bike lanes were completed within three miles of transit stations.
- Statewide, more than 69% of the sidewalks are ADA compliant.
- The Bicycle & Pedestrian Master Plan 2019 Update was completed, which identifies methods to improve access and safety for all users.
- A total of 107 park and ride lots in 20 counties encourage transit use and carpooling. On average, more than 6,700 commuters use these lots during the week. This provided an annual user savings of $59 million.
- The I-270 and US 50 corridors provide high occupancy vehicle (HOV) lanes to encourage ridesharing and increased person throughput. The I-270 HOV lanes save as much as 13 minutes in the morning and 14 minutes in the evening in travel time. The HOV lanes provide person throughput of more than 2,500 people per hour/per lane, which is substantially higher than non-HOV lanes.
- Traffic volume on the Intercounty Connector MD 200 Managed Facility has grown more than 20,000 vehicles per day in the last five years to 58,000 vehicles per day between I-370 and I-95.
- More than 26,000 vehicles per day use the I-95 express toll lanes in Baltimore County. On peak days, volumes exceed 45,000 vehicles per day.

FREIGHT MOVEMENT

- Two new virtual weigh stations along US 13 at the Maryland/Virginia State line and along Broening Highway were completed in 2019, bringing the total number of weigh stations in Maryland to 19.
- The design is underway to accommodate ten new truck parking spaces on the I-70 eastbound and westbound Welcome Centers at South Mountain.
- Various projects on the National Highway Freight Network through the FAST ACT Freight Formula Fund are under construction including I-83 over Padonia Rd, I-95/I-495 over Suitland Parkway, and I-95/I-495 over MD 214.
- Two at-grade railroad crossings were improved to increase safety. These are located in Allegany and Carroll counties.
- On-going statewide freight initiatives included expanding the Statewide Truck Parking Study to evaluate needs/gaps/funding opportunities, deploying innovative technology for preclearance at truck weigh and inspection stations, updating the Maryland Freight Story Map, and implementing the Strategic Goods Movement Plan.

TRANSPORTATION SYSTEMS MANAGEMENT & OPERATIONS (TSMO)

- MDOT SHA has fully integrated a TSMO approach to effectively manage and operate existing facilities to maximize their full potential. Ongoing projects include SMART adaptive traffic signals along various arterial corridors, the I-270 Innovation Congestion Management Plan with ATMS control software, the I-270/I-495 P3 Program with managed lanes, and the I-695 Part Time Shoulder Use from I-70 to MD 43.
- In 2019, MDOT completed initiatives including formally partnering with WAZE, developing an implementation plan, collaboration with all seven MDOT SHA Districts on TSMO projects, developing plans for freight traveler information systems and truck parking systems, and preparing a "Next Gear System of Systems" and the Concept of Operations and preliminary design for I-70/US 40 from MD 32 to I-695 TSMO project.
- We will continue to advance as Connected and Automated Vehicles (CAV) expand into the mainstream. MDOT SHA initiatives include connected vehicle technology for pedestrian safety, CAV Vissim modeling, and many training and organizational events.

MARYLAND MOBILITY STATISTICS

I-695 @ I-83

INTRODUCTION

The Maryland Department of Transportation State Highway Administration (MDOT SHA) provides an annual comprehensive review of performance and mobility trends from the previous year. The 2020 Maryland Mobility Report summarizes results and accomplishments during the 2019 calendar year. This annual report reviews Maryland's mobility strategies, projects, programs, and initiatives using a goal-oriented, performance-based approach that focuses on: *What is Happening, What is MDOT SHA Doing,* and *What are the Outcomes*.
The Maryland Mobility Report illustrates:

- The agency's data driven methodologies to identify and address congestion issues.
- Transportation investments for a safe, efficient, and reliable movement of goods and services.
- Processes to monitor existing travel trends and identify successes, challenges, and strategies to improve transportation services.

Highlights of the 2020 Maryland Mobility Report include:

- Traffic volume trends.
- Pedestrian and bicycle projects and programs.
- Roadway and freight characteristics.
- Most congested freeway/expressway sections during a normal weekday and summer weekend.
- Most congested arterial sections.
- Freeway/expressway and arterial performance year-to-year comparisons.
- Projects completed in 2019 and their benefits.
- Programs to address mobility and their results.
- Transportation Systems Management and Operations (TSMO) and Connected and Automated Vehicles (CAV) activities.

The Maryland Mobility Report is a joint effort of the MDOT SHA's Office of Preliminary Planning and Engineering (MDOT SHA OPPE) and the Office of Transportation Mobility and Operations (MDOT SHA OTMO).

TRANSPORTATION INFRASTRUCTURE

Marylanders use many methods of transportation for passenger or freight movement. The Amtrak Northeast Corridor serves heavy rail passengers – with major stops in Baltimore at Penn Station and BWI Thurgood Marshall Airport. Mass transit service is provided through subways, commuter rail, light rail, and buses operated by MDOT Maryland Transit Administration (MDOT MTA), the Washington Metropolitan Area Transit Authority, and local transit operators. Air traffic is mainly handled by the Baltimore–Washington Thurgood Marshall International Airport (BWI), which saw an increase of nearly 14% in the amount of cargo handled in 2019, while also serving almost 27 million passengers arriving/departing in 2019. By water, the Helen Delich Bentley Port of Baltimore saw a record 43.6 million tons of cargo handled in 2019, which is the 11th highest amongst US ports for cargo tonnage. Additionally, almost 225,000 people departed on cruise lines from the Port in 2019. There are numerous bicycle and walking facilities ranging from a series of off-road trails such as the North Central Railroad Trail (NCR) or BWI trail to sidewalks or bike paths along its highways. The MDOT SHA provides a multi-modal infrastructure network that supports safe and effective access and mobility for all types of transportation statewide. (Figure 1).

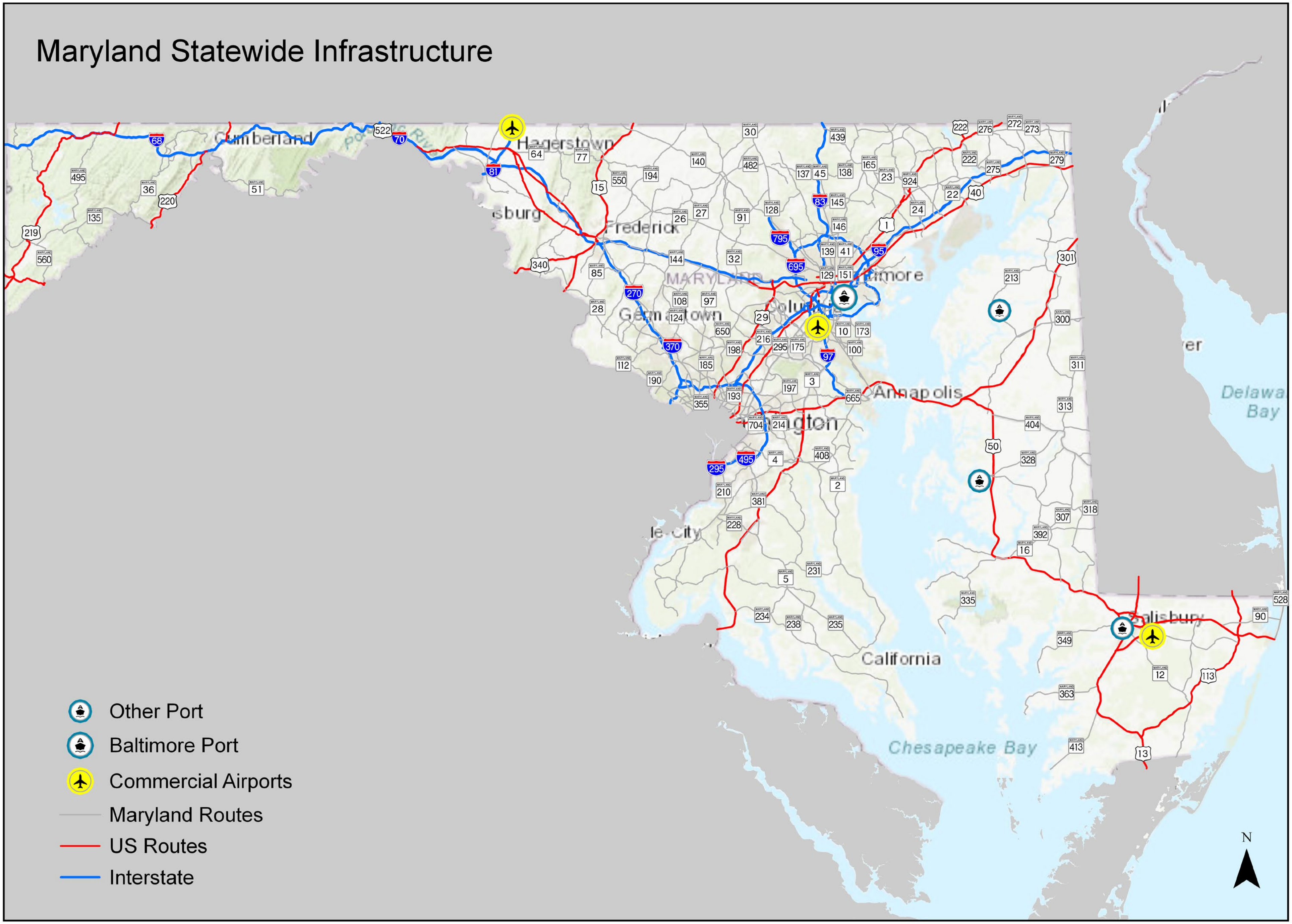
ROADWAYS

From Oakland to Ocean City, roadways provide a means to access cities, towns, and villages throughout the State of Maryland for the 4.4 million licensed motorists, truck drivers, and other travelers. The state's major roadway facilities are operated by the Maryland Department of Transportation (MDOT). The MDOT SHA maintains interstates, US routes, and numbered Maryland routes, with the exception of interstates and routes through Baltimore City and portions maintained by the Maryland Transportation Authority (MDTA) which operates all toll facilities. Roadways are classified based on the role they play in moving vehicles throughout a network of highways. This classification system identifies a road's primary use, ranging from freeways to local streets (Table 1).

Table 1

ROADWAY FUNCTIONAL CLASSIFICATION	
CLASSIFICATION	FUNCTION
Freeway/Expressways	Controlled access facilities with limited points of ingress/egress. These facilities are designed for long distance travel at higher speeds.
Arterials	Highest functioning roads normally with traffic signals. These roadways serve as interconnections between major corridors and are used for long-distance trips.
Collectors	Gather traffic from local roads and funnels to an arterial system. Serves both land access and traffic circulation.
Locals	Provide direct access to adjacent land use and does not carry through traffic.

Figure 1


Maryland Statewide Infrastructure
Cumberland
Hagerstown
Frederick
Germantown
Columbia
Baltimore
Annapolis
California
Salisbury
Chesapeake Bay
Delaware Bay
Other Port
Baltimore Port
Commercial Airports
Maryland Routes
US Routes
Interstate
N

MDOT is responsible for maintaining the majority of Interstate, US and Maryland routes. These facilities have the highest average number of lanes per mile (Table 2). Typically, the highest average number of lanes per mile correlates to the highest volumes and most congestion and mobility challenges.

Table 2

MILEAGE STATISTICS					
ROAD TYPE	ROADWAY MILES	PERCENTAGE OF ROADWAY MILES	LANE MILES[1]	AVERAGE NUMBER OF LANES/MILE	OWNERSHIP
Interstate Routes	490	2%	2,853	5.8	MDOT, MDTA, Baltimore City
US Routes	759	2%	2,705	3.6	MDOT, MDTA, Baltimore City
Maryland Routes	4,209	13%	10,556	2.5	MDOT, MDTA
Other Roadways	25,885	83%	52,920	2.0	Counties, Municipalities

1- Lane Miles = Roadway Miles x Number of Lanes

US 50/US 301 at Severn River Bridge

Maryland has more than 31,000 roadway miles.

MAJOR STRUCTURES – BRIDGES AND TUNNELS

The Chesapeake Bay and the Patapsco, Patuxent, Potomac, and Susquehanna Rivers provide the back drop of some of the most signature bridges and tunnels located in Maryland. In addition to these familiar structures, there are more than 5,000 other bridges that provide valuable connections over waterways, around rail, or across highways. These bridges are owned by many different agencies, but MDOT SHA is responsible for the highest number of bridges (Table 3 and Figure 2). The MDTA maintains the two tunnels in Maryland. The eight lane, 1.4 mile, Fort McHenry Tunnel allows I-95 traffic to pass under the Patapsco River. The I-895 Harbor Tunnel is a four lane facility approximately 1.4 miles long and is parallel to the Fort McHenry Tunnel.

MARYLAND'S SIGNATURE BRIDGES AND TUNNELS

American Legion Bridge (I-495)

Fort McHenry Tunnel (I-95)

Harbor Tunnel (I-895)

Harry Nice Bridge (US 301)

Hatem Bridge (US 40)

Key Bridge (MD 695)

Thomas Johnson Memorial Bridge (MD 4)

Tydings Memorial Bridge (I-95)

William Preston Lane Memorial (Bay) Bridge (US 50/301)

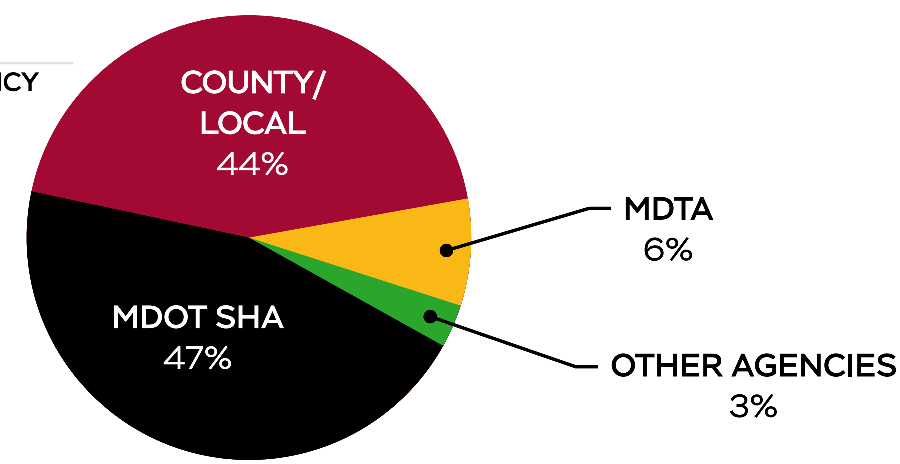
Woodrow Wilson Memorial Bridge (I-95/I-495)

Table 3

MARYLAND BRIDGES BY OWNERSHIP	
OWNER	NUMBER OF BRIDGES
MDOT SHA	2,553
County/Local	2,388
MDTA	322
Other Agencies (Federal, Railroad, Other State Agencies)	139

Figure 2

BRIDGE OWNERSHIP BY AGENCY



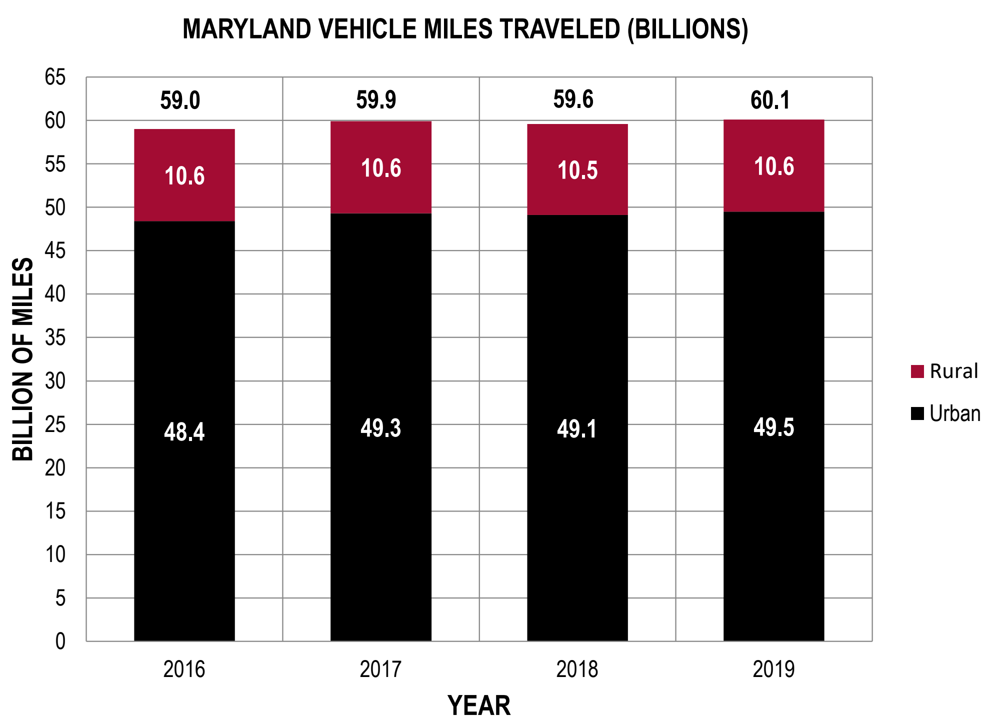
TRAFFIC TRENDS

Year to year comparisons are performed on the amount of travel along Maryland's roadways to evaluate trends. A standard performance measure to gauge overall roadway usage is Vehicle Miles Traveled (VMT). VMT is defined as the number of vehicles times the distance traversed along the system and is calculated for various roadway classifications on a local, regional, state, and national level. A comparison of VMT allows for a method to track growth and demands on different roadways.

VEHICLE MILES TRAVELED - TOTAL/URBAN/RURAL

In 2019, there was a new record for the amount of VMT on the roadway system in Maryland. This was the first time that travel on Maryland roadways exceeded 60 billion miles. This amounted to 0.5 billion VMT increase with the majority of the increase occurring on urban roadways (Figure 3).

Figure 3



VMT increased to an all-time record of 60.1 billion miles, which was more than 0.5 billion miles higher than in 2018.

VEHICLE MILES TRAVELED - BY AGENCY AND FACILITY TYPE

The amount of VMT along MDOT SHA and MDTA roadways far exceeds travel along other locally owned roadways. Despite MDOT SHA and MDTA roadways accounting for only 17% of the roadway miles, 72% of the VMT occurs on these roadways (Table 4 and Figure 4). Maryland-numbered routes account for the highest amount of VMT, with nearly 20 billion miles (Table 5 and Figure 5).

Table 4

VMT BY AGENCY	
AGENCY	VMT (BILLIONS)
MDOT SHA	39.61
County/Local/Others	16.92
MDOT MDTA	3.60

Table 5

VMT BY ROADWAY CLASSIFICATION	
ROADWAY DESIGNATION	VMT (BILLIONS)
Maryland Routes	19.19
Interstate Routes	18.11
County/Local/Others	15.76
US Routes	7.07

Figure 4

VMT BY AGENCY

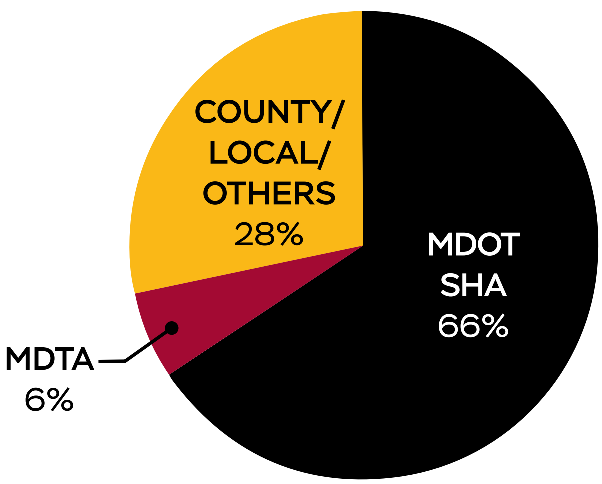
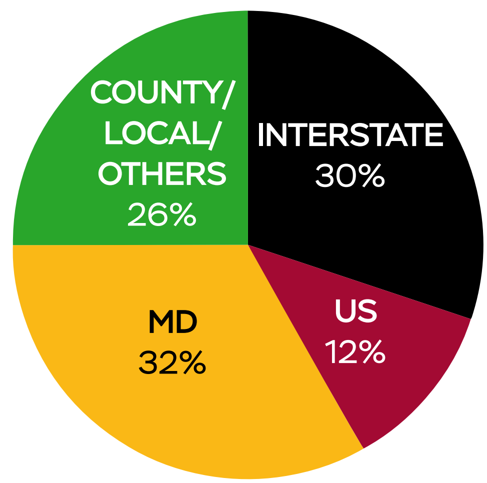


Figure 5

VMT BY ROADWAY CLASSIFICATION

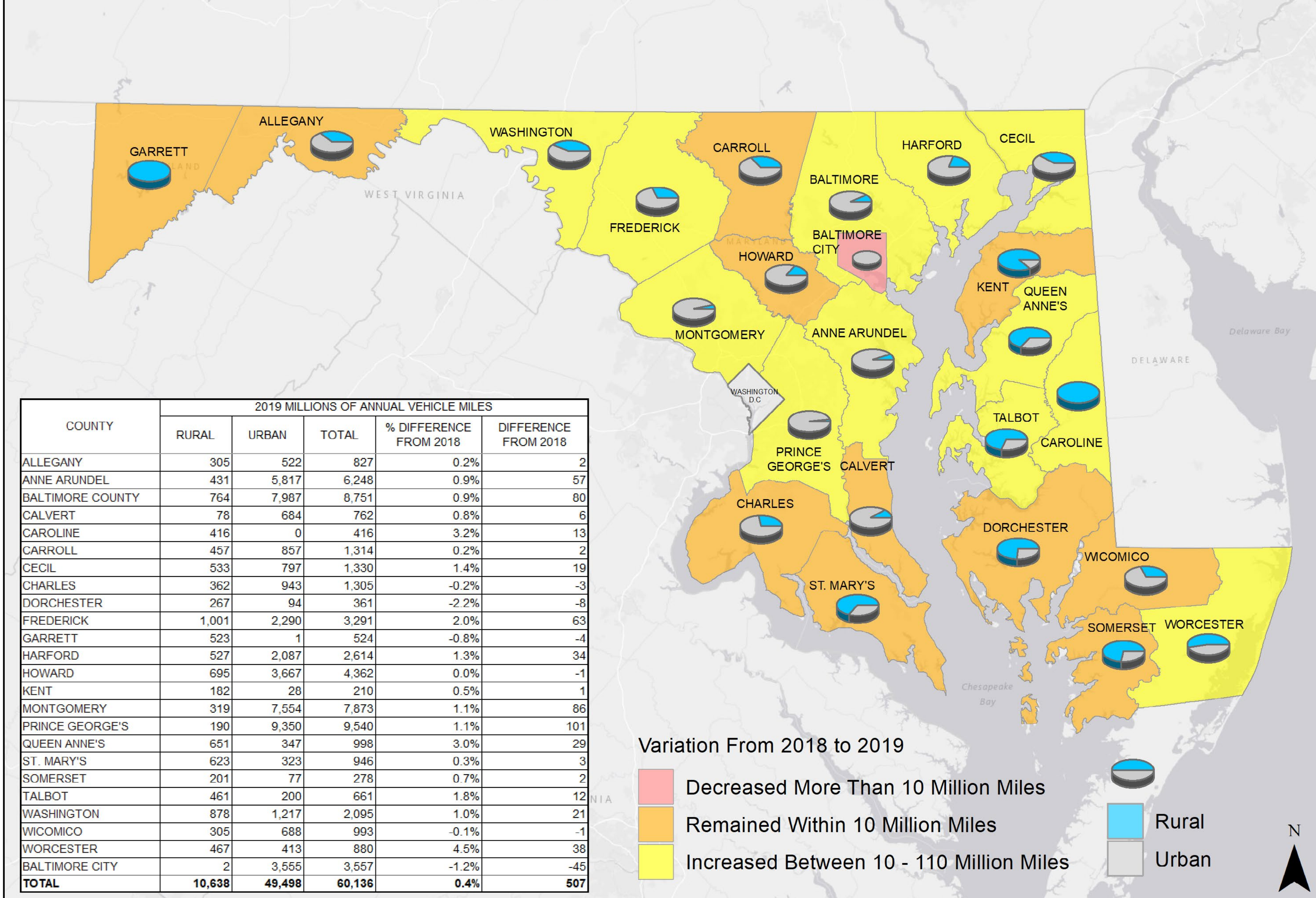


VEHICLE MILES TRAVELED – BY COUNTY

The largest increase in VMT by county occurred in the urban areas of Prince George's, Montgomery, and Baltimore Counties with each location increasing by more than 80 million vehicle miles versus 2018. The largest percentage changes occurred in the more rural counties due to lower volumes. Caroline, Queen Anne's, and Worcester County increased by more than 3% in VMT, while Dorchester County volumes decreased by more than 2%. Seventeen counties experienced an increase in VMT from 2018 to 2019 (Figure 6).

Figure 6

2019 Vehicle Miles Of Travel - By County



COUNTY	2019 MILLIONS OF ANNUAL VEHICLE MILES				
	RURAL	URBAN	TOTAL	% DIFFERENCE FROM 2018	DIFFERENCE FROM 2018
ALLEGANY	305	522	827	0.2%	2
ANNE ARUNDEL	431	5,817	6,248	0.9%	57
BALTIMORE COUNTY	764	7,987	8,751	0.9%	80
CALVERT	78	684	762	0.8%	6
CAROLINE	416	0	416	3.2%	13
CARROLL	457	857	1,314	0.2%	2
CECIL	533	797	1,330	1.4%	19
CHARLES	362	943	1,305	-0.2%	-3
DORCHESTER	267	94	361	-2.2%	-8
FREDERICK	1,001	2,290	3,291	2.0%	63
GARRETT	523	1	524	-0.8%	-4
HARFORD	527	2,087	2,614	1.3%	34
HOWARD	695	3,667	4,362	0.0%	-1
KENT	182	28	210	0.5%	1
MONTGOMERY	319	7,554	7,873	1.1%	86
PRINCE GEORGE'S	190	9,350	9,540	1.1%	101
QUEEN ANNE'S	651	347	998	3.0%	29
ST. MARY'S	623	323	946	0.3%	3
SOMERSET	201	77	278	0.7%	2
TALBOT	461	200	661	1.8%	12
WASHINGTON	878	1,217	2,095	1.0%	21
WICOMICO	305	688	993	-0.1%	-1
WORCESTER	467	413	880	4.5%	38
BALTIMORE CITY	2	3,555	3,557	-1.2%	-45
TOTAL	**10,638**	**49,498**	**60,136**	**0.4%**	**507**

ANNUAL AVERAGE DAILY TRAFFIC (AADT)

MDOT SHA administers a traffic data collection program along roadways throughout the state. The data is collected with equipment and personnel on numerous sections of roadway. Annual average daily traffic (AADT) measures the volume of traffic for the year, divided by the number of days in a year. The highest volumes along freeways, arterials, and toll facility crossings exceeded 265,000 vehicles per day (Table 6). The largest change occurred at the I-895 Baltimore Harbor Tunnel. Construction temporarily reduced the number of lanes on I-895 from two to one in each direction just north of the tunnel. Many motorists chose other routes, reducing the average daily volume by approximately 27,000 vehicles per day.

Table 6

HIGHEST ANNUAL AVERAGE DAILY TRAFFIC (AADT) VOLUMES (VEHICLES PER DAY)	
FREEWAY SECTION	2019 AADT
I-270 N of I-270 Split	267,000
I-270 N of Montrose Rd	256,000
I-495 W of I-270	255,000
I-95/I-495 W of US 1	253,000
I-95/I-495 Woodrow Wilson Bridge	247,000
ARTERIAL SECTION	2019 AADT
US 301/MD 5 S of McKendree Rd	105,000
MD 5 S of MD 223	85,000
MD 3 N of MD 424	84,000
MD 3 N of Prince George's County Line	82,000
MD 650 S of I-495	80,000
MDTA TOLL FACILITY CROSSINGS	2019 AADT
I-95 Ft. McHenry Tunnel	141,000
I-95 Tydings Bridge	85,000
US 50/301 Bay Bridge	76,000
I-895 Harbor Tunnel	47,000

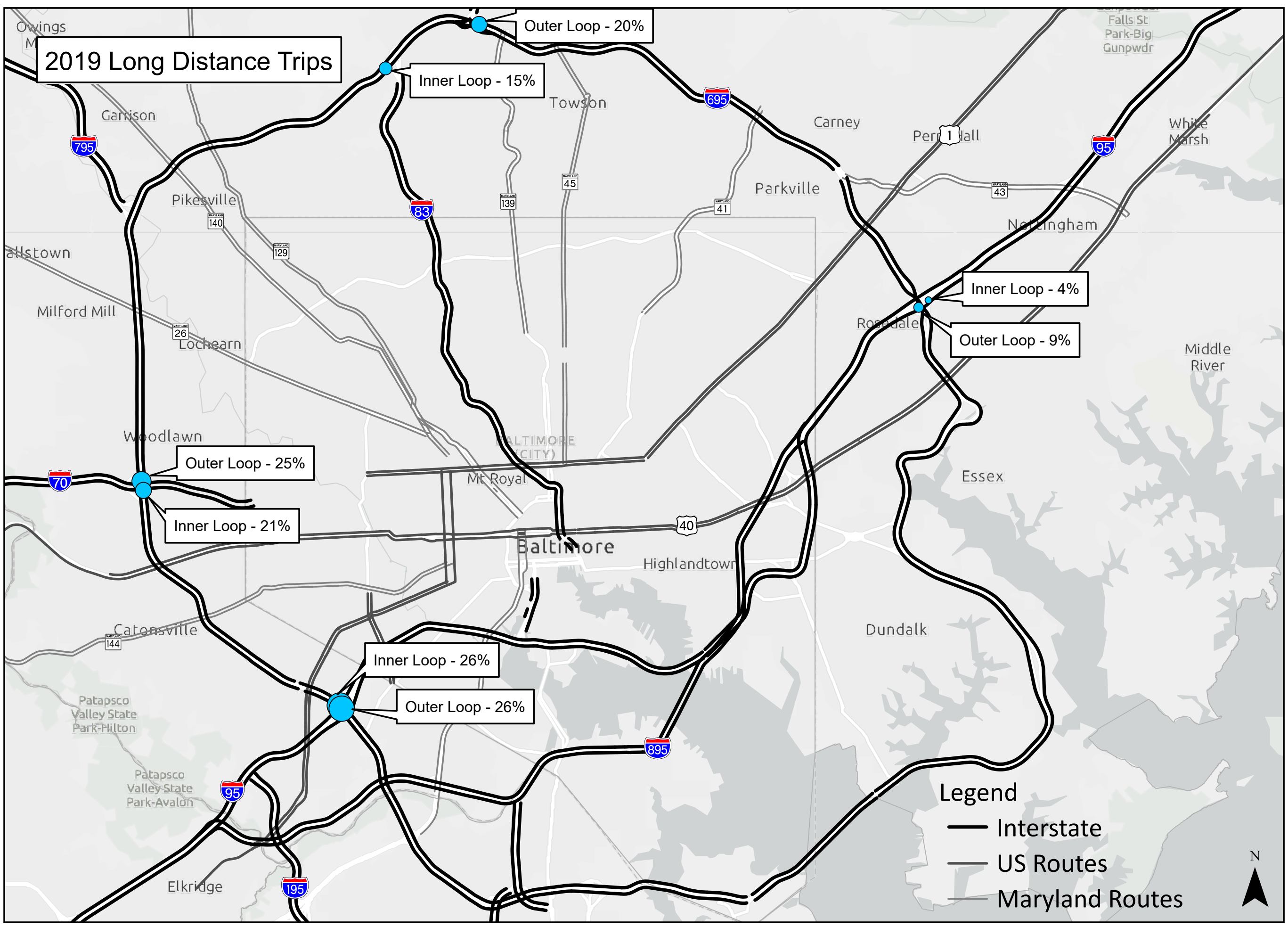
ORIGIN-DESTINATION DATA

Traditional origin-destination data is typically conducted through one-day license plate surveys due to cost and data processing demand. However, with emerging big data sources, the ability to track these trends has become easier and more reliable. Companies use Location Based Services (LBS) data, which identifies cell phone, GPS, or In-Cab device coordinates to certain apps that are installed on phones. The use of this data allows for a more comprehensive dataset. Trends can be performed on a large scale – such as a segment of roadway. This data can be broken down by vehicle type, day of week, or time of day.[1]

One example of the use of this data is determining trip patterns along I-695 (Baltimore Beltway). In this example, StreetLight data analysis provided an evaluation of various sections of I-695 to determine if trips at specific points were short or long distance in nature. The results showed a higher percentage of long distance trips occur on the Southwest side of I-695. (Figure 7). For example 26% of the trips at I-95 are long distance trips while 74% are short distance trips to the areas around Baltimore City, County and adjacent Counties.

Figure 7

I-695 TRIP PATTERNS



Source: StreetLight Data

1 - MDOT SHA provided the big picture results but does not track individual data.

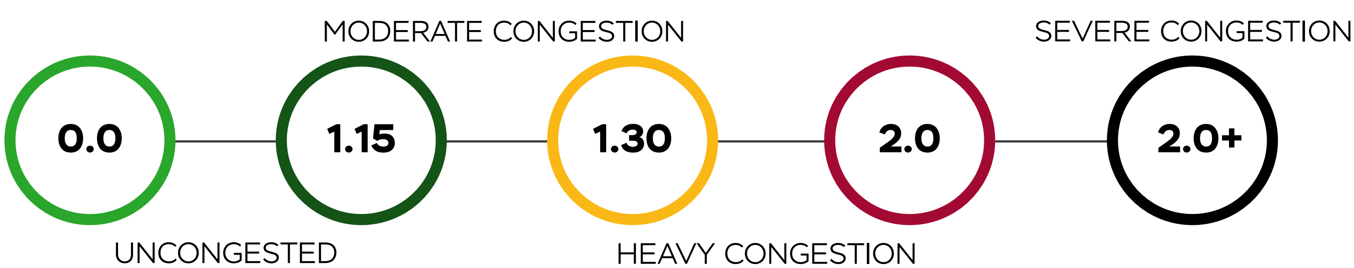
CONGESTION TRENDS

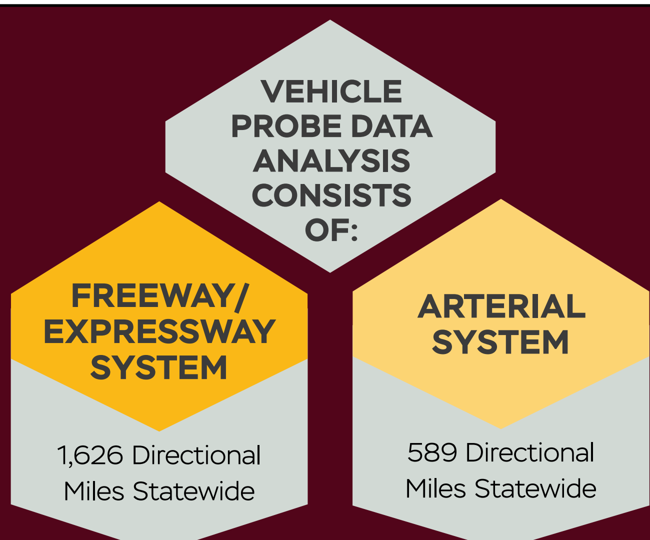
Traffic congestion can be broadly defined into two categories. The first category is called recurring congestion, which occurs daily in the morning (AM) and afternoon (PM) peak periods. This type of congestion is influenced by high automobile and truck traffic volumes, narrow lane and shoulder widths and geometrics of the roadway. Freeway/expressway operations are also influenced by areas where traffic enters and exits the roadway. Whereas, motorists who travel along arterials confront delays at traffic signals, variations in speed and different geometrics such as shoulder widths and lane widths. The second category is called non-recurring congestion; which occurs as a result of incidents including crashes, vehicle breakdowns, work zones, inclement weather; that causes motorists to experience slowing or stop and go traffic conditions.

There are various methods to measure congestion ranging from theoretical analysis to field measurements. One such method is vehicle probe data. Probes are vehicles equipped with Global Positioning System (GPS) elements such as navigation devices that transmit real time data. Analyzing this data helps evaluate mobility. Vehicle probe speed datasets are available from a variety of sources on a minute-by-minute basis. The data is provided by INRIX, a company which collects traffic speed data from an estimated 100 million probe vehicles nationwide including commercial vehicle fleets. In addition, MDOT SHA collects traffic volume data on its roadways using automated traffic recorders (ATR). The University of Maryland Center for Advanced Transportation Technology (UMD CATT) uses the vehicle probe speed data and traffic volume data to develop metrics to measure congestion (Figure 8).

Figure 8

METRIC: MEASUREMENT OF CONGESTION (TRAVEL TIME INDEX)





With vehicle probe data, the Travel Time Index (TTI) is used as the primary measure of congestion. The TTI compares the 50th percentile travel time on a segment of roadway for a particular hour to the travel time of a trip during the off-peak (off-peak is considered when free flow or uncongested conditions exist). The higher the TTI, the longer the travel time.

CONGESTION MEASURES

There are various metrics used to evaluate statewide congestion. The first set of metrics are the number of roadway miles and the percent of roadway miles that operate with heavy to severe congestion. This is reported in Table 7 for freeways/expressways and Table 8 for arterials. The last metric, percent of peak hour VMT Impacted, measures the amount of VMT that occurs in heavy to severe congestion during the peak hour and is only provided for freeways/expressways. This metric summarizes information about how many motorists experience these conditions, along with the distance they travel during the peak hour.

The 2019 values for the three congestion measures showed an increase between 2018 and 2019. This increase occurred in the number of miles in both the AM and PM peak hours that experienced the worst levels of congestion on the freeway/expressway and arterial system.

Table 7

STATEWIDE FREEWAY/EXPRESSWAY SYSTEM
(AVERAGE WEEKDAY AM & PM PEAK HOUR HEAVY TO SEVERE CONGESTION SUMMARY)

HEAVY TO SEVERE CONGESTION	2017		2018		2019		CHANGE FROM 2018 TO 2019	
	AM	**PM**	**AM**	**PM**	**AM**	**PM**	**AM**	**PM**
Roadway Miles	151	254	155	262	177	286	+22	+24
Percent of Roadway Miles	9	15	10	16	11	18	+1	+2
Percent of Peak Hour VMT Impacted	19	29	19	29	22	31	+3	+2

Table 8

STATEWIDE MAJOR ARTERIAL SYSTEM
(AVERAGE WEEKDAY AM & PM PEAK HOUR HEAVY TO SEVERE CONGESTION SUMMARY)

HEAVY TO SEVERE CONGESTION	2017		2018		2019		CHANGE FROM 2018 TO 2019	
	AM	**PM**	**AM**	**PM**	**AM**	**PM**	**AM**	**PM**
Roadway Miles	73	160	71	155	88	201	+17	+46
Percent of Roadway Miles	13	29	12	26	15	34	+3	+8

Statewide congestion (TTI) maps were developed for the freeway/expressway and arterial system for five time periods, including the average weekday AM and PM peak hours. In addition to AM and PM peak hour analysis, it has been noted that certain areas experience much greater congestion on summer weekends. To further explain the congestion trend, maps were also developed for the 6–7 PM Friday, 11 AM–12 noon Saturday, and 5–6 PM Sunday hours. These are as follows:

- AM Peak Hour 8-9 AM - Figure 9
- PM Peak Hour 5–6 PM - Figure 10
- Friday Summer 6–7 PM - Figure 11
- Saturday Summer 11 AM–12 noon - Figure 12
- Sunday Summer 5–6 PM - Figure 13

Figure 9

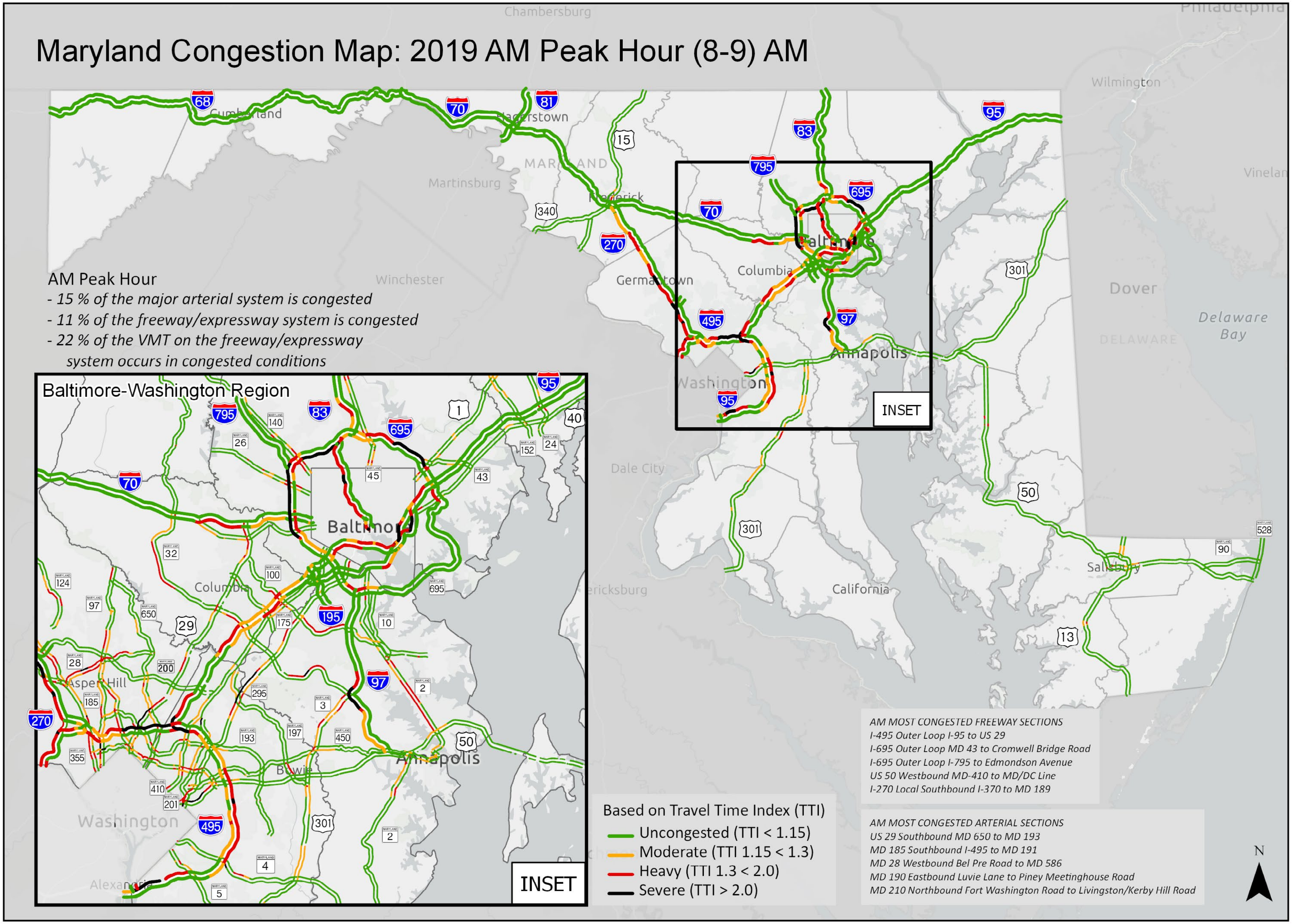
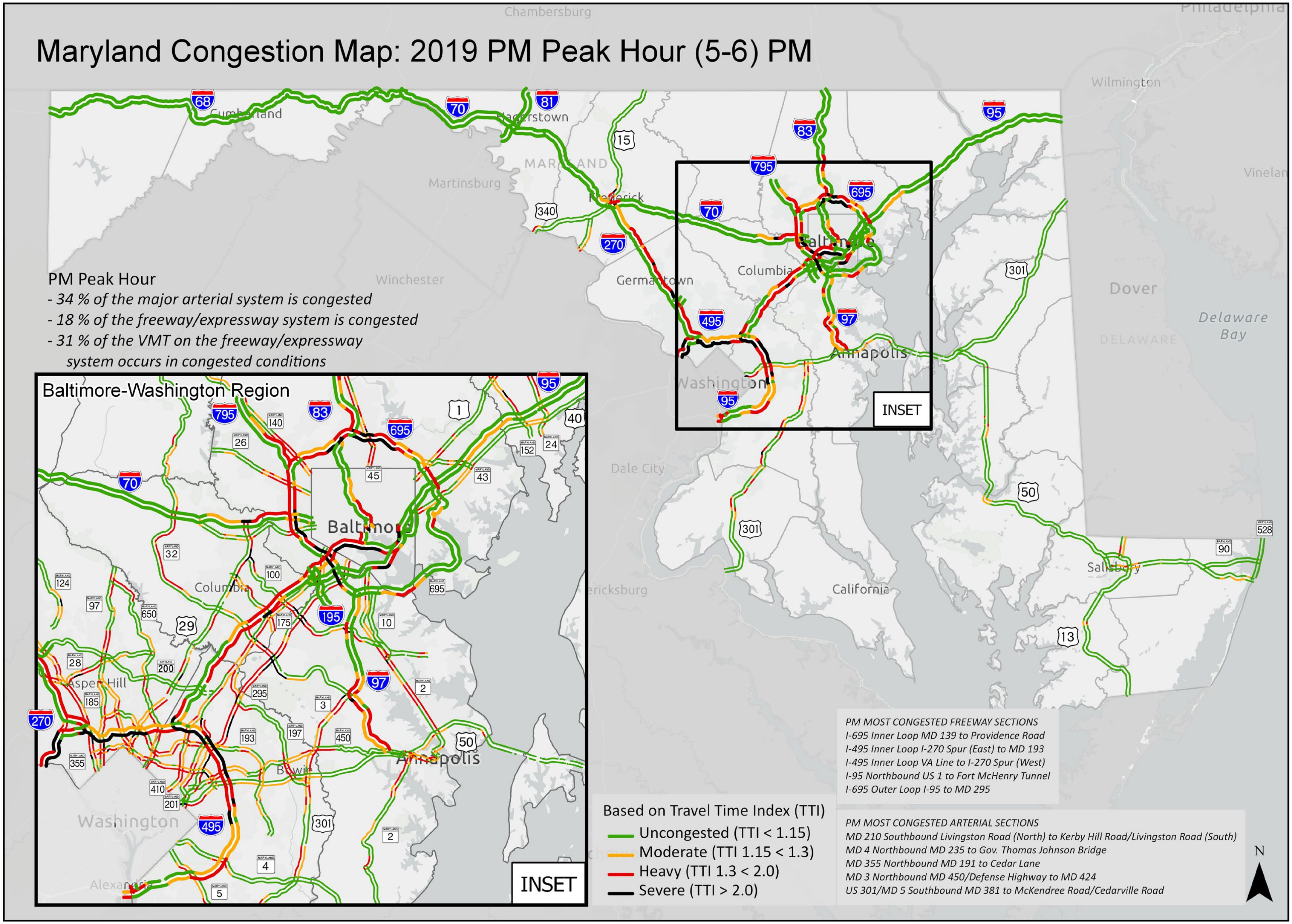

Maryland Congestion Map: 2019 AM Peak Hour (8-9) AM
AM Peak Hour
- 15 % of the major arterial system is congested
- 11 % of the freeway/expressway system is congested
- 22 % of the VMT on the freeway/expressway system occurs in congested conditions
Baltimore-Washington Region
INSET
Based on Travel Time Index (TTI)
Uncongested (TTI < 1.15)
Moderate (TTI 1.15 < 1.3)
Heavy (TTI 1.3 < 2.0)
Severe (TTI > 2.0)
AM MOST CONGESTED FREEWAY SECTIONS
I-495 Outer Loop I-95 to US 29
I-695 Outer Loop MD 43 to Cromwell Bridge Road
I-695 Outer Loop I-795 to Edmondson Avenue
US 50 Westbound MD-410 to MD/DC Line
I-270 Local Southbound I-370 to MD 189
AM MOST CONGESTED ARTERIAL SECTIONS
US 29 Southbound MD 650 to MD 193
MD 185 Southbound I-495 to MD 191
MD 28 Westbound Bel Pre Road to MD 586
MD 190 Eastbound Luvie Lane to Piney Meetinghouse Road
MD 210 Northbound Fort Washington Road to Livingston/Kerby Hill Road
N
Cumberland
Hagerstown
Martinsburg
Winchester
Frederick
Germantown
Columbia
Baltimore
Annapolis
Washington
Wilmington
Dover
Delaware Bay
DELAWARE
Salisbury
California
Dale City
Chambersburg

Figure 10



Maryland Congestion Map: 2019 PM Peak Hour (5-6) PM
PM Peak Hour
- 34 % of the major arterial system is congested
- 18 % of the freeway/expressway system is congested
- 31 % of the VMT on the freeway/expressway system occurs in congested conditions
Baltimore-Washington Region
INSET
Chambersburg
Philadelphia
Wilmington
Cumberland
Hagerstown
MARYLAND
Martinsburg
Frederick
Winchester
Germantown
Columbia
Baltimore
Annapolis
Washington
Dover
DELAWARE
Delaware Bay
Vineland
Dale City
California
Salisbury
Aspen Hill
Bowie
Alexandria
Based on Travel Time Index (TTI)
Uncongested (TTI < 1.15)
Moderate (TTI 1.15 < 1.3)
Heavy (TTI 1.3 < 2.0)
Severe (TTI > 2.0)
PM MOST CONGESTED FREEWAY SECTIONS
I-695 Inner Loop MD 139 to Providence Road
I-495 Inner Loop I-270 Spur (East) to MD 193
I-495 Inner Loop VA Line to I-270 Spur (West)
I-95 Northbound US 1 to Fort McHenry Tunnel
I-695 Outer Loop I-95 to MD 295
PM MOST CONGESTED ARTERIAL SECTIONS
MD 210 Southbound Livingston Road (North) to Kerby Hill Road/Livingston Road (South)
MD 4 Northbound MD 235 to Gov. Thomas Johnson Bridge
MD 355 Northbound MD 191 to Cedar Lane
MD 3 Northbound MD 450/Defense Highway to MD 424
US 301/MD 5 Southbound MD 381 to McKendree Road/Cedarville Road
N

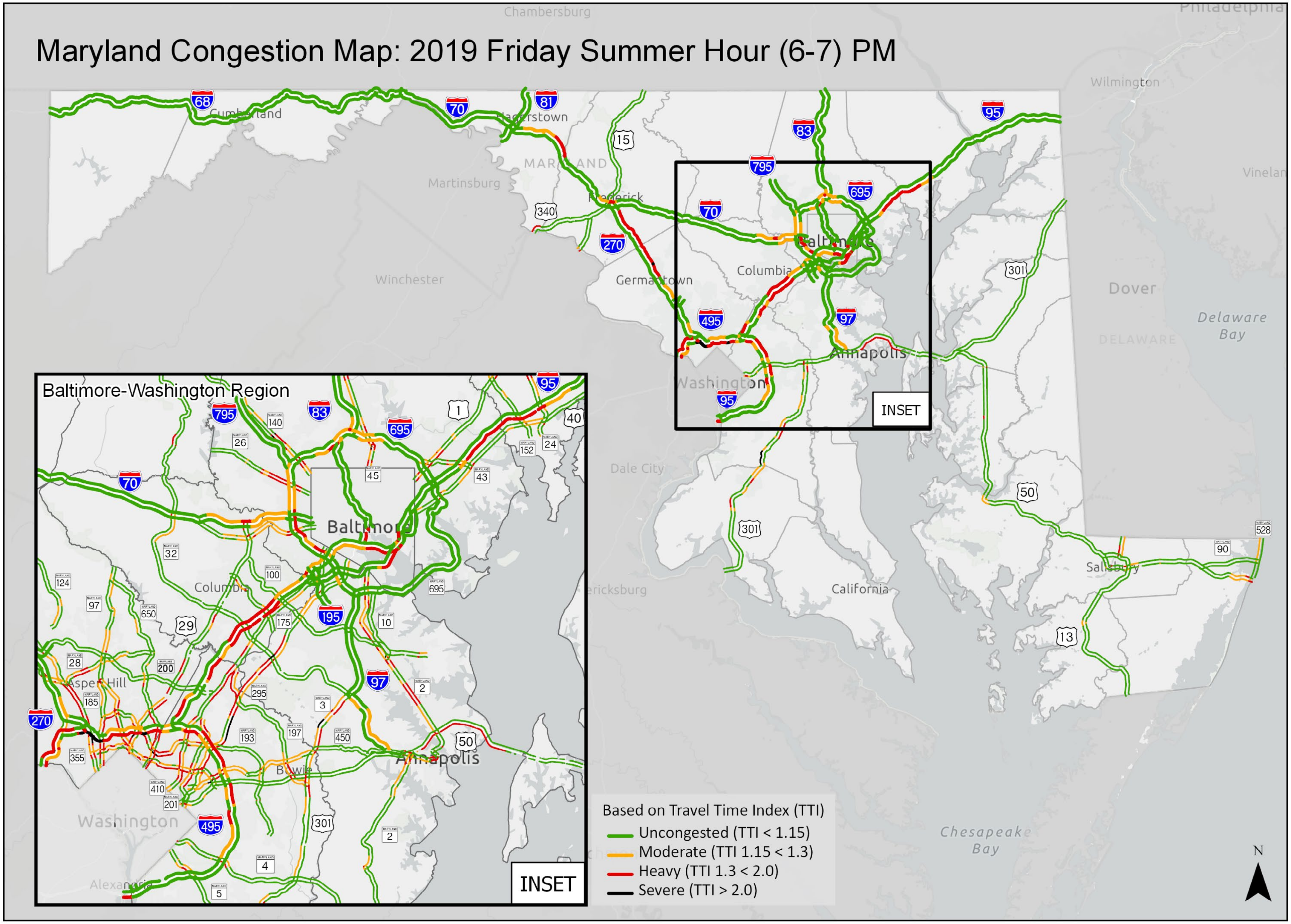
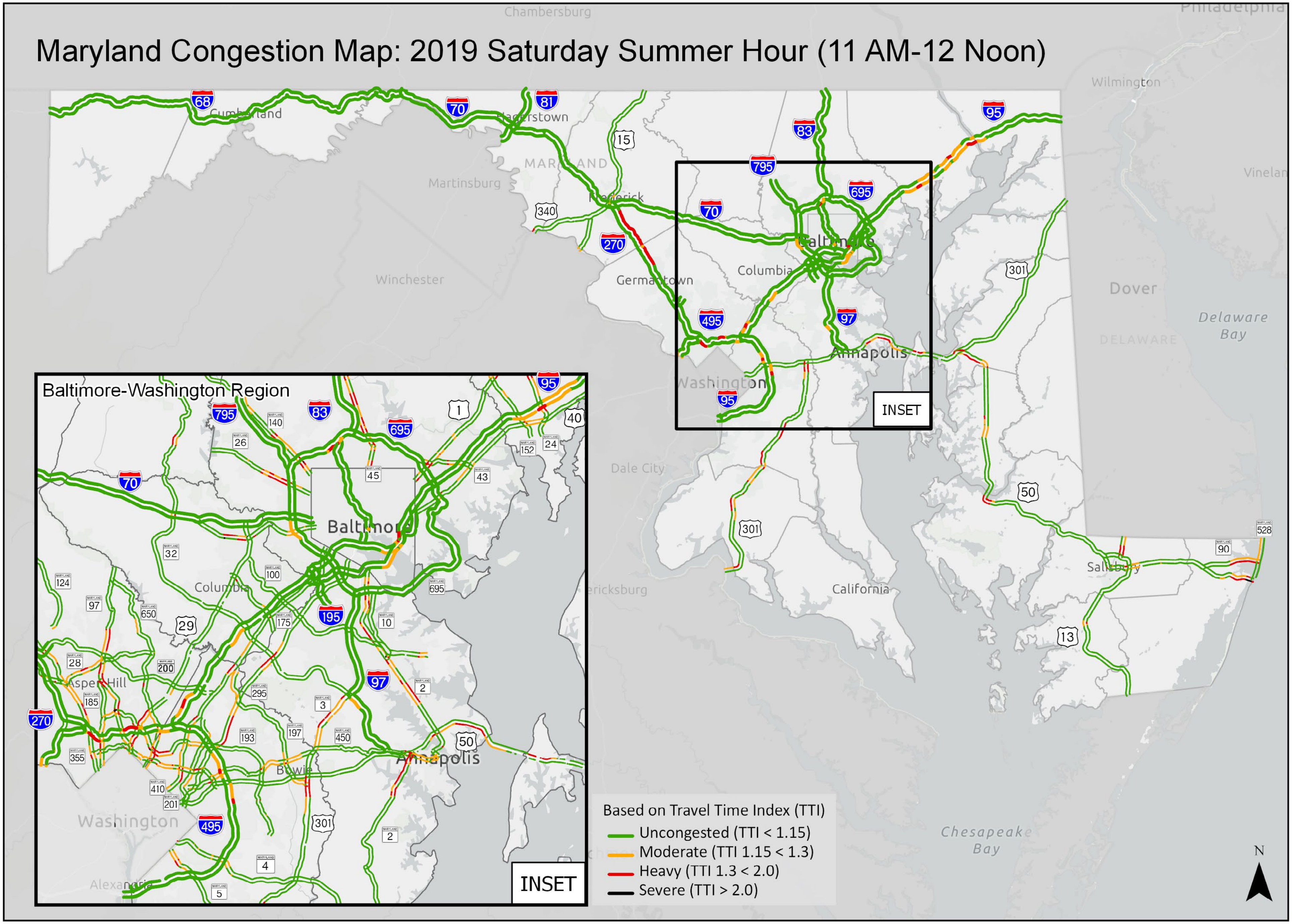
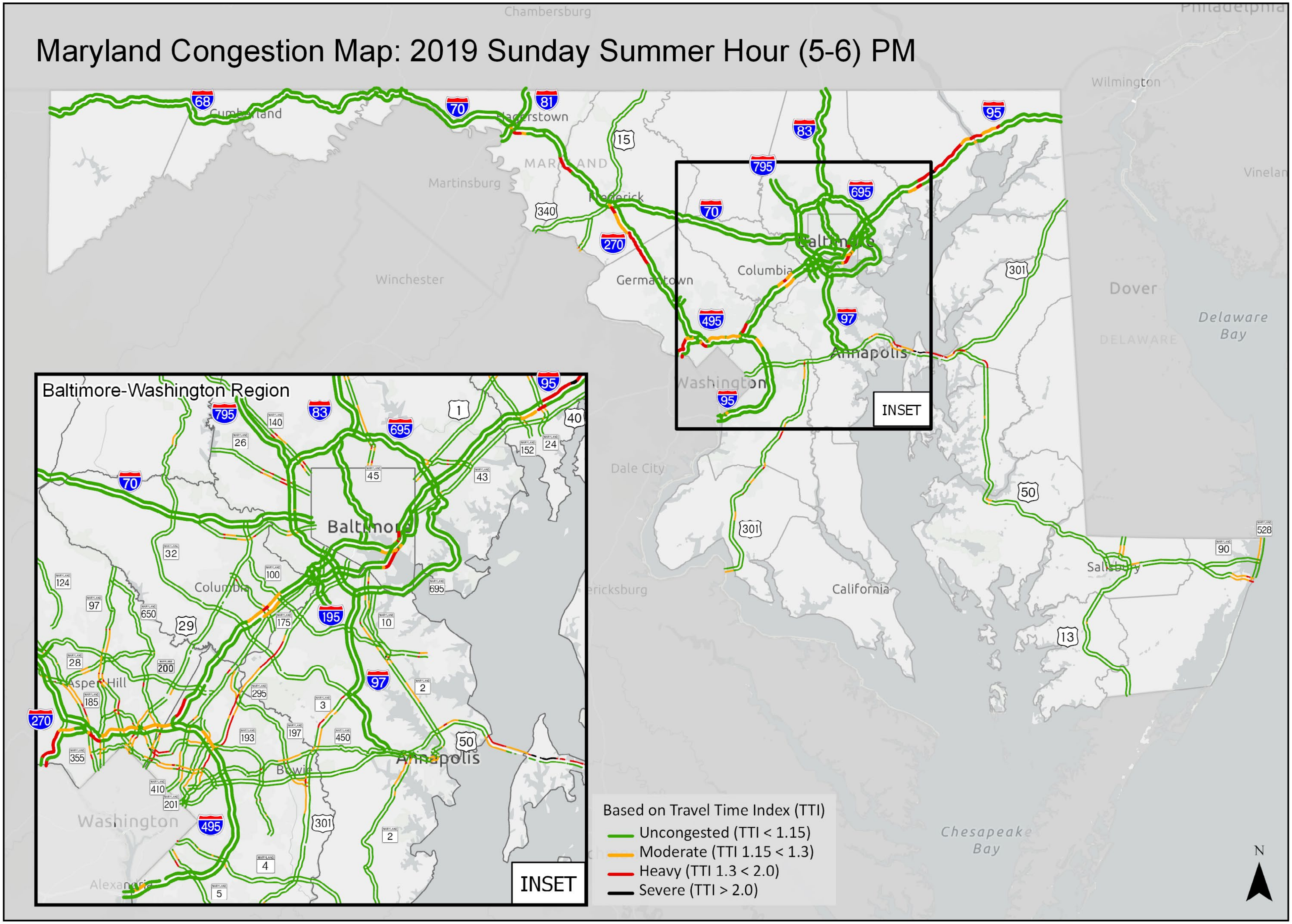

Maryland Congestion Map: 2019 Friday Summer Hour (6-7) PM
Baltimore-Washington Region
INSET
Based on Travel Time Index (TTI)
Uncongested (TTI < 1.15)
Moderate (TTI 1.15 < 1.3)
Heavy (TTI 1.3 < 2.0)
Severe (TTI > 2.0)
N
Cumberland
Hagerstown
Frederick
Germantown
Columbia
Baltimore
Annapolis
Washington
Salisbury
California
Dover
Chesapeake Bay
Delaware Bay
Bowie
Aspen Hill

Figure 12


Maryland Congestion Map: 2019 Saturday Summer Hour (11 AM-12 Noon)
Baltimore-Washington Region
INSET
Based on Travel Time Index (TTI)
Uncongested (TTI < 1.15)
Moderate (TTI 1.15 < 1.3)
Heavy (TTI 1.3 < 2.0)
Severe (TTI > 2.0)
N


Maryland Congestion Map: 2019 Sunday Summer Hour (5-6) PM
Baltimore-Washington Region
INSET
INSET
Based on Travel Time Index (TTI)
Uncongested (TTI < 1.15)
Moderate (TTI 1.15 < 1.3)
Heavy (TTI 1.3 < 2.0)
Severe (TTI > 2.0)
N
Cumberland
Hagerstown
Frederick
Germantown
Columbia
Baltimore
Washington
Annapolis
Salisbury
Dover
California
Chesapeake Bay
Delaware Bay

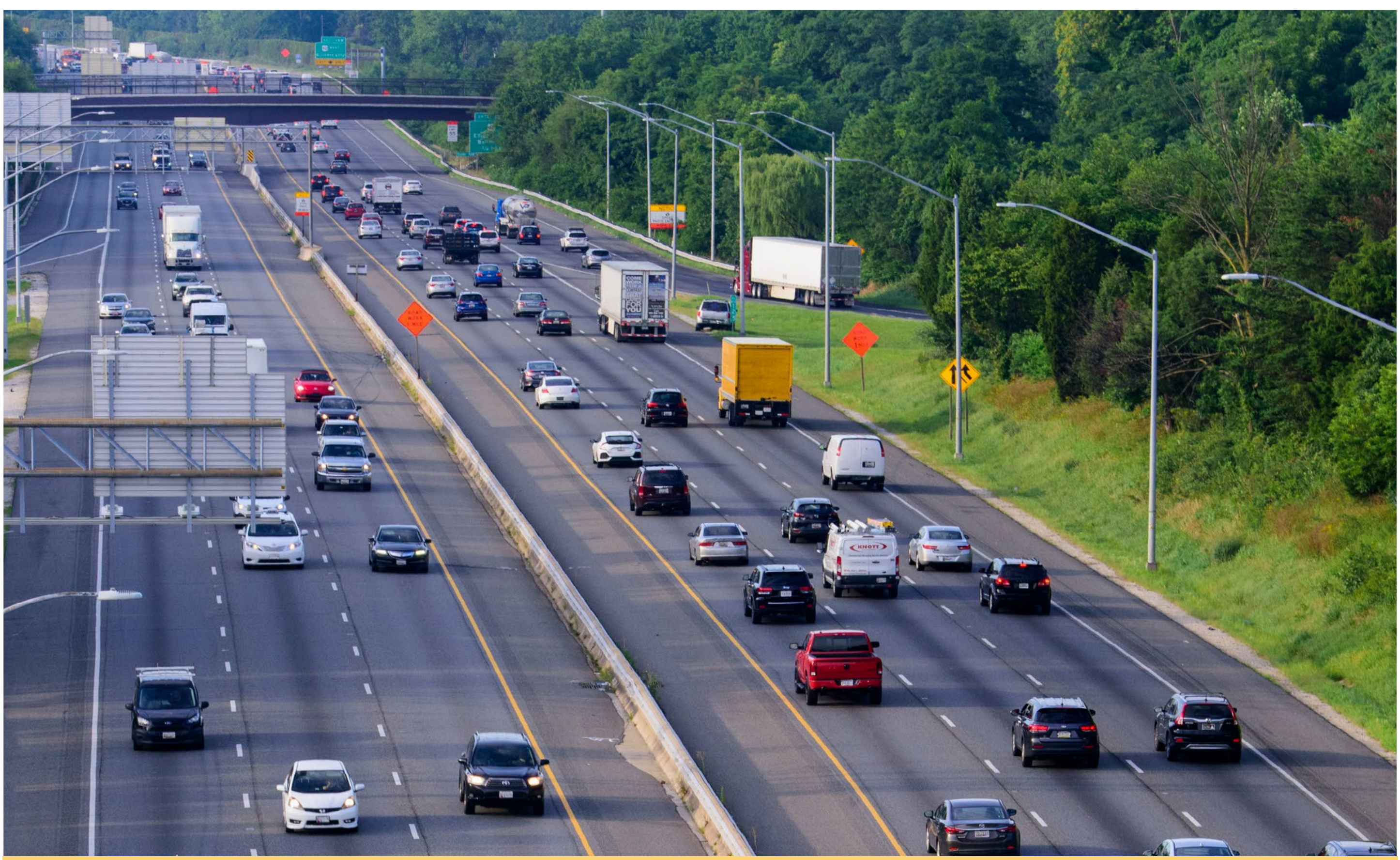
COST OF CONGESTION

There is a cost associated with congestion. The MDOT SHA calculates the statewide cost based on auto delay, truck delay, and wasted fuel and emissions. The statewide cost for congestion has increased by more than $1 billion between 2018 and 2019 (Table 9). There were various elements that influenced the increase in the congestion cost. The major factor was an overall decrease in average travel speeds in 2019, especially along freeways/expressways. This can be seen in the Top 15 AM and PM congested corridor sections on the following pages, in which the 2019 TTI values for the Top 15 were generally higher for a majority of these sections versus 2018. Another factor that influenced the increase in cost was a slightly higher value of time for auto drivers and auto passengers. Both the Baltimore and Washington regions saw significant increases in the cost of congestion from 2018 to 2019.

Table 9

TOTAL COST OF CONGESTION ON FREEWAYS/EXPRESSWAYS AND ARTERIALS ($ MILLIONS)

REGION	2017	2018	2019	CHANGE FROM 2018 TO 2019
Freeways/Expressways	$2,874	$2,727	$3,584	$+857
Arterials	$1,180	$1,241	$1,576	$+335
TOTAL	$4,054	$3,968	$5,160	$+1,192



I-695 @ I-70

TOP 15 CONGESTED CORRIDOR SECTIONS

The TTI scale presented in Figure 8, was utilized to develop metrics for individual freeway/expressway and arterial segments. The individual segments were combined to develop the AM and PM top 15 most congested freeways/expressways and arterial sections. Freeway/expressway corridors range from three to eight miles long or include the entire length of a freeway (I-370) or spur (I-270 East or West Spur), while arterial corridors range from two to five miles. The top 15 sections for the worst congestion during the AM and PM peak hours are shown in tables 10 through 13.

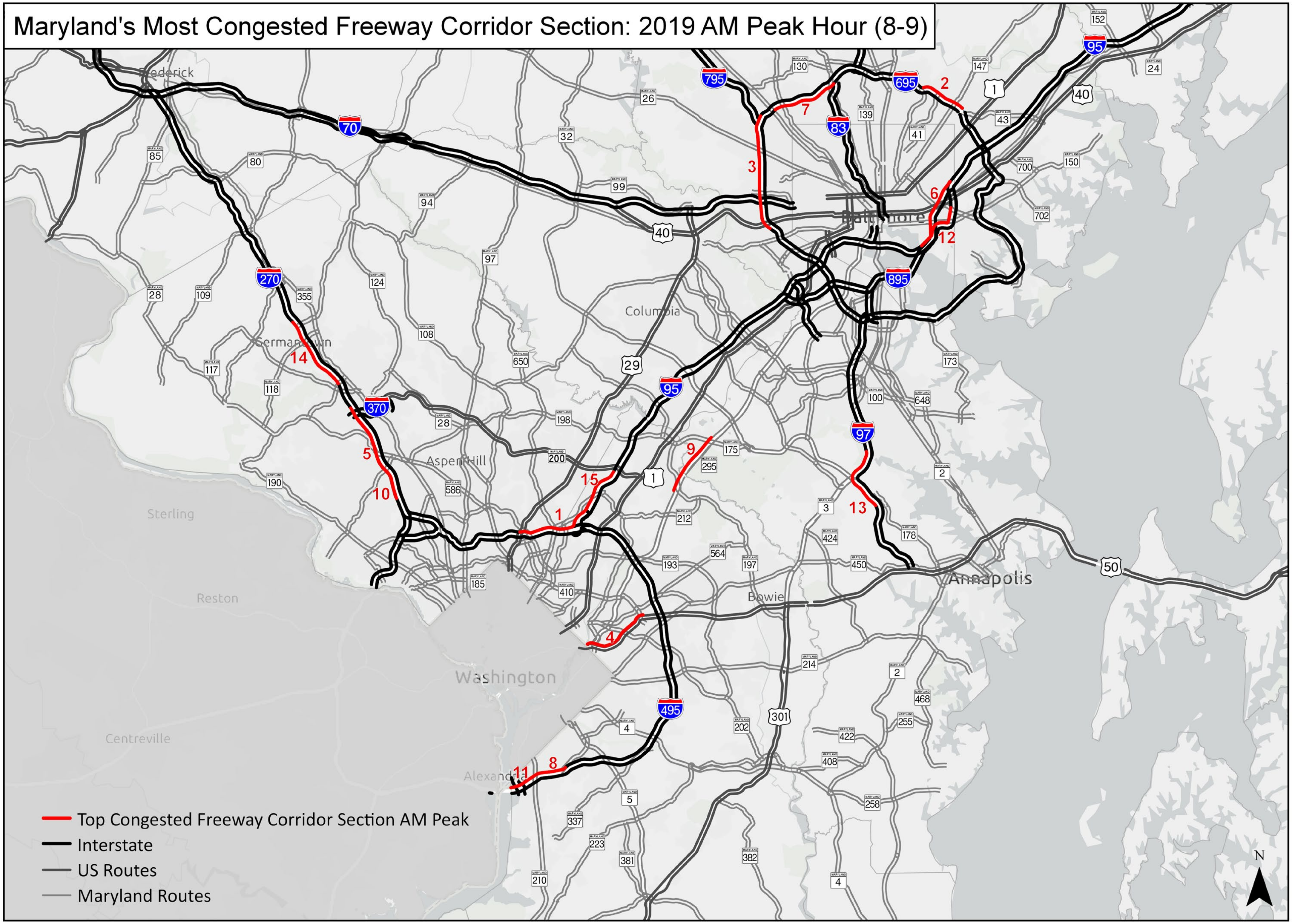
- Freeway/Expressway Sections AM Peak Hour - Table 10, Figure 14
- Freeway/Expressway Sections PM Peak Hour - Table 11, Figure 15
- Arterial Sections AM Peak Hour - Table 12, Figure 16
- Arterial Sections PM Peak Hour - Table 13, Figure 17

Most Congested Weighted Average = ($^{\Sigma}$Individual Segment TTI x Section Length)/Total Section Length.

Table 10

2019 MOST CONGESTED FREEWAY/EXPRESSWAY SECTIONS - AM PEAK HOUR					
AM RANK	ROUTE/DIRECTION	LIMITS	MILEAGE	COUNTY	TTI
1	I-495 Outer Loop	I-95 to US 29	3.42	Montgomery/ Prince George's	4.35
2	I-695 Outer Loop	MD 43 to Cromwell Bridge Road	3.01	Baltimore	2.95
3	I-695 Outer Loop	I-795 to Edmondson Avenue	7.05	Baltimore	2.66
4	US 50 WB	MD 410 to DC Line	3.87	Prince George's	2.45
5	I-270 Local SB	I-370 to MD 189	3.78	Montgomery	2.45
6	I-895 SB	I-95 to Ponca Street	3.19	Baltimore City	2.42
7	I-695 Inner Loop	MD 140 to I-83	4.37	Baltimore	2.40
8	I-95/I-495 (Local) Inner Loop	MD 414 to I-295	3.61	Prince George's	2.33
9	MD 295 SB	MD 198 to MD 197	3.43	Anne Arundel/ Prince George's	2.26
10	I-270 SB	I-370 to Montrose Road	4.42	Montgomery	2.20
11	I-95/I-495 (Through) Inner Loop	West of MD 414 to DC Line	3.15	Prince George's	2.09
12	I-95 SB	MD 151 to Fort McHenry Tunnel Toll Plaza	3.16	Baltimore City	2.04
13	I-97 SB	Benfield Boulevard to MD 178	4.02	Anne Arundel	2.02
14	I-270 SB	MD 27 to MD 124	4.03	Montgomery	1.98
15	I-95 SB	South of MD 200 to I-495	4.17	Prince George's	1.85

Figure 14



Maryland's Most Congested Freeway Corridor Section: 2019 AM Peak Hour (8-9)
Frederick
Germantown
Columbia
Baltimore
Aspen Hill
Sterling
Reston
Washington
Centreville
Alexandria
Bowie
Annapolis
Top Congested Freeway Corridor Section AM Peak
Interstate
US Routes
Maryland Routes
N

Table 11

2019 MOST CONGESTED FREEWAY/EXPRESSWAY SECTIONS - PM PEAK HOUR					
PM RANK	ROUTE/DIRECTION	LIMITS	MILEAGE	COUNTY	TTI
1	I-695 Inner Loop	MD 139 to Providence Road	3.02	Baltimore	3.61
2	I-495 Inner Loop	I-270 East Spur to MD 193	6.07	Montgomery	2.80
3	I-495 Inner Loop	VA Line to I-270 West Spur	3.74	Montgomery	2.70
4	I-95 NB	US 1 to Fort McHenry Tunnel	4.04	Baltimore City	2.63
5	I-695 Outer Loop	I-95 to MD 295	3.07	Anne Arundel/ Baltimore	2.61
6	I-95/I-495 Inner Loop	I-95 to MD 295	3.59	Prince George's	2.60
7	I-695 Inner Loop	I-95 to MD 122	6.47	Baltimore	2.48
8	I-270 NB	I-370 to MD 124	3.07	Montgomery	2.26
9	MD 295 NB	MD 198 to MD 175	3.41	Anne Arundel	2.14
10	US 29 NB	North of Broken Land Parkway to MD 103	4.43	Howard	2.11
11	I-270 Local NB	Shady Grove Road to Watkins Mill Rd	3.77	Montgomery	2.10
12	I-495/I-95 Outer Loop	MD 202 to MD 201	7.28	Prince George's	2.08
13	MD 295 NB	MD 410 to Powder Mill Road	6.46	Prince George's	2.07
14	I-895 SB	Moravia Road to Ponca Street	3.19	Baltimore City	1.98
15	I-695 Outer Loop	MD 146 to I-83	3.17	Baltimore	1.97

Figure 15

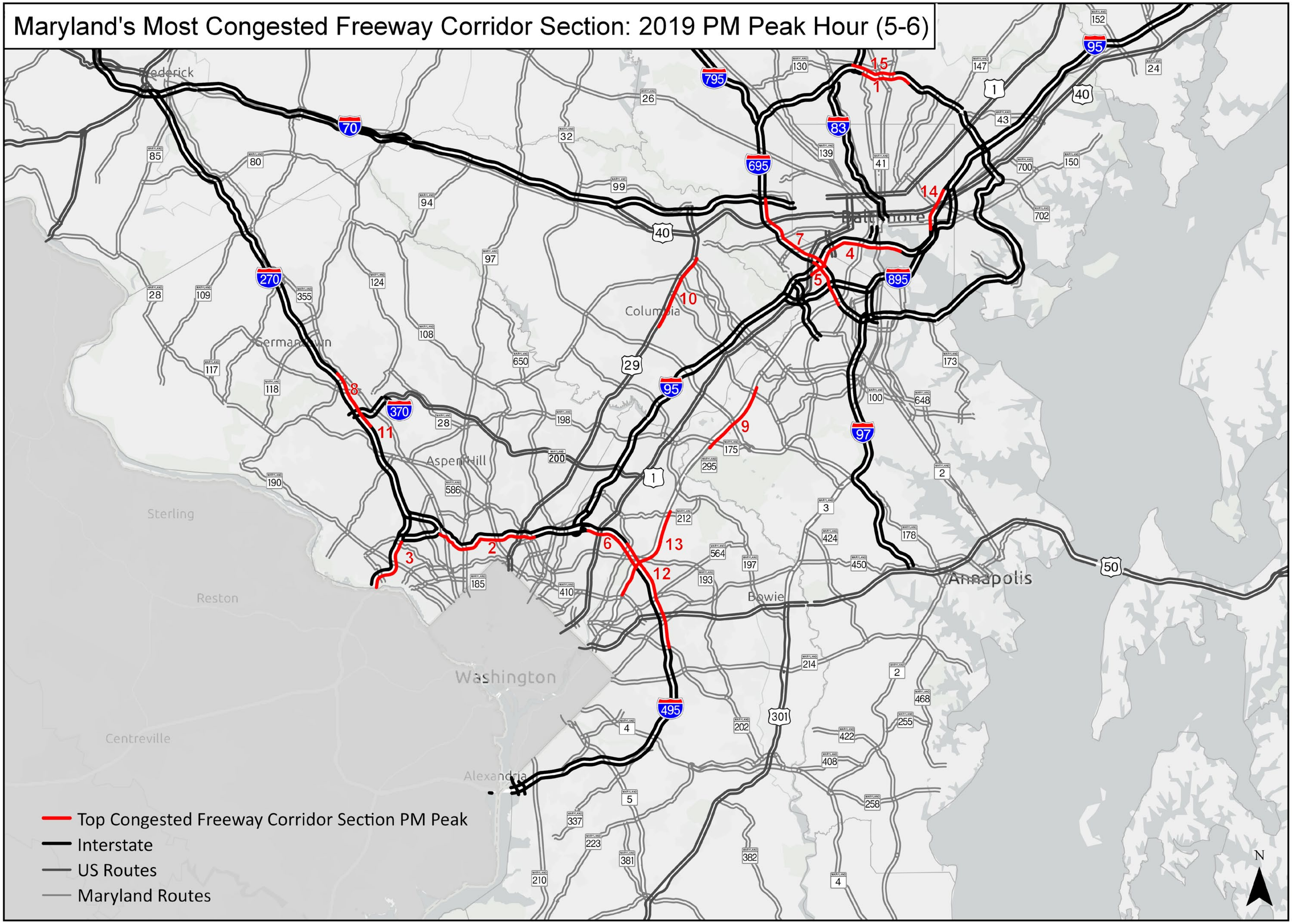

Maryland's Most Congested Freeway Corridor Section: 2019 PM Peak Hour (5-6)
Frederick
Columbia
Germantown
Aspen Hill
Sterling
Reston
Washington
Centreville
Alexandria
Bowie
Annapolis
Baltimore
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
70
270
370
95
795
695
83
895
97
495
40
29
1
50
301
Top Congested Freeway Corridor Section PM Peak
Interstate
US Routes
Maryland Routes
N

Table 12

2019 MOST CONGESTED ARTERIAL SECTIONS - AM PEAK HOUR					
AM RANK	ROUTE/DIRECTION	LIMITS	MILEAGE	COUNTY	TTI
1	US 29 SB	MD 650 to MD 193	2.17	Montgomery	2.32
2	MD 185 SB	I-495 to MD 191	2.08	Montgomery	1.81
3	MD 28 WB	Bel Pre Road to MD 586	2.62	Montgomery	1.80
4	MD 190 EB	Luvie Lane to Piney Meetinghouse Road	2.52	Montgomery	1.67
5	MD 210 NB	Fort Washington Road to Livingston/Kerby Hill Road	2.55	Prince George's	1.66
6	MD 97 SB	MD 586 to Seminary Road/ Columbia Blvd	2.03	Montgomery	1.62
7	MD 410 WB	MD 650 to US 29	2.07	Montgomery	1.55
8	MD 586 WB	Aspen Hill Road to MD 355	2.35	Montgomery	1.53
9	MD 355 SB	I-495 to MD 410	2.40	Montgomery	1.52
10	MD 2 SB	College Parkway to US 50	2.83	Anne Arundel	1.52
11	MD 5 NB	US 301 to Surratts Road	3.81	Prince George's	1.52
12	MD 32 SB	Triadelphia Road to MD 108	4.77	Howard	1.51
13	MD 410 WB	Riverdale Road to US 1	2.22	Prince George's	1.48
14	MD 4 SB	Forestville Road to Dowerhouse Road	2.00	Prince George's	1.44
15	MD 424 SB	MD 3 to MD 450	2.34	Anne Arundel	1.44

Figure 16

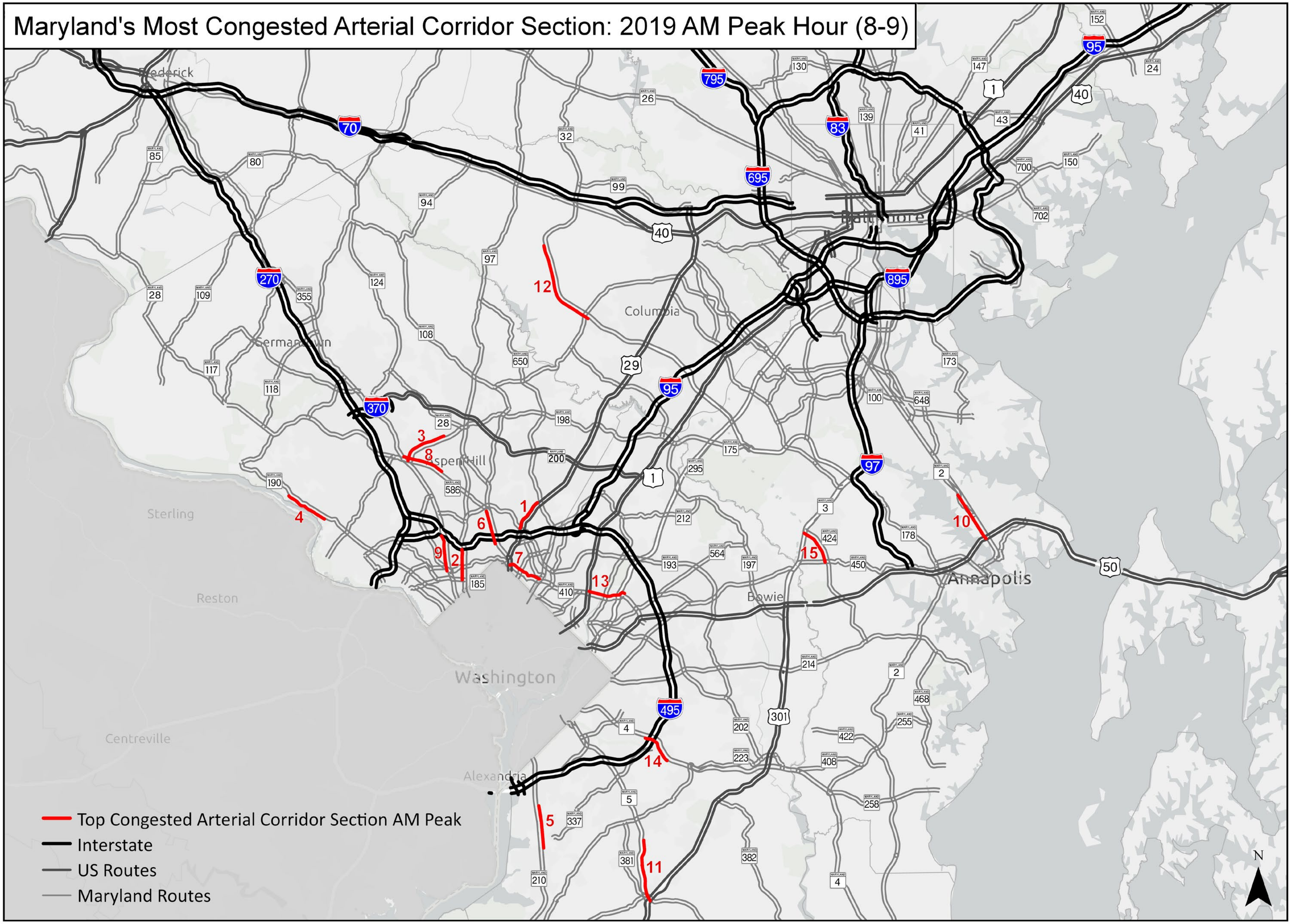
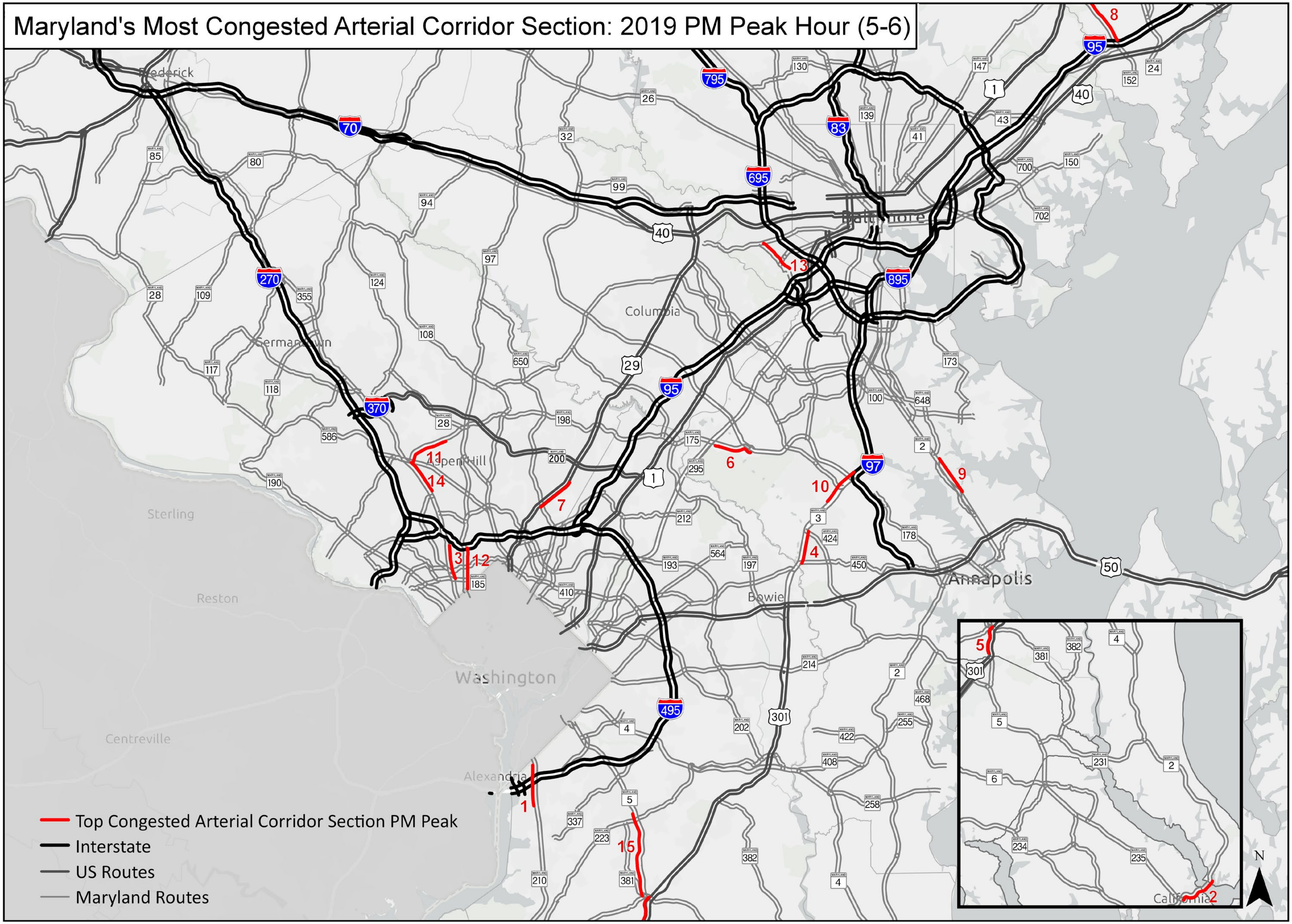

Maryland's Most Congested Arterial Corridor Section: 2019 AM Peak Hour (8-9)
Top Congested Arterial Corridor Section AM Peak
Interstate
US Routes
Maryland Routes
Frederick
Columbia
Germantown
Aspen Hill
Sterling
Reston
Washington
Centreville
Alexandria
Baltimore
Annapolis
Bowie
N

Table 13

2019 MOST CONGESTED ARTERIAL SECTIONS - PM PEAK HOUR					
PM RANK	ROUTE/DIRECTION	LIMITS	MILEAGE	COUNTY	TTI
1	MD 210 SB	Livingston Road (North) to Kerby Hill Road/Livingston Road (South)	2.43	Prince George's	1.90
2	MD 4 NB	MD 235 to Gov. Thomas Johnson Bridge	2.96	Saint Mary's	1.90
3	MD 355 NB	MD 191 to Cedar Lane	2.07	Montgomery	1.89
4	MD 3 NB	MD 450/Defense Highway to MD 424	2.01	Anne Arundel	1.89
5	US 301/MD 5 SB	MD 381 to McKendree Road/ Cedarville Road	2.58	Prince George's	1.88
6	MD 198 EB	MD 295 to MD 32	2.21	Anne Arundel	1.87
7	US 29 NB	MD 650 to Cherry Hill Road	2.23	Montgomery	1.86
8	MD 152 NB	I-95 to Old Joppa Road	2.77	Harford	1.85
9	MD 2 NB	College Parkway to Robinson Road/Leelyn Drive	2.53	Anne Arundel	1.82
10	MD 3 SB	I-97/MD 32 to St Stephens Church Road	2.89	Anne Arundel	1.82
11	MD 28 EB	MD 586 to Bel Pre-Road	2.61	Montgomery	1.81
12	MD 185 NB	DC Line to I-495	2.50	Montgomery	1.79
13	MD 166 NB	UMBC Boulevard to MD 144	2.32	Baltimore	1.72
14	MD 355 NB	MD 183 to Wootton Parkway	2.07	Montgomery	1.72
15	MD 5 SB	MD 223 to MD 373	5.02	Prince George's	1.71

Figure 17



Maryland's Most Congested Arterial Corridor Section: 2019 PM Peak Hour (5-6)
Frederick
Germantown
Columbia
Baltimore
Aspen Hill
Sterling
Reston
Washington
Centreville
Alexandria
Bowie
Annapolis
California
Top Congested Arterial Corridor Section PM Peak
Interstate
US Routes
Maryland Routes
N

SUMMER WEEKEND CONGESTION

Normally, the worst traffic conditions occur in the AM and PM peak periods. These are the times when people are commuting to and from work, freight deliveries are occurring, and school buses are on the road. However, for certain roadways, instead of during the AM or PM peak hour, motorists experience severe congestion during summer weekends. Congestion data (TTI) was analyzed to determine which locations experience the most congestion in the summer months during three different hours: from 6–7 PM on Friday, 11AM–12 noon on Saturday, and 5–6 PM on Sunday. The analysis found that the locations with more congestion on the weekends than the weekdays are mainly on the Eastern Shore (Table 14 and 15).

Table 14

2019 MOST CONGESTED SUMMER-WEEKEND FREEWAY LOCATIONS THAT NORMALLY EXPERIENCE MINIMAL CONGESTION ON WEEKDAYS

RANK/ DAY	ROUTE/DIRECTION	LIMITS	MILEAGE	COUNTY	TTI
6/Friday	US 50 EB	Buschs Frontage Rd to Chesapeake Bay Bridge	3.52	Anne Arundel	1.70
2/Saturday	US 50 EB	Buschs Frontage Rd to Chesapeake Bay Bridge	3.52	Anne Arundel	1.47
4/Saturday	US 50 WB	Piney Creek Rd to MD 8	3.11	Queen Anne's	1.43
1/Sunday	US 50 WB	Kent Narrows Rd to MD 8	4.84	Queen Anne's	1.95
2/Sunday	I-95 SB	MD 22 to MD 543	4.14	Harford	1.79

Table 15

2019 MOST CONGESTED SUMMER-WEEKEND ARTERIAL LOCATIONS THAT NORMALLY EXPERIENCE MINIMAL CONGESTION ON WEEKDAYS

RANK/ DAY	ROUTE/DIRECTION	LIMITS	MILEAGE	COUNTY	TTI
1/Saturday	US 50 EB	MD 611 to MD 378	2.76	Worcester	2.23
5/Saturday	MD 404 EB	MD 16 to MD 313	2.28	Caroline	1.67
5/Sunday	US 50 WB	Del Rhodes Ave to US 301	3.65	Queen Anne's	1.39
6/Sunday	US 50 WB	Kelly Bridge Lane to MD 611	2.09	Worcester	1.38

FREEWAY/EXPRESSWAY CORRIDOR SUMMARY

Roadways where access is limited to interchanges are termed 'controlled' access facilities. Controlled access facilities include freeways and expressways that are the highest classification of roadways in the state and also indicate the greatest capacity to convey vehicles. A summary of Maryland's freeway/expressway corridor performance was developed to include the number of miles, average daily traffic, and number of miles in the AM/PM peak hour experiencing severe congestion (Table 16). The overall operation of all freeways/expressways are depicted in the Peak Hour Statewide Congestion Maps (Figures 9 –13).

The Maryland Mobility Report Supplement provides additional in-depth information about the mobility performance of these corridors including the greatest improvement/reduction in operation over the past year and a detailed analysis of the number of miles operating at each level of congestion.

Table 16

2019 FREEWAY/EXPRESSWAY FACILITY PERFORMANCE SUMMARY							
ROUTE	LIMITS	NO. OF MILES	ANNUAL AVERAGE DAILY TRAFFIC (IN THOUSANDS)	CONGESTED MILEAGE			
				SEVERE CONGESTION			
				AM EB/NB INNER LOOP	AM WB/SB OUTER LOOP	PM EB/NB INNER LOOP	PM WB/SB OUTER LOOP
I-70 Part 1	Pennsylvania State Line to US 40 (Frederick)	48	22-82	0.0	0.0	0.0	0.0
I-70 Part 2	US 40 (Frederick) to MD 122	45	17-108	0.0	0.0	0.0	0.7
I-81	Pennsylvania State Line to West Virginia State Line	12	57-82	0.0	0.0	0.0	0.0
I-83	Pennsylvania State Line to Baltimore City Line	26	46-143	0.0	0.0	0.0	0.0
I-95 Part 1	I-495 to I-695	40	180-216	0.0	3.7	5.6	1.1
I-95 Part 2	I-695 to Delaware State Line	45	62-192	0.0	0.0	0.0	0.0
I-97	I-695 to US 50/301	17	24-163	0.0	2.3	0.1	0.6
I-270 Mainline	I-495 to I-70	41	88-268	0.0	5.4	4.8	0.5
I-270 Local	Montrose Road to MD 124	8	187-268	0.0	3.3	1.5	0.0
I-495	American Legion Bridge to Woodrow Wilson Bridge	42	111-255	4.4	5.4	15.4	6.8
I-695	I-97 to I-695	35	101-205	3.9	10.9	11.8	4.8
I-795	I-695 to MD 140	8	54-73	0.0	0.0	0.0	0.0
I-895	I-95(South) to I-95 (North)	15	14-65	0.0	1.4	1.1	1.1
US 50	Washington DC Line to Chesapeake Bay Bridge	33	76-125	2.3	0.0	0.0	1.2
MD 32	MD 108 to I-97	22	46-105	0.7	0.0	1.5	2.6
MD 100	US 29 to MD 177	22	29-112	0.0	0.0	2.3	2.3
MD 200	I-370 to US 1	19	51-60	0.0	0.0	0.0	0.0
MD 295	MD 201 to Waterview Ave	29	80-118	0.0	3.8	6.5	2.3

MAJOR ARTERIAL CORRIDOR SUMMARY

Arterials are the next highest classification of roadways after freeways/expressways. These roadways generally have multi-lanes and traffic signals and carry a large volume of traffic. Thirty-five major arterial corridors were selected based on observed traffic operations, traffic volumes, regional significance, and availability of data to analyze in further detail. Traffic analysis was performed to identify the most congested segments based on TTI values. A summary of the operational characteristics of each of these corridors was developed with an analysis of the traffic volumes and corridor length (Table 17).

The Maryland Mobility Report Supplement contains additional information related to various characteristics and performance measures of these arterial roadways including segment breakouts of TTI and PTI values, number of lanes, speed limits, signalized intersections, and traffic/transit ridership data.

Table 17

2019 MAJOR ARTERIAL FACILITY PERFORMANCE SUMMARY

ROUTE	LIMITS	NO. OF MILES	ANNUAL AVERAGE DAILY TRAFFIC (IN THOUSANDS)	CONGESTED MILEAGE			
				HEAVY TO SEVERE CONGESTION			
				AM EB/NB	AM WB/SB	PM EB/NB	PM WB/SB
MD 2	US 50/301 to MD 10	8.4	48-65	1.0	3.7	6.8	3.7
MD 3	US 50/301 to I-97	8.8	70-84	1.7	2.6	5.4	4.3
MD 4	DC Line to Dower House Rd	6.6	22-78	0.1	0.7	0.2	1.2
MD 4	MD 5 to MD 2	10.0	12-28	0.1	0.3	3.0	0.1
MD 5	US 301 to MD 223	5.4	67-85	4.0	0.0	0.0	4.0
MD 24	US 40 to US 1	7.9	24-72	0.0	0.5	4.7	1.7
MD 26	MD 32 to Balt. City Line	14.1	9-45	1.1	0.0	1.7	2.4
MD 28	Riffle Ford Rd to MD 97	11.9	24-51	1.6	2.6	4.6	3.4
MD 30	MD 30 Business to MD 86	3.7	14-20	0.0	1.2	2.4	0.0
MD 32	MD 108 to MD 26	16.3	20-30	0.7	5.6	10.2	0.7
MD 43	I-695 to US 40	6.0	29-56	0.0	0.7	0.9	1.0
MD 45	Balt. City Line to Shawan Rd.	9.3	17-42	0.3	0.2	3.8	3.8
MD 85	English Muffin Way to I-70	3.4	17-52	00	0.0	0.0	1.2
MD 97	DC Line to MD 108	12.7	30-69	0.5	3.3	4.7	3.8
MD 124	MD 28 to MD 108	16.7	12-73	0.0	1.4	1.3	0.8
MD 140	MD 97 to Balt. City Line	20.4	17-54	0.1	0.6	4.8	4.3
MD 152	US 40 to Carrs Mill Rd	7.6	21-27	0.0	0.3	2.8	0.3
MD 175	MD 32 to US 29	12.2	20-74	0.2	0.2	5.3	3.1
MD 185	DC Line to MD 97	8.3	36-78	0.0	3.5	3.7	1.8
MD 193	MD 201 to MD 650	5.5	30-50	0.2	1.4	2.4	2.7

Table 17 - Continued

2019 MAJOR ARTERIAL FACILITY PERFORMANCE SUMMARY							
ROUTE	LIMITS	NO. OF MILES	ANNUAL AVERAGE DAILY TRAFFIC (IN THOUSANDS)	CONGESTED MILEAGE			
				HEAVY TO SEVERE CONGESTION			
				AM EB/NB	AM WB/SB	PM EB/NB	PM WB/SB
MD 201	MD 450 to MD 212	7.4	23-54	0.0	0.6	3.4	1.4
MD 210	MD 228 to I-95	10.3	29-83	3.8	0.0	0.0	2.5
MD 228	MD 210 to US 301	6.8	36-39	0.0	0.0	1.3	0.0
MD 355	DC Line to MD 27	19.7	29-60	1.7	4.6	8.7	3.5
MD 410	MD 355 to US 29	3.8	14-28	0.0	0.7	2.6	0.4
MD 410	MD 650 to Pennsy Dr.	7.7	18-48	0.1	2.9	3.0	0.4
MD 450	MD 202 to MD 704	6.3	29-66	0.1	0.0	0.7	1.5
MD 650	DC Line to US 29	6.0	37-80	0.3	0.6	3.1	2.3
US 1	MD 410 to MD 198	10.7	18-47	0.0	0.0	2.8	3.2
US 1	Balt. City Line to Honeygo Blvd	5.6	23-46	0.3	0.6	2.3	1.4
US 29	MD 97 to MD 650	3.8	28-72	0.2	2.3	0.2	0.3
US 29	Industrial Pkwy to MD 198	4.4	59-69	0.0	0.0	2.7	0.0
US 40	I-70 to Cleveland Ave	3.4	25-38	0.0	0.0	0.0	0.0
US 301	Billingsley Rd to MD 5	7.8	38-105	0.0	0.1	1.3	2.6
US 301	Leeland Road to MD 4	7.8	48	0.0	0.0	0.0	3.1

CONGESTED CORRIDOR SECTION COMPARISON

Data driven analysis allows comparisons to be made from one year to the next to better identify roadways experiencing increased congestion or having improved mobility. A comparison was conducted of the operations of the freeway/expressway and major arterial corridors over the past three years. This was performed for both directions in the AM and PM peak hours. For freeways/ expressways, severe congestion (TTI >2.0) was defined for the comparison. This showed that motorists on the following freeways/expressways experience severe congestion.

- I-70
- I-95
- I-97
- I-270 Mainline
- I-270 Local
- I-495
- I-695
- I-895
- MD 32
- MD 100
- MD 295
- US 50

The roadways with the most severe congestion in the AM peak hour were I-695 Outer Loop, I-495 Outer Loop, and the mainline of I-270 Southbound. All of these roadways experienced more than five miles of severe congestion. The PM peak hour severe congestion was highest on I-495 Inner Loop, I-695 Inner Loop, and MD 295 Northbound. Motorists on these roadways all experienced more than six miles of severe congestion (Figure 18). The greatest change in congestion from 2018 (> 1.5 miles) occurred on the following freeway/expressways (Table 18).

Table 18

2019 LARGEST CHANGES IN CONGESTED FREEWAYS/EXPRESSWAYS		
ROUTE/DIRECTION	TIME PERIOD	INCREASE/DECREASE
I-95 Southbound	AM	Increase
I-97 Southbound	AM	Increase
I-95 Northbound	PM	Increase
I-495 Inner Loop	PM	Increase
I-695 Inner Loop	PM	Increase
I-695 Outer Loop	PM	Increase
I-895 Northbound [1]	PM	Decrease

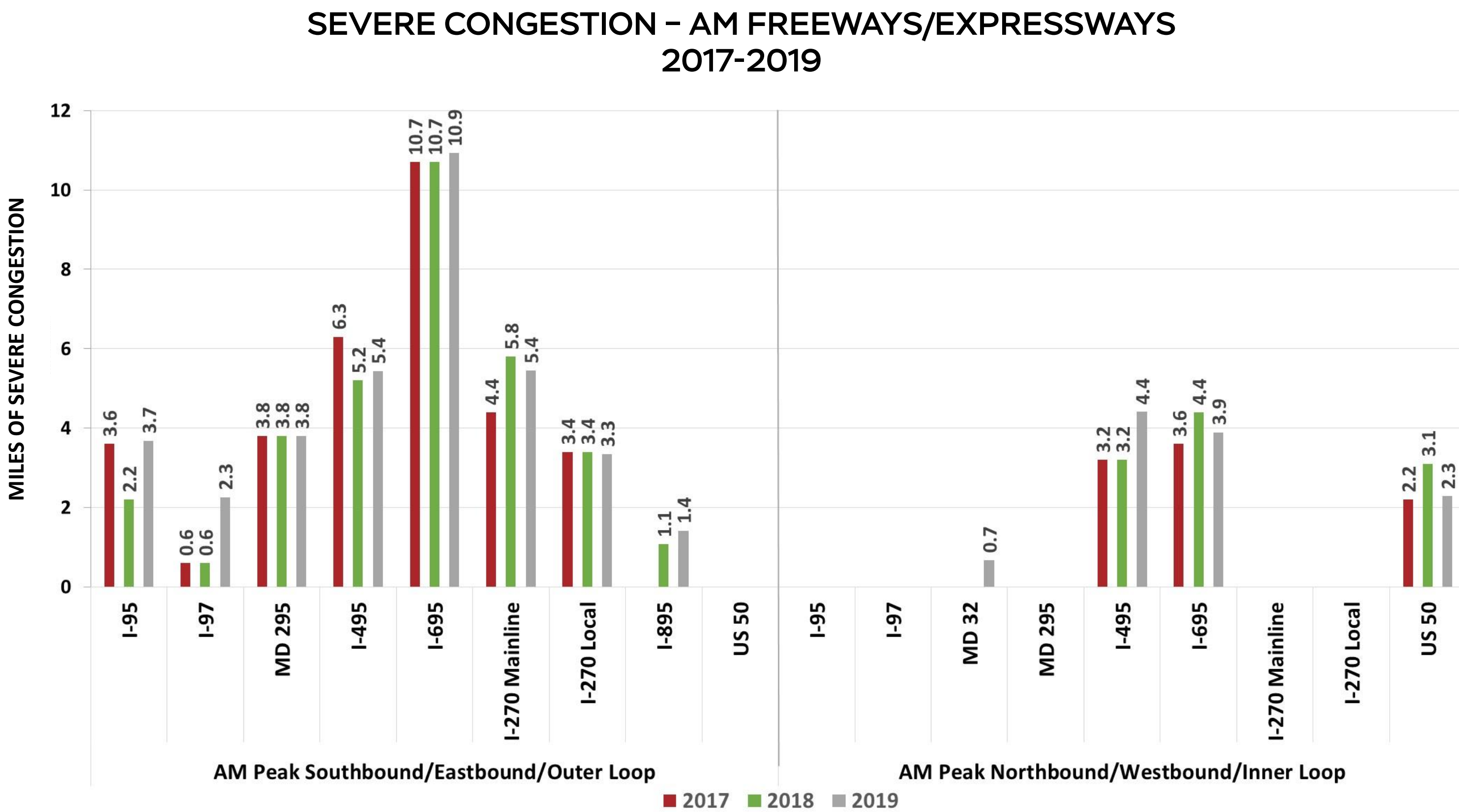
1 - The I-895 bridge over Patapsco Flats, N of MD 295, was previously under construction and opened to traffic in 2019; Project completion halted construction-related lane closures and traffic diversions, which contributed to the decrease in congestion shown in Table 18

The 35 selected major arterial corridors were compared for operations when the TTI value was greater than 1.3 for heavy to severe congestion (Figure 19). The comparison was based on the last three years of data. There were several corridors where congestion increased or decreased by one or more miles between 2018 and 2019 (Table 19).

Table 19

2019 LARGEST CHANGES IN CONGESTED ARTERIALS			
ROUTE/DIRECTION	LIMITS	TIME PERIOD	INCREASE/DECREASE
US 29 Southbound	Industrial Pkwy to MD 198	AM	Decrease
MD 85 Northbound	English Muffin Way to I-70	AM	Decrease
MD 355 Southbound	MD 27 to Washington DC Line	AM	Increase
MD 3 Southbound	I-97 to US 50/301	PM	Increase
MD 24 Northbound	US 40 to US 1	PM	Increase
MD 28 Eastbound	Riffle Ford Rd to MD 97	PM	Increase
MD 28 Westbound	MD 97 to Riffle Ford Rd	PM	Increase
MD 32 Eastbound	MD 108 to MD 26	PM	Increase
MD 45 Southbound	Shawan Rd. to Baltimore City Line	PM	Increase
MD 85 Northbound	English Muffin Way to I-70	PM	Decrease
MD 97 Northbound	Washington DC Line to MD 108	PM	Increase
MD 97 Southbound	MD 108 to Washington DC Line	PM	Increase
MD 140 Southbound	MD 97 to Baltimore City Line	PM	Increase
MD 410 Eastbound	MD 650 to Pennsy Dr	PM	Decrease
MD 175 Northbound	MD 32 to US 29	PM	Increase
MD 193 Westbound	MD 201 to MD 650	PM	Increase
MD 410 Eastbound	MD 355 to US 29	PM	Increase
MD 410 Westbound	MD 650 to Pennsy Dr	AM	Increase
MD 450 Westbound	MD 202 to MD 704	PM	Increase
US 1 Northbound	Baltimore City Line to Honeygo Blvd	PM	Increase
US 1 Northbound	MD 410 to MD 198	PM	Increase

Figure 18


SEVERE CONGESTION – AM FREEWAYS/EXPRESSWAYS
2017-2019
MILES OF SEVERE CONGESTION
AM Peak Southbound/Eastbound/Outer Loop
AM Peak Northbound/Westbound/Inner Loop
I-95
I-97
MD 295
I-495
I-695
I-270 Mainline
I-270 Local
I-895
US 50
MD 32
2017
2018
2019

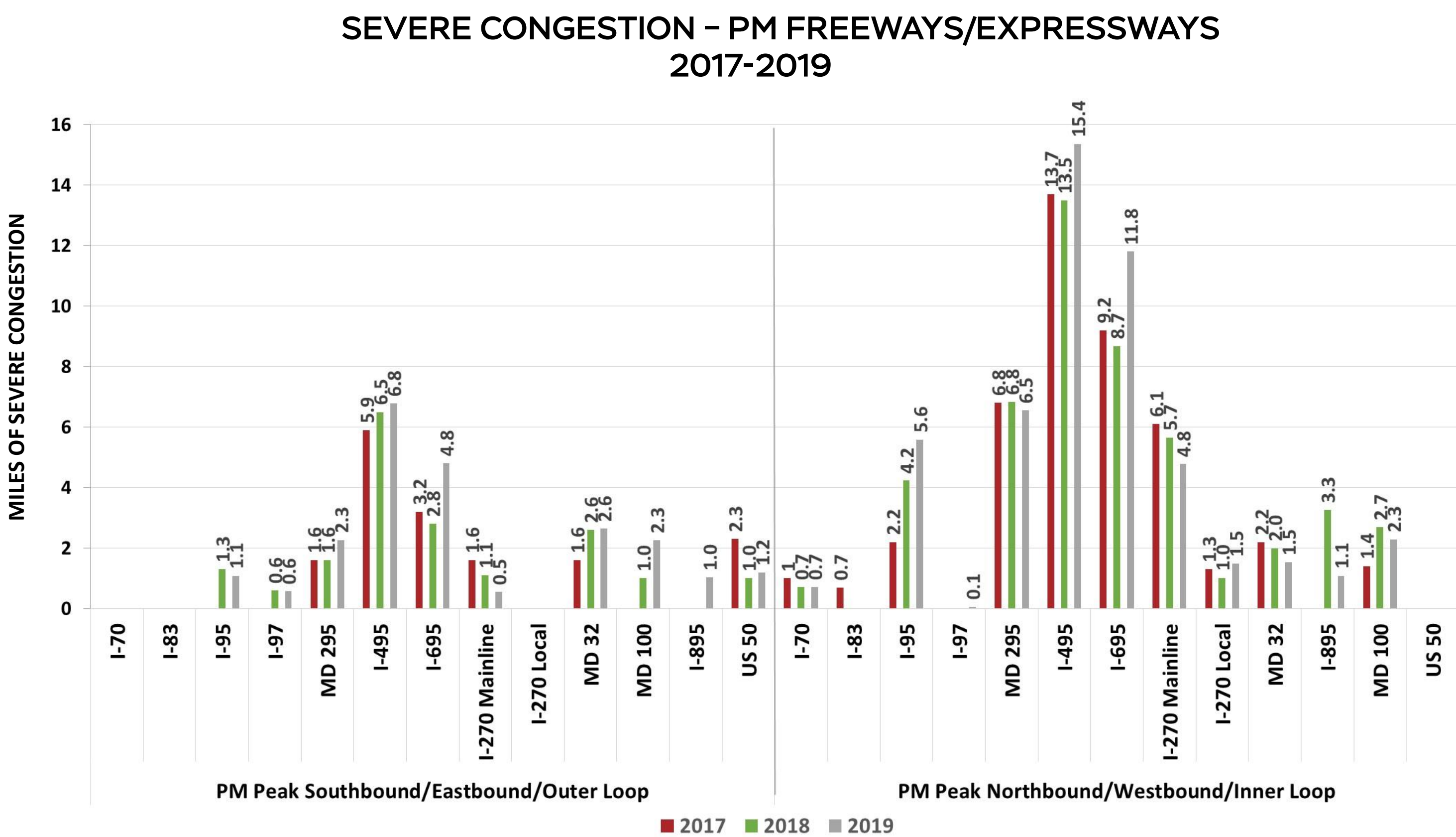
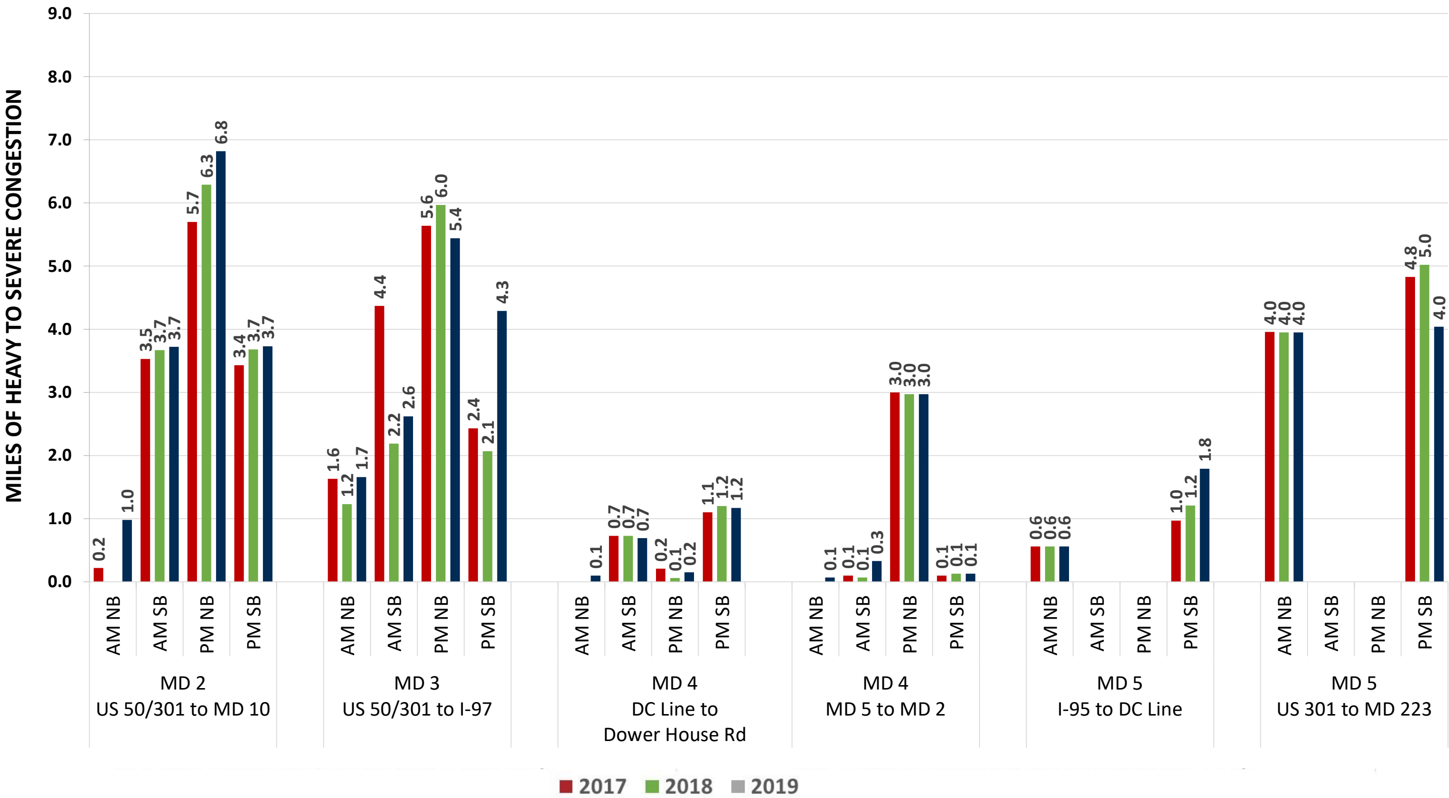

SEVERE CONGESTION – PM FREEWAYS/EXPRESSWAYS
2017-2019
MILES OF SEVERE CONGESTION
PM Peak Southbound/Eastbound/Outer Loop
PM Peak Northbound/Westbound/Inner Loop
I-70
I-83
I-95
I-97
MD 295
I-495
I-695
I-270 Mainline
I-270 Local
MD 32
MD 100
I-895
US 50
2017
2018
2019

Figure 19

HEAVY TO SEVERE CONGESTION – ARTERIALS 2017-2019



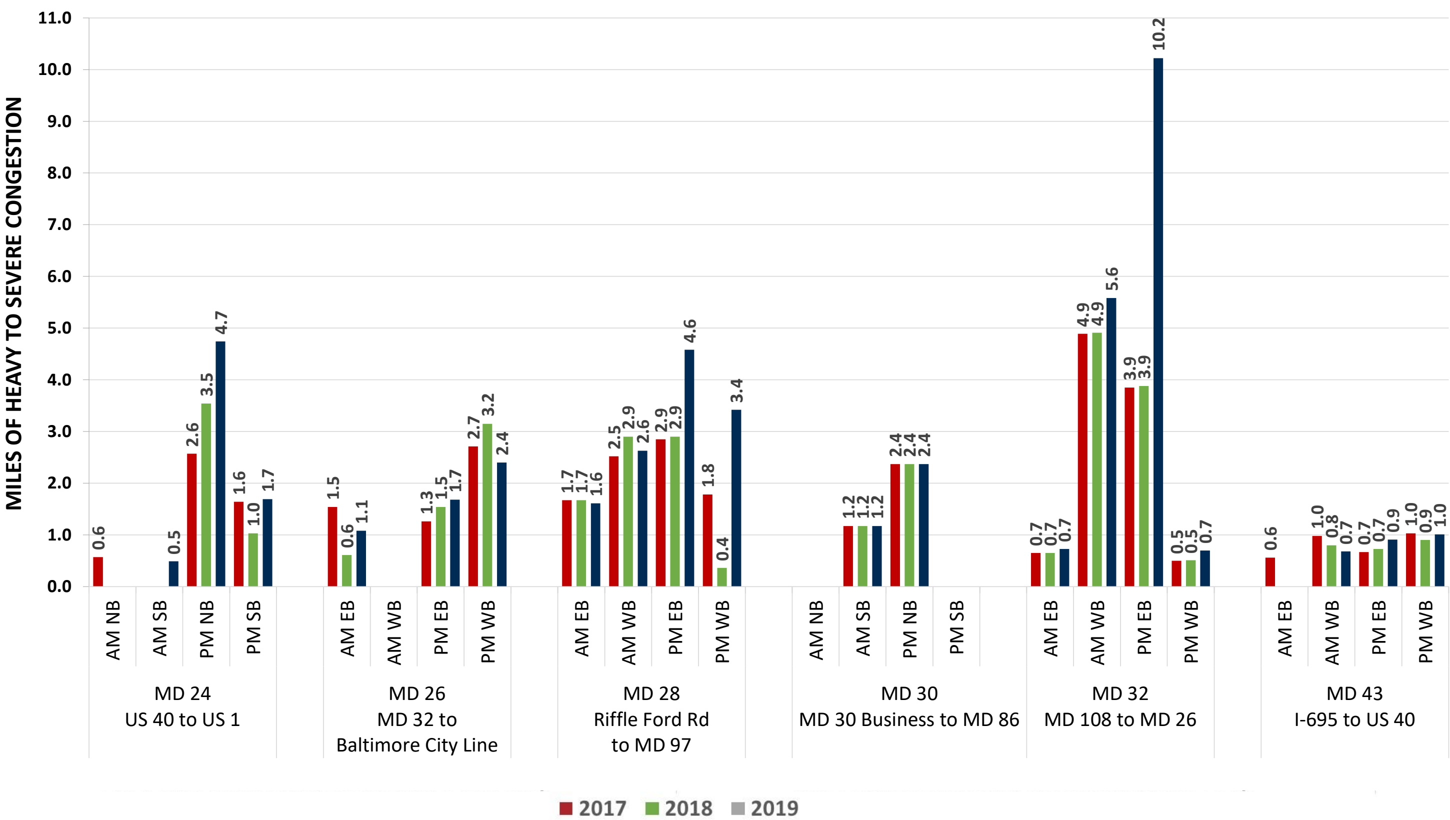
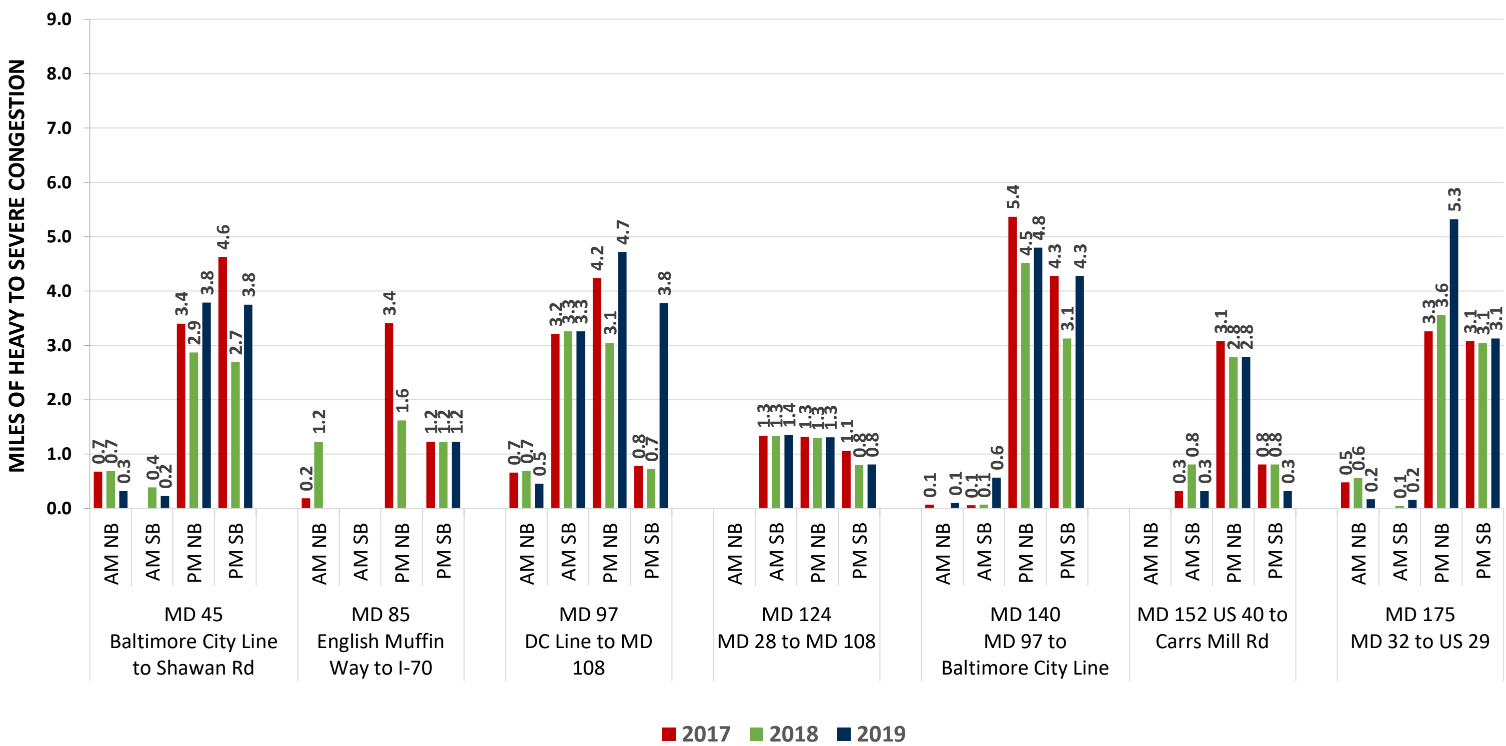


Figure 19 - *continued*

HEAVY TO SEVERE CONGESTION - ARTERIALS
2017-2019



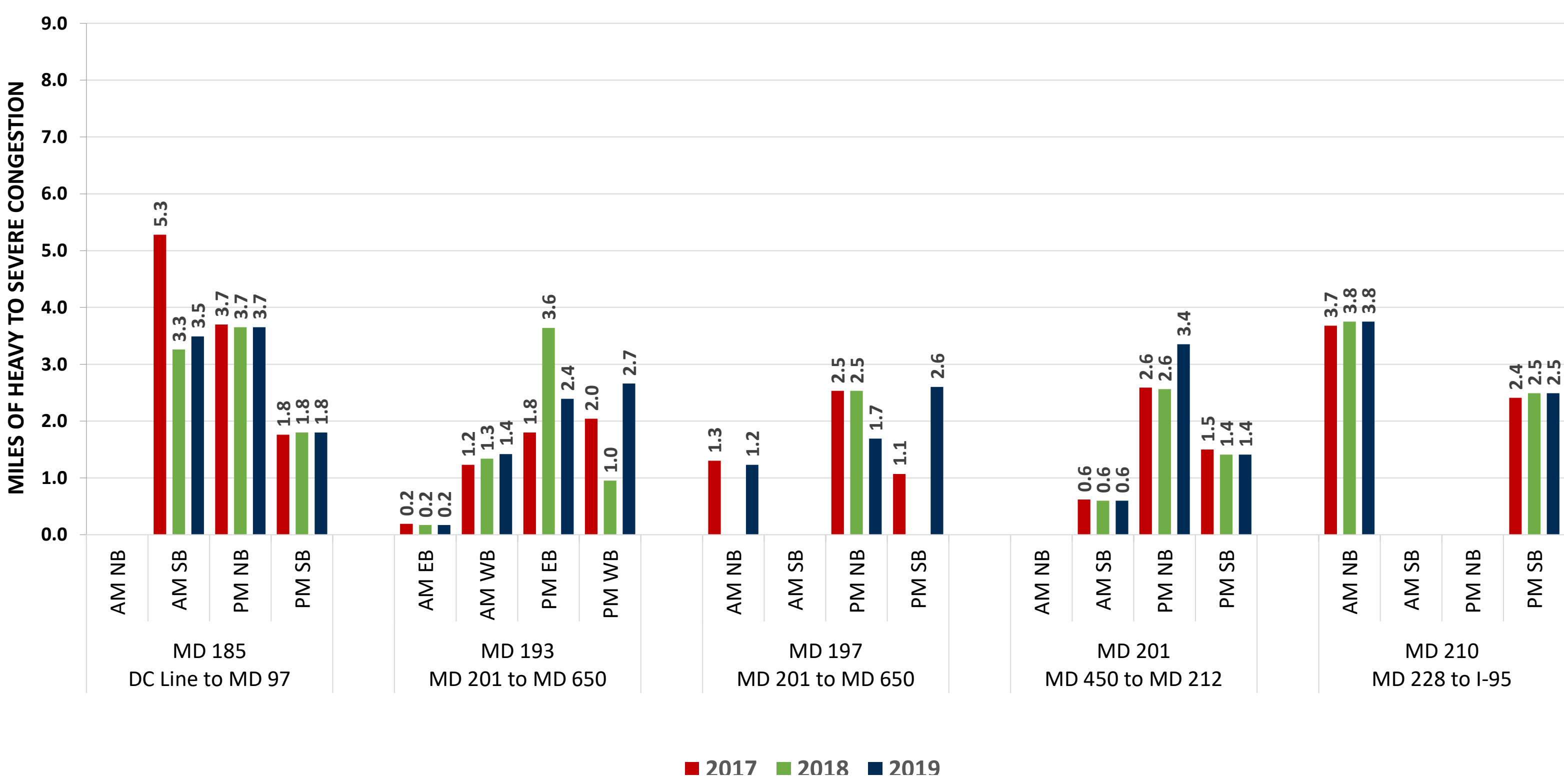
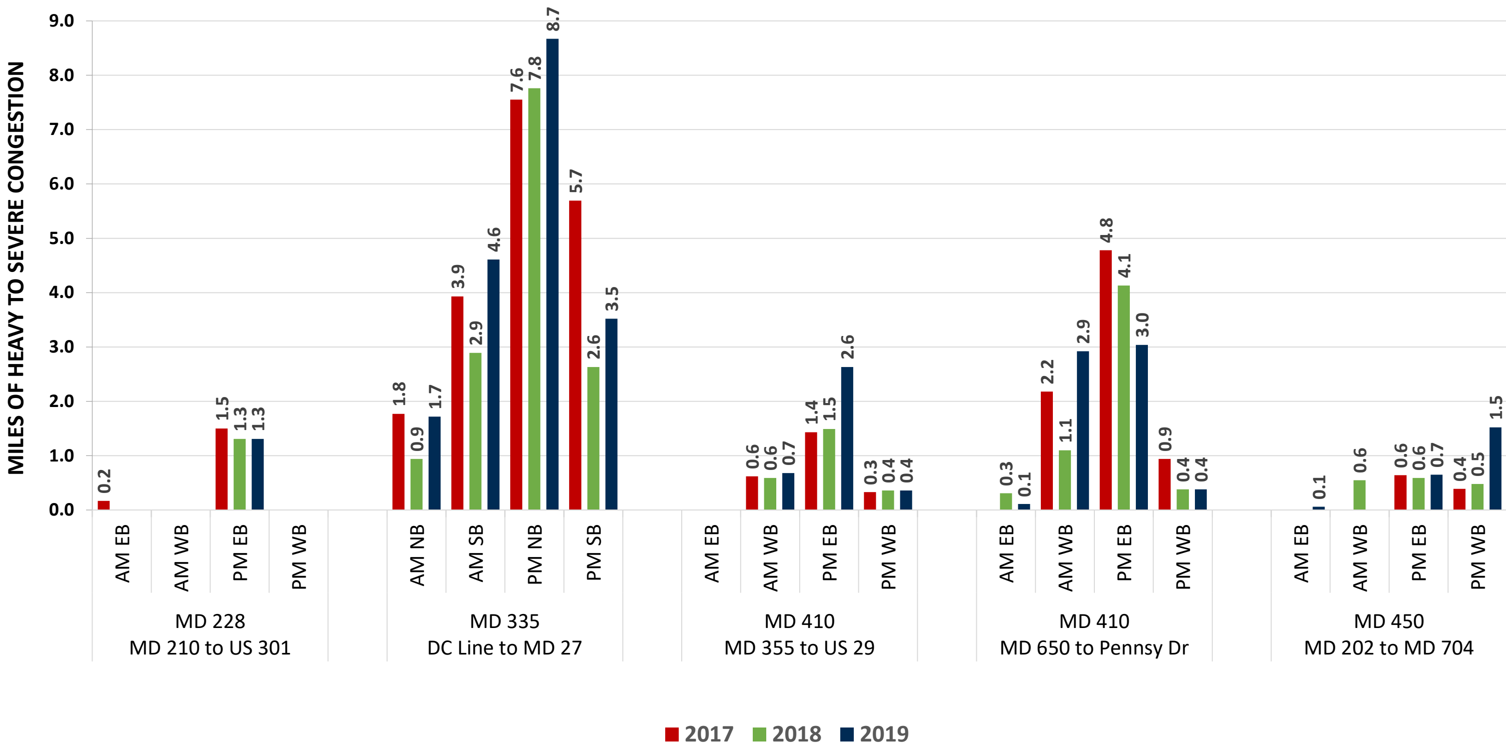


Figure 19 - *continued*

HEAVY TO SEVERE CONGESTION - ARTERIALS
2017-2019



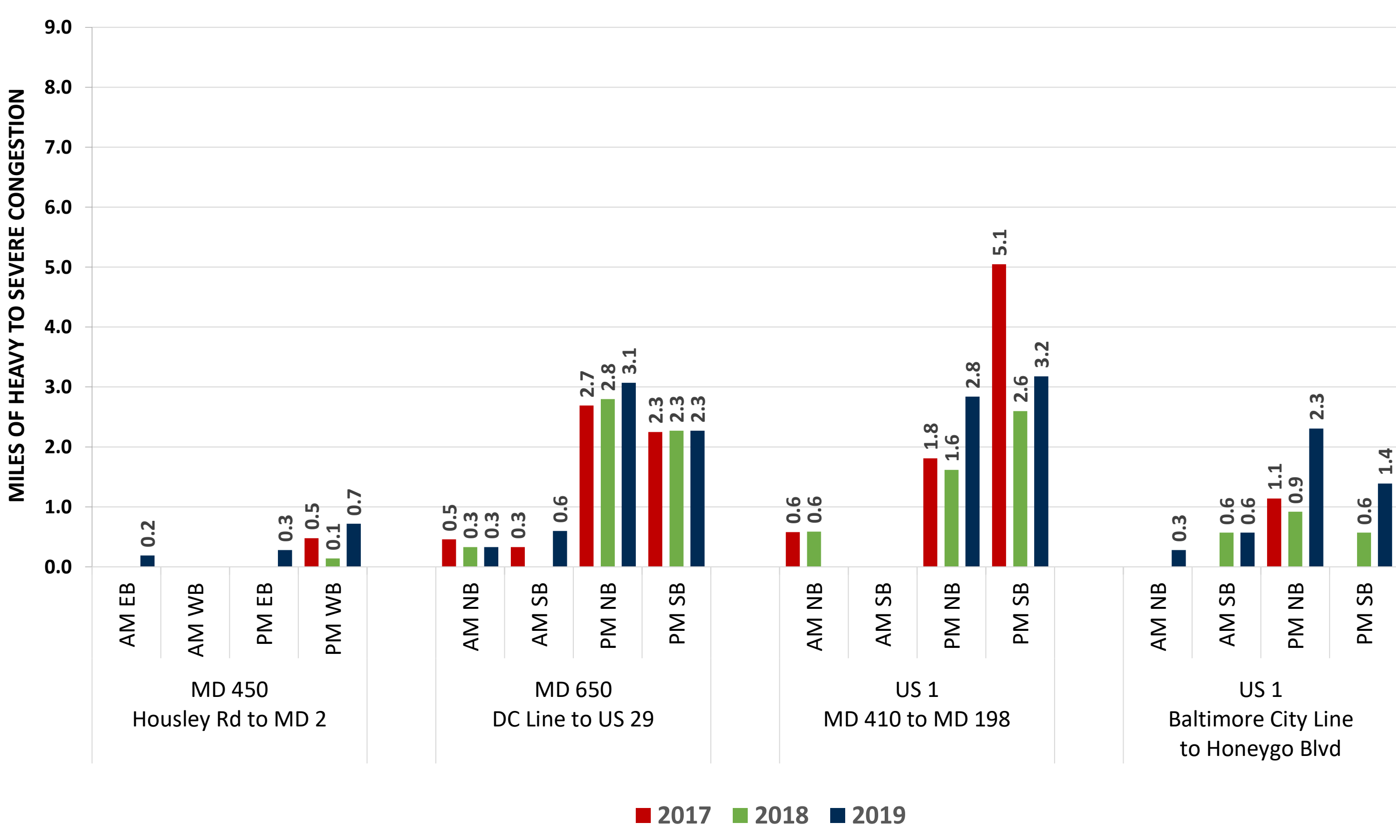
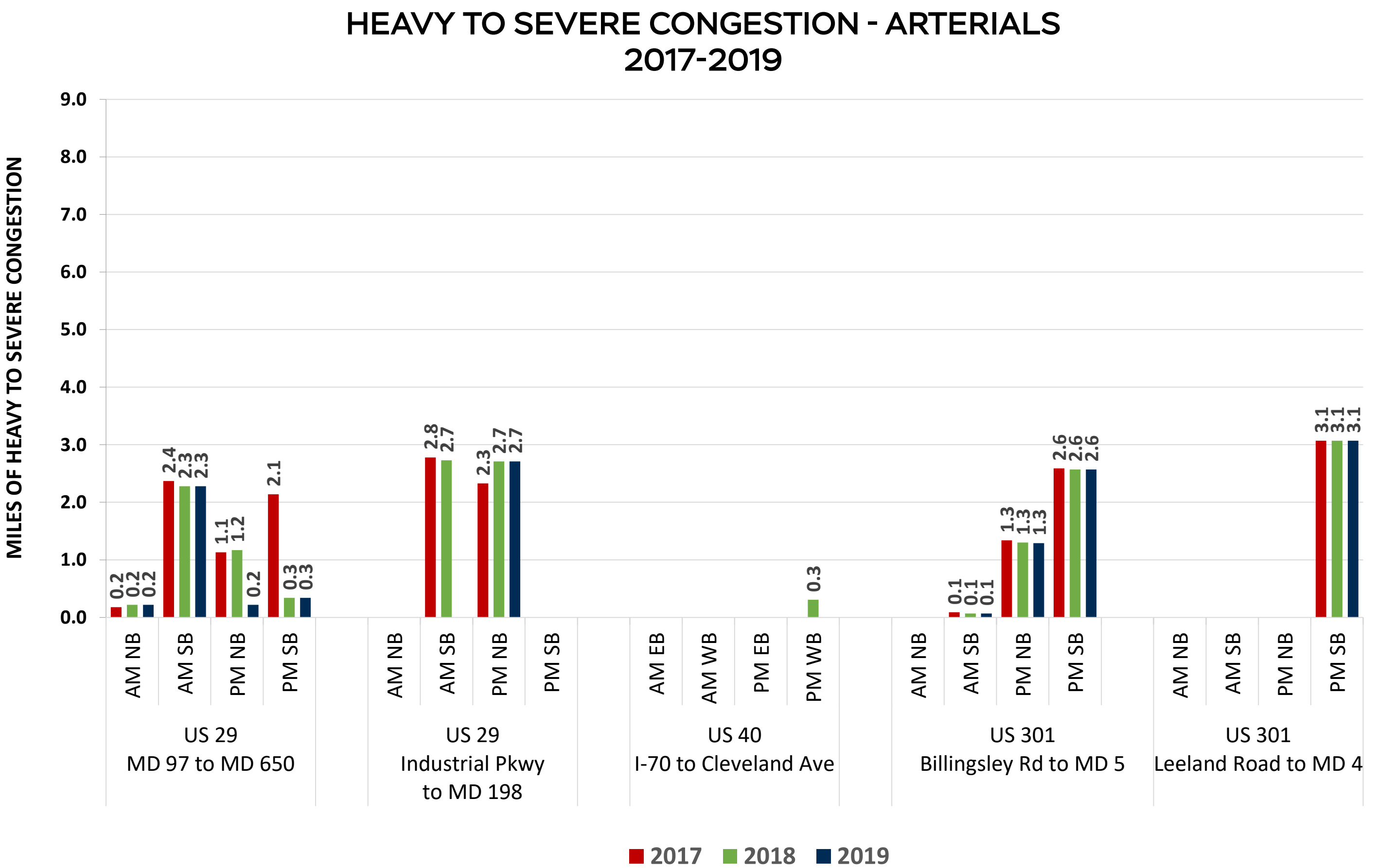


Figure 19 - *continued*



MD 410 is one of the most congested corridors, shown @ MD 212

INTERSECTIONS

Intersections and roadways segments are analyzed to determine traffic operations. The operations are graded from level of service (LOS) 'A' to 'F', with 'A' being the best and 'F' being the worst (Table 20). For purposes of this report, the intersection analysis is conducted via the critical lane analysis technique. The critical lane analysis technique evaluates the volumes of the highest conflicting movements and number of lanes.

Table 20

INTERSECTION LEVEL OF SERVICE DEFINITION	
LEVEL OF SERVICE	DESCRIPTION
A	Minimal delays
B	Low level of delay and queuing
C	Delays and queues are constant
D	Moderate delays and queues but motorist clear in one green indication
E	Long queues and delays with some motorist having to wait more than one green indication
F	Most motorists having to wait more than one green indication

At the worst performing intersections where LOS 'F' conditions exist, a further measure is developed to determine a more in-depth appraisal of operations. This is the volume/capacity ratio which represents the critical lane volume divided by the theoretical capacity of the intersection which is considered to be 1,600.

Thirty-six (36) intersections counted in the past three years operated in the AM peak hour or PM peak hour at LOS F (Tables 21 and 22). Six of these locations failed in both the AM and PM peak hours (yellow highlighted locations). In addition, during the summer weekend US 50 at MD 404 and US 50 at MD 213 failed.

Table 21

LOS "F" INTERSECTIONS AM PEAK HOUR		
INTERSECTION	COUNTY	VOLUME/CAPACITY (SORTED HIGHEST TO LOWEST)
MD 4 at MD 337/Presidential Parkway	Prince George's	1.37
MD 26 at Lord Baltimore Dr/ I-695 Outer Loop Off Ramp	Baltimore	1.31
US 29 at Rivers Edge Rd	Howard	1.20
MD 5 @ Surratts Rd	Prince George's	1.18
MD 4 at Dower House Rd	Prince George's	1.15
MD 210 at Livingston Rd/Kerby Hill Rd	Prince George's	1.13
MD 202 at Ramp to I-95 NB	Prince George's	1.12
MD 2 at Tarragon Ln	Anne Arundel	1.11
MD 4 at Chaneyville Rd	Calvert	1.05
MD 108 at Old Baltimore Rd	Montgomery	1.04
MD 410 at MD 212	Prince George's	1.04
MD 210 at Wilson Bridge Dr	Prince George's	1.03
MD 5 at Auth Way/Simpson Rd	Prince George's	1.03
MD 124 at Warfield Rd	Montgomery	1.02
MD 185 at Aspen Hill Rd	Montgomery	1.02
MD 193 at E. Franklin Ave/Franklin Ave	Montgomery	1.00

Table 22

LOS "F" INTERSECTIONS PM PEAK HOUR		
INTERSECTION	COUNTY	VOLUME/CAPACITY (SORTED HIGHEST TO LOWEST)
MD 500 at MD 410/Adelphi Rd	Prince George's	1.27
US 301 at Cedarville Rd/McKendree Rd	Prince George's	1.19
US 50 at MD 404	Talbot	1.15
MD 500 at Eastern Ave	Prince George's	1.14
MD 410 at MD 212	Prince George's	1.14
MD 202 at Ramp to I-95 NB	Prince George's	1.12
MD 41 at Putty Hill Ave	Baltimore	1.11
MD 5 at MD 637 (Naylor Rd)	Prince George's	1.10
MD 119 at I-370/Sam Eig Hwy	Montgomery	1.09
US 1 at US 1AL/Hamilton St	Prince George's	1.08
MD 4 at MD 337/Presidential Pkwy	Prince George's	1.08
US 15 SB Ramps at Rosemont Ave/Schley Ave	Frederick	1.07
MD 210 at Livingston Rd/Kerby Hill Rd	Prince George's	1.07
MD 414 at Ramp from I-95 WB	Prince George's	1.07
MD 355 at Jones Bridge Rd/Center Dr	Montgomery	1.06
MD 2 at MD 4 (Sunderland)	Calvert	1.04
MD 637 at Suitland Pkwy	Prince George's	1.04
MD 4 at Patuxent Blvd	St. Mary's	1.04
MD 3 at Crawford Blvd/Cronson Blvd	Anne Arundel	1.03
MD 26 at Lord Baltimore Dr	Baltimore	1.02
MD 2 at Tarragon Ln	Anne Arundel	1.02
MD 214 at Ritchie Rd/Garrett A. Morgan Blvd	Prince George's	1.02
MD 5 at MD 458/Iverson St	Prince George's	1.02
US 301 at Chadds Ford Dr/Timothy Branch Dr	Prince George's	1.01
MD 5 at MD 471/Flat Iron Rd	St. Mary's	1.01
MD 26 at Croyden Rd	Baltimore	1.00

RELIABILITY TRENDS

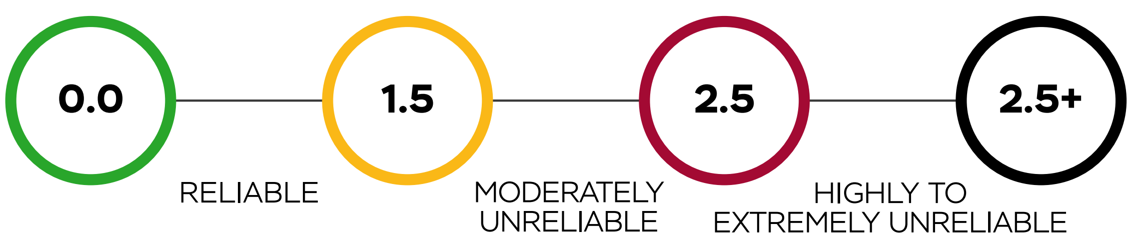
Travel time varies due to many factors. For example, a trip on the same day of the week at the same time on a congested roadway will vary in the amount of time it will take to complete the trip. This variability in travel times from day to day shows the unreliability of the system and often frustrates motorists and transit riders. This unreliability is caused by events such as incidents, vehicular breakdowns, crashes, weather, or lane reductions through work zones and can impact automobiles, trucks and on-street transit services. For all travelers there is a cost associated with the additional travel time due to the unreliability of the network. These motorists must add a buffer to reach their destination on time which takes away from time where they could be accomplishing other tasks. An unreliable system causes an undesirable customer experience for motorists, truck drivers and transit riders.

MDOT SHA understands the significance of providing a reliable transportation system by delivering programs and projects to improve system reliability. By improving reliability, travelers can better plan their trips and daily schedules. The importance of the reliability and the cost associated with it varies by purpose, nature and the importance to that particular motorist. For example, to catch a flight, to have a freight delivery occur on time, or just to be able to attend a child's event may have variable cost implications to that particular person or business.

The MDOT SHA evaluates trip reliability through the use of the Planning Time Index (PTI). Various states utilize different ranges for the PTI analysis with values being between the 80th percentile and the 95th percentile. In Maryland, the 95th percentile travel time is used for a section of roadway and is generalized as the travel time it would take if a major incident or event occurs. For example, a PTI of 2.0 means that if it takes 10 minutes to traverse a roadway segment in free flow conditions, a motorist should allow 20 minutes for travel to ensure a 95% chance of on time arrival. The lower the value the more reliable the trip, while conversely, the higher the value, the longer a trip could take. There are three levels of reliability and their range of values are depicted as follows (Figure 20).

Figure 20

METRIC: MEASUREMENT OF RELIABILITY (PLANNING TIME INDEX)



RELIABILITY MEASURES ON THE MARYLAND FREEWAY/ EXPRESSWAY SYSTEM

The average weekday AM peak hour (8-9AM) and the PM peak hour (5-6PM) are used as a basis for a yearly comparison on Maryland's freeway/expressway system for three measures associated with reliability. These three measures are (1) the number of freeway/expressway miles that are highly to extremely unreliable, (2) the percent of the total freeway/expressway system that is highly to extremely unreliable, and (3) the percent of the peak hour VMT that is impacted which compares the traffic volumes to the portion of the system that is operating at highly to extremely unreliable conditions. Five hours were evaluated on a statewide basis for reliability as follows:

- AM Peak Hour - Figure 21
- PM Peak Hour - Figure 22
- Summer Friday 6–7 PM - Figure 23
- Summer Saturday 11 AM–12 noon - Figure 24
- Summer Sunday 5–6 PM - Figure 25

Highly to extremely unreliable conditions for motorists on Maryland's freeway/expressway system showed a very slight increase in the number of roadway miles and percent of peak hour VMT impacted that experience the worst conditions in both the AM and PM peak hours (Table 23).

Table 23

STATEWIDE FREEWAY/ EXPRESSWAY SYSTEM AVERAGE WEEKDAY AM & PM PEAK HOUR RELIABILITY SUMMARY								
HIGHLY TO EXTREMELY UNRELIABLE CONDITIONS	2017		2018		2019		CHANGE FROM 2018 TO 2019	
	AM	**PM**	**AM**	**PM**	**AM**	**PM**	**AM**	**PM**
Number of Roadway Miles	101	200	107	200	109	213	+2	+13
Percent of Roadway Miles	6	12	7	12	7	13	0	+1
Percent of Peak Hour VMT Impacted	13	23	13	22	14	24	+1	+2

Normally, there is a strong correlation between sections of roadway that experience severe congestion and are highly unreliable. Conversely, some sections of roadway operate acceptably on average days but sometimes experience severe congestion. These locations are often influenced by the congestion that is occurring downstream of these sections or experience issues due to strong peaking characteristics such as related to summer traffic.

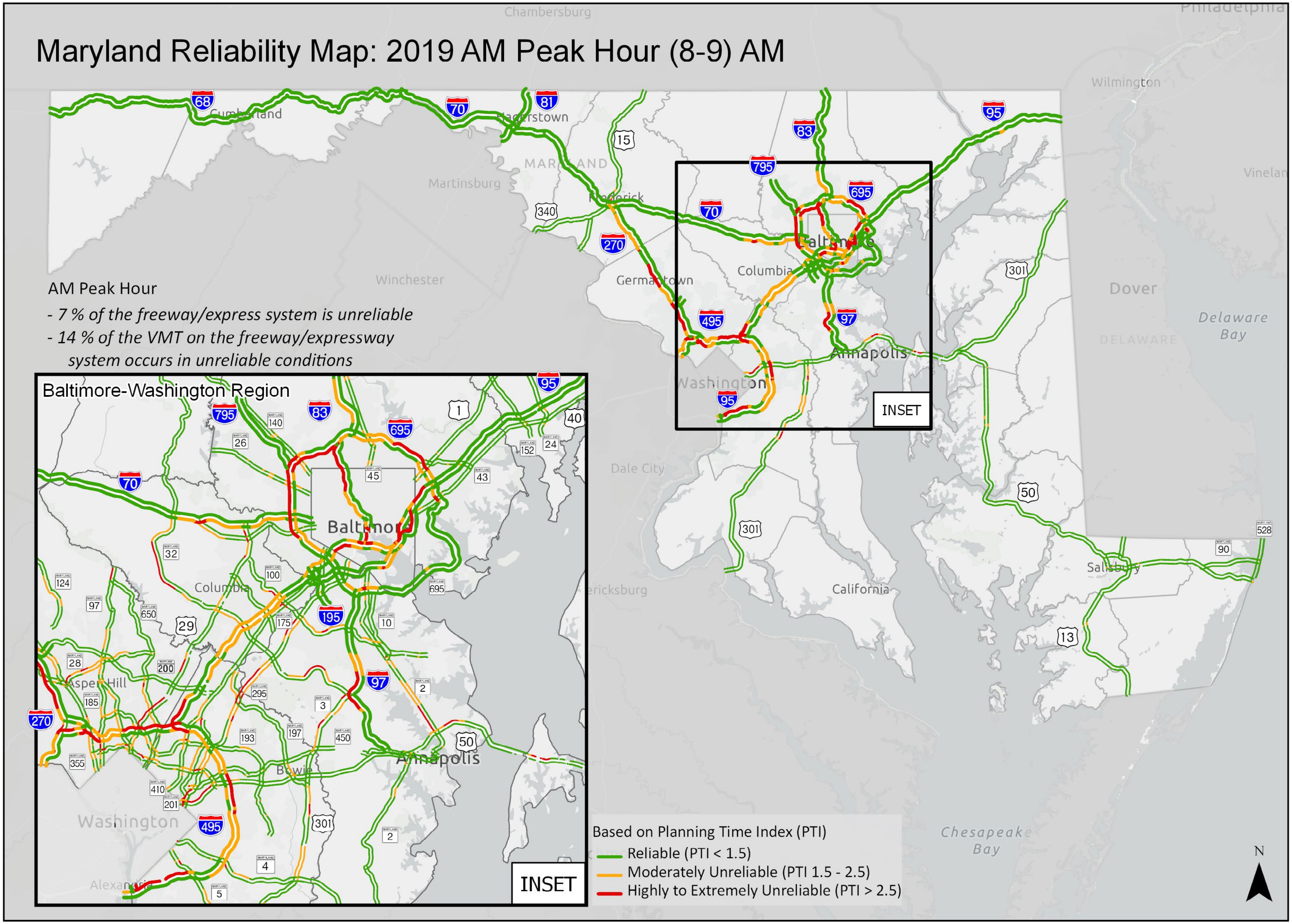
An evaluation was performed comparing reliability (PTI) values with congestion (TTI) values. The sections that have the largest difference (PTI value-TTI value) in the AM peak hour were:

- I-895 Southbound from MD 151 to O'Donnell St.
- I-695 Outer Loop from US 1 to MD 147
- I-495 Outer Loop from I-95 to MD 193
- I-270 Southbound from Father Hurley Blvd. to MD 118
- US 50 Westbound from Castle Marina Rd to MD 18

For the PM peak hour, the sections that showed the largest difference between the PTI value for reliability and the TTI value for congestion were:

- US 50 Eastbound from Whitehall Rd. to Oceanic Dr.
- I-495 Outer Loop from MD 187 to I-270 West Spur
- I-895 Southbound from MD 151 to O'Donnell St.
- I-270 West Spur Southbound from I-270 Split to I-495
- US 50 Westbound from Chester Station Lane to Duke St.

Figure 21



Maryland Reliability Map: 2019 AM Peak Hour (8-9) AM
AM Peak Hour
- 7 % of the freeway/express system is unreliable
- 14 % of the VMT on the freeway/expressway system occurs in unreliable conditions
Baltimore-Washington Region
INSET
Based on Planning Time Index (PTI)
Reliable (PTI < 1.5)
Moderately Unreliable (PTI 1.5 - 2.5)
Highly to Extremely Unreliable (PTI > 2.5)
N
Cumberland
Hagerstown
Frederick
Germantown
Columbia
Baltimore
Annapolis
Washington
Dover
Salisbury
California
Delaware Bay
Chesapeake Bay

Figure 22

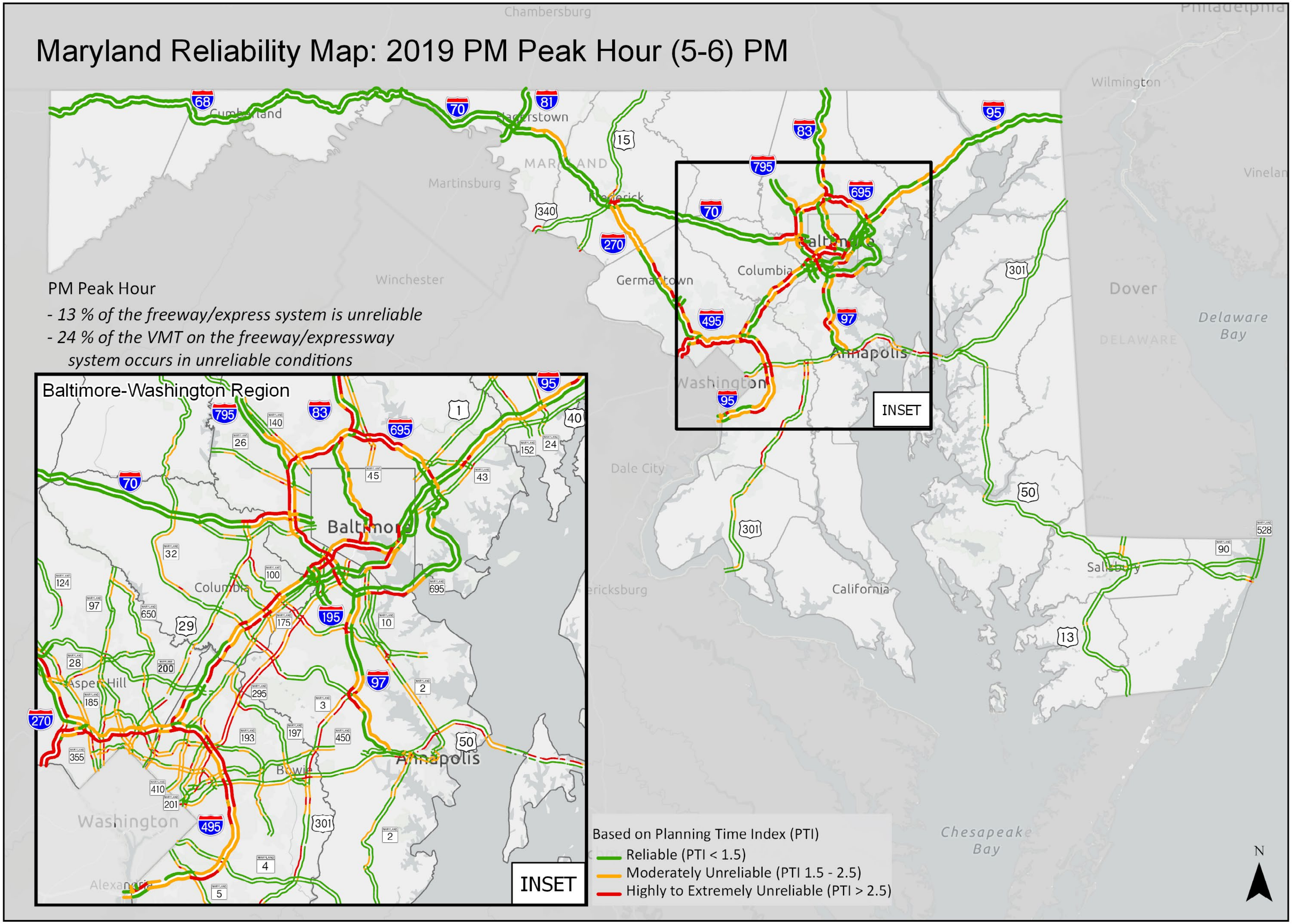
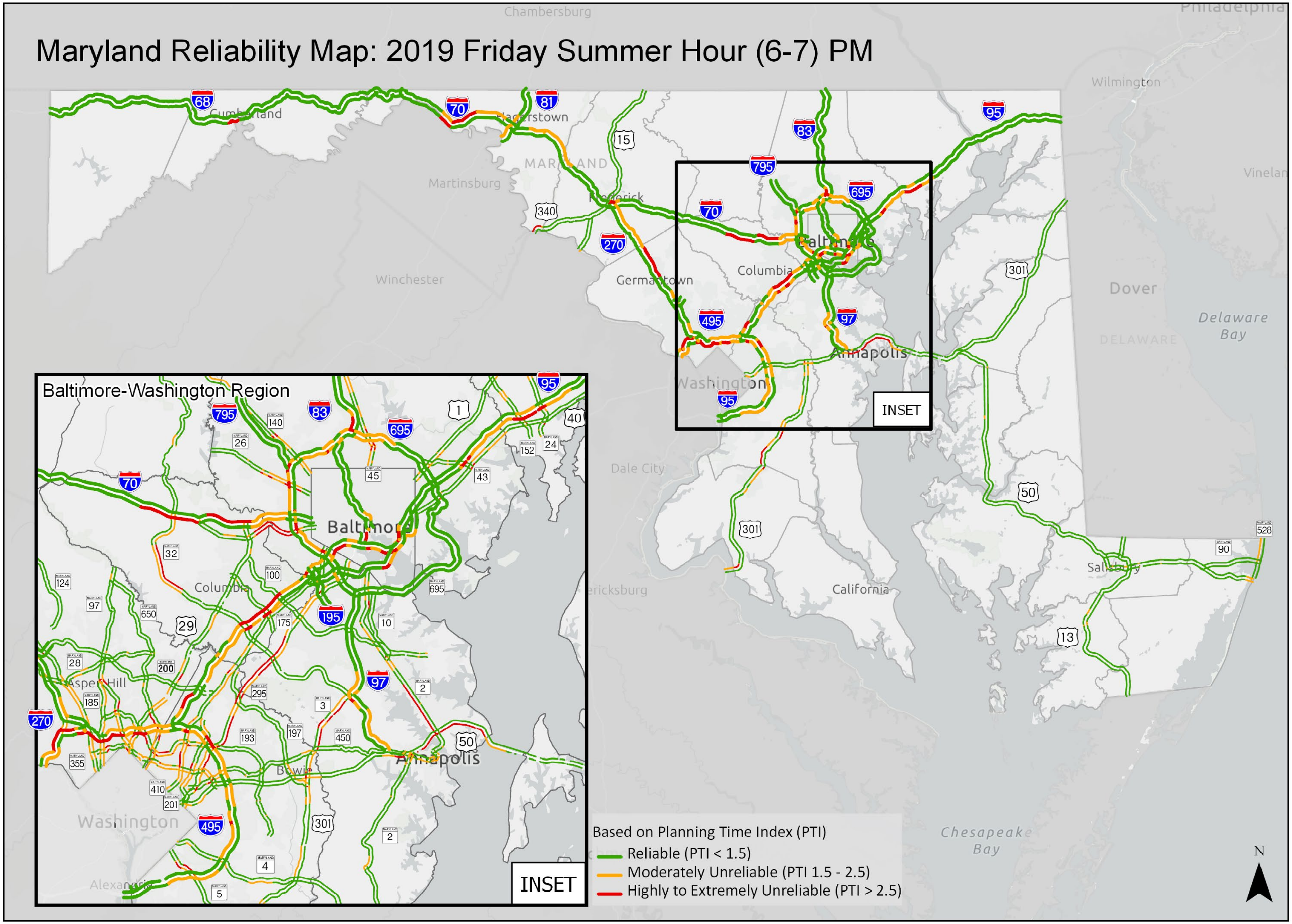
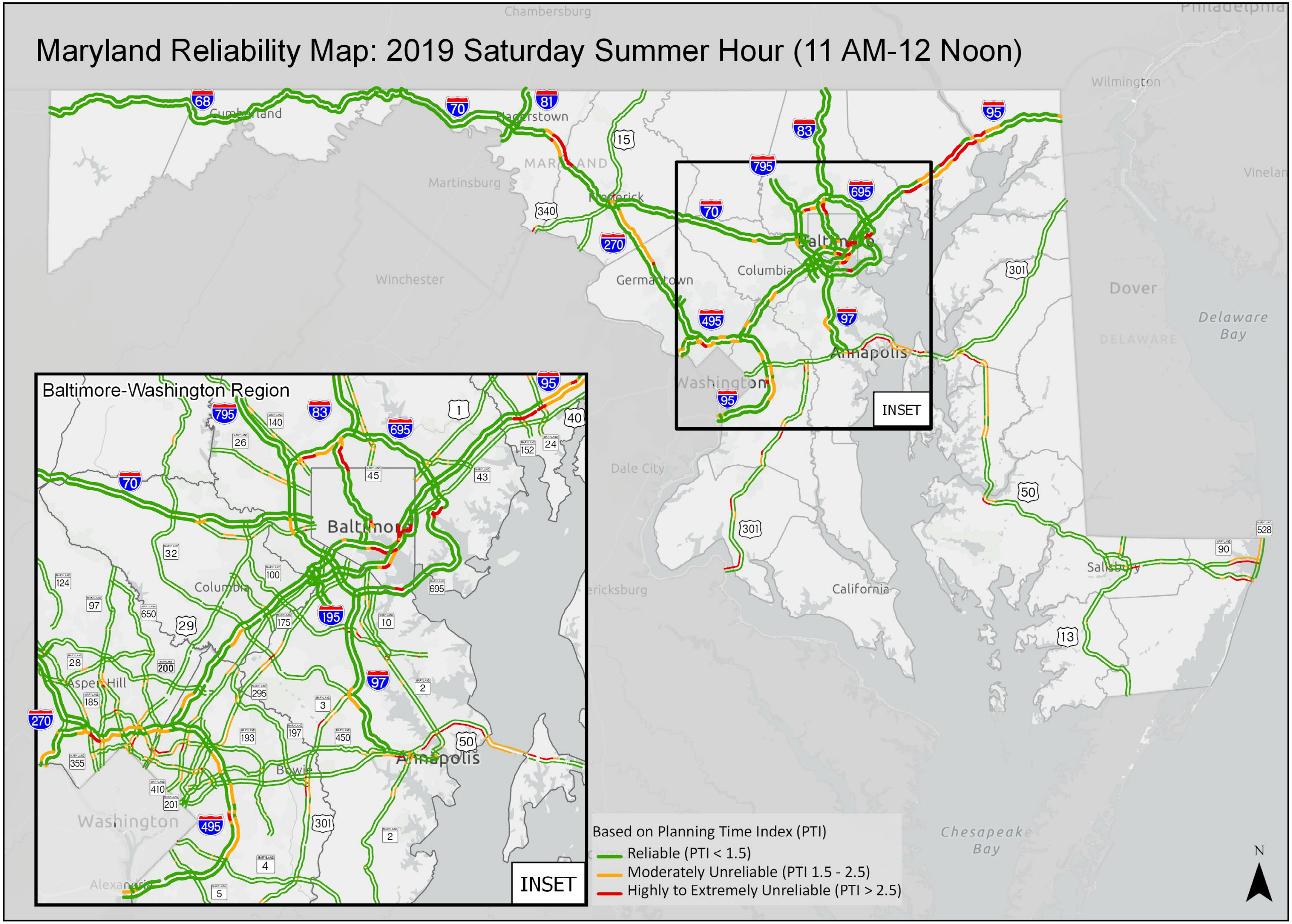

Maryland Reliability Map: 2019 PM Peak Hour (5-6) PM
PM Peak Hour
- 13 % of the freeway/express system is unreliable
- 24 % of the VMT on the freeway/expressway system occurs in unreliable conditions
Baltimore-Washington Region
INSET
Based on Planning Time Index (PTI)
Reliable (PTI < 1.5)
Moderately Unreliable (PTI 1.5 - 2.5)
Highly to Extremely Unreliable (PTI > 2.5)
N
Chambersburg
Philadelphia
Wilmington
Vineland
Cumberland
Hagerstown
Martinsburg
Winchester
Germantown
Columbia
Baltimore
Annapolis
Washington
Dover
DELAWARE
Delaware Bay
Dale City
California
Salisbury
Chesapeake Bay
Aspen Hill
Bowie
Alexandria

Figure 23



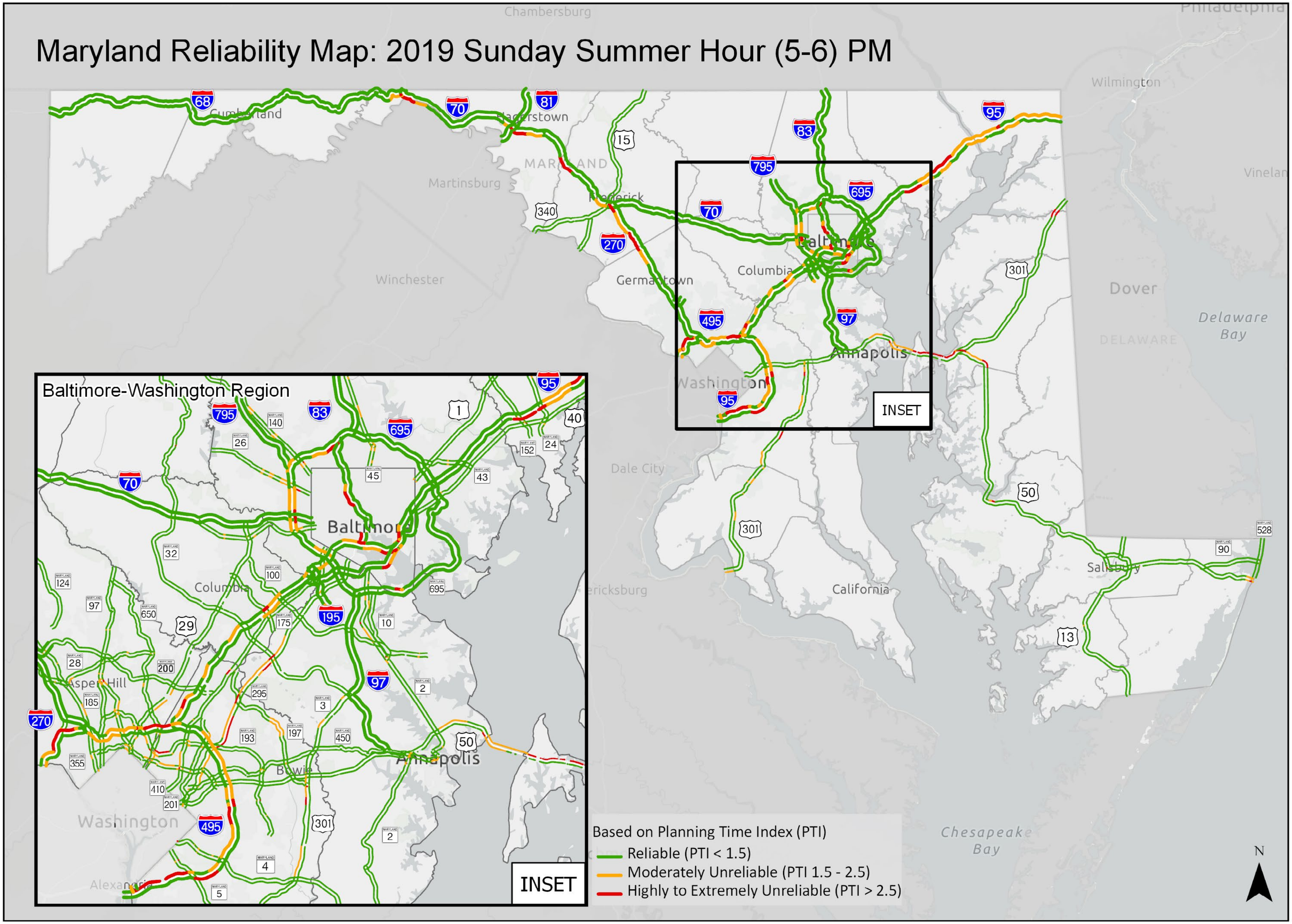
Maryland Reliability Map: 2019 Friday Summer Hour (6-7) PM
Baltimore-Washington Region
INSET
Based on Planning Time Index (PTI)
Reliable (PTI < 1.5)
Moderately Unreliable (PTI 1.5 - 2.5)
Highly to Extremely Unreliable (PTI > 2.5)
Chambersburg
Philadelphia
Wilmington
Cumberland
Hagerstown
Martinsburg
MARYLAND
Frederick
Winchester
Germantown
Columbia
Baltimore
Annapolis
Washington
Dover
DELAWARE
Delaware Bay
Dale City
California
Salisbury
Chesapeake Bay
Aspen Hill
Bowie
N

Figure 24



Maryland Reliability Map: 2019 Saturday Summer Hour (11 AM-12 Noon)
Baltimore-Washington Region
INSET
INSET
Based on Planning Time Index (PTI)
Reliable (PTI < 1.5)
Moderately Unreliable (PTI 1.5 - 2.5)
Highly to Extremely Unreliable (PTI > 2.5)
Cumberland
Hagerstown
Frederick
Germantown
Columbia
Baltimore
Annapolis
Washington
Bowie
Alexandria
Salisbury
California
Dover
Wilmington
Chambersburg
Martinsburg
Winchester
Dale City
N

Figure 25


Maryland Reliability Map: 2019 Sunday Summer Hour (5-6) PM
Baltimore-Washington Region
INSET
INSET
Based on Planning Time Index (PTI)
Reliable (PTI < 1.5)
Moderately Unreliable (PTI 1.5 - 2.5)
Highly to Extremely Unreliable (PTI > 2.5)
Cumberland
Hagerstown
Martinsburg
Winchester
Frederick
Germantown
Columbia
Baltimore
Annapolis
Washington
Dale City
Dover
Salisbury
California
Wilmington
Chambersburg
DELAWARE
Delaware Bay
Chesapeake Bay
Bowie
Aspen Hill
Alexandria
N

TRUCK DATA AND TRENDS

The movement of freight in all forms via all modes must travel through Maryland effectively to support our economy. Freight requires a well-connected and maintained network of highways, intermodal connections to ports, airports and rail terminals, and accessibility to industries via first and last mile routes. Maryland's freight infrastructure is nationally significant in that I-95, I-81, I-70, and I-68 are critical freight corridors supporting national freight flows. Trucks are critical, as they carry the bulk of freight and are necessary for the first and last mile connections. In terms of tonnage, trucks haul about 75% of freight, mostly across MDOT SHA roads. The total truck freight value in 2019 was estimated at $298 million. To evaluate truck freight movement, MDOT performs traffic data collection including identifying the number of trucks that use a particular roadway. These counts are conducted on a three-year cycle. The highest volume of trucks along each major interstate truck route is led by I-95 (Table 24). The highest percentage of trucks on a section of road range from 25% to 32% (Table 25).

Table 24

HIGHEST TRUCK VOLUME		
	LOCATION	AVERAGE DAILY TRUCK VOLUME
1	I-95 North of I-695	28,300
2	I-95/I-495 North of US 50	22,000
3	I-81 North of I-70	20,900
4	I-695 West of Greenspring Ave	17,000
5	I-270 North of I-370	13,900

Table 25

HIGHEST TRUCK PERCENTAGE LOCATIONS		
	LOCATION	TRUCK %
1	MD 159 – South of US 40	32%
2	I-81 – South of Pennsylvania State Line	31%
3	MD 550 – North of MD 26	28%
4	I-81- South of US 11	27%
5	MD 313 – South of US 301	25%

More than 20,000 trucks travel sections of I-81, I-95, and the Capital Beltway daily.

OVERNIGHT TRUCK PARKING SURVEY

Truck parking is essential for allowing drivers to receive proper rest and to maintain safety compliance. This has become one of the most critical freight problems in the U.S. Trucks parked in non-designated locations such as ramps and roadway shoulders present major safety and mobility challenges for drivers and other motorists. Maryland currently has a total of approximately 600 publicly supplied spaces and over 2,300 private parking spaces. In 2018, there were three million tractor trailers nationwide, that drove about 4 million miles per day in Maryland, with all commercial drivers subject to rest requirements. The approximate 2,900 parking spaces cannot support the demand. In 2012, Moving Ahead for Progress in the 21st Century Act (MAP-21) required the U.S. Department of Transportation to address three issues related to parking:

- Survey states' capabilities to provide adequate truck parking
- Assess commercial vehicle traffic volumes in each state
- Develop a system of metrics to assess truck parking (MAP-21, 2012)

In a 2015 report, the Federal Highway Administration (FHWA) found that truck parking is a problem every day in every state and at all times of the day, month, and year. This work helped establish the National Coalition for Truck Parking: a group of public and private stakeholders formed to generate truck parking ideas and solutions. It also helped pave the way for the Fixing America's Surface Transportation (FAST) Act in 2015, which included a freight formula fund and made truck parking an eligible use of those funds by state departments of transportation.

In 2020, MDOT released an annual statewide Truck Parking Study, which found clusters of need throughout the state and low parking availability using a combination of INRIX and Trucker Path data. The study identified the top five locations where clusters of truck parking exceeded capacity. These spots were located in areas where truck parking existed but not enough spaces were available (Table 26).

Table 26

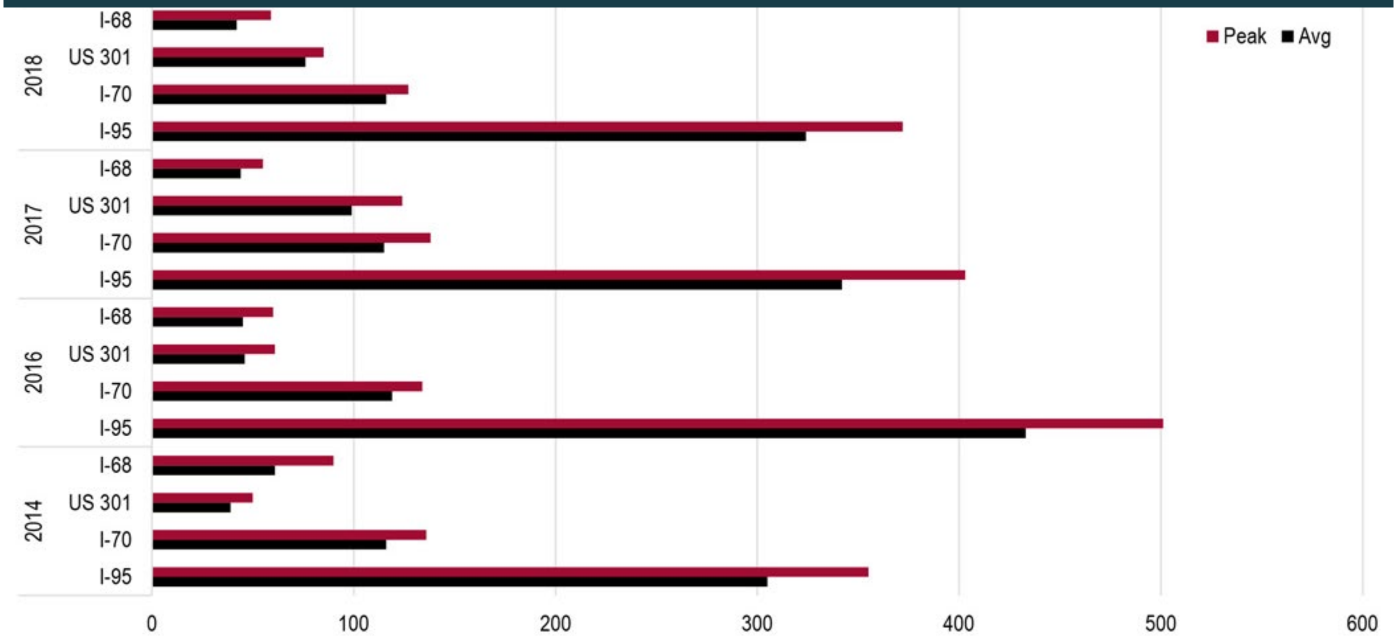
HIGH DEMAND TRUCK PARKING LOCATIONS
LOCATION
I-95 Welcome Center
I-70 South Mountain Welcome Center
I-95/I-495 Weigh Station
US 1/MD 175
I-95 Maryland House Travel Plaza

Previously, a survey was performed to identify the number of trucks and their locations on major routes, mainly along the National Highway Freight Network, twice a night for three nights at 11 PM and 4 AM. Trucks in private lots were counted but not included in the survey results. The highest volume roadways where truck parking occurred were I-95, I-70, US 301, and I-68 (Figure 26). This figure shows truck parking along those roadways averaged over the six-survey time period and during the peak time.

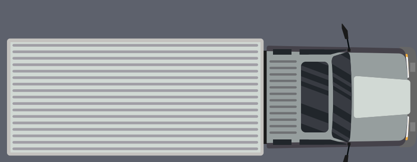
MDOT SHA is currently using INRIX Trips data to assess and understand parking behaviors to identify capital and operational investments that can help increase parking or spread awareness of parking availability. One of the ways to address truck parking is by adding spaces at existing locations and identifying ways to spread awareness about parking availability to drivers. MDOT is considering some TSMO approaches and relationships with existing In-cab information providers to push parking information out to drivers, along with valuable freight traveler information. MDOT SHA is also considering ways to develop more sophisticated traveler and truck parking information systems.

Figure 26

TOP 4 ROUTES FOR OVERNIGHT TRUCK PARKING



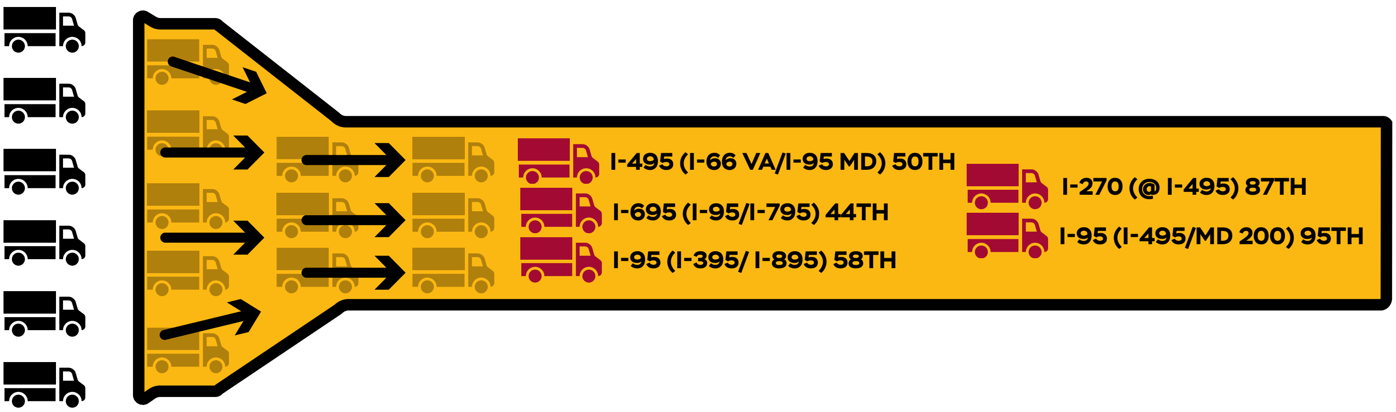
I-95 @ Susquehanna River Bridge Virtual Weigh Station



There are approximately 600 public and 2,300 private truck parking spaces in Maryland.

TRUCK CONGESTION

The Federal Highway Administration (FHWA), many states and freight stakeholders monitor freight bottlenecks. FHWA recently released a Freight Mobility Trends Resource ranking the top 100 national bottlenecks by delay per mile (DPM). The DPM measure accounts for both truck traffic volume and the length of the segments. The Freight Mobility Trends tool is TTI based on approved methodology for measuring freight performance[1]. Among the top 100 bottlenecks across the nation, Maryland has the following five:



WORST BOTTLENECKS AT FREEWAYS/EXPRESSWAYS WITH OTHER ROADWAYS

While FHWA has its new bottleneck resource, MDOT SHA also processes bottlenecks specifically for the state of Maryland using speed-based methodology. The University of Maryland CATT Lab Vehicle Probe Project (VPP) Suite analyzes speed data to identify Maryland freight bottlenecks. Bottlenecks are identified by analyzing each roadway segment to determine when and where the speed drops below 60% of the free flow speed for more than 5 minutes. From that an algorithm is used to determine and rank the bottleneck locations weighted by speed, congestion and total delay. The top five locations in Maryland that are not associated with two intersecting interstate roadways are:

1. I-695 Outer Loop @ Edmondson Ave
2. I-495 Outer Loop @ MD 97
3. I-270 SB @ MD 109
4. I-695 Inner Loop @ MD 122
5. I-95/I-495 Inner Loop @ MD 450

FREIGHT CONGESTION COSTS

A report was prepared by the American Transportation Research Institute (ATRI) estimating the congestion cost to the trucking industry nationally through its Cost of Congestion to the Trucking Industry: 2018 Update (note a 2019 report was not prepared). The congestion cost was based on the total cost and cost per mile in each state that is part of the National Highway System (NHS). The study ranked the District of Columbia number one and Maryland number three in the cost per segment mile, and the Washington DC area was number six in total congestion cost for trucking in a metropolitan area.

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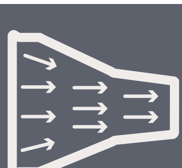
1 - Source National List of Freight Highway Bottlenecks and Congested Corridors. Federal Highway Administration (FHWA) Freight Mobility Trends: Truck Hours of Delay 2019 – FHWA Freight Management Operations (dot.gov)



Five of the Top 100 US Freight Bottlenecks Occur in Maryland.

MARYLAND FREIGHT CONGESTION COSTS

Freight operators experience congestion costs due to truck driver delay, truck cargo delay, additional fuel cost, and emissions cost along the freeway/expressway system (Table 27 and Figure 27).

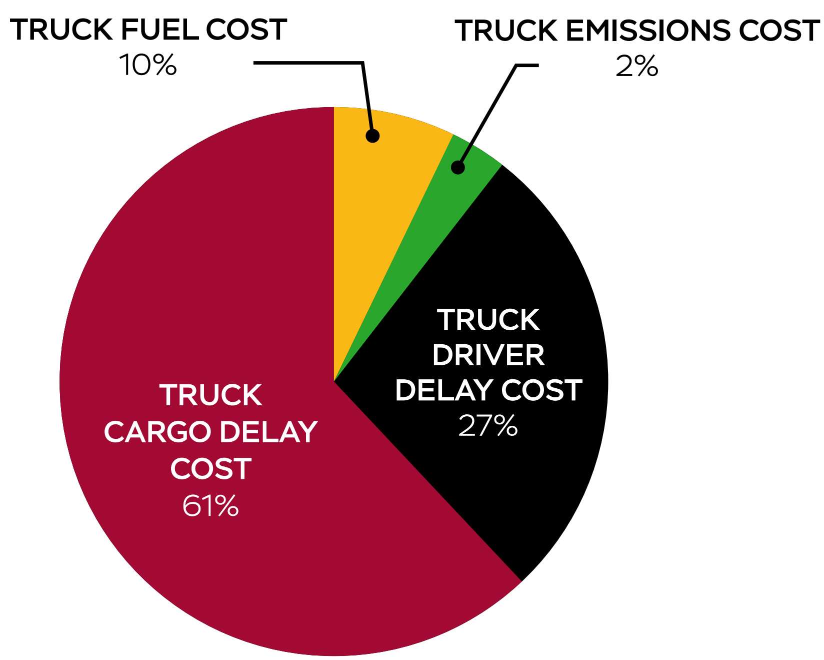
Table 27

2019 FREIGHT CONGESTION COSTS ON MARYLAND'S FREEWAY/EXPRESSWAY SYSTEM	
CONGESTION ELEMENT	COST IN MILLIONS
Truck Cargo Delay	$152
Truck Driver Delay	$69
Truck Fuel	$24
Truck Emissions	$6
TOTAL	$251

Figure 27

2019 FREIGHT CONGESTION COSTS ON MARYLAND'S FREEWAY/EXPRESSWAY SYSTEM

$251 million



Congestion costs for trucks increased by $39 million between 2018 and 2019.

TRUCK TRAVEL TIME RELIABILITY INDEX

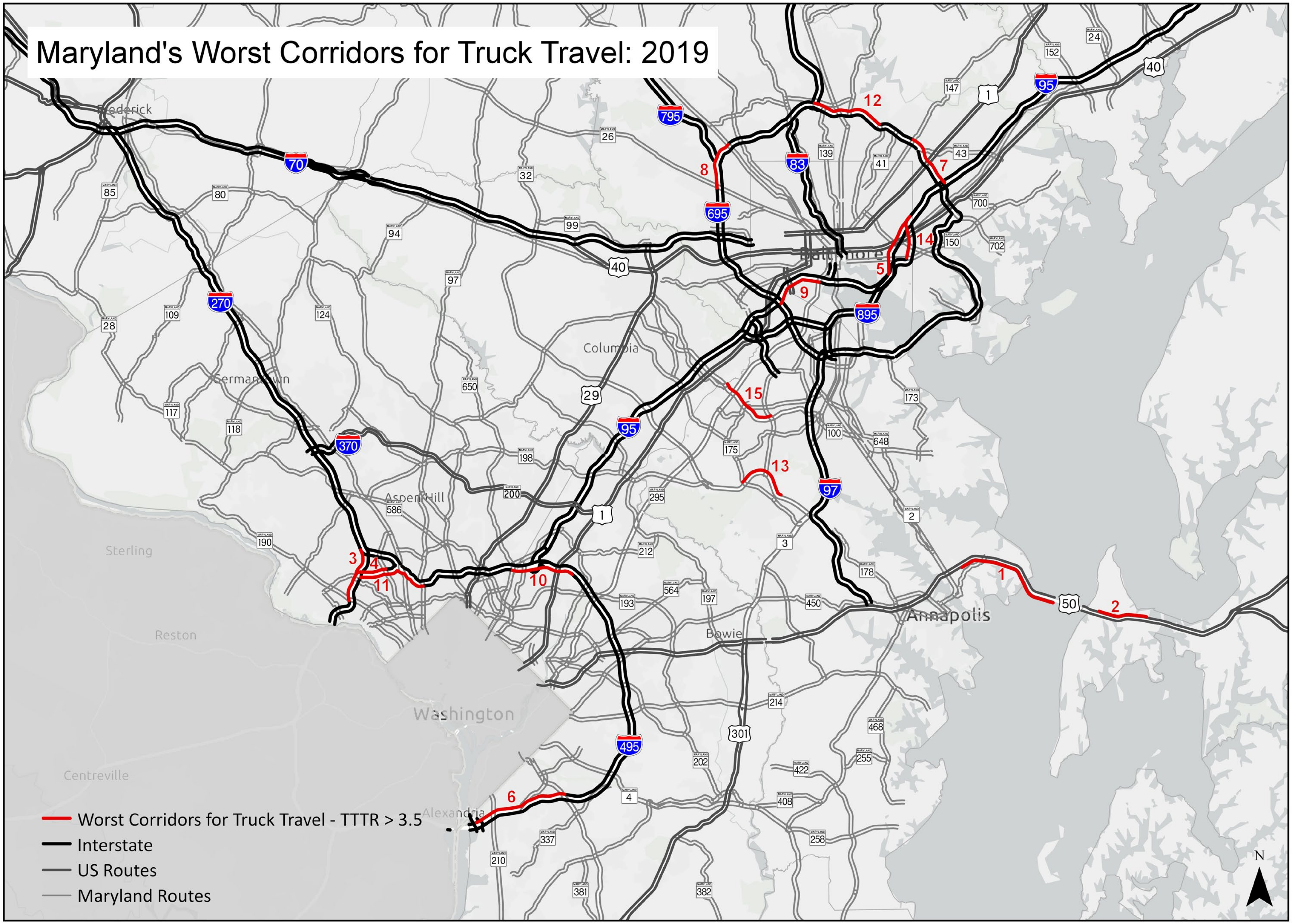
MAP-21 requires states to calculate a truck travel time reliability metric. Although various metrics exist, FHWA requested that each state report a standard level of freight performance. The Truck Travel Reliability (TTTR) Index represents the 95th percentile travel time divided by the 50th percentile travel time for each segment. The TTTR is calculated for five time periods; the maximum value determines the final system performance. Each individual TTTR value is combined to develop the limits of the most unreliable corridors on the interstate for trucks (Table 28 and Figure 28). The higher the TTTR value, the worse the operations are in that segment.

Table 28

2019 TOP 15 WORST CORRIDORS FOR TRUCK TRAVEL

RANK	ROUTE/DIRECTION	LIMITS	COUNTY	MILEAGE	TTTR MAX VALUE
1	US 50 Eastbound	Bay Dale Drive to Chesapeake Bay Bridge	Anne Arundel	3.5	6.0
2	US 50 Westbound	Piney Creek Road to MD 8	Queen Anne's	3.1	5.9
3	I-270 West Spur Southbound	I-270 Split to I-495	Montgomery	1.7	5.8
4	I-495 Outer Loop	MD 187 to MD 190	Montgomery	3.2	5.0
5	I-95 Southbound	I-895 Split to MD 150	Baltimore City	3.1	4.4
6	I-495 Inner Loop	MD 5 to I-295	Prince George's	5.6	4.3
7	I-695 Outer Loop	I-95 to MD 147	Baltimore	3.5	4.3
8	I-695 Outer Loop	MD 140 to MD 26	Baltimore	3.2	4.2
9	I-95 Northbound	I-695 to MD 295	Baltimore/ Baltimore City	3.7	4.1
10	I-495 Inner Loop	MD 650 to Greenbelt Metro Station	Prince George's	3.3	4.0
11	I-495 Inner Loop	I-270 West Spur to MD 185	Montgomery	4.1	4.0
12	I-695 Outer Loop	Cromwell Bridge Road to I-83	Baltimore	3.9	3.9
13	MD 32 Westbound	Sappington Station Road to MD 175	Anne Arundel	3.7	3.9
14	I-895 Southbound	I-95 Split to Ponca Street	Baltimore City	3.2	3.7
15	MD 100 Westbound	MD 170 to Coca Cola Drive	Anne Arundel	3.5	3.6

Figure 28



Maryland's Worst Corridors for Truck Travel: 2019
Worst Corridors for Truck Travel - TTTR > 3.5
Interstate
US Routes
Maryland Routes
Frederick
Germantown
Aspen Hill
Columbia
Baltimore
Annapolis
Bowie
Washington
Alexandria
Sterling
Reston
Centreville
N

MDOT SHA MOBILITY PROJECTS

MD 26 @ Oakland Mills Dr

CAPITAL PROJECTS

The capital projects program is one of the most recognizable ways that MDOT SHA addresses congestion and reliability issues. These projects provide increased capacity and safety improvements at locations throughout the state through a performance-based approach. Project types range from capacity improvements such as constructing interchanges, providing turn lanes at intersections, and roundabouts that improve safety. They also often include pedestrian and bicycle network enhancements. The improvement projects completed in the 2019 calendar year provide congestion relief, improve safety, and enhance traffic operations.

These completed capital projects provide benefits to the traveling public. Through reduction in delays incurred by motorists and commercial vehicles; fuel savings, and additional safety are provided to the system, resulting in an overall benefit (Table 29).

Table 29

CAPITAL IMPROVEMENT PROJECTS OPENING YEAR BENEFITS[1]					
ROUTE	LIMITS	COUNTY	CONGESTION & FUEL SAVINGS	SAFETY SAVINGS	ANNUAL COST SAVINGS
			$ (Thousands)		
MD 175	Mapes Road to Reece Road	Anne Arundel	5,390	800	6,190
MD 26	Oakland Mills Road	Carroll	430	110	540
MD 26	Exchange Drive to Calvert Way	Carroll	1,720	20	1,740
MD 97	Airport Drive to Pleasant Valley Road	Carroll	3,250	2,400	5,650
MD 273	Blue Ball Road (Roundabout)	Cecil	-10	3,450	3,440
MD 180	Mt. Zion Road (Roundabout)	Frederick	80	210	290
US 40	MD 7/MD 159	Harford	4,030	1,520	5,550
MD 32	Linden Church Road to MD 108	Howard	25,130	1,060	26,190
MD 97	MD 28	Montgomery	4,580	<103	4,580
MD 337	I-95/I-495 Northbound Ramp to Suitland Road	Prince George's	3,060	70	3,130
MD 235/ MD 4	Woodland Acres	St Mary's	950	<10	950
Total			48,610	9,640	58,250

1 - For more details see Mobility Report Supplement

The improvement projects completed in 2019 provide more than $58 million in user cost savings in the opening year or approximately $5 million per project on average.

PAST PROJECT BENEFITS

There have been several major capital projects completed over the last eight years. These locations were analyzed to quantify travel time savings after roadway improvements were implemented and open to traffic. The use of vehicle probe data allowed for a comparison between traffic operations before projects were constructed with operations after projects were constructed. The most recent 2019 data was included to determine the mobility benefits. The locations listed below were the sites of construction that improved congestion and traffic operations.

- MD 295 – I-195 to I-695
- US 50/US 301 at Severn River Bridge
- I-95 – I-895 to MD 43
- I-695 – US 1 to MD 372
- I-695 – MD 41 to MD 43
- US 29 Northbound – MD 32 to MD 175
- I-95 – MD 198 to MD 212

The Travel Time Index (TTI) was used to compare the 2011 base-year pre-construction data with the 2019 data (Table 30). The 2011 base-year represents the oldest year INRIX data was used to analyze for TTI.

Table 30

CONGESTION IMPROVEMENT BY COMPLETED PROJECTS						
ROUTE/DIRECTION	LIMITS	LENGTH (MILES)	COUNTY	2011 TTI	2019 TTI	% REDUCTION IN DELAY
MD 295 AM SB	I-695 to W. Nursery Rd	1.1	Anne Arundel	1.45	1.09	+25
MD 295 PM NB	I-195 to W Nursery Rd	1.8	Anne Arundel	1.87	1.32	+30
US 50 PM EB	MD 450 to MD 2	2.7	Anne Arundel	1.80	1.23	+32
I-95 AM SB	MD 43 to S of I-695	4.3	Baltimore	1.72	1.05	+39
I-95 PM NB	US 40 to MD 43	6.9	Baltimore	1.32	1.08	+18
I-695 Inner Loop PM	I-895 to I-95	1.6	Baltimore	1.31	1.12	+14
I-695 Inner Loop PM	MD 41 to MD 147	1.8	Baltimore	1.49	1.38	+7
US 29 NB PM	S of MD 32 to N of Broken Land Parkway	2.3	Howard	1.97	1.11	+44
I-95 AM SB	S of MD 200 to S of MD 212	1.9	Prince George's	1.73	1.51	+13

PEDESTRIAN PROJECTS

Pedestrians are one of the most vulnerable users of a roadway facility; with fatalities on Maryland roadways exceeding 100 persons in 2019. In order to address this, MDOT SHA has prioritized improving pedestrian facilities. This occurs through projects associated with roadway improvements or as standalone projects through various funding sources to improve safety and create greater opportunities for walking. Pedestrian facility improvements include filling in sidewalk gaps, upgrading sidewalks in poor condition, the addition of off road trails, countdown signals, HAWK signals, crosswalk upgrades and ADA facilities such as ramps and audible pedestrian signals. In fiscal year 2019, MDOT SHA expended $3.6 million on designing and constructing new sidewalks plus an additional $6.8 million on sidewalk improvements. New sidewalks were constructed in 19 counties (Table 31).

Table 31

NEW SIDEWALK LOCATIONS 2019		
ROUTE	LIMITS	COUNTY
MD 936	along Grant Street	Allegany
MD 2	at Admirals Ridge Dr	Anne Arundel
MD 3	at MD 175	Anne Arundel
MD 170	at Wieker Rd	Anne Arundel
MD 175	Brock Bridge Rd to Sellner Rd	Anne Arundel
MD 176	Kiddie Academy Entrance to Airport 100 Way	Anne Arundel
MD 177	at Appalachian Dr/Royal Palm Dr	Anne Arundel
MD 178	at MD 450	Anne Arundel
MD 435	Herbert Sachs Boulevard to Annapolis St	Anne Arundel
MD 450	at MD 424	Anne Arundel
MD 456	at MD 256	Anne Arundel
MD 713	Ridge Rd at Greystone Village	Anne Arundel
MD 122	I-695 to Baltimore City Line	Baltimore
MD 151	at Old Battle Grove Rd	Baltimore
US 40	at Ebenezer Rd	Baltimore
MD 2/MD 4	at Harrow Ln/Chick-fil-A Entrance/Exit	Calvert
MD 2/MD 4	at MD 765	Calvert
MD 261 NB	Mears Ave to Fishing Creek Bridge	Calvert
MD 331	MD 324 to north of Payne Road	Caroline
MD 27	South of Hollow Rock Rd to south of EB MD 140 Ramp	Carroll
MD 267	Market St to MD 7C (W. Old Philadelphia Rd)	Cecil
MD 227	Oakwood Ct to McCormick Dr	Charles
MD 228	at Baden Pl	Charles
MD 180	MD 383 to Old Holter Rd	Frederick
Monocacy Blvd	at US 15	Frederick

Table 31 - continued

ROUTE	LIMITS	COUNTY
Monocacy Blvd	at Park and Ride	Frederick
MD 194	at Glade Blvd	Frederick
MD 22	at Thurlow Ct/The Townes at Bynum Run	Harford
MD 24	at Maurice Dr/Rock Spring Station	Harford
MD 543	Amyclae Dr to north of Eva Mar Blvd	Harford
MD 924	Box Hill S. Pkwy to St Clair Dr	Harford
US 1 Business	at S. Tollgate Rd.	Harford
MD 99	Woodstock Rd and Dorchester Way	Howard
MD 103	at Locust Thicket Way/Wesley Ln/Wexley Apts.	Howard
MD 103	East of I-95	Howard
MD 28	Siesta Key Way to Omega Dr	Montgomery
MD 28	at Norbeck Blvd/Bradford Rd	Montgomery
MD 97	at Randolph Rd	Montgomery
MD 355	at Clarksburg Square Rd/Redgrave Pl	Montgomery
MD 206	south along Van Dusen Rd	Prince George's
MD 223	at King Gallahan Ct	Prince George's
MD 337	south of I-95/I-495 NB Off-Ramp to north of Suitland Rd/Westover Dr	Prince George's
MD 450	at Church Rd/High Bridge Rd	Prince George's
US 301	at Village Dr W	Prince George's
Kent Narrows Rd	Cross County Connector Trail	Queen Anne's
MD 4	from MD 235 to FDR Blvd	St. Mary's
MD 5	south of Golden Beach Rd	St. Mary's
MD 5	MD 243 to Clarks Rest Ln	St. Mary's
MD 245	College of Southern Maryland to Leonard's Grant Pkwy	St. Mary's
MD 328	at Galloway Meadows Apts.	Talbot
MD 60	at Marsh Pike/Emerald Square	Washington
MD 845A	along S. Main Street	Washington
US 40	at Cleveland Ave	Washington
US 13	at Dagsboro Rd	Wicomico
US 50	at Berlin Fire Station 3	Worcester
US 50 Bike Path	MD 611 to Harry W. Kelly Memorial Bridge	Worcester

There were 7.1 miles of new sidewalks constructed in 2019 by MDOT SHA.

69% of sidewalks are ADA compliant along Maryland Routes.

BICYCLE PROJECTS

The concept of Complete Streets utilized by MDOT SHA provides that all multi-modal users of a facility must be considered. One of the ever-expanding users of roadway facilities is the bicyclist. The MDOT SHA strives to improve bicycle safety and accessibility while also looking for opportunities to provide additional services such as shared bike lanes. Upgrades to a roadway could include bicycle facilities such as on-street bike lanes, signing, pavement markings and accommodation improvements at intersections. Standalone bicycle facilities (such as separated bike paths), are also part of bicycle upgrade projects. Capital for these projects is received through a wide variety of sources ranging from money set aside for bicycle facilities to funding dedicated to resurfacing, maintenance, safety and capacity improvement projects. As of 2019, MDOT SHA has improved 427 directional miles for bicycle access along with almost 20 miles of shared lanes. Selected bicycle facility upgrades that took place in 2019 depict a number of different improvements. (Table 32).

Table 32

SELECTED BIKE FACILITY UPGRADE LOCATIONS IN 2019

ROUTE	LIMITS	COUNTY	IMPROVEMENT
MD 176	MD 170 to MD 648E	Anne Arundel	Bicycle signing/sharrows/continental sidewalk
MD 178	Veterans Hwy to Sunrise Beach Dr	Anne Arundel	Bicycle signing/sharrows
MD 179	College Pkwy to Woodland Circle	Anne Arundel	Bicycle signing/sharrows
MD 214	Prince George's County Line to MD 424	Anne Arundel	Bicycle signing/sharrows
MD 648F	US 50 to MD 2	Anne Arundel	Bicycle signing/sharrows
MD 931Q	College Pkwy to Peregoy Park Pl	Anne Arundel	Bicycle signing/sharrows
MD 931R	MD 908B to Cape St. Claire Rd	Anne Arundel	Bicycle signing/sharrows
MD 26	Emerald Ln to Calvert Way	Carroll	0.5 miles of new bike lanes
MD 26	Oakland Mills Rd	Carroll	Intersection improvements including bike lanes
MD 528	59th St to 63rd St	Worcester	Modified bike lane signage

2019 SYSTEM UPGRADES

80 miles of additional marked bike facilities

Approximately 23 mile increase in bike facilities within three miles of transit

FREIGHT PROJECTS

It is vital for the economy of the state to be able to move freight to meet the needs of the population. In order to keep up with increasing freight movement, the roadway network must be able to meet the demand. This requires implementation of freight projects and operational/TSMO solutions. Freight projects are divided into two categories. The first category addresses roadway projects that enhance overall mobility, which provide improvements for freight operators (logistics). The second category encompasses projects that are directly associated with improving trucking operations (systematic efficiency). The ultimate goal of all these projects is to enhance the mobility of trucks while keeping other users of this same network (motorists/bicyclists/pedestrians/transit) safe.

In order to keep freight moving efficiently, there are several on-going projects operated by MDOT SHA's Motor Carrier Division. The "Maryland One Permit System" allows for the state to process applications more effectively for large shipments. Previously, permit approval could take hours or days depending upon the request. The improved automated hauling permit system now auto-issues:

- 82% of all permits for loads up to and including 200,000 pounds, 13' wide, 14'6" high, and 90' long, if the route analysis is approved. Of these types of requests, 95 % of all permits are issued within 2 hours or less and nearly 100% are issued within 2 days or less.

Megaloads permits (up to 1 million pounds) require coordination between numerous agencies and take a longer period of time to be processed.

The Motor Carrier Division is also responsible for the construction and maintenance of Virtual Weigh Stations (VWS). VWS utilize technology through a system of sensors and cameras to record commercial motor vehicles traveling at highway speed. The VWS can record speed, height, weight and every axle without requiring a vehicle to stop. This system improves mobility and assists in limiting damage to roads and bridges by not having overweight trucks on the road. There are currently 19 active VWS sites with the MD 32 site decommissioned at this time due to construction. Two more are proposed to be operational in 2020 (Figure 29).

VWS sites at US 13 North at the MD/VA border and MD 695 South (Broening Highway) became operational in 2019. Two more sites are slated to be complete in 2020 at I-95 South (Tydings Bridge) and I-81 North at the West Virginia State line.

One area related to safety for both truck drivers and motorists is overnight truck parking. Truck parking at Rest Areas and Welcome Centers provides safe, off-road locations (Figure 29) to reduce the potential for crashes between parked trucks and moving vehicles. Trucks parked along shoulders or entrance/exit ramps can create a safety hazard to other truck and car drivers. Unfortunately, identifying locations for new or expanded truck parking can be challenging. Truck drivers prefer to stop close to their destination, which are often near populated urban centers with limited available right-of-way or where expansions/new lots are negatively perceived by nearby residents. MDOT SHA's Freight Planning Program is working on truck parking solutions. As of 2019, up to 20 more spaces are being designed at Welcome Centers for overnight truck parking.

In addition, MDOT SHA's Office of Transportation Mobility and Operations (OTMO) working on solutions to help drivers become aware of parking availability. This includes using the data from the 2020 Statewide Truck Parking Study to identify locations where parking is needed and to identify state-owned property that can support parking easily and safely. Other efforts include working to establish freight traveler and truck parking information systems that can alert drivers to available parking and to determine how to push existing data available from MDOT SHA OTMO to the freight community.

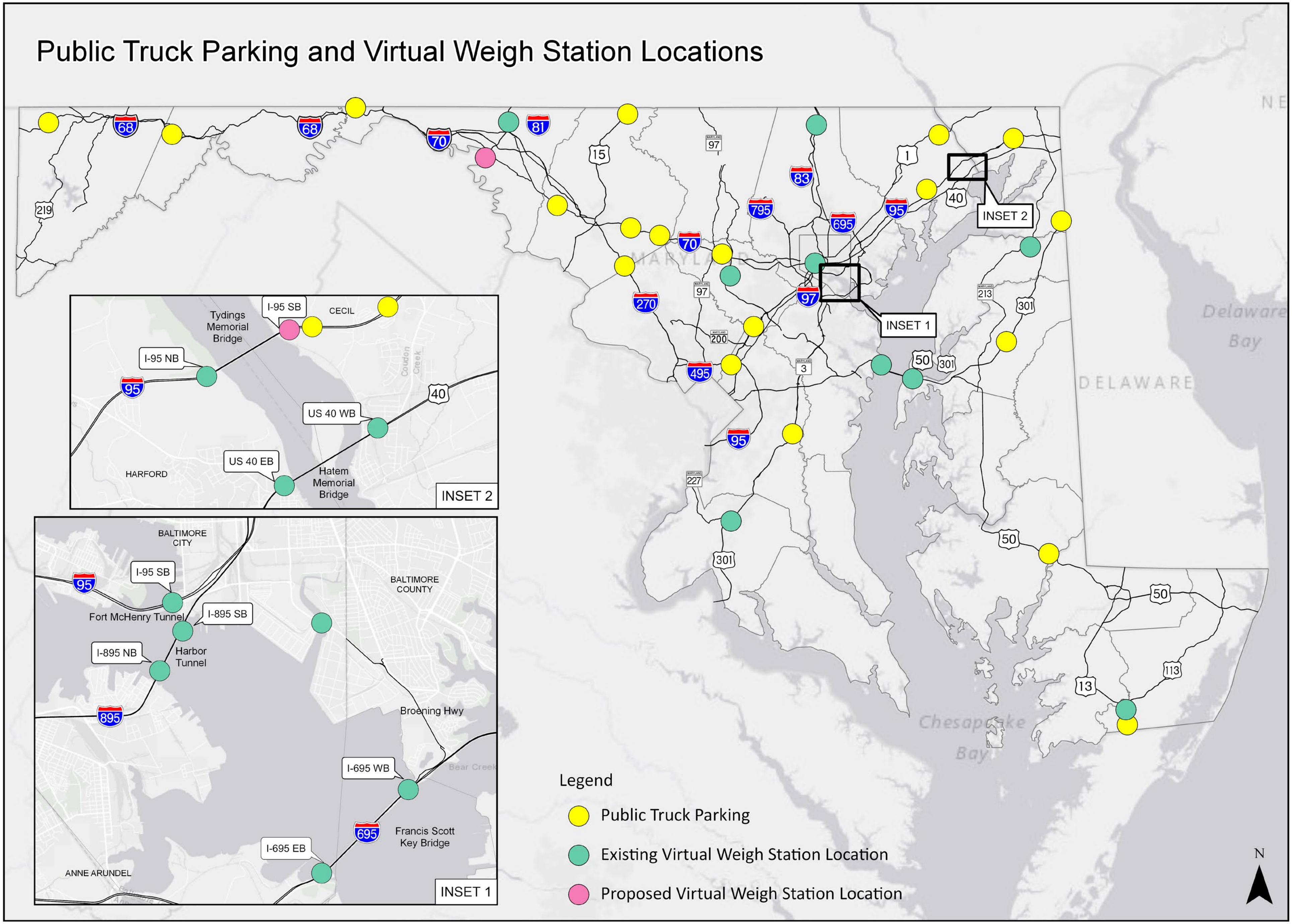
OVERNIGHT TRUCK PARKING EXPANSION

I-70 Westbound Welcome Center Frederick County - Up to 10 added spaces under design[1]

I-70 Eastbound Welcome Center Frederick County - Up to 10 added spaces under design[1]

1 - Presently on hold.

Figure 29



Public Truck Parking and Virtual Weigh Station Locations
MARYLAND
DELAWARE
Delaware Bay
Chesapeake Bay
INSET 1
INSET 2
Tydings Memorial Bridge
I-95 SB
CECIL
I-95 NB
US 40 WB
US 40 EB
HARFORD
Hatem Memorial Bridge
BALTIMORE CITY
BALTIMORE COUNTY
Fort McHenry Tunnel
I-895 SB
I-895 NB
Harbor Tunnel
Broening Hwy
I-695 WB
I-695 EB
Francis Scott Key Bridge
ANNE ARUNDEL
Legend
Public Truck Parking
Existing Virtual Weigh Station Location
Proposed Virtual Weigh Station Location
N

RAILROAD GRADE CROSSING PROJECTS

Motorists and trains interact at locations where at-grade crossings exist. These locations can present a safety issue for all transportation users. Each year MDOT SHA provides safety improvements for locations with at-grade railroad crossings. These improvements include installing new flashing light signals (with or without gates), updating the components at existing active warning devices and improving crossing surfaces. In 2019, MDOT SHA completed two projects to improve at-grade crossings.

- Baltimore Street – City of Cumberland
- Shepherds Mill Road - Carroll County

Baltimore St RR Crossing in Cumberland

There are 633 public at-grade and 22 separate pedestrian crossings of railroads in Maryland.

DEVELOPER PROJECTS

There are numerous types of developments occurring throughout the State. These developments could include new residential units, commercial centers, office buildings, warehouses or the redevelopment of an existing site. As a result, the roadways around these sites will experience the additional traffic they generate; therefore developers are often required to mitigate the additional volume. In 2019, these improvements ranged from minor to major intersection modifications, interchange improvements as well as access improvements (such as acceleration and deceleration lanes) (Table 33). MDOT SHA through a joint permitting process works to offset the traffic impacts of developments with improvements that are beneficial throughout the corridor. Without these improvements, operational issues can result. For example, motorists would have to wait multiple traffic signal cycles or traffic from turn lanes can extend into through lanes, thus blocking through traffic and causing safety issues.

Table 33

SELECTED DEVELOPER IMPROVEMENT PROJECTS			
ROUTE	LIMITS	COUNTY	IMPROVEMENT
MD 295	W. Nursery Rd	Anne Arundel	Ramp modifications
MD 272	Rogers Rd/Gateway Dr	Cecil	Turn lane additions and signalization
I-70	MD 144	Frederick	Entrance ramp to I-70 westbound
MD 543	Prospect Mill Rd	Harford	Turn lane addition
US 1	Hotel Dr; Campus Dr	Prince George's	Turn lane additions and lengthening; new signal
MD 18	Castle Marina Rd; Piney Creek Rd	Queen Anne's	Roundabout and turn lane lengthening
MD 4	MD 235 to FDR Blvd.	St Mary's	Widening
MD 65	MD 65A; I-70 EB Ramp; I-70 WB ramp	Washington	Turn lane additions

US 1 @ Hotel Dr

MDOT PROGRAMS TO IMPROVE MOBILITY 2019 RESULTS

MD 7 SMART Signal Corridor

TRANSPORTATION SYSTEMS MANAGEMENT & OPERATIONS - CHART

The cost, right-of-way and environmental impacts of completing capacity related improvement projects limit the ability of MDOT SHA to address all the needs of the transportation system. In order to deal with mobility issues, other programs have been established to improve traffic flow and reduce congestion through a variety of methods including reducing the demand on the roadway and making better use of the existing pavement. One such program includes the use of Transportation Systems Management and Operations (TSMO) through the Coordinated Highway Action Response Team (CHART). CHART is a multi-agency effort to improve mobility for the Maryland highway system through its Advanced Traffic Management Systems (ATMS), service patrols, communications, systems integration and incident response and management.

The CHART program focuses on non-recurring congestion. Non-recurring congestion could be caused by crashes, vehicle breakdowns, work zones, special events, and weather events. These non-recurring congestion events affect mobility, safety, and reliability of the roadway system. Mobility and reliability are influenced by the time motorists spend waiting for the incident to clear. Safety is impacted by secondary incidents or those crashes that occur by the sudden slowing of traffic caused by the original incident. The CHART program identifies incidents quickly, allows emergency personnel to be altered, and minimizes time motorists spend in congestion; and thereby, saves motorists time and money. The improved response time reduces the potential for secondary collisions and decreases the amount of time motorists are in traffic; and thereby, lowers the cost impact of these incidents. The typical approach of CHART incident management is shown below.

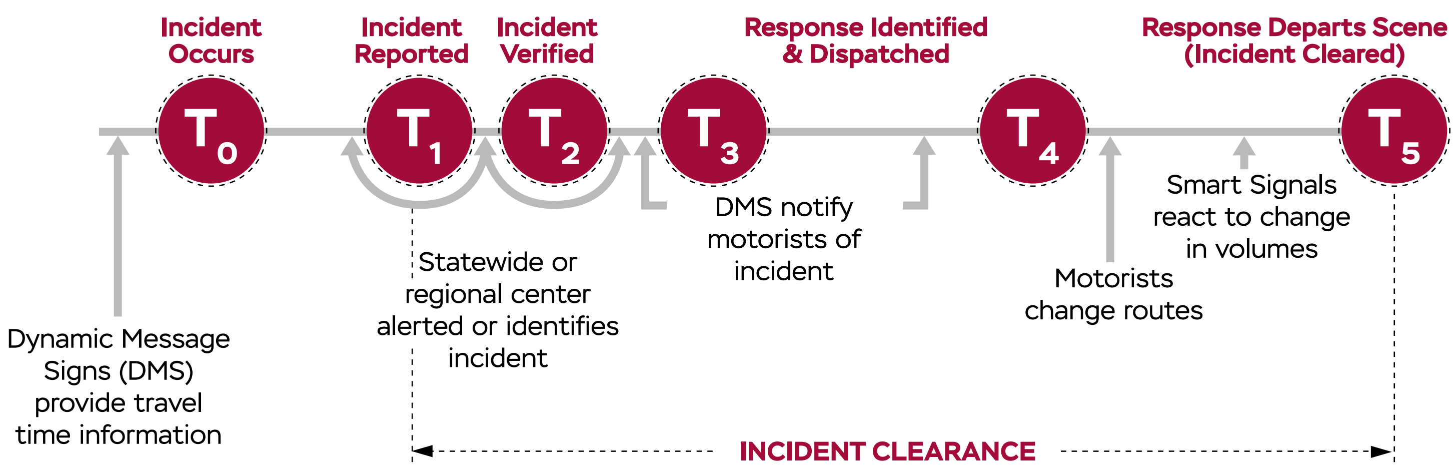


CHART is involved in the following activities to address non-recurring congestion:

- Emergency Preparedness
- Emergency Weather Operations
- Incident Management
- Traffic Management
- Traffic and Roadway Monitoring
- Traffic Information

The many different resources dedicated to traffic management that CHART has includes:

- Emergency Traffic Patrols
- Emergency Response Units
- Freeway Incident Traffic Management Plans and Response Trailers
- Intelligent Transportation Systems (ITS) Equipment
- Clear the Road Policy and Move It Law
- Information Exchange Network Clearinghouse

CHART incorporates many different types of data to evaluate how the roadway system is operating. This data is collected from a wide variety of ITS equipment that are strategically located throughout the State. Travel time information is made available based on the analysis of INRIX probe speed data and displayed on more than 200 DMS. The Maryland 511 Travel Information Service continues to provide useful, high-quality, and timely travel information. Presently CHART and MDTA have access to:

- 90+ Closed Circuit Television (CCTV) Cameras
- 300+ Speed Detectors
- 200+ DMS
- 60+ Roadway Weather Information Systems (RWIS)
- 50+ Traveler Advisory Radio
- 15+ Variable Toll Rate Signs

The information from these devices is coordinated through the Statewide Operations Center and three strategically located Traffic Operations Centers at:

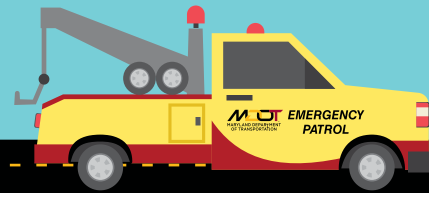
- Hanover (Statewide Operations Center)
- College Park
- Essex
- Frederick

Emergency Traffic Patrols (ETPs) assist drivers when their vehicles become disabled or when involved in a crash. These ETPs are assigned to high volume/high incident routes to boost the efficiency of the emergency response program. Areas served by ETPs include:

- Annapolis, Baltimore, Frederick and Washington (Full Time)
- Eastern Shore (Summer)

I-83 @ Padonia Rd

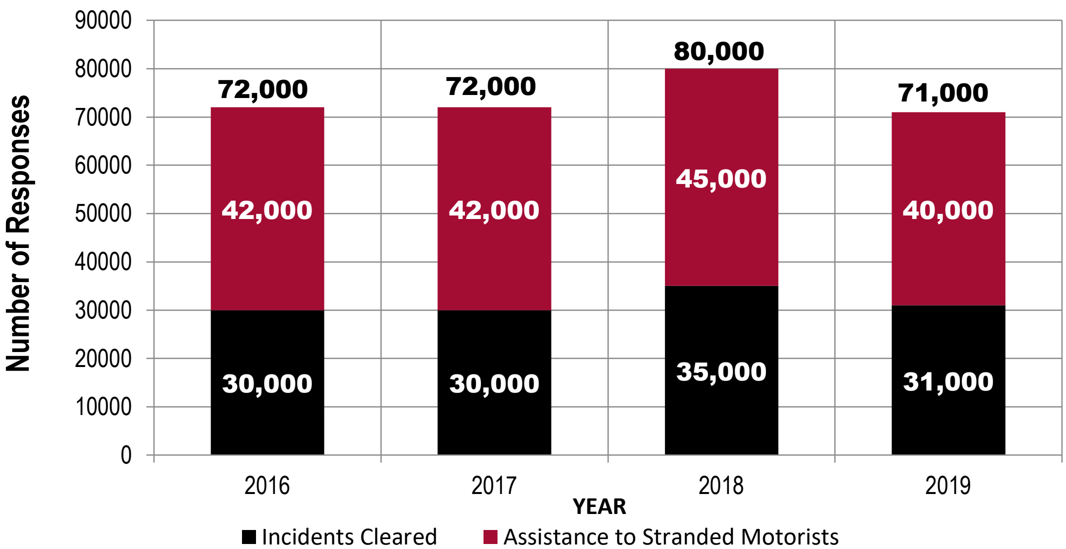
There are 46 full time emergency traffic patrols that operate 24 hours a day seven days a week.



In 2019, ETPs responded to over 70,000 service calls to address motorist and emergency response agency needs along Maryland's highways. This included responding to over 31,000 incidents along Maryland roadways and almost 40,000 service calls for assistance to motorists (Figure 30). Assistance to stranded motorists included changing flat tires, providing hotshots and delivering fuel. In the last four years, ETPs have responded to over 70,000 events each year.

Figure 30

EMERGENCY TRAFFIC PATROL RESPONSES



I-70 West of MD 32

A decrease in response and incident clearance time translates into a reduction in delay. CHART services reduce the amount of delay and ultimately provide annual user cost savings. The annual vehicle hours of delay savings and the average incident duration for the last four years are identified (Figure 31 and 32).

Figure 31

ANNUAL VEHICLE HOURS OF DELAY SAVINGS

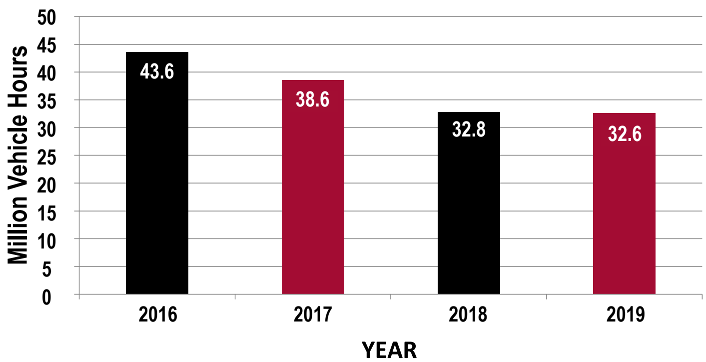
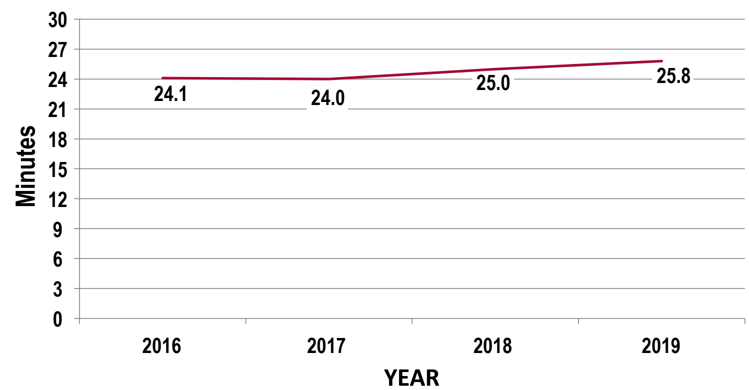


Figure 32

AVERAGE INCIDENT DURATION



Every minute saved through reductions in delay translates into savings in annual user costs. The annual user cost savings to Maryland travelers amounted to $1.39 billion dollars in 2019 (Figure 33). Annual user cost savings includes reduction in delay, savings in fuel and emissions.

Figure 33

ANNUAL USER COST SAVINGS BY CHART

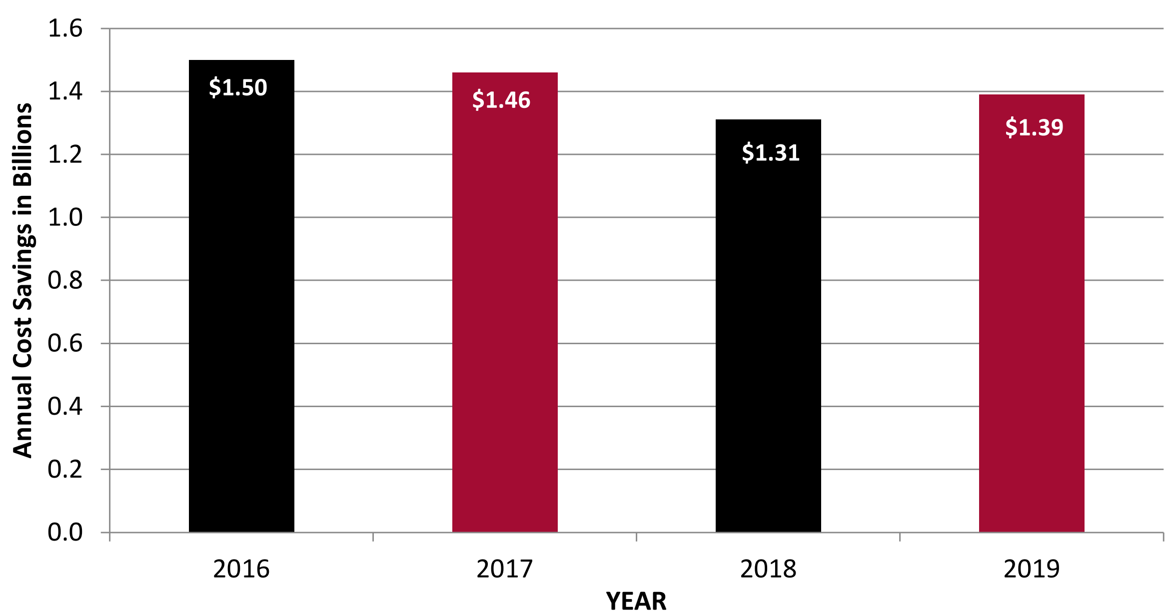


CHART services provided an annual benefit of $ 1.39 billion and reduced delay by 32.6 million hours.

SIGNAL OPERATIONS

Traffic signals that are poorly timed can frustrate motorists and lead to running red lights. They often feel they have to wait too long to receive the green indication or get stopped at every signal. In order to reduce delay and improve mobility, optimizing traffic signal timing is one of the most cost effective methods to address recurring and non-recurring congestion. Signal timing improvements can reduce delay, decrease emissions and provide for a more walkable environment. Individual signals that are adjacent to each other are often grouped together into a signal system that allow motorists to progress along an entire corridor more efficiently. Overall, MDOT SHA is responsible for:

- 1,581 Traffic Signals
- 262 Signal Systems

In 2019, the timings for 124 signals in 19 systems along with 31 other intersections were reviewed to improve progression and operations. Other areas addressed with signal operation efforts are: timing modifications, new signal testing, phase modifications, reviewing proposed developer signals, innovation support such as ramp metering and network integration and Purple Line transit project reviews. The overall Improvements for the 19 systems resulted in:

- Reduced over 885,000 Hours of Delay
- Saved over 155,000 Gallons of fuel
- Reduced delay by 10%
- Annual User Savings was $36 million with a benefit/cost ratio of 45:1

In 2019, MDOT SHA's signal system upgrades were implemented in 12 counties and resulted in delay savings (Table 34).

Table 34

2019 NETWORK DELAY SAVINGS FOR MDOT SHA SIGNAL SYSTEMS UPGRADES

ROUTE	LIMITS	COUNTY	NO. OF SIGNALS	DELAY SAVINGS (VEH-HRS)
MD 4	Westphilia Rd to Dower House Rd.	Prince George's	3	220,000
US 1	Prince George's Ave to Cherry Hill Rd.	Prince George's	12	202,000
US 40	Chatham Rd to Normandy Center Dr/Normandy Woods Dr	Howard	5	122,000
US 301; MD 228/ MD 5 Business	Smallwood Dr to Chadds Ford Dr; Western Pkwy and Post Office Rd	Charles	20	79,000
MD 7	MD 588 to Rossville Blvd.	Baltimore	5	62,000
MD 704	Glen Dale Rd to US 50	Prince George's	6	54,000
MD 704	Whitfield Chapel Rd to Addison Rd	Prince George's	10	47,000
MD 212	Adelphi Rd to Metzerott Rd	Prince George's	2	41,000
MD 26; MD 32	Johnsville Rd to Monroe Ave; MacBeth Way to Johnsville Rd	Carroll	10	19,000
US 13	Center Rd to MD 675	Wicomico	5	12,000
US 50	MD 309 to Dutchmans Lane	Talbot	7	10,000
MD 175	MD 713 to Disney Rd	Anne Arundel	2	7,000
MD 65	Poffenberger Rd to Doub Way	Washington	8	5,000
MD 270	Point Pleasant Rd to MD 10 Ramp	Baltimore	2	4,000
US 219	MD 39 to Memorial Dr and MD 39 @ 2nd St	Garrett	6	2,000
MD 332	Larchmont Ave to Capitol Heights Blvd	Prince George's	2	N/A
MD 22	Technology Dr to US 40 Ramps/N Rogers Ave	Harford	8	N/A
US 301	Rosaryville Rd to Croom Rd	Prince George's	6	N/A
MD 228	Manning Road to Middletown Rd	Prince George's	5	N/A
	TOTAL		**124**	**886,000**

N/A - Delay savings were anticipated to be calculated in 2020, but not completed due to COVID-19.

The highest overall delay reduction by percentage were:

- MD 4 – Westphalia Rd. to Dower House Rd. (16%)
- US 1 – Prince Georges Ave to Cherry Hill Rd. (15%)
- MD 7 – MD 588 to Rossville Blvd. (14%)
- MD 270 – Point Pleasant Rd to MD 10 Ramp (14%)

TRANSIT SIGNAL PRIORITY

Transit signal priority (TSP) at signalized intersections allows for buses to gain a time advantage to encourage more riders and improve on-time performance and reliability. TSP allows transit vehicles to jump in front of the queue or extend the green time before the particular approach turns yellow. The following systems are operating or planned:

Ride On extRa service

- MD 355 – Lakeforest Mall to Medical Center METRO Station - 30 signals
- In 2019, buses operating on the corridor made over 800,000 TSP requests at signalized intersections

Ride On FLASH service (Operational in October 2020)

- US 29 – Burtonsville to Silver Spring METRO - 15 signals
- Construction is underway for all stations
- Roadside TSP hardware has been installed
- Vehicle TSP hardware is being installed by the bus manufacturer

MD 65 @ I-70

SMART/ADAPTIVE SIGNAL SYSTEMS

MDOT SHA has undertaken a program in some of the State's most congested corridors to upgrade signal systems, deploying innovative Smart/adaptive signal technology that supports real-time signal timing adjustments. Smart signals use computer software that respond to real-time traffic conditions, effectively deploying artificial intelligence to keep traffic moving. These systems maximize the green time for the major roadway, while taking into account operation of the minor street. Linking the Smart signals at multiple intersections along a major roadway corridor can improve normal traffic flow, and dynamically respond to non-recurring congestion such as from special events or incidents. Adaptive signals differ from standard signal timing improvements by allowing for timing modifications to occur instantly as traffic flow changes throughout the network.

In 2019, adaptive signal systems were implemented in seven corridors containing 41 signals (Table 35). This increases the total number of adaptive signal systems in operation statewide to 13.

Table 35

2019 ADAPTIVE SIGNAL IMPLEMENTATION CORRIDORS			
ROUTE	LIMITS	COUNTY	# OF SIGNALS
MD 2	Annapolis Harbor Center Dr to Tarragon Ln	Anne Arundel	12
MD 3	MD 450 to St Stephens Church Rd	Anne Arundel/Prince George's	4
MD 7	MD 588 to Rossville Blvd	Baltimore	5
MD 22	Technology Way to North Rogers St/ US 40 Ramp	Harford	8
MD 198	Sweitzer Ln to Old Gunpowder Rd	Prince George's	2
MD 202	I-95/I-495 Ramp to Arena Dr	Prince George's	5
US 13	Winner Blvd to Centre Rd	Wicomico	5

The Planning Time Index (PTI) was used to evaluate the benefits adaptive signals have provided. This analysis was based on the PTI the year before the adaptive system was operational and 2019. The largest improvement in PTI was 26% on US 40 in Baltimore County (Table 36).

Table 36

CORRIDOR BENEFITS OF ADAPTIVE SIGNALS				
ROUTE	LIMITS	COUNTY	PEAK HOUR/ DIRECTION	% IMPROVEMENT
MD 2	Hammond Ln to 11th Ave	Anne Arundel	AM/NB	13
US 40	Nuwood Dr to Coleridge Rd	Baltimore	AM & PM/EB	26
MD 24	Singer Rd to Bouton Rd	Harford	PM/SB	13
US 1	Montgomery Rd to MD 175	Howard	PM/NB	19
US 301	Governor Bridge Rd to Powder Ridge Rd	Prince George's	PM/NB	21
MD 198	Sweitzer Rd to Old Gunpowder Rd	Prince George's	PM/EB	13

PARK AND RIDE LOTS

Numerous agencies in the State of Maryland have developed a network of park and ride lots which serve as vital parking for carpooling and transit services. MDOT SHA and MDTA maintain the largest number of locations with 107 park and ride lots in 20 counties that include shared lots with MDOT MTA. Additional park and ride locations are operated by MDOT MTA and other transit and local agencies. MDOT Park and Ride lots also provide safe emergency event parking locations for trucks. The lots provide over 13,500 spaces and range from less than 10 spaces to over 800. The largest lots are located along MD 5 in the Waldorf area of Charles County and along MD 665 at Riva Road in Annapolis.

MDOT SHA performs biannual surveys of all facilities to assess utilization. Overall, 6,700 motorists on the average survey day utilized the park and ride lots (Figure 34). In 2019, the following locations showed the largest increase in parking demand:

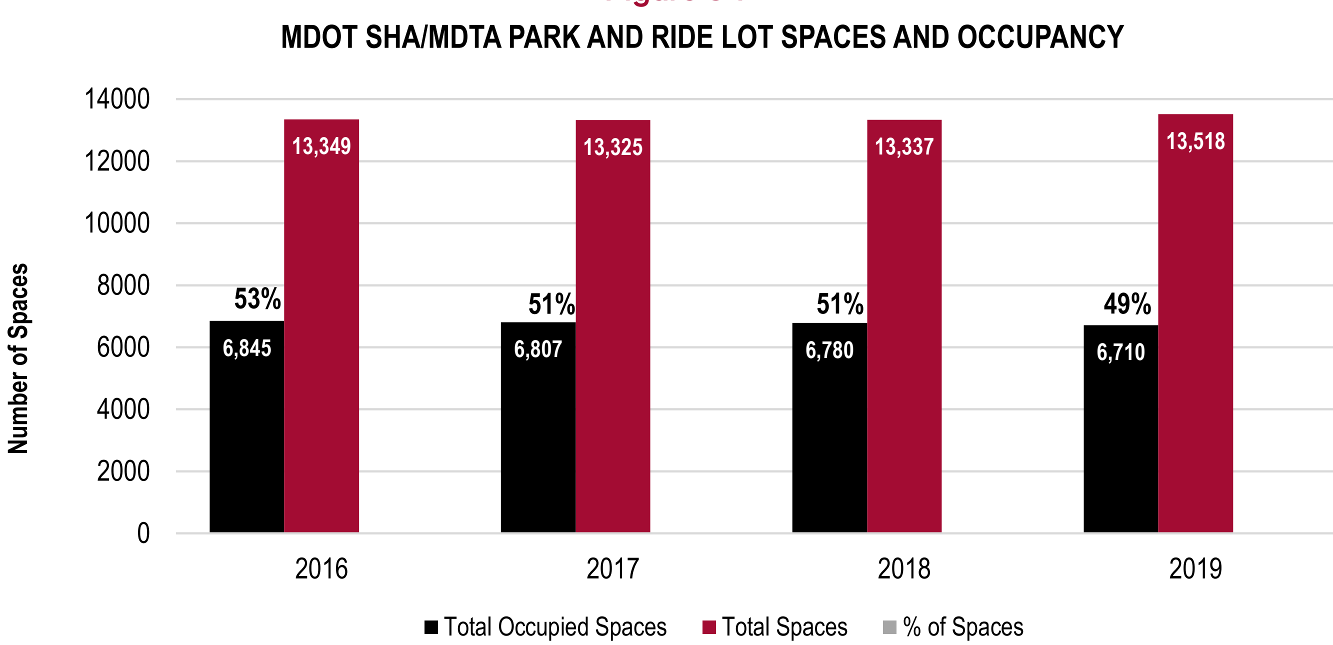
- I-95 at MD 152 (33)
- I-270 at MD 117 (25)
- MD 210 at MD 373 (21)
- I-270 at MD 80 South Lot (16)
- MD 175 at Snowden River Pkwy (15)

The 2019 surveys showed that at four lots there were more motorists parking than there were designated number of spaces. This was at:

- MD 2/4 at Ball Road
- US 340 at Lander Road
- I-70 at MD 355
- I-270 at MD 80 South Lot

The over-capacity situation at the MD 2/4 at Ball Road park and ride lot was resolved with the addition of almost 100 spaces during 2019. The I-270 at MD 80 location resulted from over parking at the south lot while the north lot had available spaces. A new park and ride lot opened at US 15/Monocacy Boulevard with 390 spaces while the lot at MD 193 at Baltimore-Washington Parkway Armory was closed in 2018[1].

Figure 34

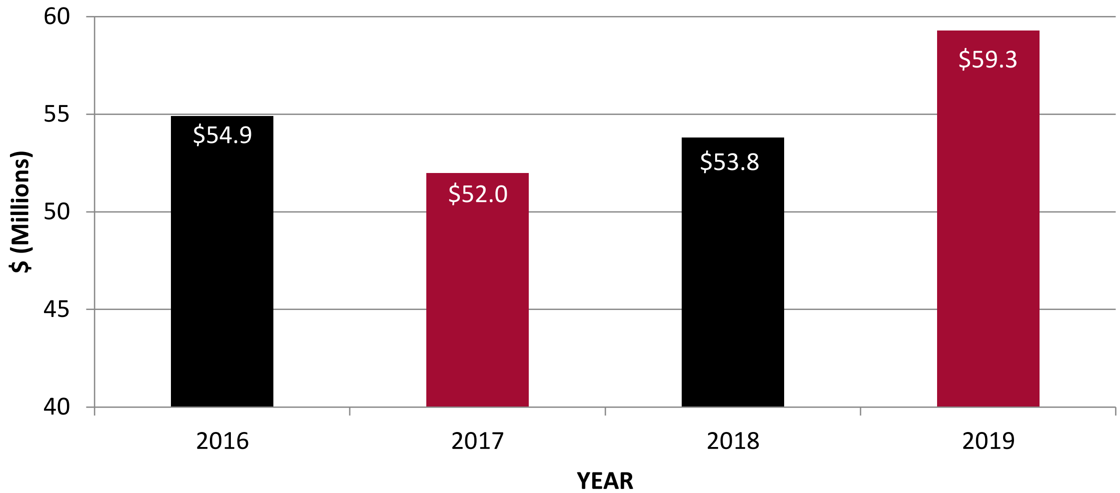


1 - Lease agreement terminated by Armory.

The availability of these park and ride lots reduced the amount of VMT driven on Maryland roadways and resulted in over $59 million in annual cost savings in 2019 (Figure 35). This benefit increased slightly over 2018 due to an increase in utilization of the average per mile cost to operate a vehicle and longer trip patterns.

Figure 35

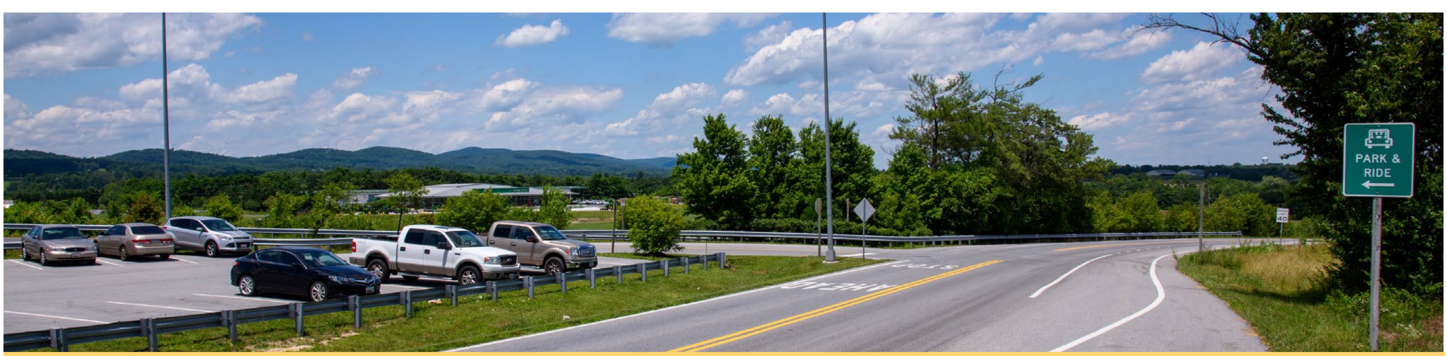
MDOT SHA/MDTA PARK AND RIDE ANNUAL COST SAVINGS TO MOTORISTS (MILLIONS)



Various new lots, expansions to existing lots and upgrades are in construction or design. New park and ride lots have been completed during 2019 at MD 5/MD 373 with 167 spaces and at MD 42 at Maple Street in Friendsville with 42 spaces. The west lot at MD 32/ Broken Land Parkway has been expanded by 47 spaces. In addition, the existing lot entrances were widened for MTA commuter buses at Waysons Corner. The existing 89 space lot at US 15 and Mt. Zion Road is being replaced with a new commuter parking lot that will contain 154 spaces upon completion. This project is funded for construction.

In addition to MDOT SHA and MDTA, the MDOT MTA and the Washington Metropolitan Area Transit Authority (WMATA) operate lots to support their transit operations. The MDOT MTA lots supply connections to light rail, MARC, Baltimore METRO and bus service while WMATA provides service to the Washington Metrobus and Metrorail systems. The latest surveys show the following usage for an average day:

- WMATA – 27,900 persons per day
- MDOT MTA - Over 21,000 persons per day



US 15 @ Mt Zion Rd/Elmer Derr Rd

MDOT SHA and MDTA Park and Ride lots usage was relatively flat from 2018 to 2019 with 6,700 motorists per day parking.

Over 200 additional spaces are available to motorists via park and ride lots constructed in 2019.

HIGH OCCUPANCY VEHICLES (HOV) LANES

HOV LANE AHEAD

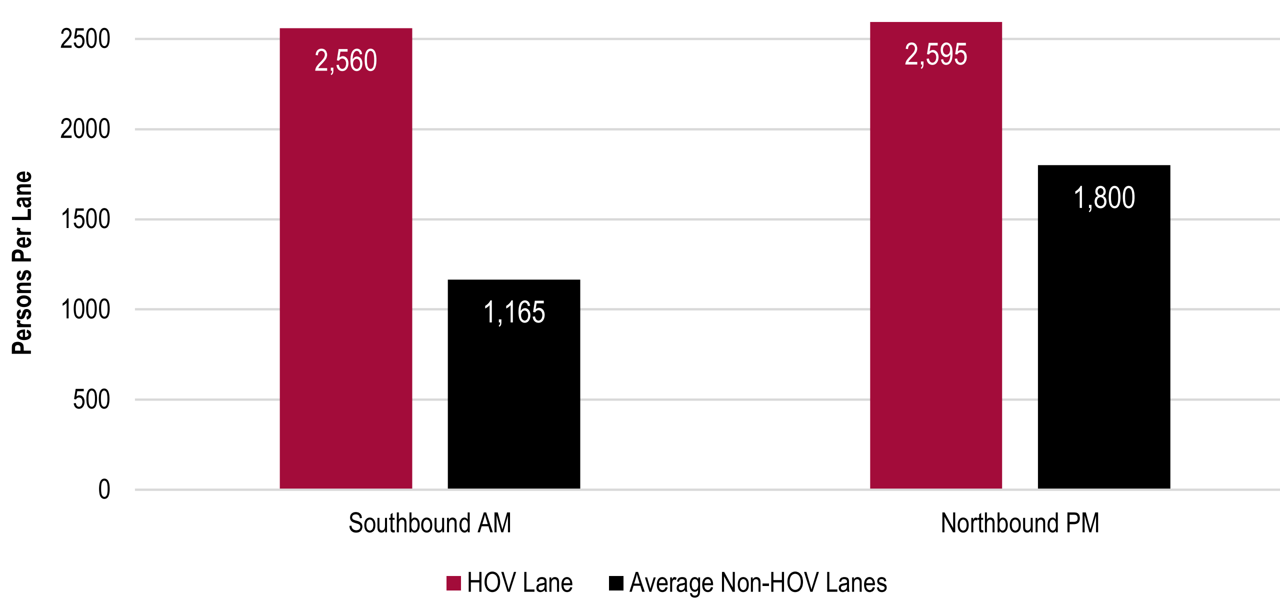
A strategy to maximize usage of the existing pavement along freeways/expressways is to provide for high occupancy vehicle (HOV) lanes. This strategy encourages carpooling and increases the number of persons (person throughput) that use a roadway without expanding the number of lanes. These lanes provide a travel time advantage savings to multi-occupant vehicles. Maryland has two corridors served by HOV lanes. Only vehicles with two or more occupants, transit vehicles, motorcycles or plug-in electric vehicles may use these lanes during the directional operating hours listed below.

- I-270 Southbound – North of I-370 to North of I-495 (East and West Spurs) [6:00 to 9:00 AM]
- I-270 Northbound – North of I-495 (East and West Spur) to MD 121 [3:30 to 6:30 PM]
- US 50 Eastbound and Westbound- West of US 301 to east of I-95/I-495 [All Day]

An evaluation was performed of the operations in 2019 associated with the HOV and general purpose or other lanes along I-270 and US 50. This was accomplished by performing vehicle occupancy counts at multiple sites and performing travel time studies using GPS. Person throughput evaluates the total number of people moved in each lane versus the total number of vehicles. On I-270, the person throughput in the HOV lanes was approximately 800 to 1,400 people per lane per hour higher compared to an average non-HOV lane based on MDOT SHA vehicle occupancy counts (Figure 36).

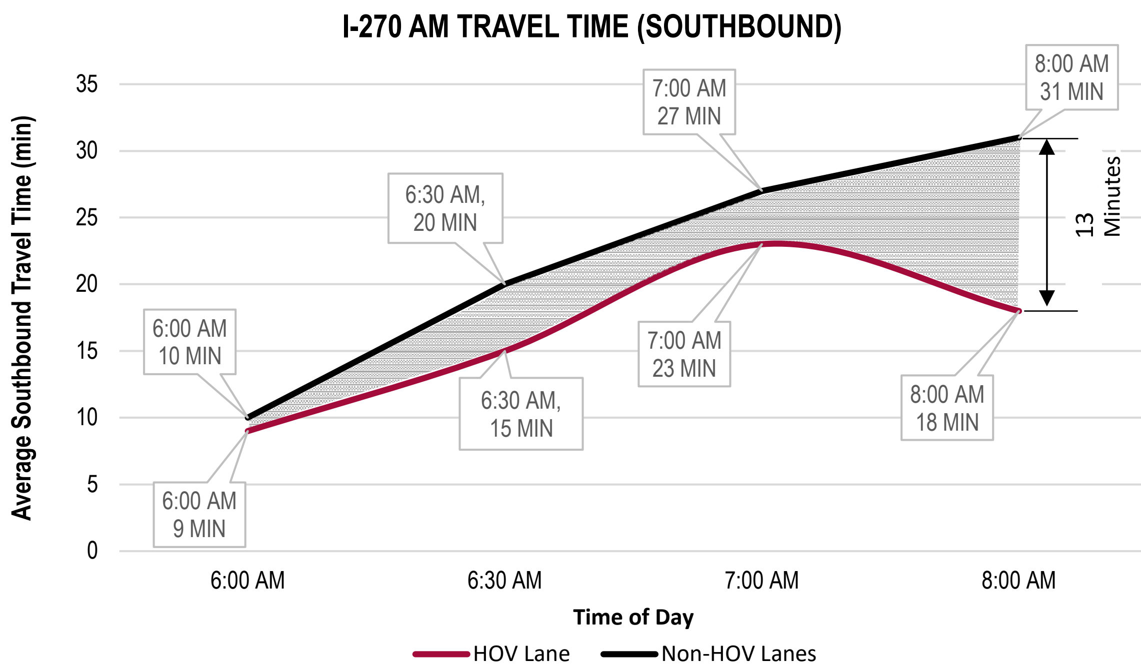
Figure 36

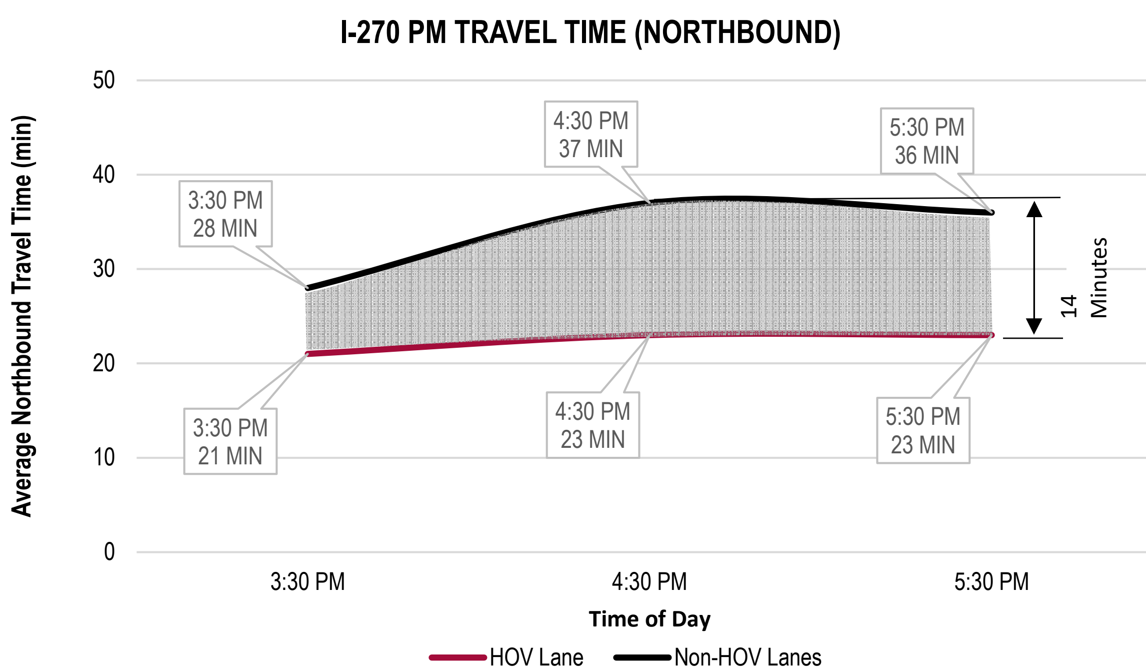
I-270 PERSON THROUGHPUT PER LANE PER HOUR



The travel time studies determined the travel time in the HOV lanes versus the general purpose lanes or other travel lanes. Travel time savings depend upon the time of day as shown for I-270 Southbound in the AM peak period and I-270 Northbound in the PM peak period. The travel time savings range from one minute to 14 minutes (Figure 37).

Figure 37





The travel time savings on I-270 in the HOV lane amounted to as much as 13 minutes in the AM peak period (6 minutes on average) and 14 minutes in the PM peak period (12 minutes on average).

REVERSIBLE LANES

In many areas, commuting patterns are very directional with motorists mostly traveling one way in the morning and the opposite direction in the afternoon. At such locations, one strategy to make for a more efficient use of the existing pavement is to provide for reversible lanes. Using reversible lanes allow for one or more lanes of a roadway to be converted from one direction to the opposite direction depending on the time of day to accommodate for the increase in peak hour volumes. This Active Transportation Demand Management (ATDM) Strategy better serves the higher volume of traffic without widening the road. There are four reversible lane locations along MDOT roadways (Table 37).

Table 37

REVERSIBLE LANE LOCATIONS ALONG MDOT ROADWAYS			
LOCATION	LIMITS	COUNTY	LENGTH (MILES)
US 50/US 301	Chesapeake Bay Bridge	Anne Arundel/ Queen Anne's	4.5
MD 177	MD 100 to West of South Carolina Ave	Anne Arundel	1.6
US 29	Sligo Creek Pkwy to MD 97	Montgomery	1.0
MD 97	I-495 to MD 390	Montgomery	0.5

The MD 177, US 29 and MD 97 reversible lanes are operated to improve the standard AM and PM peak period commuting traffic flows. The most recognizable and most utilized is the five lane Chesapeake Bay Bridge (US 50/301). On the Chesapeake Bay Bridge, the lanes are reversed through the use of overhead lane signing in the PM peak period and during the summer on Saturday morning and Friday evenings. This allows for the two eastbound and three westbound lanes to be converted to three eastbound and two westbound lanes. The traffic volumes for motorists using the reversible lanes range from approximately 300 to 1,600 vehicles per hour (Table 38).

Table 38

REVERSIBLE LANE VOLUMES AND NUMBER OF LANES								
LOCATION	VOLUME OF PEAK DIRECTION FOR NON-REVERSIBLE LANES (VEHICLES PER HOUR)		NUMBER OF NON-REVERSIBLE LANES		VOLUME OF PEAK DIRECTION FOR REVERSIBLE LANE(S) (VEHICLES PER HOUR)		NUMBER OF REVERSIBLE LANES	
	AM	**PM**	**AM**	**PM**	**AM**	**PM**	**AM**	**PM**
US 50/301	N/A	3,200[I]	N/A	2	N/A	1,520[I]	N/A	1
MD 177	885	1,065	1	1	295	275	1	1
US 29	1,305	1,105	2	2	985	1,075	2	2
MD 97	2,425	2,425	3	3	530	730	1	1

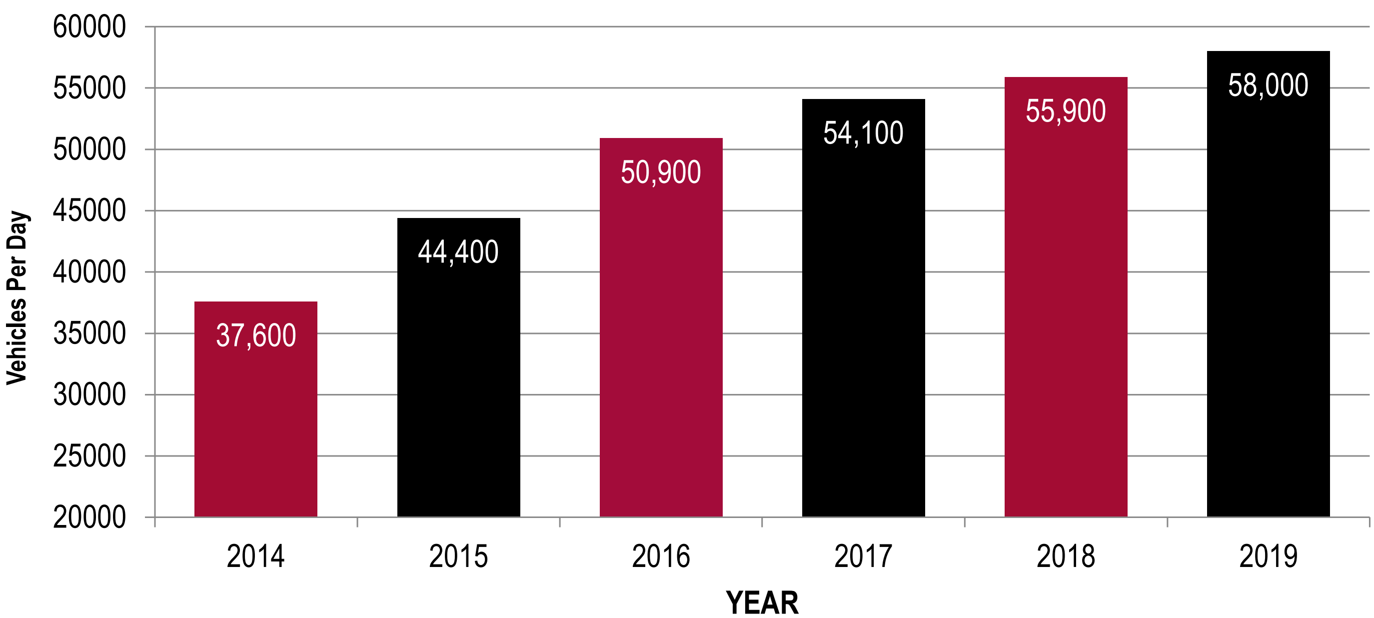
I - Volumes represent Saturday peak hour

MANAGED LANE FACILITIES AND EXPRESS TOLL LANES

Projects to increase capacity can involve a number of different strategies. Along freeways/expressways this could include separated lanes or a separate facility that would operate at acceptable speeds without experiencing delays. These separate or managed lanes could include high occupancy vehicle lanes, truck lanes or various tolling strategies. In Maryland, two projects have been in operation since 2014 that were developed to improve traffic flow by utilizing tolls. The first project, MD 200 (Intercounty Connector), was the first all-electronic toll collection facility in Maryland where tolls are collected at highway speed either with E-ZPass® or through video tolling. Toll rates vary by the time of day. MD 200 extends from I-370 in Montgomery County to US 1 in Prince George's County for approximately 19 miles. In 2019, traffic volumes on MD 200 averaged over 58,000 vehicles per day between I-370 and I-95 (Figure 38).

Figure 38

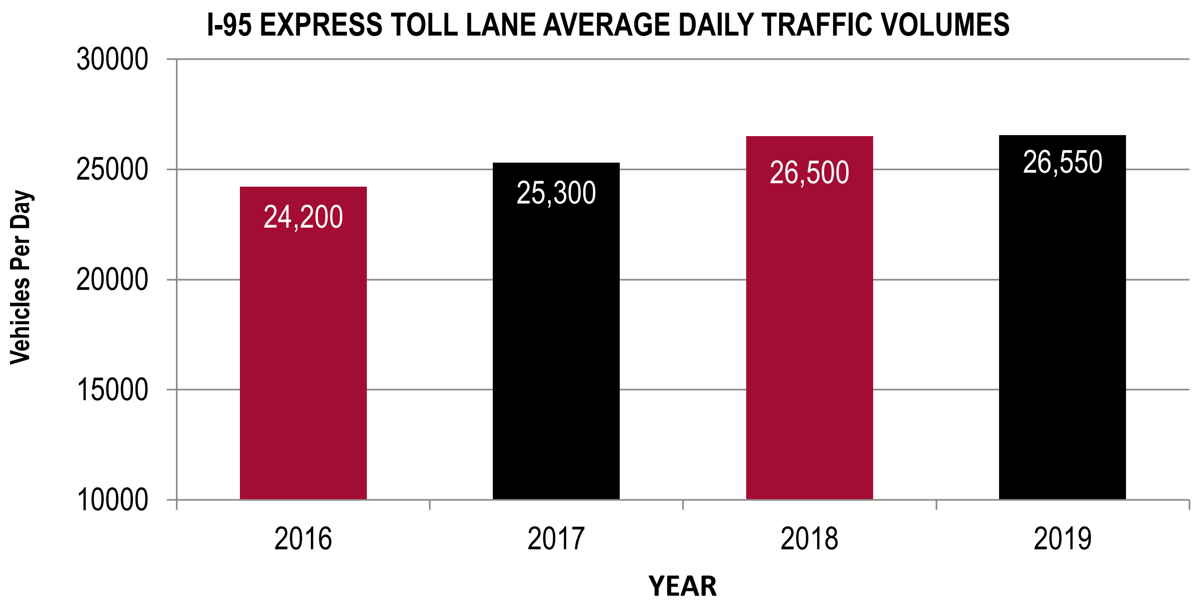
MD 200 AVERAGE DAILY TRAFFIC VOLUMES BETWEEN I-370 AND I-95 FOR FIVE SEGMENTS



Traffic Volumes have increased by over 20,000 vehicles per day on MD 200 in the five years since it opened.

A second type of managed lane project was introduced in December 2014 along I-95 from south of I-895 in Baltimore City to north of MD 43 in Baltimore County. Instead of the entire facility being tolled as with MD 200, motorists are given an option. They can either utilize the four free general purpose lanes or pay a toll using E-ZPass® to travel in the free flow express toll lanes. Transit vehicles may use the express toll lanes at all times for free. This improves transit time reliability to better meet schedules for routes in the corridor. In 2019, just over 26,500 motorists per day used the express toll lanes on average over the entire year (Figure 39). The second section of express toll lanes along I-95 from north of MD 43 to south of MD 543 is now under construction.

Figure 39



I-95 Express Toll Lanes

Peak usage of the I-95 ETLs exceed 3,500 vehicles in one hour and 45,000 vehicles in one day.

MOBILITY INITIATIVES

MD 450 @ Church Rd

BICYCLE AND PEDESTRIAN

MDOT SHA developed the "*Context Driven: Access and Mobility For All Users*" guide in 2019 to address pedestrian and bicycle safety and provide for a balanced and sustainable multi-modal transportation system. Using innovative treatments and strategic investments, framed by Complete Streets and Practical Design principles, this guide will help MDOT SHA improve safety, accessibility, and mobility for multi-modal users. In addition, MDOT SHA incorporates bicycle and pedestrian facilities into roadway projects and provides grants for the planning, design, and construction of bicycle and pedestrian facilities on non-state-owned facilities.

PROGRAMS

MDOT and other state agencies are committed to improving and providing safer facilities for pedestrians and bicyclists. Programs have been established to implement the planning, design and construction of bicycle and pedestrian facilities throughout the State. These range from enforcement campaigns to increase the safe usage of existing facilities, student/pedestrian/bicycle safety education, and engineering solutions such as the construction of sidewalks, trails, cycle tracks, curb ramps and signing and pavement marking upgrades. These initiatives provide funding in the following programs: (2020-2025 $ in millions[1])

- Bicycle Retrofit Program ($17.5)
- Maryland Bikeways Program ($9.5)
- New Sidewalk Construction for Pedestrian Access ($33.5)
- Recreational Trails Program ($5.6)
- Sidewalk Reconstruction for Pedestrian Access ($43.9)
- Transportation Alternatives Program and Safe Routes to School ($40.4)
- Primary / Secondary Program ($4.4)
- Urban Reconstruction Program ($5.3)
- Maryland Transit Administration ($1.4)
- Maryland Highway Safety Office Bicycle Programs ($0.1)
- Other State/Federal grant programs include the Community Legacy Program, Program Open Space, Maryland Heritage Areas Program, Community Parks and playgrounds, BUILD, Rivers, Trails and Conservation Assistance Program, Federal Lands Access Program, the Transportation Land Use Connections Program and State Transportation Innovation grants.

1 - Consolidated Transportation Program 2020-2025.

Bicycle and pedestrian project funding for the fiscal year 2020-2025 amounts to over $160 million.

BICYCLE AND PEDESTRIAN MASTER PLAN

In January 2019, MDOT released "The 2040 Maryland Bicycle and Pedestrian Master Plan 2019 Update". The plan provides a vision to encourage active transportation and to offer solutions to Maryland's current challenges regarding bicycle/pedestrian facilities and safety. The 2040 Maryland Bicycle and Pedestrian Plan 2019 Update documents the review of existing conditions, development of strategies and objectives and key initiatives to encourage increase bicycle and pedestrian usage. The major goals of the plan include:

- Improve Safety
- Provide Connected Networks
- Develop Data Driven Tools for Analysis and Planning
- Form Partnerships
- Encourage Economic Development

The 2040 Maryland Pedestrian and Bicycle Master Plan 2019 Update ties into the goals of the Towards Zero Deaths campaign to enhance safety for bicyclists and pedestrians. In 2019, there were 123 pedestrians and 10 bicyclists involved in fatal crashes. This was a decrease of 10 pedestrian fatalities but an increase of 6 bicycle fatalities over 2018. In order to reduce the number of fatalities and injuries, the plan identifies the following strategies:

- Install bicycle improvements such as marked bike lanes
- Perform Pedestrian Road Safety Audits
- Perform Educational Outreach with programs such as "A Cyclist Could Be Someone You Know" and "Look Alive"
- Evaluate Innovative Treatments such as green pavement, cycle tracks and bicycle signal heads
- Promote use of connected vehicle technology and technology for emergency response personnel to prevent and reduce severity of collisions
- Implement Legislation and Training

A sample of MDOT and local agency initiatives to improve the safety and mobility of bicyclists and pedestrians and encourage their use include:

- Upgraded all possible MARC cars with bike racks
- Approved "*Context Driven: Accessibility and Mobility for all Users*" guide
- Initiated the Look Alive and Street Smart outreach campaign
- Began planning for Walk Maryland Day and Walktober
- Began developing the Level of Traffic stress project
- Planned bike parking at park and ride facilities
- Adopted Pedestrian Safety Fund Act of 2019 and Vision Zero Legislation

TRANSIT ORIENTED DEVELOPMENT (TOD)

The State of Maryland has encouraged development near transit stations as an important part of Maryland's strategy to address traffic congestion, environmental issues, and sprawl since the passing of legislation in 2008. The State of Maryland had defined Transit-Oriented Development (TOD) as a place of relatively higher density development that allow for people to live, work and play and is designed to encourage multi-modal access to the station area. The MDOT has actively sought to promote TOD as a tool to support economic development, to promote transit ridership, and to maximize the efficient use of transportation infrastructure. There are 17 designated TOD sites along the major fixed rail transit lines of the Baltimore/Washington, D.C. region (Figure 40) with eight other potential sites.

LOCATIONS (TRANSIT SERVICE PROVIDED)

- Aberdeen (MARC)
- Owings Mills (Baltimore METRO)
- Reisterstown (Baltimore METRO)
- State Center (Baltimore METRO)
- Westport (Baltimore Light Rail)
- Savage (MARC)
- Odenton (MARC)
- Laurel (MARC)
- Dorsey (MARC)
- Shady Grove (Washington METRO)
- Twinbrook (Washington METRO)
- White Flint (Washington METRO)
- Wheaton (Washington METRO)
- Greenbelt (Washington METRO)
- New Carrolton (Washington METRO)
- Branch Avenue (Washington METRO)
- Naylor Road (Washington METRO)

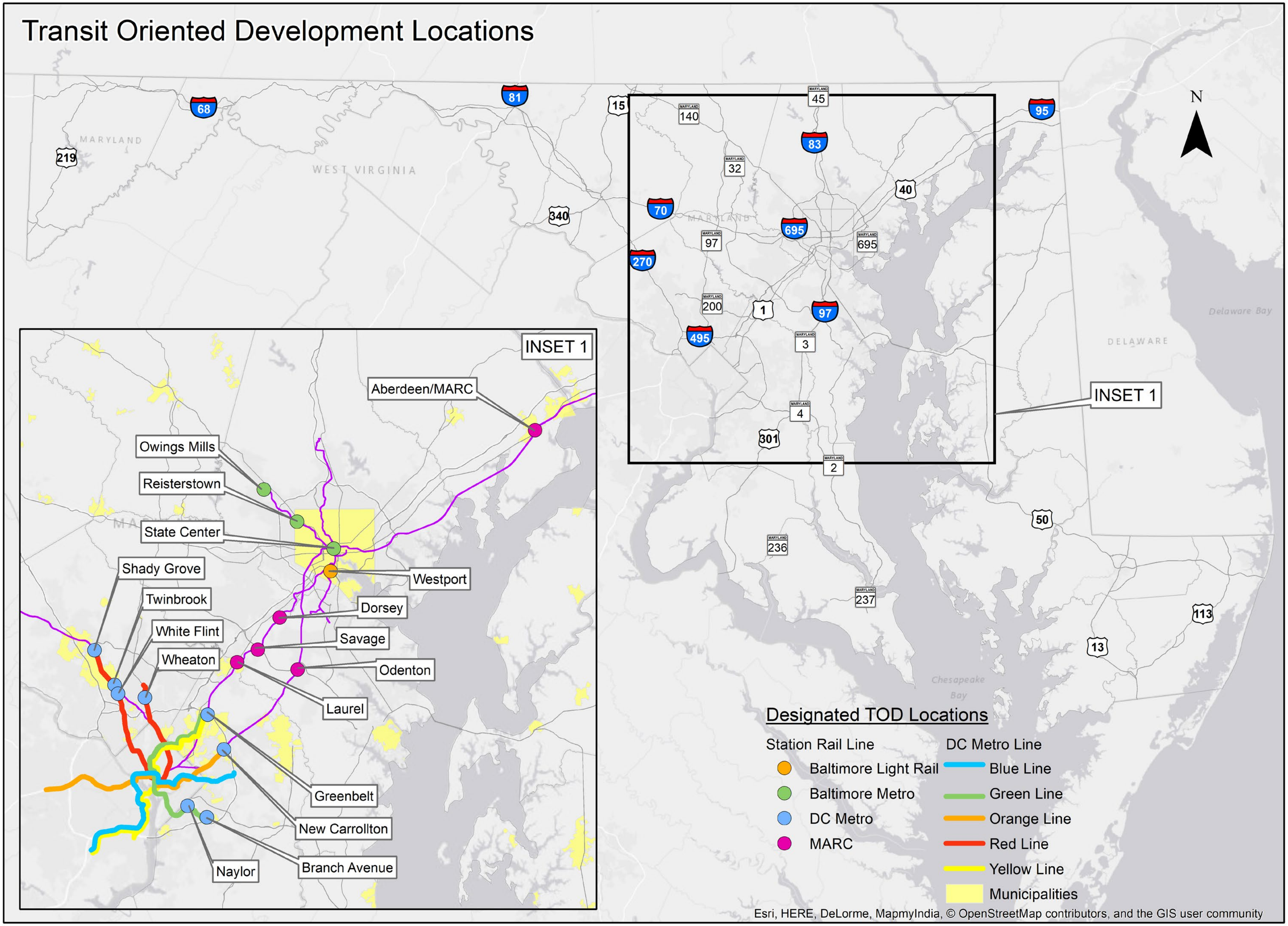
The level of development at each of the 16 sites varies throughout the State. Certain locations are much more active with on-going construction while market conditions will determine when development will occur at other sites. The most active sites included a combination of retail, residential, and office uses (Table 39).

Table 39

ACTIVE DEVELOPMENT AT TODS		
TOD LOCATION	MULTI-MODAL CONNECTION	DEVELOPMENT STATUS
Metro Centre @ Owings Mills	MDOT MTA-METRO	4,500 SF of retail space and 114 residential units completed in 2019. 235 room hotel construction underway. 230 unit residential building to begin construction in 2020.
Annapolis Junction/ Savage	MARC	416 apartment units, 5,400 sf retail, 101,200 sf office buildings and 700 space garage are completed; Planning underway for a hotel and additional retail along with reconfigured bus loop and METRO Kiss and Ride.
New Carrollton	WMATA-METRO	200,000 SF Kaiser Permante Office Building opened in 2019; 280 apartment units under construction; WMATA's Maryland office building to begin construction in 2020.
White Flint	WMATA-METRO	294 unit apartment under construction. Additional apartment building and new entrance to White Flint METRO Station are being planned.

TOD sites are located in six counties and Baltimore City.

Figure 40


Transit Oriented Development Locations
MARYLAND
WEST VIRGINIA
DELAWARE
Delaware Bay
Chesapeake Bay
68
81
15
140
45
83
95
219
32
40
70
695
97
695
340
270
200
1
97
495
3
4
301
2
50
236
237
113
13
INSET 1
INSET 1
Aberdeen/MARC
Owings Mills
Reisterstown
State Center
Westport
Shady Grove
Dorsey
Twinbrook
Savage
White Flint
Wheaton
Odenton
Laurel
Greenbelt
New Carrollton
Branch Avenue
Naylor
N
Designated TOD Locations
Station Rail Line
Baltimore Light Rail
Baltimore Metro
DC Metro
MARC
DC Metro Line
Blue Line
Green Line
Orange Line
Red Line
Yellow Line
Municipalities
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FREIGHT

Freight travels by several modes including truck, airplane, ship, train, or pipeline. In order to meet the needs of the public and demands of businesses, the MDOT SHA is leading the nation to understand the magnitude of freight-related issues by assessing freight performance and system needs through the use of truck probe data and TSMO methods. Trucks are the major conveyor of freight in Maryland. This is accomplished through the establishment of a designated system of roadways that are conducive to commercial vehicles and that link to multi-modal connections. MAP-21 established a National Freight Network and the requirement that states measure freight performance. This network was further refined by the FAST Act. The FAST Act set forth a National Highway Freight Network (NHFN) that consists of:

- The Primary Highway Freight System (PHFS) – Interstates selected by FHWA as a primary freight network for the entire United States.
- Other Interstates not on the PHFS – Non-PHFS Interstates are part of the NHFN even though they are not considered primary for freight.
- Critical Urban Freight Corridors (CUFC) – 75 miles of Metropolitan Planning Organization (MPO) designated urban roadways.
- Critical Rural Freight Corridors (CRFC) – 150 miles of state designated roadways.

The CUFC routes were determined by a joint effort between MDOT SHA and the State's MPOs based on methodology developed by the Metropolitan Washington Council of Governments (MWCOG). Twenty five miles of the CUFCs occur in both the MWCOG and the Baltimore Metropolitan Council MPO areas and the remaining 25 miles are split between the five other MPOs in Maryland.

The CRFCs were selected based on criteria developed by MDOT SHA. The criteria considered FHWA guidance and additional freight data developed during the state freight planning process to identify the most critical corridors.

Freight Cars

Together the PHFS, Interstates, CUFCs, and CRFCs comprise Maryland's Highway Freight Networks, along with the freight planning network which was developed as required by MAP-21. The freight networks encompass roadways in Western Maryland, Central Maryland, Southern Maryland, and the Eastern Shore (Figure 41).

Maryland receives an apportionment of freight formula funds from FHWA that can support capital projects on the defined NHFN. MDOT has programmed these federal funds for projects to support freight on the NHFN including:

- I-695 from US 40 to MD 144
- I-83 Bridge over Padonia Road
- I-95 Bridges over MD 214
- I-95/I-95 Bridges over Suitland Parkway
- MD 4 - New Interchange at Suitland Parkway
- I-81 - US 11 to West Virginia State Line
- MD 175 - Widening from National Business Parkway to McCarron Court
- US 219 - Bridge replacements over Youghiogheny River
- MD 32 - Capacity and safety improvements from north of Linden Church Rd to I-70
- US 13BU - Bridge replacements over East Branch Wicomico River

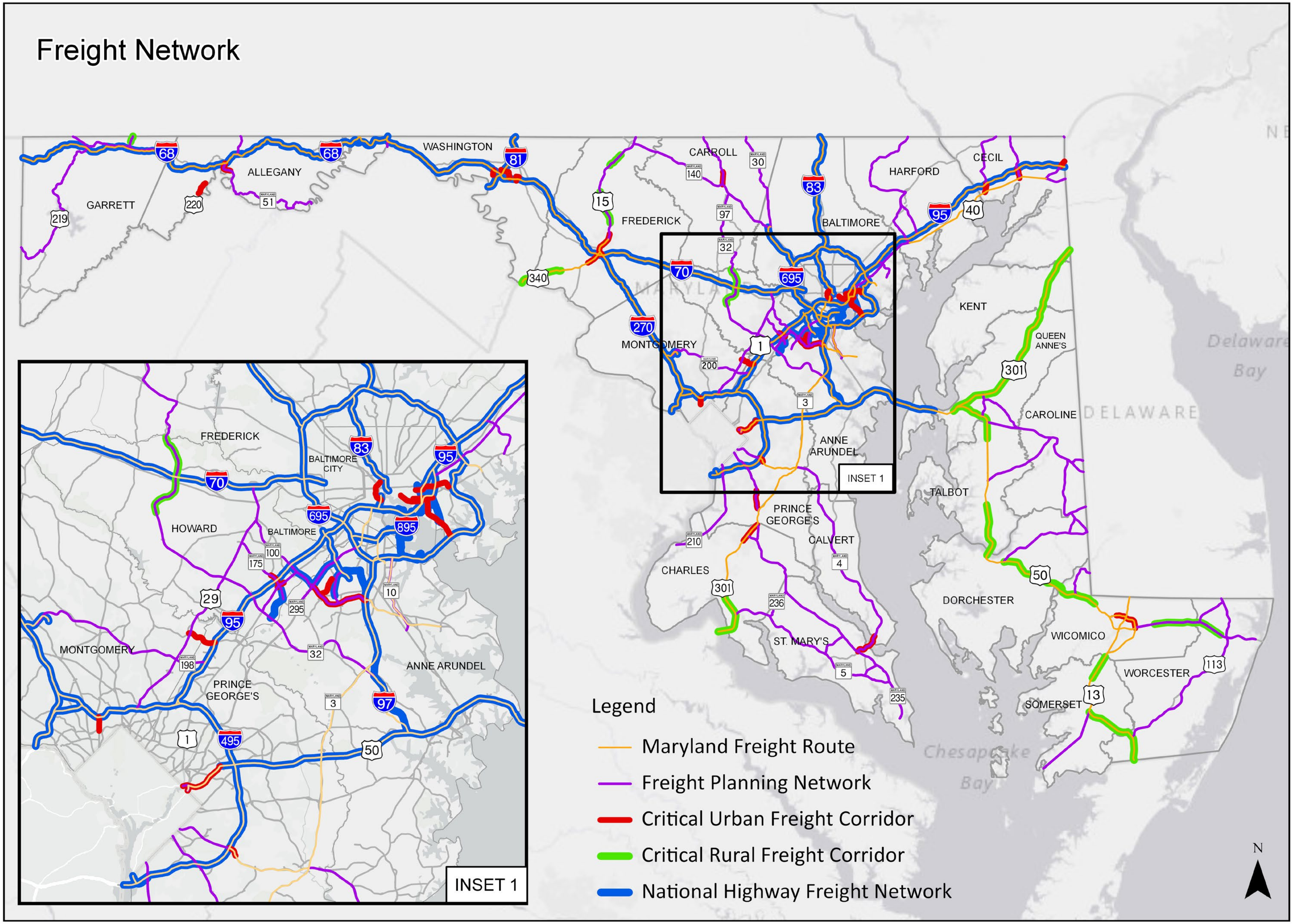
In order to address the continued growth in freight movement on Maryland roadways, MDOT uses the freight formula program and other resources to support various projects and planning efforts. Projects completed or underway in 2019 include:

- Maryland Statewide Truck Parking Study
- Expansion of Virtual Weigh Stations
- Operating and refining the Maryland One Hauling Permit System
- Innovative Technology Deployment including using Drivewyze geofencing application for commercial vehicle preclearance at truck weigh and inspection stations

Ongoing planning efforts include:

- Implementation of the Maryland Statewide Truck Parking Study which evaluated existing parking demand, needs and gaps in the system, linked challenges and opportunities while identifying funding and grant options for innovative areas such as Public-Private Partnerships, Electric Vehicles and Connected and Automated Vehicles
- Development of an update to the Strategic Goods Movement Plan
- Creation of Transportation Systems Management and Operations concept of operations for freight movement
- Update of Maryland Freight Story Map to provide a visual overview of the Strategic Goods Movement Plan
- Advanced Data Viewer for planning purposes
- Multimodal freight coordination
- State Freight Advisory Committee meetings and collaboration

Figure 41



Freight Network
GARRETT
ALLEGANY
WASHINGTON
FREDERICK
CARROLL
BALTIMORE
HARFORD
CECIL
KENT
QUEEN ANNE'S
CAROLINE
TALBOT
DORCHESTER
WICOMICO
WORCESTER
SOMERSET
MONTGOMERY
PRINCE GEORGE'S
ANNE ARUNDEL
CHARLES
CALVERT
ST. MARY'S
DELAWARE
Delaware Bay
Chesapeake Bay
INSET 1
FREDERICK
HOWARD
BALTIMORE CITY
BALTIMORE
MONTGOMERY
PRINCE GEORGE'S
ANNE ARUNDEL
Legend
Maryland Freight Route
Freight Planning Network
Critical Urban Freight Corridor
Critical Rural Freight Corridor
National Highway Freight Network
N

TRANSPORTATION SYSTEMS MANAGEMENT & OPERATIONS (TSMO)

Transportation Systems Management and Operations (TSMO) is an integrated approach to effectively manage and operate existing facilities and systems to maximize their full service potential. In order to accomplish this, all aspects of a project ranging from planning and engineering to operations and maintenance are involved with the goal of improving the reliability, security, safety, and security of the transportation system. MDOT SHA's TSMO program is managing a System of Systems through modern innovative solutions (focused on managing the system as a whole), which combines traffic management strategies, technologies, roadway improvements, and partnerships to take advantage of the network, optimize traffic flow, and improve safety. The overall goals of the program are:

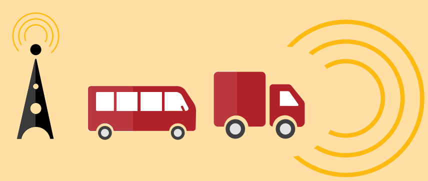
TSMO
MARYLAND TRANSPORTATION SYSTEMS MANAGEMENT & OPERATIONS

GOAL 1

BUSINESS PROCESSES & COLLABORATION

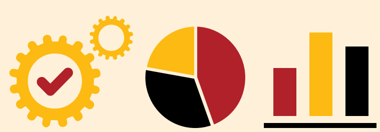
GOAL 2

SYSTEMS & TECHNOLOGY



GOAL 3

DATA ANALYSIS & PERFORMANCE MANAGEMENT



GOAL 4

CUSTOMER EXPERIENCE & ENGAGEMENT

In order to achieve the goals of the program, various TSMO strategies are utilized by MDOT SHA to actively manage the multimodal transportation network. These strategies include:

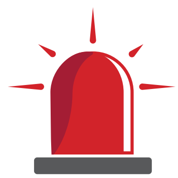
Homeland Security Preparedness

Transit Priority/Integration

Connected and Automated Vehicle Technology

Work Zone Management

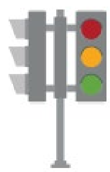
Emergency Response



Road Weather Management

Traffic Incident Management

Traffic Signal Coordination



Maintenance Fleet Management

Electronic Payment/Toll Collection

Freeway/Arterial Management

Freight Management

A key aspect of TSMO is better utilization of the existing system. In order to accomplish this, technology plays a crucial role by meeting customers' needs for providing real-time travel information and advancing the ability of MDOT SHA to react quickly to trends and changes in travel patterns. The data technology that supports TSMO are:

Real Time Applications

Archived Data Applications

Inhouse-tools with support from the University of Maryland CATT Lab

MDOT Common Operating Picture

Priorities for system enhancement using TSMO strategies were established and identified as follows:

- Improving coordination during incident management
- Decreasing incident duration and delay
- Allowing the traveling public to make better informed decisions
- Offering active traffic management and integrated corridor management solutions
- Enhancing coordination between MDOT SHA and local signal operators to optimize signal timings
- Managing traffic and increasing safety for work zones and special events

In 2019, various initiatives were undertaken and several were completed. These included efforts from an administration, planning, design and construction standpoint to continue to build upon the TSMO foundation developed in 2018. The implementation of these TSMO concepts into active projects will help optimize the capacity of the system and improve performance by reducing delays and incidents and providing cost savings to motorists. The 2019 accomplishments include:

- Premiered the TSMO Program educational outreach video
- Attended Spring/Summer District Tours and unveiled customized presentations with each District to educate and begin to partner with them on specific TSMO projects and initiatives
- Formed/solidified a partnership with Waze for sharing of data
- Developed I-270 ICM corridor ATMS control software
- Prepared Next Gear System of Systems and design/implementation of System 1 (I-70/US 29/US 40/MD 144/MD 99) Concept of Operations, including development of fiber network infrastructure, smart signals, queuing devices, etc.
- Developed an Implementation Plan, taking the goals and objectives of the TSMO Working Group and identified specific action items, tools to implement, and timeframes to accomplish
- Conducted Work Zone Safety/ Management Workshop

CONNECTED AND AUTOMATED VEHICLES (CAV)

Connected vehicles are capable of interpreting and relaying information over one or more communication channels between two or more vehicles or between a vehicle and a roadside communication device. Automated vehicles are vehicles that can perform at least one aspect of the driving task without direct driver input. Industry terms relating to this field include vehicle to infrastructure (V2I) communication or vehicle to everything (V2X) communication through cellular networks and dedicated short range communication wireless spectrum.

The following activities are for the MDOT SHA CAV program only, which is internal to MDOT SHA. There is also a Maryland Statewide CAV Working Group that advances their CAV initiatives, but this report does not reflect accomplishments from that group. For more information on the Maryland Statewide CAV Working Group please visit http://mdot.maryland.gov/MarylandCAV.

For 2019, the MDOT SHA Connected and Automated Transportation Systems (CATS) Division listed six objectives to focus on.

- Support CAV Deployment Efforts
- Develop a Technology-based Project List
- Develop and Maintain CAV Educational Materials
- Sustain National & Regional Involvement
- Planning & Background Efforts
- Strategic Telecommunications Plan and Fiber Map

Throughout 2019, the agency carried out several activities that helped further these objectives. The MDOT SHA CAV Working Group evaluated how the program had performed for each 2019 objective. Among the 2019 CAV accomplishments, the CAV Working Group received a $40,000 State Transportation Innovation Council (STIC) Grant to deploy Connected Vehicle Technology for pedestrian safety, held the first ever agency-wide webinar Lunch and Learn on CAV and released online CAV 101 Training Application for MDOT SHA employees, and participated in a Connected Vehicle Capability Maturity Workshop to help direct priorities for the coming years. Accomplishments in each of the six objectives were as follows:

OBJECTIVE #1

SUPPORT CAV DEPLOYMENT EFFORTS

- The CAV Technology Deployment Dashboard was updated to include several MDOT SHA ITS devices.
- Received a $40,000 State Transportation Innovation Council (STIC) Grant to deploy Connected Vehicle Technology for pedestrian safety.
- Developed a Data Governance document on the creation and management of MAP messages.

SURVEY RESULTS

70%

OF PARTICIPANTS FELT EXPECTATIONS

WERE MET

"Seem like important tasks were completed."

OBJECTIVE #2
DEVELOP TECHNOLOGY-BASED PROJECT LIST

SURVEY RESULTS
53%
OF PARTICIPANTS FELT EXPECTATIONS
WERE MET

- Developed a scope for a Truck Parking and Information Management System pilot project on the I-95 corridor.

"Truck parking implementation with tech needed for a long time plus need a wider map of 'pilots'."

OBJECTIVE #3
DEVELOP AND MAINTAIN CAV EDUCATIONAL MATERIALS

- Held the first ever agency-wide webinar Lunch and Learn on CAV, with over 120 attendees.
- Released a CAV 101 Training Application for MDOT SHA employees

"I thought this is where MDOT SHA really shined this year- definitely exceeded expectations."

SURVEY RESULTS
78%
OF PARTICIPANTS FELT EXPECTATIONS WERE
EXCEEDED

OBJECTIVE #4
SUSTAIN NATIONAL & REGIONAL INVOLVEMENT

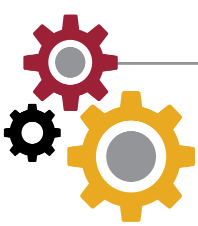
SURVEY RESULTS
65%
OF PARTICIPANTS FELT EXPECTATIONS WERE
EXCEEDED

Participated in the following organizational events:

- Connected Vehicle Pooled Fund Study (CVPFS)
- ITS America V2X/AV/Cybersecurity/Smart Infra/MOD alliance
- AASHTO Committee on Transportation Systems Operations (CTSO)
- National Institute of Standards and Technology (NIST)
- I-95 Corridor Coalition Mid-Atlantic CAV Group

"National & Regional involvement helps us learn about how other jurisdictions are doing things & what challenges they face. Very important."

OBJECTIVE #5
PLANNING BACKGROUND EFFORTS



- Performed a preliminary CAV VISSIM analysis of two major corridors in the state.
- Participated in a Connected Vehicle Capability Maturity Workshop to help direct priorities for the coming years.
- Performed a preliminary statewide sensitivity run of the impacts of CAVs on Vehicle Miles Traveled.
- Development of a CAV Solutions "Toolbox" for MDOT SHA Planning Staff

SURVEY RESULTS
63%
OF PARTICIPANTS FELT EXPECTATIONS
WERE MET

OBJECTIVE #6

STRATEGIC TELECOMMUNICATIONS PLAN AND FIBER MAP

SURVEY RESULTS
83%
OF PARTICIPANTS FELT EXPECTATIONS
WERE MET

- No CAV efforts were completed in 2019, though significant resources were assigned to projects within the State.

"This is critical for us to be a leader in the CAV/CATS space."

OVERALL CAV PROGRAM EVALUATION

Given that the MDOT SHA CAV program is well into its fourth year, the Working Group was asked to take everything into consideration, rate the entire CAV program to date, and provide feedback and recommendations. Overall, the program was ranked:

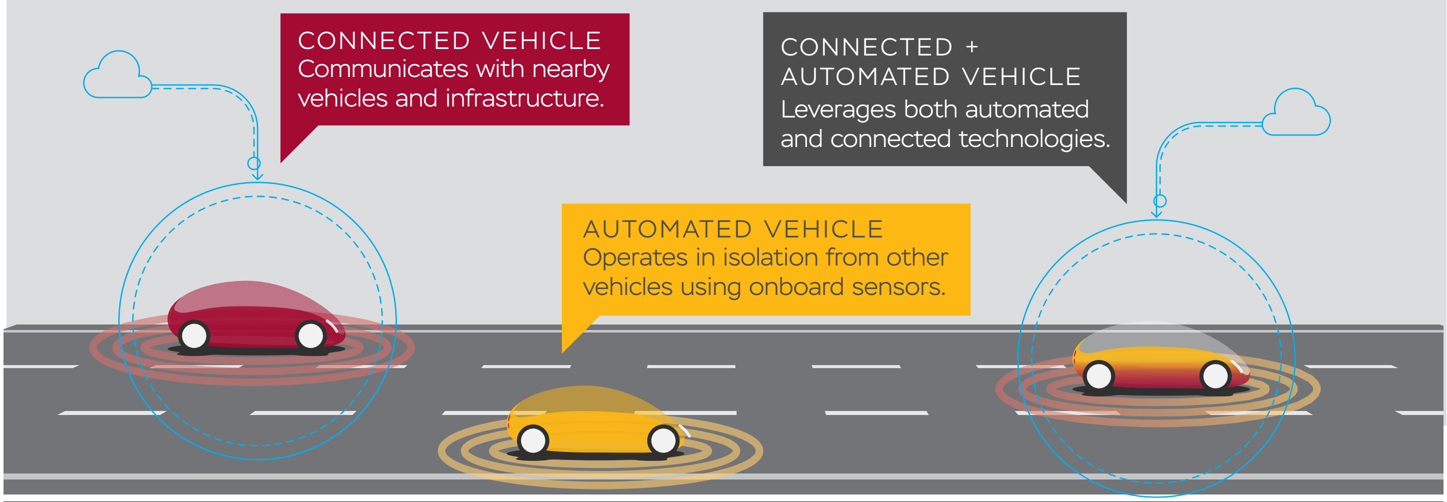
BELOW EXPECTATIONS	MET EXPECTATIONS	EXCEEDED EXPECTATIONS
0%	61%	39%

THE ROAD AHEAD

In preparation for the successful implementation and adoption of Connected and Automated Vehicles (CAV), the Maryland Department of Transportation State Highway Administration (MDOT SHA) outlined some planning efforts going forward to explore. The upcoming efforts are outlined below:

- Evaluate MDOT SHA's automated transportation readiness
- Finalize MDOT SHA's ITS Communications Plan
- Release an updated MDOT SHA CAV Strategic Plan
- Release a matrix and 'toolbox' of CAV solutions for planning staff

For more information on the MDOT CAV program, please contact the program manager at SHACAV@mdot.maryland.gov



MOBILITY ON DEMAND

An alternative to using your own vehicle, walking or taking transit to move from one place to another is through shared mobility on demand services. The range of alternative modes to supplement the traditional model include bicycles, electric bikes, scooters, car sharing and ride sharing services. The use of these services provide challenges and opportunities for the transportation system. The challenges include a rise in curbside demand making it more difficult especially in urban areas for competing interests wanting the same space such as transit vehicles, motorists parking and drop-offs/pick-ups from mobility service providers. Another issue from these services is providing safe operations for all users. These services can reduce demand for parking and rental cars which can impact revenues at airports but also make better use of urban space. In Maryland, the following services exist:

- Uber – Throughout most of Maryland; Ride Sharing Service
- Lyft- Throughout most of Maryland; Ride Sharing Service
- Zipcar – Throughout the Baltimore -Washington area; Ride Sharing Vehicles
- Lime – Baltimore City, Montgomery County including Silver Spring; Scooters
- Bird – University of Maryland; Scooters
- Jump – Baltimore City; Electronic Bikes and Scooters
- Spin – Baltimore City; Scooters and Bicycles
- Zagster – Baltimore Washington International Thurgood Marshall Airport and Annapolis; bicycles
- Montgomery County, Howard County and Annapolis – Bike Sharing Service

Based on voluntary information from rideshare companies, the following are the most requested locations for service:

- Baltimore Washington International Thurgood Marshall Airport
- MGM National Harbor
- Gaylord National Resort and Convention Center
- Uptown Towson
- BWI Airport Rail Station
- Owings Mills METRO Station
- Eastover Shopping Center
- Suitland Metro Station
- Various locations in Baltimore City

MARYLAND DEPARTMENT OF TRANSPORTATION

STATE HIGHWAY ADMINISTRATION

LARRY HOGAN
Governor

BOYD K. RUTHERFORD
Lt. Governor

GREGORY SLATER
MDOT Secretary

TIM SMITH, P.E.
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