MARYLAND DEPARTMENT OF TRANSPORTATION

STATE HIGHWAY ADMINISTRATION

2016 Maryland

State Highway Mobility Report

2016 Maryland

State Highway Mobility Report

Fifth Edition

AUTHORS **Subrat Mahapatra, Matthew Wolniak, Kaveh Farokhi Sadabadi**

CONTENT CONTRIBUTORS **Sepideh Eshragh, Eric Beckett, Abhay Nigam (AC), Tom Costello, Ben Myrick, L'Kiesha Markley, Sarah Gary, Masoud Hamedi, Clyde Munz, Theresa Pyzik Cox, Thomas Jacobs**

REVIEW PANEL **Gregory Slater, Nicole Katsikides, John Thomas (JT), Glenn McLaughlin, David Buck, Lisa Shemer**

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Executive Summary

I-695 North of I-70

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The Maryland Department of Transportation's State Highway Administration (MDOT/SHA) is focused on providing a balanced, reliable, safe and efficient transportation system for the travelling public. MDOT/SHA focuses on policies and projects with a performance-based and practical transportation approach that systematically addresses recurring and non-recurring congestion. The 2016 Maryland Mobility Report describes the mobility trends along SHA and Maryland Transportation Authority facilities and the agency's efforts in calendar year 2015.

Congestion and Reliability Trends

The following is a summary of congestion and reliability trends on the Maryland highway network in 2015:

- A record number of vehicle miles of travel (VMT) occurred on Maryland roadways in 2015. This amounted to 57.3 billion which is a 1.6% increase over 2014.
- The majority (72%) of the VMT occurred on state highways and toll facilities. The volume on state facilities increased by approximately 650 million VMT.
- In 2015, VMT in the Baltimore - Washington region increased by approximately 700 million miles to 45.1 billion. The VMT on the Eastern Shore, southern and western Maryland facilities was 12.2 billion, an approximate 200 million mile increase over 2014 levels.
- The largest percentage increase for VMT in 2015 from 2014 occurred in St. Mary's County (almost 5%) while the biggest percentage decrease took place in Cecil County, a 3% drop.
- In the last five years, changes in VMT have varied by locality. In St. Mary's and Worcester Counties, VMT has grown by more than 10% while Dorchester and Garrett Counties experienced a 7% drop.
- Analysis of 2015 vehicle probe speed data for the Maryland freeway/expressway system indicated 9% of the system experienced heavy to severe congested conditions in the AM peak hour. The PM peak hour provided the worst congestion with 15% of the system experiencing heavy to severe congested conditions. This is a 1% increase in the AM peak hour and 2% in the PM peak hour over 2014 levels.
- On the freeways/expressway system 18% of the AM peak hour VMT and 27% of the PM peak hour VMT occurred in congested conditions compared to 16% and 24% (AM and PM peak hour respectively) in 2014.
- On weekdays, almost 100% of the peak hour congestion occurred in the Baltimore - Washington region.
- The cost of congestion to travelers on Maryland freeways/expressways system amounted to more than $2 billion dollars annually. This is an increase of approximately $350 million over 2014 levels.
- Motorists experienced a total annual delay of 47.9 million hours and consumed 22.6 million gallons of extra fuel due to congestion.
- Highly to extremely unreliable conditions occur on 8% of the freeway/expressway network in the AM peak hour and 14% in the PM peak hour. The 2014 and 2015 conditions were within ±1%.
- Sixty-four (64) SHA owned intersections operated at a failing level of service (LOS F) based on traffic count data from the last three years.

The most congested freeway/expressway sections for the AM and PM peak hours are as follows:

2015 MOST CONGESTED FREEWAYS/EXPRESSWAY SECTIONS (AVERAGE WEEKDAY)	
AM Peak (8-9 AM)	**PM Peak (5-6 PM)**
I-495 Outer Loop - I-95 to MD 97	I-495 Inner Loop - Virginia State Line to I-270 West Spur
I-695 Outer Loop - US 1 to MD 41	I-270 West Spur Southbound - I-270 to I-495
US 50 Westbound - MD 202 to MD 201	I-495 Outer Loop - I-270 West Spur to Virginia State Line
I-270 Southbound - I-370 to Montrose Road	I-695 Inner Loop - MD 139 to MD 41
I-695 Outer Loop - I-795 to US 40	I-95 Inner Loop - I-495 to MD 295

MDOT Accomplishments

MDOT/ SHA implements a combination of policies, programs and strategies to address congestion issues. A summary of the successes of these policies, programs and strategies to improve mobility in calendar year 2015 include:

- SHA's Coordinated Highways Action Response Team (CHART) program responded to and cleared more than 35,000 incidents and assisted almost 43,000 stranded motorists on Maryland roadways.
- CHART's Emergency Traffic Patrol expansion in 2014 continued to allow SHA to respond to incidents promptly and alert motorists more quickly. This resulted in a reduction of an estimated 39 million vehicle hours of delay amounting to over $1.3 billion in savings.
- Forty-three (43) signal systems including 340 individual signals were reviewed in 2015 by the Office of Traffic and Safety. Approximately 75% of the signals were in need of retiming. The retiming of traffic signals provided for an estimated reduction of 789,000 hours of delay and an estimated 248,000 gallons of fuel savings. This resulted in $29.3 million annual user cost savings.
- Mobility improvement projects were completed at nine locations. This included three roundabout projects at MD 20 @ MD 291@ High Street, MD 144 @ MD 910C and MD 822 @ MD 675. Four intersection improvement projects were constructed at MD 586 @ Ferrara Ave, MD 185 @ Jones Bridge Rd, MD 349 @ Crooked Oak Lane and US 13 Business @ S. Division St. The final two projects involved the construction of an auxiliary lane along US 15 northbound between Motter Avenue and MD 26; and a second eastbound lane on MD 4 between MD 235 and Patuxant Blvd. These projects are projected to result in an annual user cost savings of $4.25 million.
- A project was completed on I-95 at Konterra Drive to improve accessibility to the West Laurel area of Prince George's County. This included a new interchange and collector - distributor roads along I-95 to reduce travel time to the area and increase the prospects for economic development.
- The first express toll lane (ETL) project in Maryland has now been operational for one year. The project provides motorists an option to travel on an eight mile section of I-95 from I-895 to north of MD 43

in White Marsh to use the free flow express toll lanes or utilizing the general purpose lanes. The ETLs' are used by approximately 22,500 motorists per day and public perception has been very positive. This project improved travel times on I-95 by 20% - 40% on average in the peak hour peak direction.

- The Intercounty Connector (ICC)/MD 200, provides a vital east-west connection between I-270 and I-95. The final section from I-95 to US 1 opened in December 2014. Traffic usage on the sections from I-270 to I-95 is increasing with most sections averaging more than 45,000 vehicles per day. This is a 75% increase in the last four years.
- The initiation of Governor Hogan's transportation investment program has led to construction starting on several mobility improvements. This includes the widening of I-695 from MD 41 to MD 147 and reconstructing the MD 147 interchange, widening of I-695 from US 40 to MD 144, widening of US 29 from Seneca Drive to MD 175 and the continued widening of MD 404 in Caroline County.
- MDOT continues to focus on a multi-modal approach to all highway projects and completed several pedestrian and bicycle projects. MDOT constructed 11 miles of new sidewalk and approximately 13 miles of marked bicycle facilities. The number of accessible pedestrian signals increased by 9% statewide and the number of sidewalks now ADA compliant exceeded 68%.
- More than 7,000 motorists connect to transit or ride with other commuters at 104 park and ride lots operated by SHA and MDTA in 20 counties. This provides a savings of more than 107 million vehicle miles travelled annually, a $58 million user cost savings.
- The US 50 and I-270 HOV lanes encourage ridesharing and increased person throughput. The I-270 HOV lanes provide as much as 17 minutes in travel time savings in the PM peak hour. Person throughput along the corridor is substantially increased with a HOV lane accommodating as much as 1,700 additional people compared to a non-HOV lane. HOV lane operations on I-270 resulted in $5.7 million user cost savings.
- Commercial vehicles are a major user of the state roadway system. A variety of projects, including virtual weigh stations, improvements to at-grade railroad crossings and providing more overnight parking spaces were completed. Approximately eight upgrades to railroad crossings were completed. Additional overnight parking spaces at the I-95 southbound Welcome Center near Laurel and the US 301/MD 834 Bay County Rest Area in Queen Anne's County were constructed.
- A Transportation Systems Management and Operations (TSM&O) Strategic/Implementation Plan has been released to streamline agency structure and functions for improving travel time reliability. Various policies and pilot opportunities are being considered for implementation of active traffic management (ATM) and Integrated Corridor Management (ICM) strategies.
- MDOT is at the forefront of several nationwide research initiatives. Since 2014, SHA has received more than $2 Million in FHWA Strategic Highway Research Program (SHRP-2) implementation assistance. A total of seven (7) projects are being implemented to advance mobility performance management, state-of-the-art modeling tools, and innovations for transportation planning and operations.

What is in the Maryland? State Highway Mobility Report

Introduction

Maryland's location in the Mid-Atlantic region requires an infrastructure that facilitates the movement of people, goods and services. The ability to minimize congestion and improve mobility through maximizing the roadway network performance are critical to this mission. The 2016 Maryland Mobility Report provides a summary of performance along the Maryland State Highway Administration (SHA) and the Maryland Transportation Authority (MDTA) facilities for calendar year 2015. This includes identifying successes, challenges and strategies to improve the transportation services the Maryland Department of Transportation (MDOT) delivers to Marylanders and the traveling public.

In order to address mobility issues, various programs have been established to ensure safe, reliable and efficient travel of people and goods. Various initiatives have been announced by Governor Hogan to improve roads, bridges and pedestrian and bicycle facilities throughout Maryland, including eighty-four (84) new projects. New grants to enhance mobility and provide for the safe movement of people and goods have been received. MDOT continues to focus on policies, programs and projects to systematically address both recurring (every day congestion) and non-recurring congestion (due to weather, crashes, vehicle breakdowns, etc.) These programs have been developed based on a performance driven approach to provide the users with a high quality, reliable system.

The 2016 Maryland Mobility Report describes performance and mobility trends in 2015 and comparing them to past years plus identifying accomplishments. This follows a general theme of "What is Happening" and "What is MDOT/SHA doing and what are the outcomes." Key elements reviewed include Transportation Systems Management and Operations (TSM&O), multi-modalism, and major capital projects that were undertaken in the past year.

What is in the Maryland State Highway Mobility Report?

Organization Of The Report:

The 2016 Maryland State Mobility Report is broadly written around the central theme of:

- **What is Happening? (Trends and Needs Identification - Chapter I)**
  - Chapter I reviews Mobility Trends including sections on traffic volume, congestion, reliability and freight movement for the calendar year 2015. Other highlights include statewide congestion and reliability maps for the peak hours. The Top 15 AM and PM peak hour congestion and reliability sections on the Maryland freeway/expressway system are identified along with arterial corridor metrics.
- **What is MDOT/SHA doing and what are the outcomes? (Mitigation Strategies/Solutions - Chapter II)**
  - Chapter II reviews the Capital Projects from both a mobility and accessibility standpoint that were implemented in 2015 along with the user benefits. Programs and policies include CHART activities and other multimodal strategies implemented to improve mobility.
  - Appendices A - C include fact sheets to highlight the performance of major freeways/ expressways, arterial corridors and capital projects completed in 2015.

What's New In The 2016 Report:

- Expansion of arterial corridors.
- Additional year to year comparisons.
- Top 15 arterial and freeway/expressway sections.
- Ratings of intersection operation.

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TABLE OF CONTENTS

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Mobility
Trends in Maryland

I-495

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A. Traffic Volume Trends

I-495 South of MD 190

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MD 213 Chestertown

Traffic Volume Trends

Traffic volumes across the country are experiencing the largest increases in years. Nationwide, there was a 3.5% growth rate in 2015, which was approximately twice the growth rate of the previous year and represents the fourth straight year of increase in travel.

The following facts highlight trip patterns in Maryland:

- Maryland is second in the nation in terms of longest commuting times according to the American Community Survey with an average of 32.3 minutes. The District of Columbia which includes many Maryland commuters is fourth in the nation with commuting times averaging 29.3 minutes each way.
- Approximately 240,000 people commute from Maryland into Washington D.C based on AirSage data analysis. An additional 120,000 people commute to Montgomery and Prince George's counties from out of state.
- There are almost 140,000 people commuting into Baltimore City each day, mainly from Baltimore, Anne Arundel, Howard and Harford counties.
- Maryland's population in 2015 was approximately 6.01 million, about 240,000 people higher than 2010 according to the US Census Bureau. By 2040, population is projected to increase to more than 6.9 million based on projections from the Maryland Department of Planning. In addition, job growth in Maryland is expected to keep pace with an estimated 600,000 additional jobs between 2015 and 2040.
- The 2015 Urban Mobility Scorecard developed by Texas A&M Transportation Institute has cited the Washington, DC region as number one (1) in the nation in terms of annual delay per auto commuter, increased fuel consumed due to travel in congested conditions, and congestion cost per auto commuter in 2014.
- In measures developed as part of the 2015 Urban Mobility Scorecard, the Baltimore Metropolitan area is ranked #14 in truck congestion costs, #18 in excess fuel consumed and #18 in total congestion costs in the nation. The annual delay experienced by Baltimore area commuters, the leading sign of congestion, ranks #23 nationwide.

I-95 North of I-495

SHA owns and maintains the numbered, non-toll routes in Maryland's 23 counties, a total of 14,800 lane-miles and 2,566 bridges representing the backbone of Maryland's transportation system. This infrastructure forms the majority of the National Highway System (NHS) which includes interstate highways, freeways and major arterial roadways. The MDTA owns and operates all toll roads in the state including I-95 from the Baltimore City line (south side) to the Delaware State Line, I-895 including spurs to I-97 and MD 2, MD 695 from east of MD 10 to MD 151, the Hatem Bridge (US 40), the Chesapeake Bay Bridge (US 50/301), the Nice Bridge (US 301) and MD 200 (Intercounty Connector). The Key Bridge, Fort McHenry Tunnel, Harbor Tunnel, and Tydings Memorial Bridge are part of the system.

These roadways provide for both long distance travel and for access to major commercial, office and residential centers. The state transportation network not only provides roadway connections but also multi-modal connectivity to airports, railroads, mass transit, and the Port of Baltimore.

Traffic volume growth along different roadways has varied greatly over the last twenty-five years. Interstate freeways, major arterials, and roadways in suburban areas have seen tremendous growth. Traffic volumes along rural roadways or in the center of cities have seen flat or negative growth. The following chart illustrates the growth in traffic volumes along selected roadways over the last twenty-five years:

HISTORIC GROWTH ON MAJOR ROADWAYS

Location	1990 Average Daily Traffic (ADT)	2015 Average Daily Traffic	Average Annual Growth
MD 528 North of MD 90	31,000	48,000	1.8%
US 40 East of MD 272	23,000	32,000	1.3%
MD 5 South of MD 337	66,000	126,000	2.6%
I-70 West of I-695	58,000	101,000	2.3%
US 50 East of MD 2	56,000	97,000	2.2%
I-81 at West Virginia State Line	30,000	61,000	2.9%
US 15 South of MD 26	42,000	85,000	2.9%

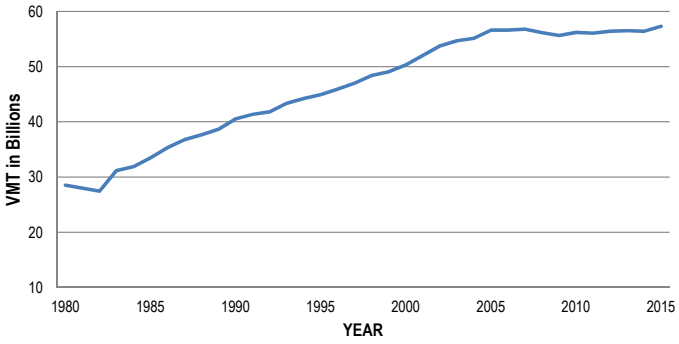
The highest volume SHA freeway, SHA arterial and MDTA toll facilities based on the SHA Traffic Volume maps include:

HIGHEST AVERAGE DAILY TRAFFIC VOLUMES	
Freeway Section	**2015 ADT**
I-270 N of I-270 Split	255,000
I-495 E of MD 650	253,000
I-270 N of MD 189	251,000
I-495 S of I-270 West Leg	249,000
I-495 W of MD 97	228,000
Arterial Section	
US 301/MD 5 N of Chadds Ford Road	88,000
MD 5 S of MD 223	83,000
MD 650 S of I-495	77,000
MD 175 E of MD 108	75,000
MD 210 S of I-95	74,000
MDTA Toll Facility Crossings	
I-95 Ft. McHenry Tunnel	116,000
I-95 Tydings Bridge	83,000
I-895 Harbor Tunnel	77,000
US 50/301 Bay Bridge	72,000

Vehicle Miles Traveled (VMT) is a standard performance measure of travel for various roadway classifications on a local, regional, state, and national level. VMT is defined as the number of vehicles times the distance traversed along the network. VMT has been measured for decades in each state including Maryland. Measuring VMT allows for a comparison in growth from month to month or year to year. Many areas in Maryland have seen growth in VMT outpacing population growth and SHA's ability to expand the roadway network, particularly in the Baltimore - Washington region.

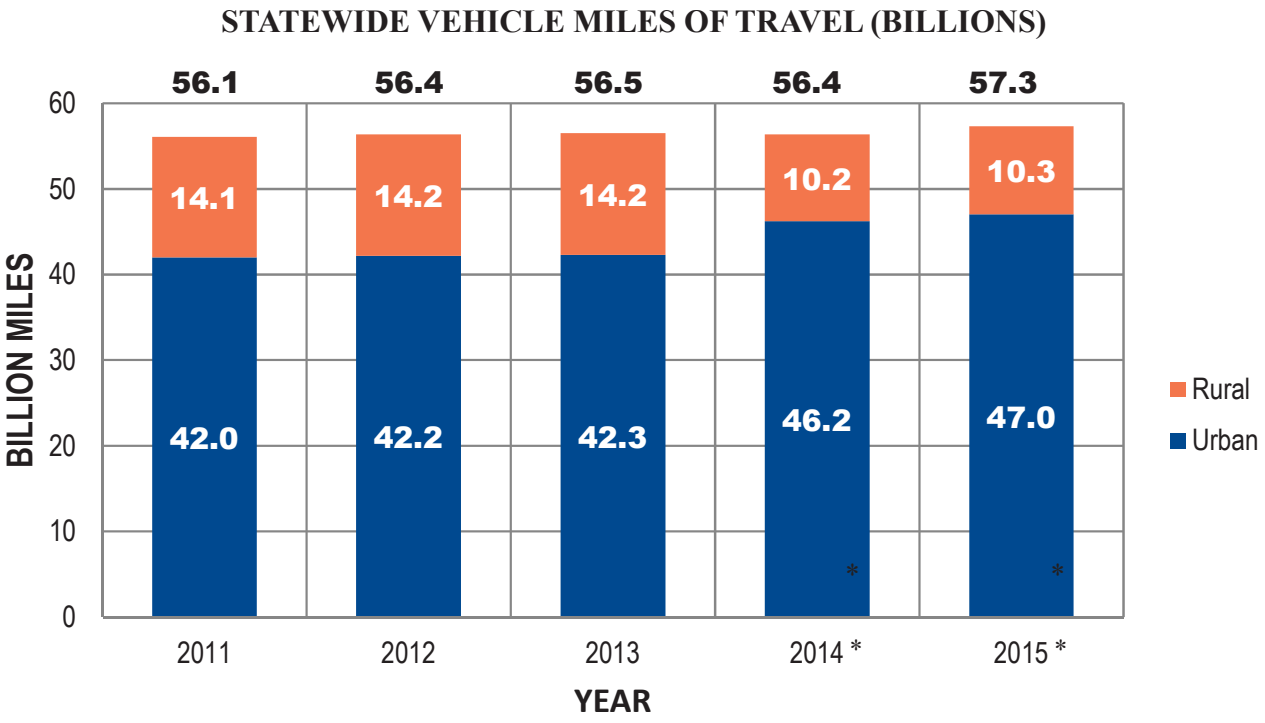
Consistent with national trends, various economic and social conditions have impacted the amount of travel in Maryland since the 1980s. The annual VMT has remained relatively flat since 2005 as depicted in the following graph.

STATEWIDE ANNUAL VEHICLE MILES OF TRAVEL



I-95 South of MD 200

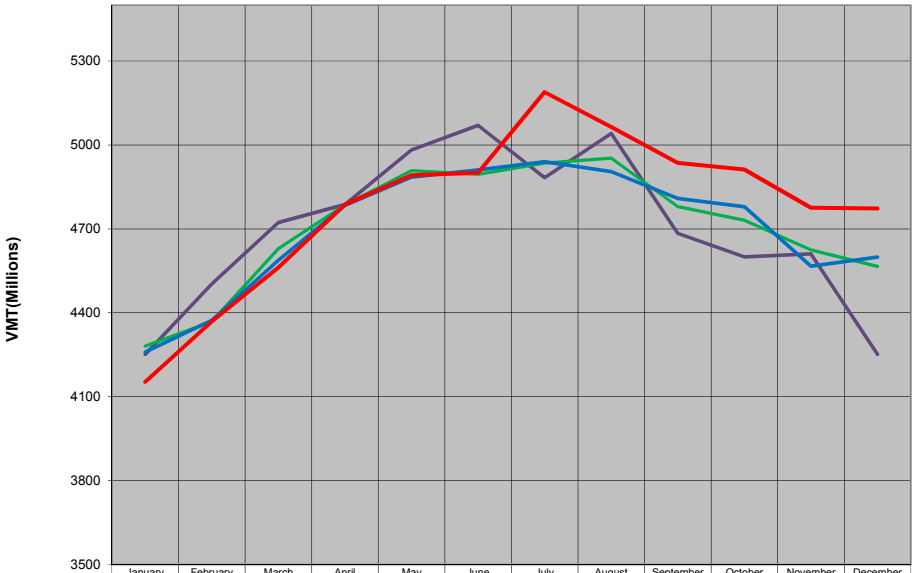
VMT was relatively flat between 2011 and 2014 as the economy recovered from the great recession. In 2015, the statewide VMT climbed to an all time record of 57.3 billion vehicle miles, a 1.6% increase over 2014 VMT. Travel along and through urban area roadways was the major reason for the increase in VMT. Urban area VMT was approximately 47.0 billion vehicle miles travelled, an increase of 800 million miles from 2014. The increase in urban VMT was predicated upon the growth of population and jobs in the metropolitan area. Rural VMT climbed 100 million vehicle miles.



*Represents new urban/rural limits.

The monthly distribution of VMT shows the majority of growth in VMT occurred in the second half of 2015 as depicted below.

MONTHLY DISTRIBUTION OF ANNUAL VEHICLE MILES OF TRAVEL

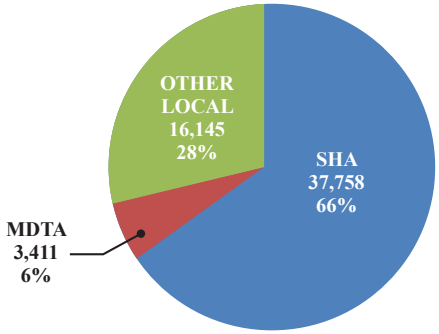


	January	February	March	April	May	June	July	August	September	October	November	December
2012 VMT (Millions)	4252	4504	4723	4787	4982	5070	4883	5042	4684	4600	4611	4252
2013 VMT (Millions)	4281	4369	4629	4785	4908	4895	4935	4953	4780	4731	4625	4566
2014 VMT (Millions)	4260	4373	4588	4784	4885	4911	4940	4905	4809	4779	4567	4599
2015 VMT (Millions)	4153	4369	4562	4787	4892	4901	5189	5064	4936	4912	4776	4773

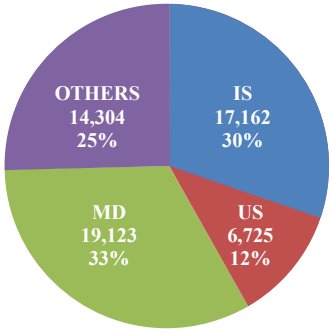
NOTE: This chart displays estimated monthly Vehicle Miles of Travel compared with the previous year based on data collected at approximately 61 continuous count stations throughout the State.

The 2015 VMT on all state and toll maintained roadways was 41.2 billion, which is an increase of approximately 700 million miles (1.7%) over 2014. MDOT facilities account for only 23% of the states lane miles, but 72% of travel occurs on them. Last year the greatest increase of VMT was on Maryland state roadways an increase of 650 million miles(1.7%). The 2015 VMT along all other roadways increased to 16.1 billion from 15.9 billion (1.6%) in 2014. The following graphs show VMT by ownership and the type of roadway.

2015 VMT BY OWNERSHIP (MILLION)

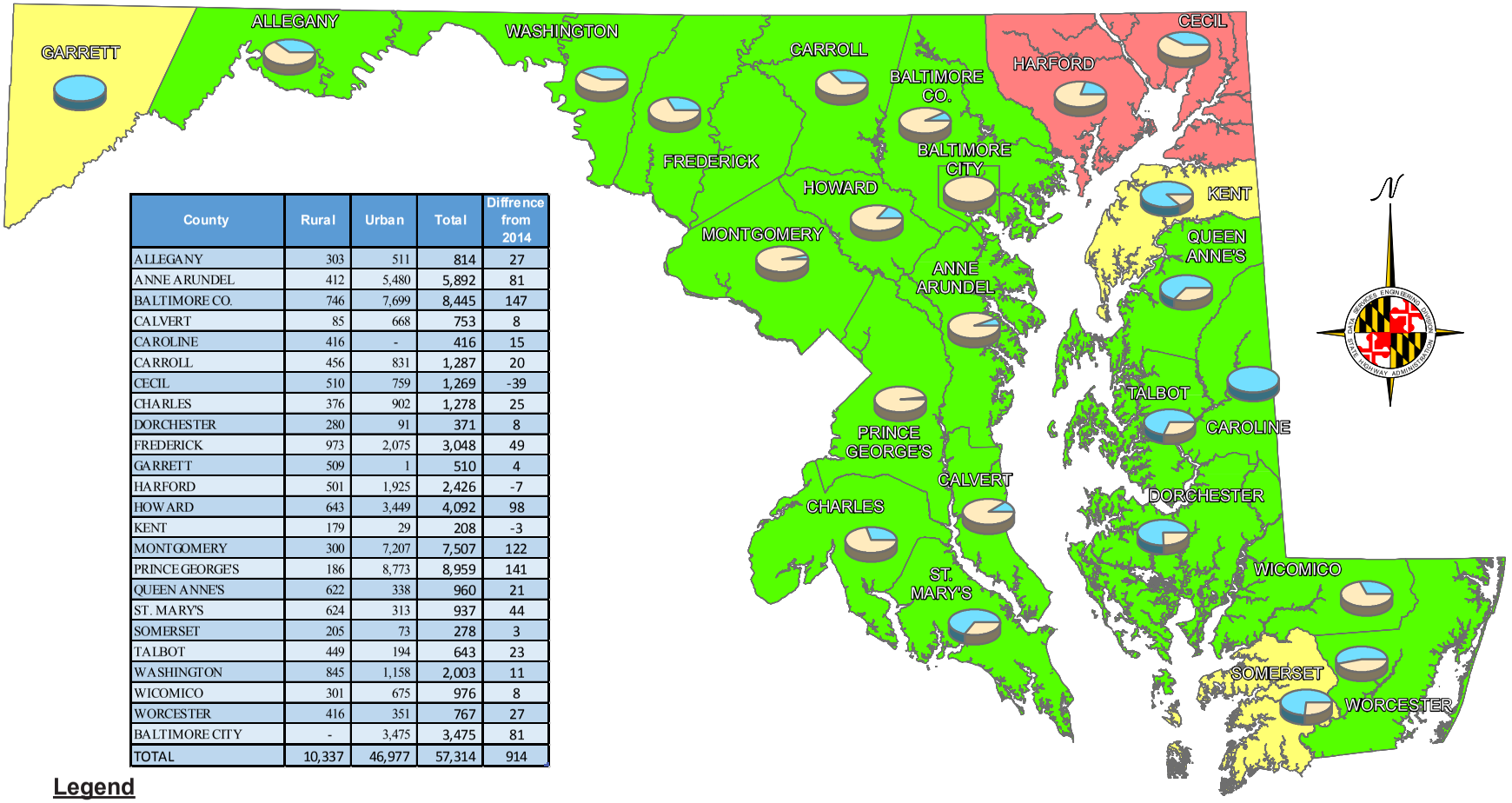


2015 VMT BY ROADWAY TYPE (MILLION)



On a county-wide basis, the change in VMT varies with all but three counties showing an increase over 2014. The largest increase in VMT was in Baltimore County while Cecil County had the greatest decrease in total VMT. On a percentage basis, St Mary's County experienced nearly a 5% growth while four other counties grew at greater than 3%. This is shown in the following figure.

2015 VEHICLE MILES OF TRAVEL



County	Rural	Urban	Total	Diffrence from 2014
ALLEGANY	303	511	814	27
ANNE ARUNDEL	412	5,480	5,892	81
BALTIMORE CO.	746	7,699	8,445	147
CALVERT	85	668	753	8
CAROLINE	416	-	416	15
CARROLL	456	831	1,287	20
CECIL	510	759	1,269	-39
CHARLES	376	902	1,278	25
DORCHESTER	280	91	371	8
FREDERICK	973	2,075	3,048	49
GARRETT	509	1	510	4
HARFORD	501	1,925	2,426	-7
HOWARD	643	3,449	4,092	98
KENT	179	29	208	-3
MONTGOMERY	300	7,207	7,507	122
PRINCE GEORGE'S	186	8,773	8,959	141
QUEEN ANNE'S	622	338	960	21
ST. MARY'S	624	313	937	44
SOMERSET	205	73	278	3
TALBOT	449	194	643	23
WASHINGTON	845	1,158	2,003	11
WICOMICO	301	675	976	8
WORCESTER	416	351	767	27
BALTIMORE CITY	-	3,475	3,475	81
TOTAL	10,337	46,977	57,314	914

Legend

Variation From 2014 to 2015

- Increased More Than 5 Million Miles
- Remained Within 5 Million Miles
- Decreased More Than 5 Million Miles

- Rural VMT
- Urban VMT

For a regional analysis of traffic and congestion trends, the state of Maryland is subdivided into five geographic regions: Baltimore Metropolitan; Washington Metropolitan; Southern Maryland; Eastern Shore; and Western Maryland.

BALTIMORE METROPOLITAN REGION

- Anne Arundel County
- Baltimore City
- Baltimore County
- Carroll County
- Harford County
- Howard County

WASHINGTON METROPOLITAN REGION (MARYLAND COUNTIES)

- Frederick County
- Montgomery County
- Prince George's County

SOUTHERN MARYLAND

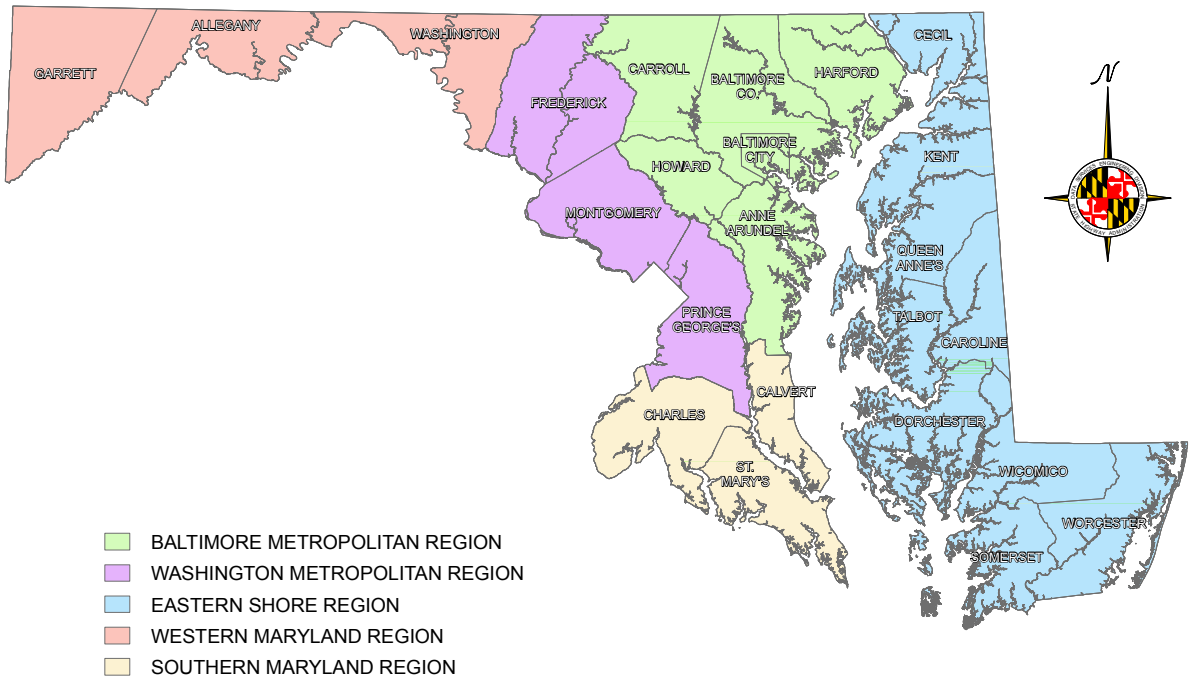
- Calvert County
- Charles County
- St. Mary's County

EASTERN SHORE

- Caroline County
- Cecil County
- Dorchester County
- Kent County
- Queen Anne's County
- Somerset County
- Talbot County
- Wicomico County
- Worcester County

WESTERN MARYLAND

- Allegany County
- Garrett County
- Washington County



The following chart shows that four of the five regions experienced a growth in VMT compared to 2014 with only Western Maryland remaining flat.

VMT BY REGION

VMT	2011	2012	2013	2014	2015
Baltimore Region	25.0	25.2	25.2	25.2	25.6
Washington Region	19.1	19.1	19.2	19.2	19.5
Southern Region	2.8	2.8	2.9	2.9	3.0
Eastern Shore Region	5.8	5.9	5.8	5.8	5.9
Western Region	3.4	3.4	3.4	3.3	3.3
Total	**56.1**	**56.4**	**56.5**	**56.4**	**57.3**

B. Congestion and Reliability Trends

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I-95 North of MD 43

Congestion Trends

Congestion broadly falls into two categories: recurring and non-recurring. Recurring congestion generally relates to roadway segments in the AM and PM peak periods where vehicles experience delay every weekday. This includes sections of a freeway where motorists merge or diverge from the roadway, locations where the volume is greater than the capacity or in weave sections where traffic is both trying to enter or exit from the freeway. Recurring congestion is influenced by high automobile and truck traffic volumes, geometrics, lane widths and shoulder widths. Non-recurring congestion relates to events including crashes, vehicle breakdowns, work zones, and inclement weather that cause motorists to experience slowing or stop and go conditions. The impacts of a congested system are detrimental to the individual user, including increased costs, environmental impacts, and degradation of the overall quality of life.

The methods used to measure congestion have changed dramatically over past several years as vehicle probe speed data is now available from a variety of private sources on a minute by minute basis over the entire year. This data, together with analyses methodologies that have been developed and tested over time, provides a detailed snapshot of mobility for travelers using the highway system in Maryland. The private data for this analysis is from INRIX, a company providing both real-time and historic traffic speed data collected from an estimated 100 million probe vehicles nationwide including commercial vehicle fleets. In addition, public data is developed from a statewide program that collects traffic volume data on all of its roadways in a continual cycle. The University of Maryland Center for Advanced Transportation Technology (UMD CATT) uses the INRIX speed data, together with detailed traffic volume data from the MDOT to develop metrics to measure congestion and reliability for major roadways. These congestion and reliability measures have been closely coordinated with the Baltimore Regional Transportation Board (BRTB) and National Capital Regional Transportation Planning Board (NCRTPB) Metropolitan Planning Organizations (MPOs) to ensure regional consistency in reporting.

I-695 @ I-70

I-270 West Spur

I-95 @ MD 175

MDOT/SHA uses the Travel Time Index (TTI) as one of the primary measures of congestion on freeways/expressways. The TTI compares the 50th percentile travel time of a trip on a segment of freeway/ expressway for a particular hour to the travel time of a trip during off peak (free-flow or uncongested) conditions. The higher the TTI, for a given hour of the day, the longer the travel times. For example, a TTI of 2.0 indicates that a trip that takes 10 minutes in light traffic will take twice as long, or 20 minutes in congested conditions.

MDOT/SHA, defines the various levels of congestion in four categories based on TTI. These are:

- Uncongested (TTI < 1.15)
- Moderate Congestion (1.15 < TTI < 1.3)
- Heavy Congestion (1.3 < TTI < 2.0)
- Severe Congestion (TTI > 2.0)

The TTI for each highway segment is calculated to provide a comprehensive picture of the statewide freeway/expressway network for average weekday peak hour conditions. The analysis was conducted on a statewide basis for the five major geographic regions. The congestion and reliability measures are further analyzed for the combined Baltimore - Washington region, where the majority of weekday congestion occurs.

The freeway/expressway analysis of vehicle probe speed data involves 1,655 directional miles, approximately 95% of these type of roadways in Maryland. This includes 1,116 directional miles of freeways/ expressways in the combined Baltimore - Washington region with the remaining directional miles on the Eastern Shore, Southern Maryland and Western Maryland. MDOT/SHA utilizes three key metrics to measure congestion on freeways/expressways:

1. Percent System Congested
2. Percent Peak Hour VMT in Congested Conditions
3. Annual Cost of Congestion

CONGESTION MEASURES ON THE MARYLAND STATE FREEWAY/EXPRESSWAY NETWORK

1. Percent System Congested

An analysis was performed to determine the TTI for each segment of the freeway/expressway system in Maryland for an average weekday travel. The analysis was conducted for the highest levels of congestion in the morning and afternoon peak hour which occur from 8-9 AM and from 5-6 PM.

Figures 1-2 show the average weekday AM and PM peak hour state of congestion on the Maryland freeway/expressway network based on TTI.

Motorists experience heavy to severe congestion on a total of 149 road miles (9% of the statewide freeway/expressway network) during the AM peak hour (8-9 AM). The PM peak hour is more congested than the AM peak hour. For the 5-6 PM peak hour, heavy to severe congestion occurs on a total of 252 road miles, which is 15% of the statewide freeway/expressway network. This reflects the segments of the freeway/expressway network where the TTI is greater than 1.3. The 1.3 value represents the locations motorists travel at or below approximately 75% of the free-flow speed.

The majority of the average weekday congestion occurs in the Baltimore - Washington Region. The roadways in the area that carry the highest traffic volumes consist of a mixture of commuting and through travel plus visitors to the region. The high traffic volumes impact mobility by reducing speeds not only to motorists but also to on-road transit and freight operators. Severe to heavy congestion takes place on 149 miles of the freeways/expressways in the Baltimore - Washington region in the AM peak hour.

In the Baltimore - Washington region, the highest levels of congestion occur in the afternoon peak hour. This amounts to a total of 251 road miles that motorists experience heavy to severe congestion (TTI > 1.3). In comparison to 2014, this is a 30 mile increase in the number of road miles that experience heavy to severe congestion.

The Eastern Shore, Southern Maryland and Western Maryland experience congestion in selected areas. The Eastern Shore including northeast Maryland is characterized by seasonal congestion along the US 50 and I-95 corridors. Kent Island and the Town of Elkton experience more traditional peak period operational issues. In Southern Maryland corridors such as US 301, MD 5, MD 228, and MD 2/4 experience congestion as commuters utilize these roadways to access Washington D.C. and its suburbs. Motorists experience reduced travel times during the peak periods along MD 4, MD 5 and MD 235 which provide access to the Naval Air Station Patuxent River. The majority of the congestion along Western Maryland roadways mainly occurs in the Hagerstown area including the crossroads near I-70/I-81 interchange and selected areas of the mainline of these two interstates where high truck volumes contribute to reduced speeds.

2. Percent Peak Hour VMT in Congested Conditions

A second measure of congested operations is the amount of VMT motorists experience heavy to severe congestion during the peak hour of travel. This amounts to 18% of the morning peak hour VMT. In the PM peak hour, heavy to severe congestion occurs for 27% of the afternoon VMT.

A comparison was performed between 2015 and 2014 metrics which shows that roadway performance statewide has decreased slightly over the past year. The AM peak hour performance showed a 1% increase in heavy to severe congestion (13 road miles), while the PM peak hour showed a 2% increase (28 roadway miles) in heavy to severe congestion on the freeway/expressway system. The percent of peak hour VMT occuring in these increased by 2% in the AM and 3% in the PM peak hours.

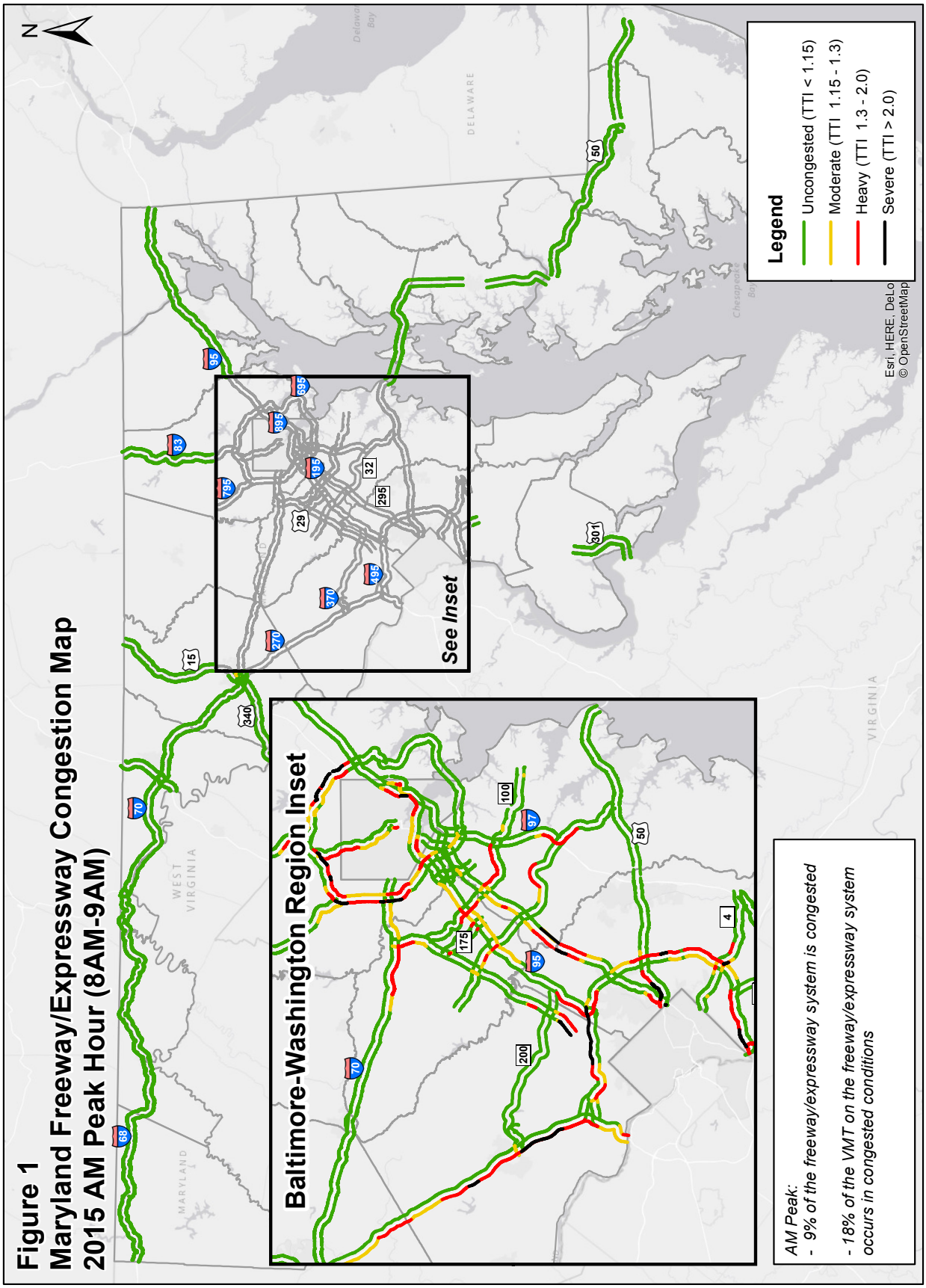
Figure 1
Maryland Freeway/Expressway Congestion Map
2015 AM Peak Hour (8AM-9AM)
Baltimore-Washington Region Inset
See Inset
Legend
Uncongested (TTI < 1.15)
Moderate (TTI 1.15 - 1.3)
Heavy (TTI 1.3 - 2.0)
Severe (TTI > 2.0)
AM Peak:
- 9% of the freeway/expressway system is congested
- 18% of the VMT on the freeway/expressway system occurs in congested conditions
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© OpenStreetMap
DELAWARE
MARYLAND
WEST VIRGINIA
VIRGINIA

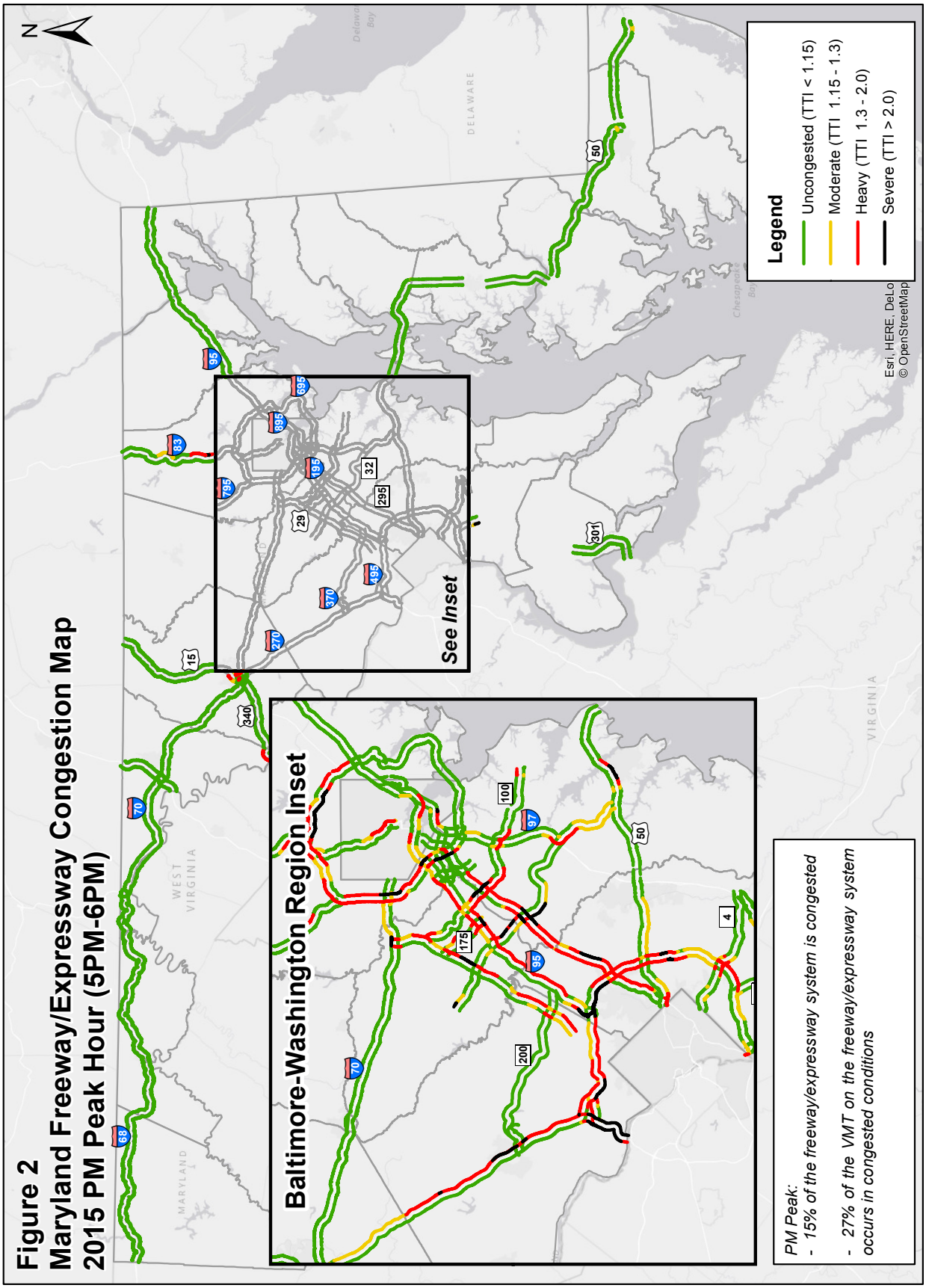


Figure 2
Maryland Freeway/Expressway Congestion Map
2015 PM Peak Hour (5PM-6PM)
Baltimore-Washington Region Inset
See Inset
Legend
Uncongested (TTI < 1.15)
Moderate (TTI 1.15 - 1.3)
Heavy (TTI 1.3 - 2.0)
Severe (TTI > 2.0)
PM Peak:
- 15% of the freeway/expressway system is congested
- 27% of the VMT on the freeway/expressway system occurs in congested conditions
Esri, HERE, DeLo
© OpenStreetMap
N
MARYLAND
WEST VIRGINIA
DELAWARE
VIRGINIA

The following table shows a summary of the congestion metrics for the last three years.

STATEWIDE FREEWAY/EXPRESSWAY NETWORK (AVERAGE WEEKDAY AM & PM PEAK HOUR HEAVY TO SEVERE CONGESTION SUMMARY)								
Heavy to Severe Congestion	2013		2014		2015		CHANGE 2014 TO 2015	
	AM	PM	AM	PM	AM	PM	AM	PM
Roadway Miles	130	209	136	224	149	252	+13	+28
Percent of Roadway Miles	8	12	8	13	9	15	+1	+2
Percent of Peak Hour VMT Impacted	16	22	16	24	18	27	+2	+3

3. Statewide Annual Cost of Congestion

The statewide cost of congestion was estimated based on the auto delay, truck delay, and wasted fuel and emissions that occurs on the freeway/expressway network on a statewide and region-wide basis. The statewide cost for 2015 is estimated to be $2.05 billion which includes:

- Auto Delay Cost: $1.937 Billion
- Truck Delay Cost: $114 Million
- Wasted Fuel Cost: $58 Million
- Air Emissions Cost: $58 Million

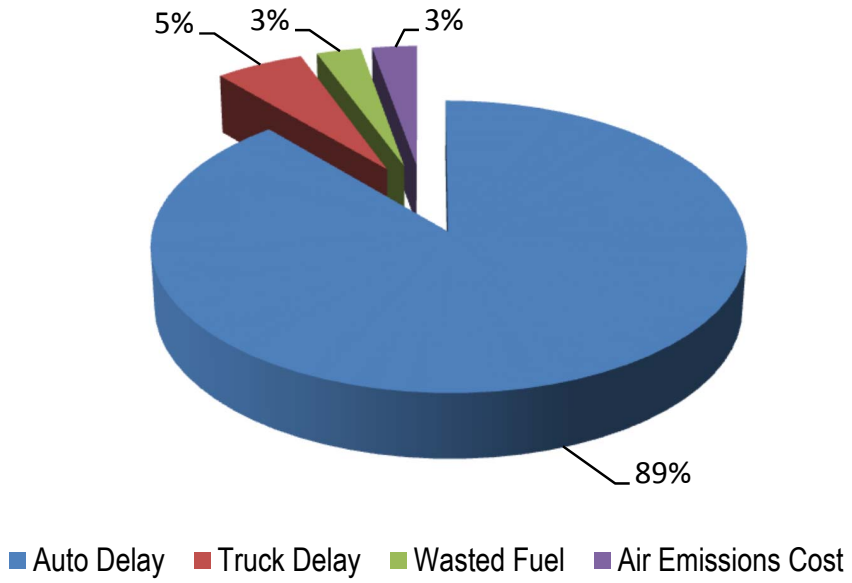
The highest user cost was experienced in the Baltimore - Washington region. It was estimated that congestion cost in the area was $2.028 billion. The cost associated with congestion for the Eastern Shore, Southern and Western Maryland regions is estimated at $24 million. The overall state and region wide congestion costs for this year and previous three years is depicted in the following table.

TOTAL COST OF CONGESTION ON FREEWAYS/EXPRESSWAYS ($ MILLIONS)				
Region	2013	2014	2015	CHANGE 2014 TO 2015
Statewide	1,676	1,698	2,052	+324
Baltimore Region	681	686	806	+120
Washington Region	949	954	1,222	+268
Eastern Shore Region	31	47	20	-27
Southern Region	4	5	1	-4
Western Region	11	6	3	-3

The increase in congestion costs was related to the additional delay experienced by auto drivers especially in the Baltimore - Washington region. The following graphs identify the percentage breakdown of the congestion costs by source and by different regions for the freeway/expressway system:

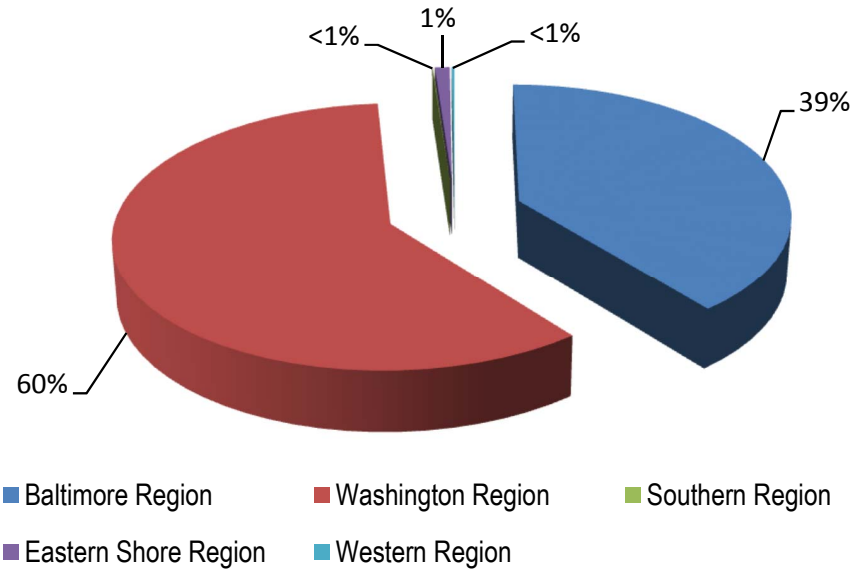
PERCENT OF 2015 STATEWIDE CONGESTION COST BY SOURCE

(TOTAL CONGESTION COST = $2.05 BILLION)



PERCENT OF 2015 STATEWIDE CONGESTION COST BY REGION FOR FREEWAY/EXPRESSWAY ROUTES

(TOTAL CONGESTION COST = $2.05 BILLION)



Top 15 Freeway/Expressway Sections

The individual segments utilized to develop the TTI were combined together to develop roadway sections with similar travel conditions. These sections range from approximately two miles to slightly over eight (8) miles. The length of the section was based on the individual segment TTI and engineering judgement. A weighted average was developed for each section by multiplying the individual segment TTI by segment length for each segment and dividing it by the section length. The Top 15 sections were developed for the AM and PM peak hours.

The Top 15 sections for the freeway/expressway sections are shown in the following tables and in Figures 3 and 4.

2015 MOST CONGESTED FREEWAY/EXPRESSWAY SECTIONS - AM PEAK HOUR

AM Rank	Route	Locations	TTI Value	County	Mileage
1	I-495 Outer Loop	Prince George's County Line to MD 97	3.64	Montgomery	4.2
2	I-695 Outer Loop	US 1 to MD 41	2.42	Baltimore	4.1
3	US 50 Westbound	MD 202 to MD 201	2.18	Prince George's	4.3
4	I-270 Southbound	I-370 to Montrose Rd	2.03	Montgomery	6.4
5	I-695 Outer Loop	I-795 to US 40	2.01	Baltimore	7.5
6	I-495 Outer Loop	US 1 to Montgomery County Line	1.94	Prince George's	3.5
7	I-695 Outer Loop	MD 542 to Providence Rd	1.91	Baltimore	2.0
8	I-695 Inner Loop	MD 140 to MD 25	1.89	Baltimore	5.3
9	MD 295 Southbound[1]	Prince George's County Line to Powder Mill Rd	1.80	Prince George's	3.0
10	I-270 Spur Southbound	I-270 to I-495	1.74	Montgomery	2.0
11	I-270 Southbound	Father Hurley Blvd to MD 124	1.72	Montgomery	7.0
12	I-495 Inner Loop	MD 5 to Virginia State Line	1.65	Prince George's	8.2
13	I-495 Outer Loop	MD 214 to US 50	1.51	Prince George's	7.5
14	I-97 Southbound	Benfield Blvd to MD 178	1.39	Anne Arundel	6.4
15	MD 100 Eastbound	MD 103 to US 1	1.39	Howard	2.9

[1] Owned and operated by National Park Service

2015 MOST CONGESTED FREEWAY/EXPRESSWAY SECTIONS - PM PEAK HOUR					
PM Rank	Route	Locations	TTI Value	County	Mileage
1	I-495 Inner Loop	Virginia State Line to I-270 West Spur	2.95	Montgomery	3.9
2	I-270 West Spur Southbound	I-270 to I-495	2.71	Montgomery	2.0
3	I-495 Outer Loop	I-270 West Spur to Virginia State Line	2.46	Montgomery	3.9
4	I-695 Inner Loop	MD 139 to MD 41	2.42	Baltimore	5.7
5	I-495 Inner Loop	I-95 to MD 295	2.23	Prince George's	5.5
6	I-270 West Spur Northbound	I-495 to I-270	2.09	Montgomery	2.0
7	I-695 Inner Loop	US 40 to MD 26	2.03	Baltimore	5.8
8	I-695 Outer Loop	Nursery Rd to MD 170	2.01	Anne Arundel	1.9
9	US 50 Eastbound	MD 2 (Solomons Island Rd) to MD 2 (Ritchie Hwy)	1.94	Anne Arundel	2.2
10	I-695 Inner Loop	I-95 to US 40	1.94	Baltimore	4.9
11	MD 100 Westbound	MD 170 to Coca Cola Dr	1.89	Anne Arundel	3.5
12	I-270 Northbound	Shady Grove Rd to Middlebrook Rd	1.78	Montgomery	7.4
13	I-495 Inner Loop	US 50 to MD 214	1.78	Prince George's	5.0
14	MD 295 Northbound[1]	Prince George's County Line to MD 175	1.77	Anne Arundel	6.8
15	MD 295 Northbound[1]	I-495 to Anne Arundel County Line	1.75	Prince George's	8.5

[1] Owned and operated by National Park Service

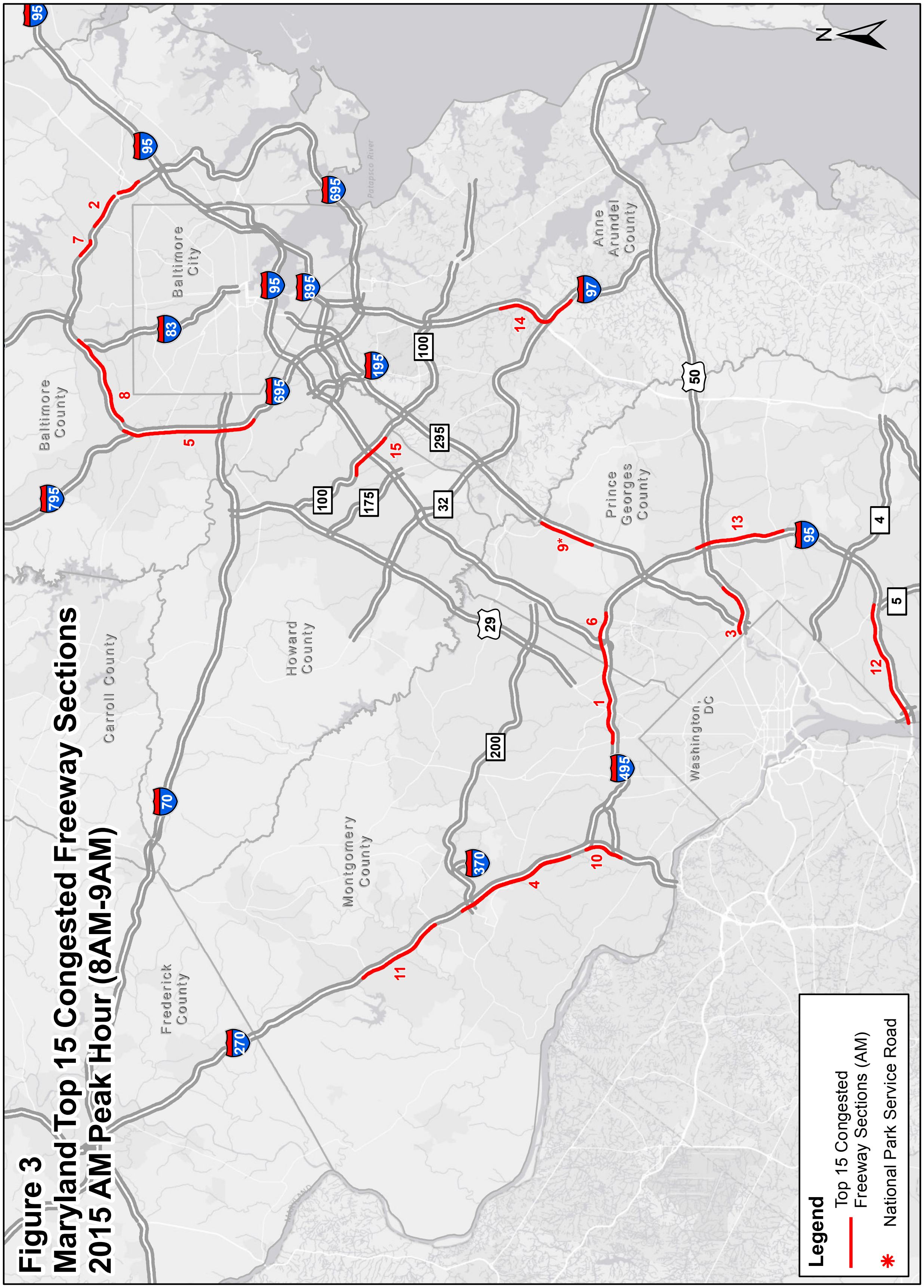


Figure 3
Maryland Top 15 Congested Freeway Sections
2015 AM Peak Hour (8AM-9AM)
Legend
Top 15 Congested Freeway Sections (AM)
* National Park Service Road
Baltimore County
Baltimore City
Anne Arundel County
Carroll County
Howard County
Prince Georges County
Frederick County
Montgomery County
Washington, DC
Patapsco River
N

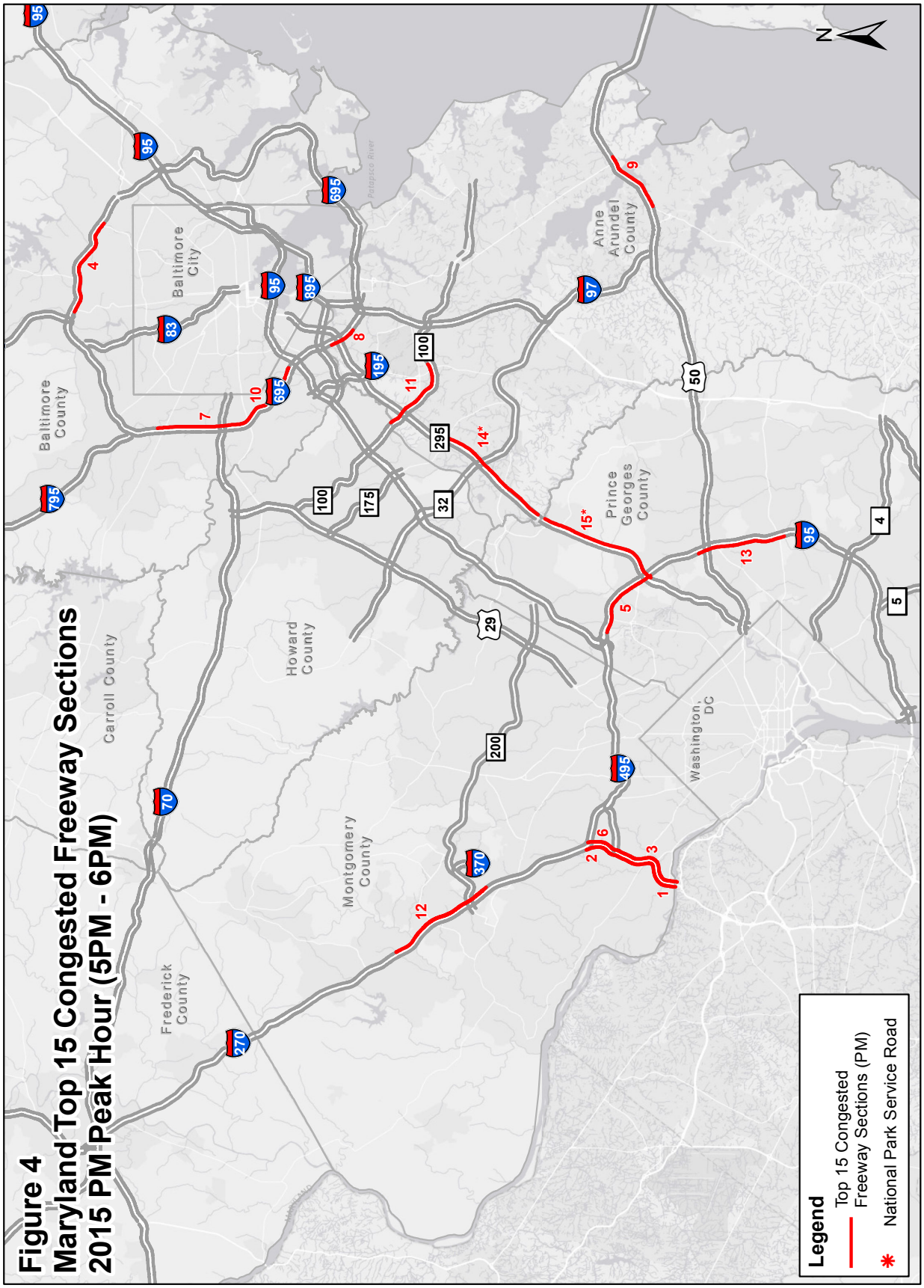


Figure 4
Maryland Top 15 Congested Freeway Sections
2015 PM Peak Hour (5PM - 6PM)
Legend
Top 15 Congested Freeway Sections (PM)
National Park Service Road
N
Baltimore City
Baltimore County
Anne Arundel County
Howard County
Carroll County
Montgomery County
Prince Georges County
Frederick County
Washington, DC
Patapsco River
1
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14*
15*

Reliability Trends

One of the major reasons for motorists' frustration is the unreliability of the roadway network. A motorist can plan accordingly if they know their trip will take a few extra minutes. However, when their travel times vary greatly it results in motorists frustration. Motorists have to add a buffer to reach their destination on time and there is a cost associated with the additional travel time. The cost of any trip varies by purpose and nature and the importance to that particular motorist. For example, to catch a flight, have a freight delivery occur on time, or just to be able to make a child's event may have very high costs to that particular person or business. A more reliable freeway system allows for trips to be better planned and meet expectations of the motorists using the network.

The unreliability or variability of travel time on any road is caused by incidents, vehicular breakdowns, crashes, weather, and lane reductions through work zones. This non-recurring congestion impacts automobiles, trucks and on-street transit services. Reliability is critical for transit operations. Variations in travel time make it difficult for transit operators to provide reliable schedules which in turn leads to a decrease in rider confidence and the potential to reduce ridership on the impacted routes.

MDOT/SHA measures trip reliability using the Planning Time Index (PTI). The PTI represents the total time motorists should allow to ensure they arrive at their destination on-time while taking into account potential impacts due to non-recurring congestion. The percentile utilized for the PTI index varies nationwide. In Maryland, the 95th percentile travel time for a section of roadway is utilized as the baseline. Motorists travelling in free flow conditions that take five (5) minutes to traverse a section of roadway should allow for 15 minutes to ensure arriving on time when the PTI is 3.0. The lower the PTI number, the more reliable the trip. The higher the value, the less reliable and longer a trip might take. For reporting purposes, PTI for freeways/expressways is categorized as:

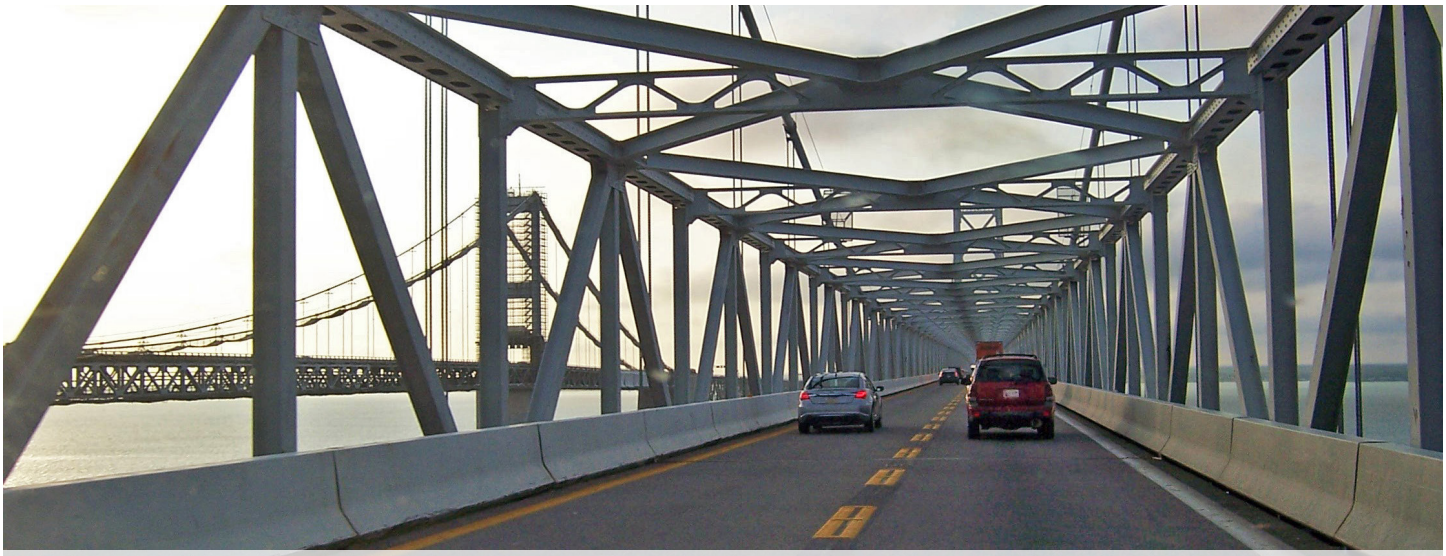
- Reliable (PTI < 1.5)
- Moderately Unreliable (1.5 < PTI < 2.5)
- Highly to Extremely Unreliable (PTI > 2.5)

1. Statewide Freeway/Expressway Peak Hour Reliability

The statewide freeway/expressway network was analyzed for the AM (8-9 AM) and PM (5-6 PM) peak hours to determine the PTI. The results of the analysis are shown in Figures 5 and 6.

The worst operations on the network termed highly to extremely unreliable conditions (PTI > 2.5) occur on a total of 139 road miles (8% of the statewide freeway/expressway network) in the AM peak hour.

In the PM peak hour, 14% of the statewide freeway/expressway network operates under highly to extremely unreliable condition (232 road miles). Almost all the freeway/expressway segments that have a PTI > 2.5 are in the Baltimore - Washington region.



US 50/301 Bay Bridge

2. Percent VMT in Unreliable Conditions

MDOT/SHA defines highly to extremely unreliable conditions as segments having a PTI of greater than 2.5. Statewide, an estimated 17% of the morning peak hour VMT and 26% of the afternoon peak hour VMT occur in highly to extremely unreliable travel conditions.

Reliability trends statewide over the past year have mixed results. A slight decrease occurred in the AM peak hour for number of roadway miles that experienced highly to extremely unreliable conditions, but there was a 1% increase in the VMT that occurred in those surroundings. In the PM peak hour, operations were worse with an additional 21 miles experiencing unreliable conditions amounting to the 3% of the VMT. This is depicted in the following chart.

STATEWIDE FREEWAY/EXPRESSWAY NETWORK
AVERAGE WEEKDAY AM & PM PEAK HOUR RELIABILITY SUMMARY

Highly to Extremely Unreliable Conditions	2013		2014		2015		CHANGE 2014 to 2015	
	AM	PM	AM	PM	AM	PM	AM	PM
Number of Roadway Miles	145	213	141	211	139	232	-2	+21
Percent of Roadway Miles	9	13	9	13	8	14	-1	+1
Percent of Peak Hour VMT Impacted	17	22	16	23	17	26	+1	+3

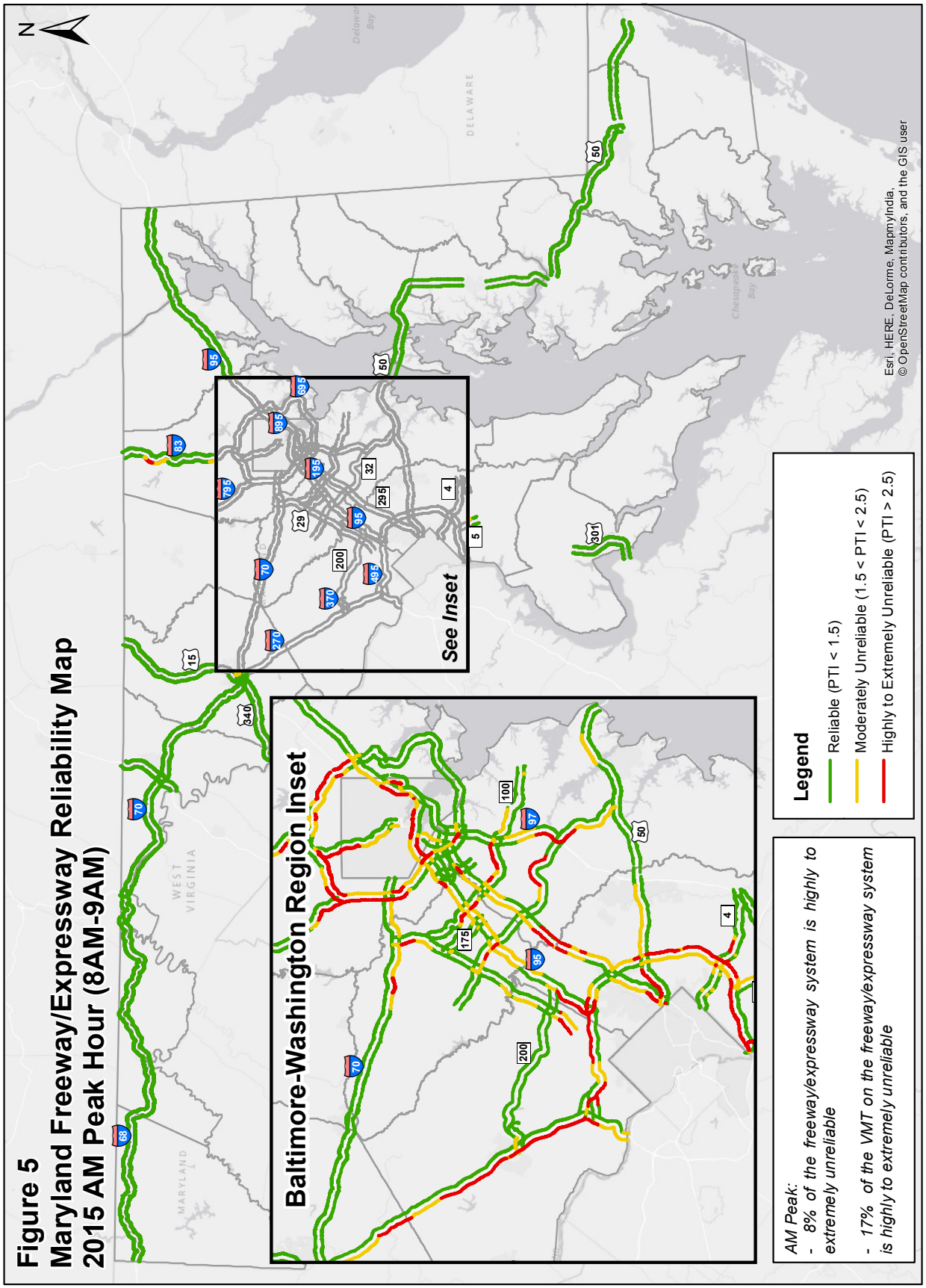


Figure 5
Maryland Freeway/Expressway Reliability Map
2015 AM Peak Hour (8AM-9AM)
N
Baltimore-Washington Region Inset
See Inset
Legend
Reliable (PTI < 1.5)
Moderately Unreliable (1.5 < PTI < 2.5)
Highly to Extremely Unreliable (PTI > 2.5)
AM Peak:
- 8% of the freeway/expressway system is highly to extremely unreliable
- 17% of the VMT on the freeway/expressway system is highly to extremely unreliable
Esri, HERE, DeLorme, MapmyIndia, © OpenStreetMap contributors, and the GIS user
MARYLAND
WEST VIRGINIA
DELAWARE

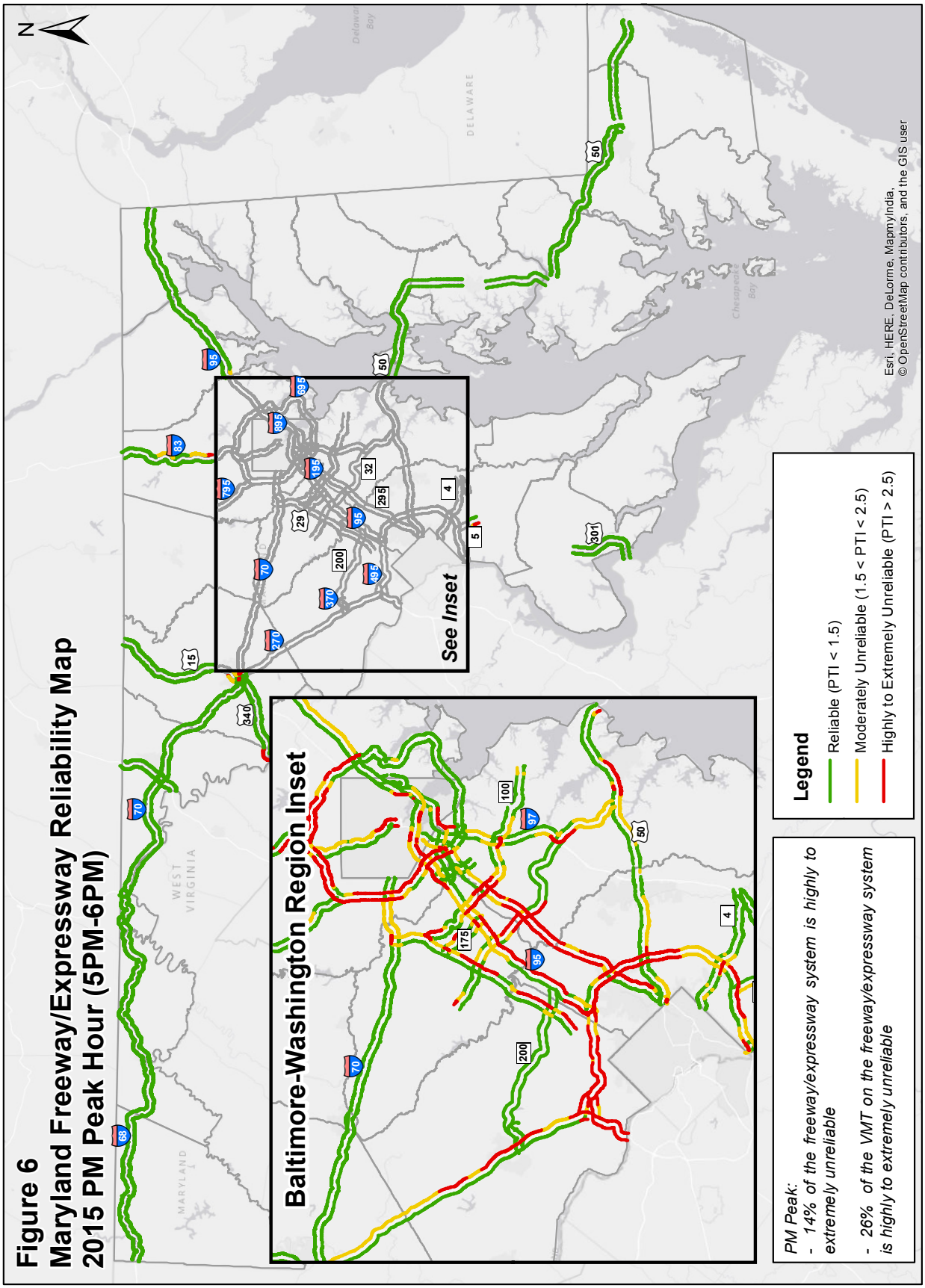


Figure 6
Maryland Freeway/Expressway Reliability Map
2015 PM Peak Hour (5PM-6PM)
N
Baltimore-Washington Region Inset
See Inset
Legend
Reliable (PTI < 1.5)
Moderately Unreliable (1.5 < PTI < 2.5)
Highly to Extremely Unreliable (PTI > 2.5)
PM Peak:
- 14% of the freeway/expressway system is highly to extremely unreliable
- 26% of the VMT on the freeway/expressway system is highly to extremely unreliable
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MARYLAND
WEST VIRGINIA
DELAWARE

Top 15 Unreliable Sections

The Top 15 unreliable sections were developed based on the summation of the PTI for each individual segment multiplied by the mileage of that segment divided by the total mileage. This weighted PTI value was calculated for the highest levels of unreliability in the AM peak hour (8-9 AM) and PM peak hour (5-6 PM). The Top 15 unreliable sections in the peak hours, in the state on average weekdays are depicted in the following tables. Figures 7 and 8 show the locations of these sections for the AM and PM peak hour respectively.

2015 MOST UNRELIABLE FREEWAY/EXPRESSWAY SECTIONS - AM PEAK HOUR

AM Rank	Route	Location	PTI	County	Mileage
1	I-495 Outer Loop	US 1 to MD 97	6.79	Montgomery	6.4
2	I-695 Outer Loop	East of US 1 to Providence Rd	5.58	Baltimore	5.8
3	I-695 Outer Loop	North of I-795 to South of US 40	5.14	Baltimore	7.5
4	I-495 Inner Loop	North of MD 5 to Virginia State Line	4.88	Montgomery	8.2
5	I-270 Southbound	North of I-370 to South of Montrose Rd	4.49	Montgomery	6.4
6	US 50 Westbound	West of MD 202 to MD 201	4.49	Prince George's	3.7
7	I-895 Southbound	Moravia Rd to Holabird Ave	4.35	Baltimore City	3.2
8	I-270 (Local) Southbound	I-370 to South of Montrose Rd	4.09	Montgomery	6.0
9	MD 295 Southbound[1]	MD 410 to MD 201	3.94	Prince George's	3.1
10	I-270 Southbound	North of Father Hurley Blvd to MD 124	3.71	Montgomery	7.0
11	I-695 Inner Loop	South of MD 140 to East of MD 25	3.42	Baltimore	5.3
12	I-270 Spur Southbound	I-270 to I-495	3.28	Montgomery	2.1
13	MD 295 Southbound[1]	MD 198 to Powder Mill Rd	3.17	Prince George's	5.2
14	MD 32 Westbound	East of MD 170 to MD 198	3.07	Anne Arundel	5.9
15	I-495 Outer Loop	MD 214 to US 50	2.96	Prince George's	4.0

[1] Owned and operated by National Park Service

2015 MOST UNRELIABLE FREEWAY/EXPRESSWAY SECTIONS - PM PEAK HOUR					
PM Rank	Route	Location	PTI	County	Mileage
1	I-270 Spur Southbound	I-270 to I-495	10.90	Montgomery	2.1
2	I-695 Inner Loop	MD 139 to MD 41	6.66	Baltimore	5.6
3	I-495 Inner Loop	Virginia State Line/American Legion Bridge to I-270	5.37	Montgomery	3.9
4	I-495 Outer Loop	MD 187 to Virginia State Line/ American Legion Bridge	5.26	Montgomery	5.3
5	MD 100 Westbound	MD 170 to Howard County Line	4.99	Anne Arundel	3.6
6	US 50 Eastbound	I-97 to Severn River Bridge	4.53	Anne Arundel	5.4
7	I-695 Inner Loop	US 1 Alt to MD 26	4.10	Baltimore	9.9
8	I-695 Outer Loop	MD 140 to US 40	3.86	Baltimore	7.0
9	I-695 Outer Loop	Providence Rd to MD 139	3.81	Baltimore	2.7
10	MD 295 Southbound[1]	MD 175 to Prince George's County Line	3.77	Anne Arundel	6.8
11	MD 295 Northbound[1]	Prince George's County Line to MD 175	3.69	Anne Arundel	6.8
12	I-83 Southbound	Padonia Rd to I-695	3.69	Baltimore	3.2
13	I-495 Inner Loop	MD 187 to MD 650	3.67	Montgomery	8.6
14	US 40 Westbound	I-70 to US 15	3.53	Frederick	1.5
15	I-695 Outer Loop	US 1 Alt to MD 170	3.49	Anne Arundel	2.6

[1] Owned and operated by National Park Service

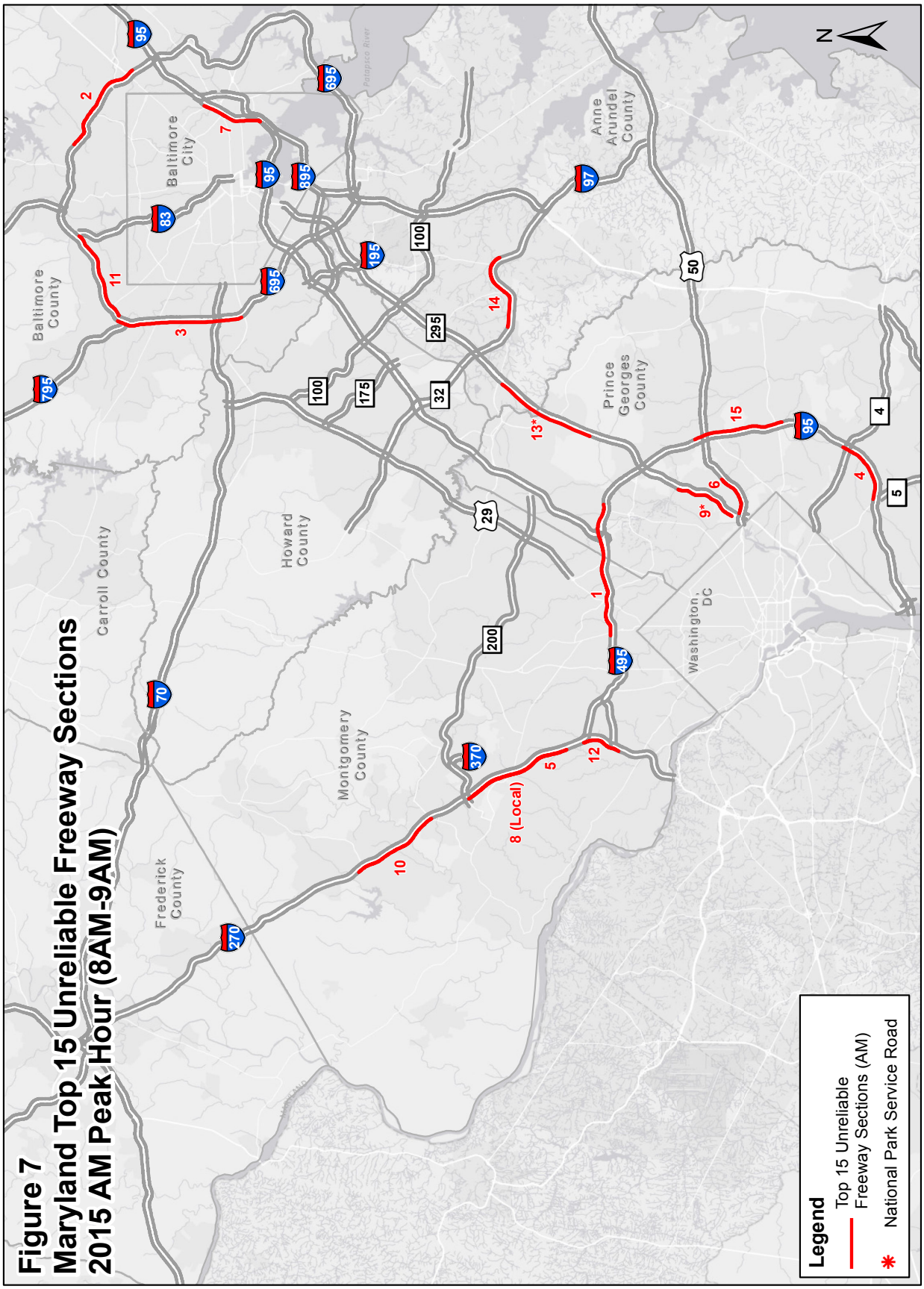
Figure 7
Maryland Top 15 Unreliable Freeway Sections
2015 AM Peak Hour (8AM-9AM)
Legend
Top 15 Unreliable Freeway Sections (AM)
National Park Service Road
N
Baltimore City
Baltimore County
Anne Arundel County
Carroll County
Howard County
Prince Georges County
Montgomery County
Frederick County
Washington, DC
Patapsco River
1
2
3
4
5
6
7
8 (Local)
9*
10
11
12
13*
14
15

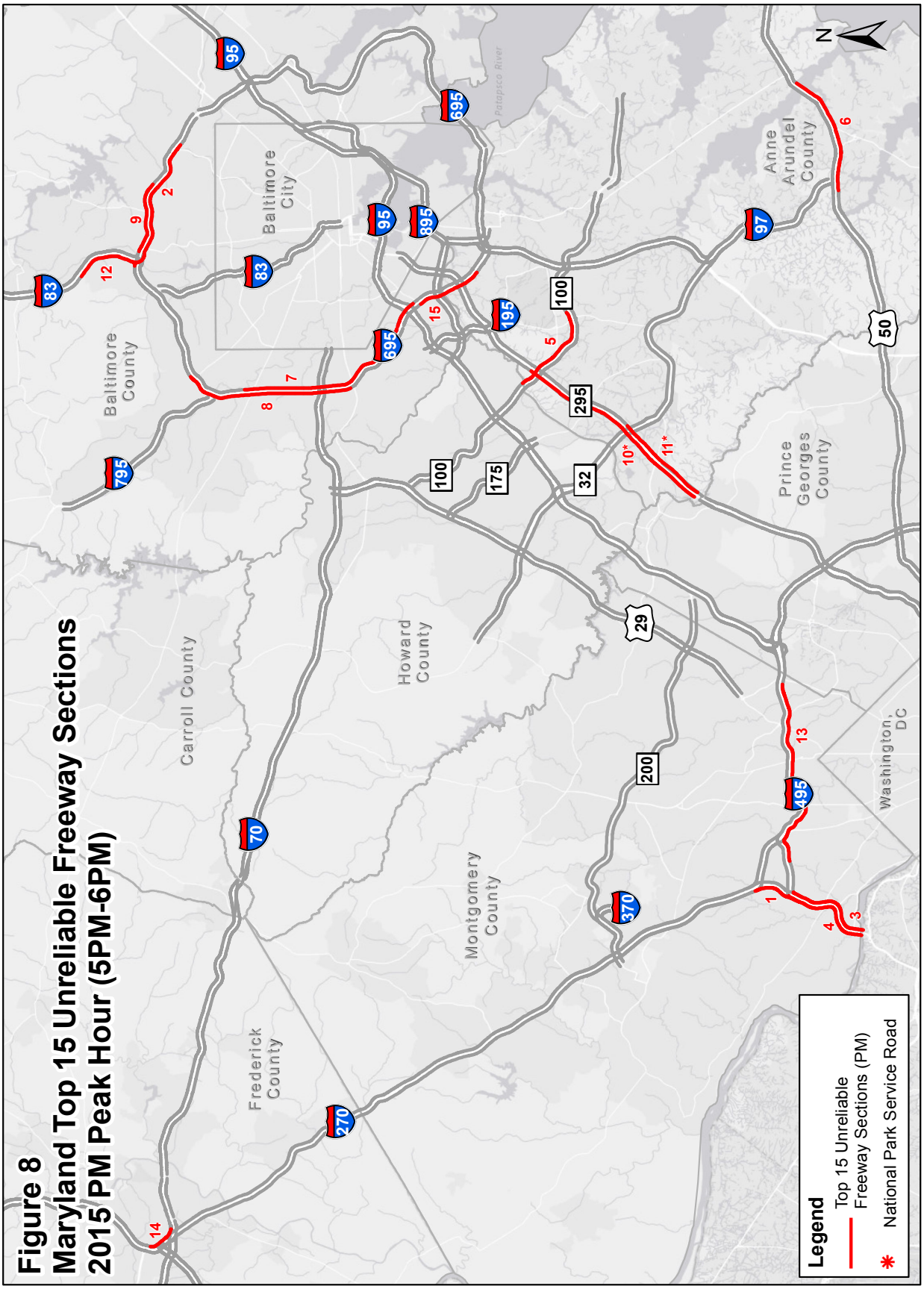
Figure 8
Maryland Top 15 Unreliable Freeway Sections
2015 PM Peak Hour (5PM-6PM)
Legend
Top 15 Unreliable Freeway Sections (PM)
National Park Service Road
N
Baltimore City
Baltimore County
Anne Arundel County
Prince Georges County
Howard County
Carroll County
Frederick County
Montgomery County
Washington, DC
Patapsco River
95
695
83
395
97
795
195
100
295
50
175
32
29
200
70
270
370
495

Congestion and Reliability Correlation Trends

Motorists traveling along roadways that experience high levels of recurring congestion are more likely to be impacted by minor incidents. These incidents can produce severe back-ups and system level unreliable conditions for hours. Therefore, there is a strong correlation between the average congestion (TTI based maps shown in Figures 1 - 2) and the reliability (PTI based maps in Figures 3-4). Roadways with lower TTI have some reserve capacity to absorb the disruption caused by non-recurring congestion and show higher reliability. The following tables represent the Top 30 congested segments (segments are part of a section) and their unreliability values for 2015 and 2014.

TOP 30 CONGESTED SEGMENTS AND ASSOCIATED UNRELIABILITY VALUES AM PEAK

ROAD	LOCATION	DIRECTION	2015 RANK & (TTI)	2014 RANK & (TTI)	2015 RANK & (PTI)	2014 RANK & (PTI)
I-495	MD 650 to MD 193	Outer Loop	1 (4.4)	2 (3.9)	6 (8.5)	6 (7.5)
I-495	@ MD 650	Outer Loop	2 (4.4)	1 (4.0)	1 (9.2)	1 (9.0)
I-495	Prince George's County Line to MD 650	Outer Loop	3 (3.7)	3 (3.6)	2 (9.1)	2 (8.7)
I-495	MD 193 to US 29	Outer Loop	4 (3.6)	4 (3.2)	15 (6.3)	15 (5.8)
I-695	@ MD 147*	Outer Loop	5 (3.5)	5 (3.2)	9 (7.5)	9 (6.9)
I-695	MD 43 to MD 147*	Outer Loop	6 (3.4)	6 (2.8)	7 (8.3)	8 (7.2)
I-695	US 1 to MD 43	Outer Loop	7 (3.0)	13 (2.4)	3 (9.1)	5 (7.7)
I-495	US 29 to MD 97	Outer Loop	8 (2.8)	7 (2.5)	48 (4.4)	47 (4.0)
MD-295	US 50 to Washington DC Line[1]	Southbound	9 (2.8)	12 (2.5)	24 (5.3)	13 (5.8)
US-50	MD 202 to MD 459	Westbound	10 (2.6)	14 (2.4)	37 (4.8)	37 (4.4)
I-695	@ I-70	Outer Loop	11 (2.6)	11 (2.5)	12 (6.5)	12 (6.3)
I-695	MD 147 to MD 41	Outer Loop	12 (2.5)	9 (2.5)	42 (4.7)	4.0 (4.3)
I-270	@ MD 189	Southbound	13 (2.5)	17 (2.2)	36 (4.9)	43 (4.2)
I-270	Shady Grove Rd to MD 28	Southbound	14 (2.4)	10 (2.5)	20 (5.6)	17 (5.6)
I-495	I-95 to Montgomery Co Line	Outer Loop	15 (2.4)	8 (2.5)	4 (9.0)	3 (8.6)
I-270	Shady Grove Rd to MD 28 CD Lanes	Southbound	16 (2.4)	24 (2.1)	25 (5.3)	32 (4.6)
I-495	@ MD 97	Outer Loop	17 (2.4)	16 (2.3)	68 (3.7)	86 (3.3)
MD-295	@ MD 197[1]	Southbound	18 (2.4)	28 (2.0)	64 (3.9)	69 (3.6)
I-270	MD 189 to Montrose Rd	Southbound	19(2.4)	21 (2.1)	50 (4.3)	63 (3.7)
US-50	MD 459 to MD 201	Westbound	20 (2.3)	15 (2.3)	88 (3.4)	85 (3.3)
I-495	MD 414 to MD 210	Inner Loop	21 (2.3)	20 (2.1)	8 (8.1)	11 (6.8)
US-50	@ MD 202	Westbound	22 (2.3)	22 (2.1)	30 (5.1)	24 (4.9)
MD-295	Prince George's County Line to MD 198[1]	Southbound	23 (2.2)	44 (1.8)	59 (4.0)	87 (3.3)
I-695	I-70 to US 40*	Outer Loop	24 (2.2)	18 (2.2)	56 (4.1)	49 (3.9)
I-270	I-370 to Shady Grove Rd	Southbound	25 (2.2)	29 (2.0)	13 (6.5)	22 (5.1)
I-695	@ US 1	Outer Loop	26 (2.2)	50 (1.8)	5 (8.6)	10 (6.8)
I-95	MD 210 to I-295 CD Lanes	Inner Loop	27 (2.2)	19 (2.1)	28 (5.2)	28 (4.6)
I-695	MD 26 to MD 122*	Outer Loop	28 (2.2)	25 (2.1)	26 (5.3)	20 (5.2)
I-895	MD 150 to O'Donnell St[2]	Southbound	29 (2.2)	131 (1.3)	40 (4.8)	79 (3.4)
I-270	@ MD 118	Southbound	30 (2.1)	33 (1.9)	51 (4.3)	45 (4.0)

[1] Owned by the National Park Service [2] Owned and Maintained by the Maryland Transportation Authority *Under or Nearby Construction

TOP 30 CONGESTED SEGMENTS AND ASSOCIATED UNRELIABILITY VALUES PM PEAK

ROAD	LOCATION	DIRECTION	2015 RANK & (TTI)	2014 RANK & (TTI)	2015 RANK & (PTI)	2014 RANK & (PTI)
I-695	MD 45 to MD 146	Inner Loop	1 (4.1)	2 (3.7)	4 (9.1)	8 (7.6)
I-695	@ MD 146	Inner Loop	2 (4.0)	4 (3.4)	6 (8.3)	10 (6.5)
I-695	MD 139 to MD 45	Inner Loop	3 (3.9)	1 (4.0)	3 (10.4)	4 (9.5)
I-495	Cabin John Pkwy to MD 190	Inner Loop	4 (3.7)	3 (3.6)	9 (7.4)	9 (7.1)
I-270 Spur	@ I-495	Southbound	5 (3.6)	50 (2.0)	2 (12.0)	3 (9.6)
I-695	MD 146 to Providence Rd	Inner Loop	6 (3.6)	10 (3.0)	13 (6.7)	23 (5.3)
MD 32	Great Star Dr to MD 108	Westbound	7 (3.4)	6 (3.2)	14 (6.6)	18 (5.8)
I-495	Clara Barton Pkwy to Cabin John Pkwy	Inner Loop	8 (3.2)	7 (3.1)	17 (6.3)	20 (5.6)
I-495	MD 190 to I-270 Spur (West)	Inner Loop	9 (3.1)	8 (3.1)	38 (5.1)	26 (5.3)
I-270	MD 124 to Middlebrook Rd CD Lanes	Northbound	10 (3.0)	9 (3.0)	45 (4.9)	19 (5.7)
I-495	@ Clara Barton Pkwy (.295 Miles)	Inner Loop	11 (3.0)	11 (2.9)	27 (5.5)	25 (5.3)
I-270 Spur	@ Democracy Blvd	Southbound	12 (3.0)	74 (1.8)	1 (15.0)	1 (11.7)
I-495	MD 191 to MD 190	Outer Loop	13 (2.9)	62 (1.9)	19 (6.2)	40 (4.7)
I-495	US 1 to Greenbelt Metro	Inner Loop	14 (2.9)	16 (2.5)	40 (5.0)	48 (4.6)
MD-100	@ MD 295	Westbound	15 (2.8)	17 (2.5)	16 (6.3)	27 (5.3)
I-495	MD 190 to Cabin John Pkwy	Outer Loop	16 (2.8)	53 (2.0)	42 (5.0)	71 (4.0)
I-270	@ MD 124 CD Lanes	Northbound	17 (2.8)	21 (2.4)	39 (5.0)	36 (5.0)
MD-100	@ Coca Cola Dr	Westbound	18 (2.7)	13 (2.6)	63 (4.2)	79 (3.8)
I-695	@ MD 139	Inner Loop	19 (2.6)	5 (3.2)	5 (8.7)	2 (10.0)
I-270	@ Shady Grove Rd CD Lanes	Northbound	20 (2.6)	15 (2.6)	46 (4.8)	51 (4.4)
MD 295	MD 32 to MD 198[1]	Southbound	21 (2.6)	29 (2.2)	33 (5.2)	33 (5.0)
US 29	MD 32 to Broken Land Pkwy*	Northbound	22 (2.6)	18 (2.5)	89 (3.9)	93 (3.8)
MD 295	Powder Mill Rd to MD 197[1]	Northbound	23 (2.5)	19 (2.5)	67 (4.2)	77 (3.9)
MD 32	MD 295 to MD 198/Fort Meade Rd	Eastbound	24 (2.5)	N/A	61 (4.2)	N/A
I-495	MD 355 to MD 185	Inner Loop	25 (2.5)	38 (2.1)	32 (5.2)	16 (6.0)
I-495	@ MD 185	Inner Loop	26 (2.5)	35 (2.2)	36 (5.1)	15 (6.0)
I-70	@ US 29	Westbound	27 (2.4)	43 (2.1)	31 (5.2)	44 (4.6)
I-695	@ MD 122	Inner Loop	28 (2.4)	20 (2.4)	51 (4.5)	45 (4.6)
MD-295	@ MD 32[1]	Northbound	29 (2.4)	12 (2.7)	52 (4.5)	41 (4.7)
I-695	@ Hammonds Ferry Rd/Nursery Rd	Outer Loop	30 (2.4)	24 (2.3)	94 (3.9)	105 (3.6)

[1] Owned by the National Park Service *Under or Nearby Construction

There is also a close correlation between the statewide ranking of the TTI value and the PTI value. There are exceptions to this which mostly occur in segments that border on the worst congested segments. The top 5 locations for PTI values that are not part of the Top 30 congested segments:

HIGHEST PTI LOCATIONS WITH LOWER TTI VALUES

2015 AM Peak Hour

Location	PTI Value	Statewide Rank
I-695 @ I-795 Outer Loop	7.29	10
I-695 - MD 140 to I-795 Outer Loop	6.57	11
I-495 @ MD 414 Inner Loop	6.14	16
MD 295 - MD 202 to US 50 Southbound	6.07	17
US 50 - MD 410 to MD 202 Westbound	5.93	18

2015 PM Peak Hour

Location	PTI Value	Statewide Rank
MD 100 - MD 713 to MD 295 Westbound	8.30	7
MD 100 - MD 170 to MD 713 Westbound	7.97	8
I-495 - MD 187 to MD 355 Inner Loop	6.93	11
I-495 @ MD 355 Inner Loop	6.77	12
I-695 @ I-95 Inner Loop	6.40	15

C. Truck Trends

I-95 @ NB Welcome Center

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I-95 @ SB Welcome Center

Truck Trends

Maryland's economy depends on a system of multi-modal freight and goods movement ranging from transporting raw materials to connecting warehouse distribution centers to ultimately delivering finished goods to homes/businesses. Freight dependent industries account for more than one million jobs in Maryland. It is estimated that freight originating and terminating in Maryland amounts to 400 million tons and was valued at $460 billion annually.

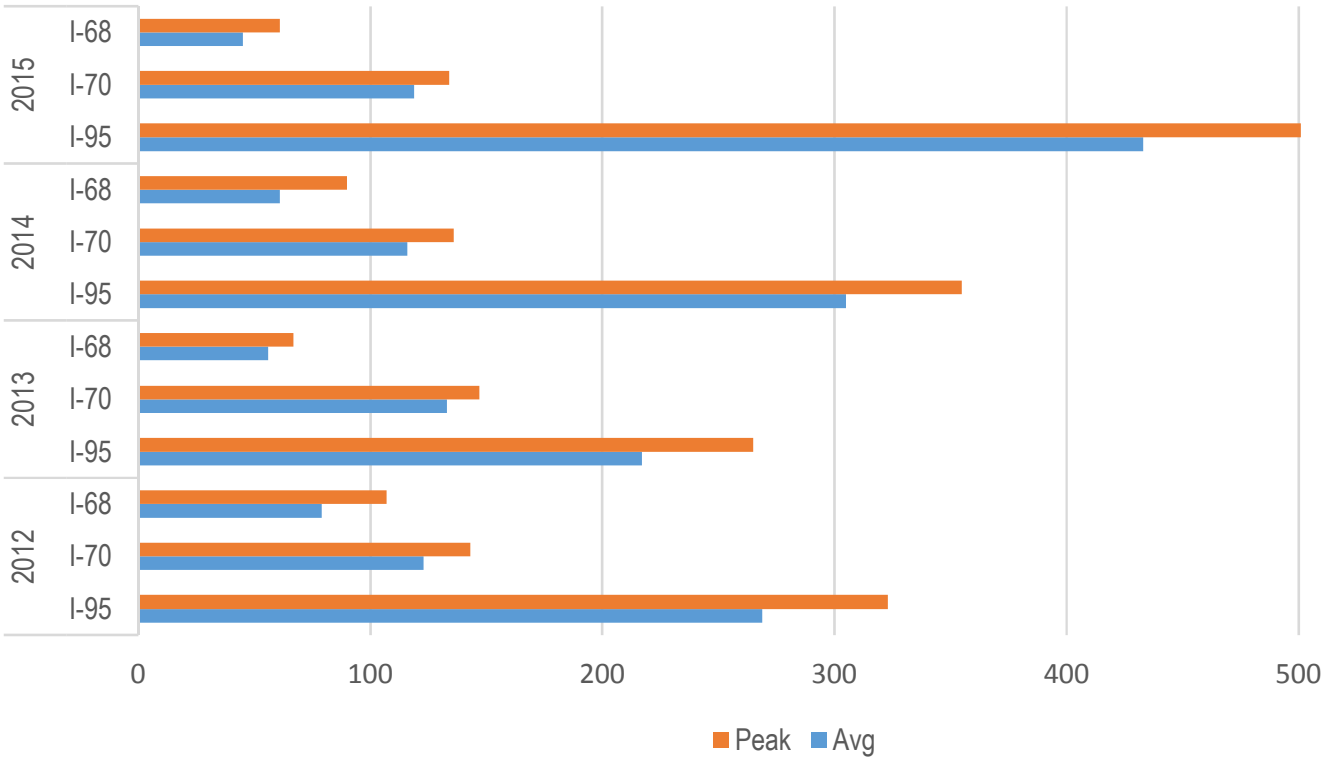
Maryland has an excellent system of highways, port infrastructure, rails, and airport access to support the movement of freight. The majority of freight is moved by trucks, the major choice for short distance freight movement, carrying items such as food products, machinery, and consumer products. Approximately 74% of the freight tonnage in Maryland moves on highways. In order to support the economic vitality, SHA processed more than 136,000 oversize/overweight truckload permits last year for the movement of goods in or around Maryland. Maryland's position as a "through" state with I-95 and I-81 as primary routes continues to require freight congestion to be minimized. Truck volumes along many sections of interstate roadways in Maryland top 20,000 vehicles per day as depicted in the following chart:

HIGHEST TRUCK VOLUME AND PERCENTAGE LOCATIONS				
	Location	Average Daily Truck Volume	Location	Truck %
1	I-95 South of US 50	28,000	I-81 South of PA Line	32%
2	I-95 South of MD 175	26,800	US 301 South of Kent Co. Line	32%
3	I-95 South of MD 543	26,700	I-81 South of US 11	32%
4	I-495 East of MD 650	24,200	I-70 South of PA Line	31%
5	I-270 South of Montrose Road	22,600	I-68 West of US 219	30%

One of the primary challenges facing all drivers is unpredictable congestion. The impact on freight movement is even greater due to the nature of the product.The trend toward leaner supply chains and changes in on-line retail require efficient roadway networks, warehouses, and intermodal facilities to ensure timely and cost-effective delivery. Planners and policymakers are paying special attention to freight demand, increases in warehouse and distribution facilities in high volume corridors and growth in intermodal traffic which is further expected to increase with the completion of the Panama Canal expansion project. Numerous warehouse developments have occurred along the I-95 corridor including distribution giant Amazon opening a one million square foot distribution center in southeast Baltimore in 2015.

A yearly program established by MDOT monitors overnight truck parking. Truck parking at rest areas provide for safe locations to reduce the potential for crashes between parked trucks and moving vehicles. Parking along shoulders of highways and at entrance/ exit ramps creates a hazard. A survey was performed twice a night for three nights on the major routes in the Maryland Truck Route System to identify locations where overnight truck parking is occurring. The results identified more than 800 trucks parked along the system not including private lots during the peak day. This represents an increase of approximately 17% from 2014. The highest number of trucks were parked along I-95 with an average of 400 trucks parked at night. The I-95 northbound and southbound Welcome Center in Howard County and the Maryland House Travel Plaza northbound in Harford County with more than 50 trucks parked overnight were the highest recorded locations for overnight truck parking. Truck parking along the highest three interstate routes is shown below.

TOP 3 ROUTES FOR OVERNIGHT TRUCK PARKING



The Federal Highway Administration (FHWA) Office of Freight Management and Operations monitors interstate highways as part of the Freight Performance Measures (FPM) Initiative. A major monitoring effort is the identification of bottlenecks on the nations interstate system. The American Transportation Research Institute (ATRI) developed the 2015 Congestion Impact Analysis of Freight Significant Highway Locations. This report identifies a "total freight congestion value" in a four step process which includes determining free flow speed, the average truck speed deviation from free flow, an hourly freight congestion based on speed and on volume, and the cumulative 24 hour freight congestion values. Four of the top 100 locations at the junction of two interstates were in Maryland including:

- I-95 @ I-495
- I-95 @ I-695 (South)
- I-95 @ I-395
- I-495 @ I-270

Congestion costs were developed by ATRI for trucking on the interstate system based on the total cost and cost per mile of the number of miles in each state that are part of National Highway System(NHS). Maryland was rated 4th highest among all states in congestion costs per NHS segment mile and 11th in overall total congestion cost. The Washington DC metropolitan area experienced the 4th highest congestion costs for highway freight movement.

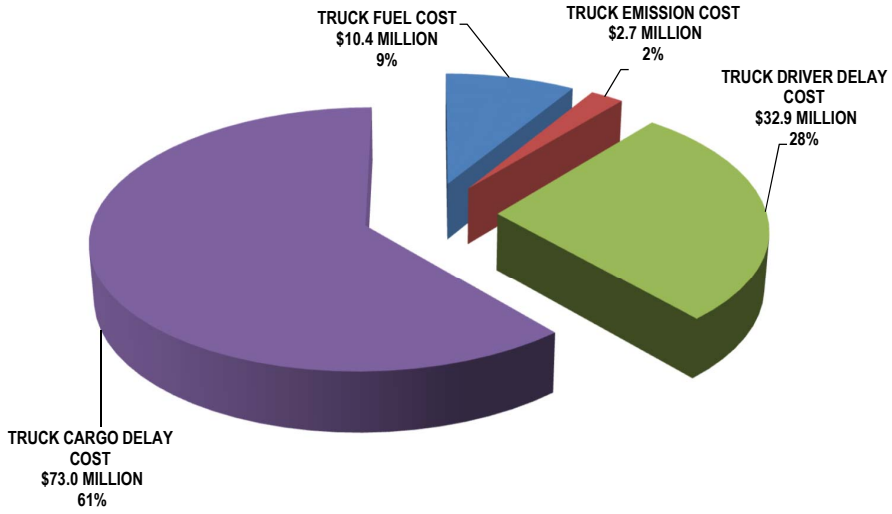
The impact of congestion on trucks increases the cost of the products we buy due to increased fuel consumption and more time spent on the roadways. Among the locations where truckers experience the greatest amount of delay not at the junction of two interstate highways include:

- I-95 Inner Loop @ MD 214
- I-95 Northbound @ MD 100
- I-95 Outer Loop @ US 1/Greenbelt Metro
- I-695 Outer Loop @ Edmondson Ave

The cost of congestion on the freeway/expressway network experienced by truckers includes driver delay costs, cargo delay costs, diesel costs, and increased emissions, amounting to an estimated $119 million in 2015.

The following graph illustrate the cost breakdowns.

2015 FREIGHT CONGESTION COSTS ON MARYLAND'S FREEWAYS/EXPRESSWAYS ($119 MILLION)



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D. Regionally Significant Corridors

I-95 @ I-495

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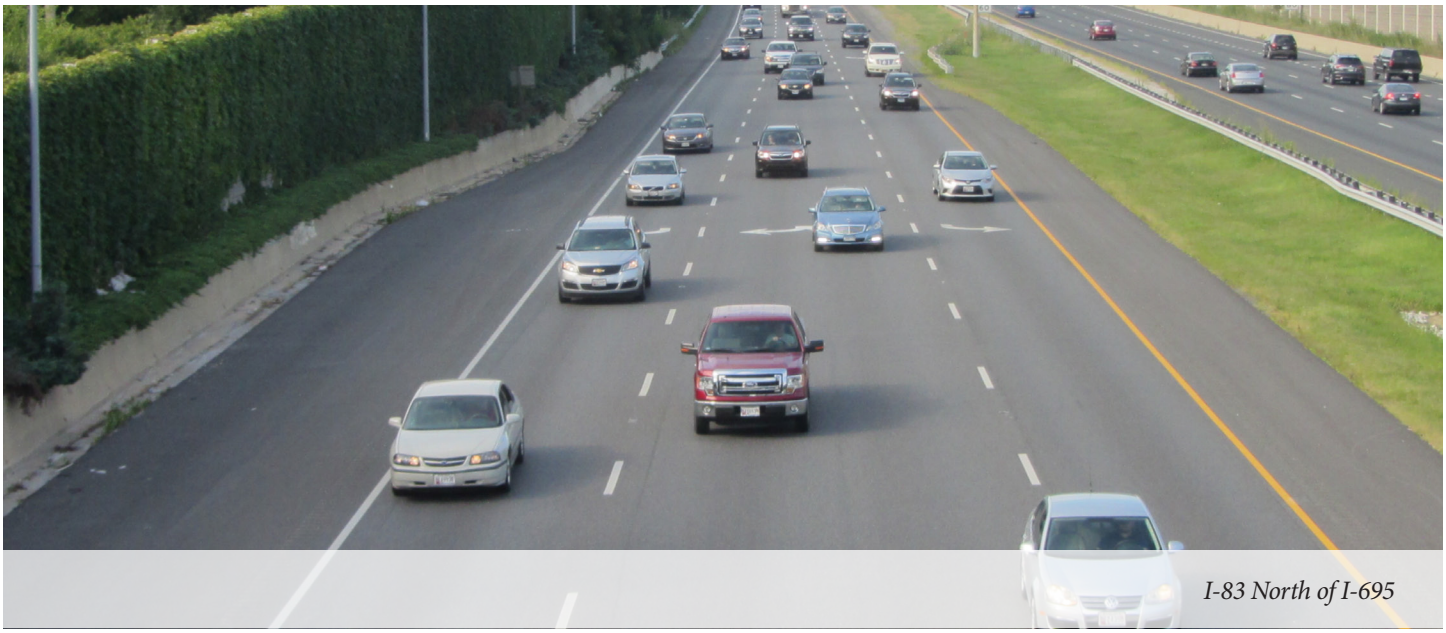


I-83 North of I-695

Controlled Access Facilities

Controlled access facilities are the highest functional classification of roadways in the state. In most instances, they are high speed facilities that provide the maximum capacity/mobility. These facilities include freeways and expressways. Analysis was performed on these roadways to evaluate various attributes such as mobility and reliability including the travel time index, planning time index, daily variability, speed, and the location of the top bottlenecks. The facilities evaluated include:

- I-70 (Pennsylvania Border to US 40 (Frederick))
- I-70 (US 40 in Frederick to I-695)
- I-81
- I-83
- I-95 (Capital Beltway to I-695 North)
- I-95 (I-695 North to Delaware State Line)
- I-97
- I-270
- I-495 Capital Beltway
- I-695 Baltimore Beltway
- I-795
- I-895
- US-50 (D.C Line to William Preston Lane Bridge (Bay Bridge))
- MD 32
- MD 100
- MD 295

A summary of the attributes of each corridor is shown on the following page.

Appendix A contains more in-depth information about the mobility performance of these corridors.

2015 CONTROLLED ACCESS FACILITY OPERATION SUMMARY

FREEWAY/EXPRESSWAY	NO. OF MILES	AVG TTI		AVG PTI		AVERAGE DAILY TRAFFIC	NO. OF LANES
		AM	PM	AM	PM		
I-70 - Pa. State Line to US 40 (Frederick)	48	1.00	1.00	1.00	1.02	49,000	4
I-70 - US 40 to I-695 (Frederick)	43	1.01	1.00	1.05	1.06	65,000	6
I-81	12	1.00	1.00	1.01	1.06	64,000	4
I-83	26	1.03	1.07	1.15	1.22	87,000	4-6
I-95 -I-495 to I-695	40	1.12	1.15	1.30	1.33	157,000	8
I-95 - I-695 to Del. State Line	45	1.00	1.00	1.01	1.06	102,000	6-12
I-97	17	1.07	1.10	1.23	1.37	110,000	4-6
I-270	41	1.22	1.19	1.42	1.35	168,000	4-12
I-495	42	1.25	1.46	1.47	1.88	199,000	6-8
I-695	35	1.26	1.39	1.54	1.78	156,000	6-8
I-795	8	1.03	1.03	1.17	1.16	81,000	4-6
I-895	15	1.06	1.05	1.17	1.18	58,000	4
US 50 - Washington DC Line to Chesapeake Bay Bridge	33	1.03	1.06	1.10	1.20	100,000	4-10
MD 32 - MD 108 to I-97	22	1.04	1.10	1.15	1.26	67,000	4
MD 100 - US 29 to MD 177	22	1.05	1.17	1.14	1.37	71,000	4-8
MD 295 - MD 201 to Waterview Ave	29	1.14	1.35	1.28	1.73	106,000	4-6

Arterial Facilities

Arterial roadways are a vital element of the transportation network. They provide the connections between the freeway/expressway system and the collector roadways that tie into the local roadway network. These roadways normally have traffic signals and carry the next highest volumes of traffic in comparison to freeways/ expressways.

Thirty-three (33) major arterial corridors were identified for evaluation based on traffic volumes, regional significance and availability of data. Traffic analysis was performed to identify the most congested intersections and the accompanying levels of service, TTI, and PTI on a segment basis. Various roadway characteristics such as the number of lanes, speed limits, signalized intersections, and traffic/transit ridership data were analyzed. The following corridors were analyzed:

- US 1 - MD 410 to MD 198
- US 1 - Baltimore City Line to Honeygo Blvd
- US 29 - MD 97 to MD 650
- US 29 - Industrial Parkway to MD 198
- US 40 - I-70 to Cleveland Ave
- US 301 - Billingsley Rd to MD 5
- MD 2 - 5th Ave to I-695
- MD 3 - US 50/301 to I-97
- MD 4 - Washington DC Line to Anne Arundel County Line
- MD 5 - I-95 to Washington D.C. Line
- MD 5 - US 301 to MD 223
- MD 24 - US 1 to US 40
- MD 26 - MD 32 to Baltimore City Line
- MD 28 - MD 124 to MD 97
- MD 32 - MD 108 to MD 26
- MD 43 - I-695 to US 40
- MD 45 - Baltimore City Line to Shawan Rd
- MD 97 - Washington DC Line to MD 108
- MD 124 - MD 28 to MD 108
- MD 140 - MD 97 to Baltimore City Line
- MD 175 - MD 32 to US 29
- MD 185 - Washington DC Line to MD 97
- MD 197 - US 301 to MD 450
- MD 198 - MD 197 to Russett Green
- MD 201 - MD 450 to MD 212
- MD 210 - MD 228 to I-95
- MD 214 - I-95 to Washington DC Line
- MD 228 - MD 210 to US 301
- MD 355 - Washington DC Line to MD 27
- MD 410 - MD 650 to Pennsy Drive
- MD 450 - MD 355 to US 29
- MD 450 - MD 202 to MD 704
- MD 450 - Housley Rd to MD 2

A summary of the operational characteristics of each of these 33 corridors is shown on the following page.

Appendix B contains additional information related to various characteristics and performance measures of the above major arterials.

2015 ARTERIAL FACILITY OPERATIONS SUMMARY

ARTERIAL	NO. OF MILES	AVERAGE DAILY TRAFFIC (THOUSANDS)	INTERSECTIONS LOS E		INTERSECTIONS LOS F		AVG. TTI SEGMENT MILEAGE LOS E		AVG. TTI SEGMENT MILEAGE LOS F	
			AM	PM	AM	PM	AM EB/WB NB/SB	PM EB/WB NB/SB	AM EB/WB NB/SB	PM EB/WB NB/SB
MD 2 - 5th Ave to I-695	3.7	24-41	0	0	0	0	1.7/0.5	2.4/2.3	0.0/0.0	0.8/0.5
MD 3 - US 50/301 to -97	8.8	65-82	1	1	1	2	0.8/4.0	1.3/4.9	1.7/2.2	5.7/2.3
MD 4 – DC Line to Anne Arundel County Line	14.1	54-72	2	2	2	2	0.6/0.8	0.6/2.7	1.8/0.9	0.4/0.9
MD 5 - I-95 to DC Line	3.1	28-69	1	1	0	0	1.5/0.0	2.5/1.5	1.6/0.0	0.0/0.0
MD 5 - US 301 to MD 223	5.4	58-83	0	1	2	0	0.0/0.0	0.6/1.6	4.1/0.0	0.0/3.8
MD 24 - US 40 to US 1	7.9	22-67	0	1	0	1	2.9/0.9	2.3/1.9	0.0/0.0	4.4/3.9
MD 26 - MD 32 to Balt. City Line	14.1	9-49	1	0	0	0	2.3/1.7	1.9/1.8	0.9/0.5	4.3/3.3
MD 28 - MD 124 to MD 97	11.4	25-49	2	2	1	0	2.1/4.7	6.2/3.8	5.0/1.6	2.3/3.3
MD 32 - MD 108 to MD 26	16.3	20-28	0	0	0	0	0.0/3.2	9.3/0.0	0.0/5.4	3.4/0.0
MD 43 - I-695 to US 40	6.0	27-54	1	1	0	0	0.7/2.2	2.7/1.9	0.0/1.0	1.1/1.9
MD 45 - Balt. City Line to Shawan Rd.	9.3	20-40	0	3	1	1	1.5/1.6	2.8/2.1	0.4/0.4	5.4/5.7
MD 97 - DC Line to MD 108	12.7	28-62	5	2	3	1	3.4/5.0	3.7/10.2	0.5/4.5	7.2/2.0
MD 124 - MD 28 to MD 108	16.7	11-73	1	1	0	1	2.5/2.5	1.3/1.5	0.5/1.3	1.6/0.7
MD 140 - MD 97 to Balt. City Line	20.4	18-54	1	2	1	0	3.7/3.9	5.7/2.2	1.2/0.0	3.8/4.4
MD 175 - MD 32 to US 29	12.2	18-75	1	3	0	2	3.0/3.7	8.7/3.0	0.0/0.0	1.8/6.8
MD 185 - DC Line to MD 97	8.3	34-66	0	1	2	4	0.8/4.1	3.5/2.3	0.0/3.3	3.9/1.9
MD 197 - US 301 to MD 450	3.2	19-34	0	1	0	0	0.2/0.2	0.2/0.0	1.7/0.0	1.7/1.9

2015 ARTERIAL FACILITY OPERATIONS SUMMARY

ARTERIAL	NO. OF MILES	AVERAGE DAILY TRAFFIC (THOUSANDS)	INTERSECTIONS LOS E		INTERSECTIONS LOS F		AVG. TTI SEGMENT MILEAGE LOS E		AVG. TTI SEGMENT MILEAGE LOS F	
			AM	PM	AM	PM	AM EB/WB NB/SB	PM EB/WB NB/SB	AM EB/WB NB/SB	PM EB/WB NB/SB
MD 198 - MD 197 to Russett Green	2.2	35-40	0	2	0	0	0.0/0.0	1.0/1.0	0.0/0.0	0.0/1.2
MD 201 - MD 450 to MD 212	7.4	25-49	0	0	0	0	1.5/1.9	4.5/2.9	0.0/0.6	1.5/2.4
MD 210 - MD 228 to I-95	10.3	28-74	2	3	4	4	0.0/2.9	1.9/0.0	3.7/0.0	2.6/3.5
MD 214 -DC Line to I-95	10.9	22-53	0	1	0	0	0.0/1.8	3.8/1.7	0.0/0.0	0.0/0.0
MD 228 - MD 210 to US 301	6.8	35-40	1	0	0	1	0.0/0.0	3.0/3.0	0.0/0.0	1.5/0.0
MD 355 -DC Line to MD 27	19.7	30-63	2	4	3	2	6.4/4.7	9.5/5.6	3.3/4.0	7.2/10.0
MD 410 - MD 355 to US 29	3.8	20-27	0	1	1	0	0.0/1.7	2.1/1.1	0.0/2.1	0.5/0.0
MD 410 - MD 650 to Pennsy Dr.	7.7	22-49	0	2	0	2	2.1/3.9	3.3/7.3	1.0/2.1	4.1/0.0
MD 450 - MD 202 to MD 704	6.3	26-65	1	0	0	1	0.0/0.0	1.1/1.7	0.0/0.0	0.6/0.0
MD 450 - Housley Rd to MD 2	1.2	32-47	0	0	0	0	0.6/0.3	0.6/0.4	0.0/0.0	0.2/0.6
US 1 - MD 410 to MD 198	10.7	19-45	0	1	0	1	1.0/3.8	3.6/5.9	0.6/0.0	5.3/4.8
US 1 – Balt. City Line to Honeygo Blvd	5.6	28-48	0	0	0	0	0.4/3.2	4.0/3.0	0.0/0.0	1.6/0.0
US 29 - MD 97 to MD 450	3.8	34-68	4	3	0	0	0.0/1.5	2.0/2.8	1.0/2.0	1.3/1.0
US 29 - Industrial Pkwy to MD 198	4.4	60-67	0	1	2	1	1.4/0.6	4.2/3.2	0.0/1.4	0.2/0.0
US 40 - I-70 to Cleveland Ave.	3.4	27-39	0	0	0	0	0.0/0.7	2.1/2.1	0.0/0.0	0.0/1.3
US 301 - Billingsley Rd to MD 5	7.8	38-88	1	2	0	4	0.0/6.6	2.5/0.0	1.9/0.0	1.7/1.9

An evaluation was performed of the arterial roadway system, based on the Highway Capacity Manual. The ranking system took into account the level of service and the directional volumes per lane but does not include the impact of signalized intersections. The Top 15 worst performing arterial segments are shown in Figures 9 and 10 and the following tables:

2015 TOP 15 AM PEAK HOUR CONGESTED ARTERIAL SECTIONS

AM PEAK HOUR

Statewide Rank	Route	Description	Direction	Miles	No. of Lanes	2015 ADT
1	MD 85	I-270 to Crestwood Blvd	Southbound	0.43	2	49,000
2	MD 117	MD 124 to I-270	Eastbound	0.49	1-3	47,000
3	MD 108	Harpers Farm Rd to US 29	Eastbound	3.40	1-2	18,000 - 36,000
4	MD 28	MD 97 to E. Gude Dr	Westbound	3.22	2	46,000
5	MD 117	MD 118 to MD 124	Eastbound	3.69	1	23,000
6	MD 70	US 50 to College Ave	Southbound	1.61	2	39,000
7	US 1	I-95 to MD 193	Southbound	1.19	2	49,000
8	US 29	I-495 to Dale Dr	Southbound	0.87	3	60,000
9	MD 355	E. Gude Dr to MD 28	Southbound	1.90	3	43,000
10	MD 26	I-695 to Essex Rd	Eastbound	0.62	2	49,000
11	MD 146	I-695 to MD 45	Southbound	0.78	2	38,000
12	MD 108	US 29 to Harpers Farm Rd	Westbound	3.40	1-2	18,000 - 36,000
13	MD 140	I-695 to McDonough Rd	Northbound	1.22	2	54,000
14	MD 185	MD 410 to MD 191	Southbound	0.78	3	47,000
15	US 1	MD 430 to Campus Dr	Southbound	0.71	2	36,000

2015 TOP 15 PM PEAK HOUR CONGESTED ARTERIAL SECTIONS

PM PEAK HOUR

Statewide Rank	Route	Description	Direction	Miles	No. of Lanes	2015 ADT
1	MD 24	I-95 to South of Singer Rd	Northbound	0.57	2	42,000
2	MD 5	Surratts Rd to MD 373	Southbound	3.49	2	69,000
3	MD 117	MD 124 to I-270	Eastbound	0.49	1-3	47,000
4	MD 85	I-270 to Crestwood Blvd	Southbound	0.43	2	49,000
5	MD 108	US 29 to Harpers Farm Rd	Westbound	3.40	1-2	18,000 - 36,000
6	MD 210	MD 373 to MD 228	Southbound	0.49	2	49,000
7	MD 201	I-95 to Sunnyside Ave	Southbound	1.63	1	27,000
8	MD 103	MD 104 to Old Columbia Pike	Northbound	1.82	1	30,000
9	MD 564	MD 450 to Cipriano Rd	Eastbound	0.31	1	26,000
10	MD 166	South Entrance to UMBC to MD 372	Northbound	0.59	1	21,000
11	MD 32	MD 851 to MD 26	Northbound	2.24	1	26,000
12	MD 198	I-95 to Van Dusen Rd	Eastbound	1.03	2	52,000
13	MD 177	MD 100 to Bodkin Rd	Eastbound	1.61	1	27,000
14	MD 197	MD 295 to Powder Mill Rd	Southbound	1.74	1	23,000
15	MD 32	I-70 to MD 851	Northbound	3.80	1	25,000

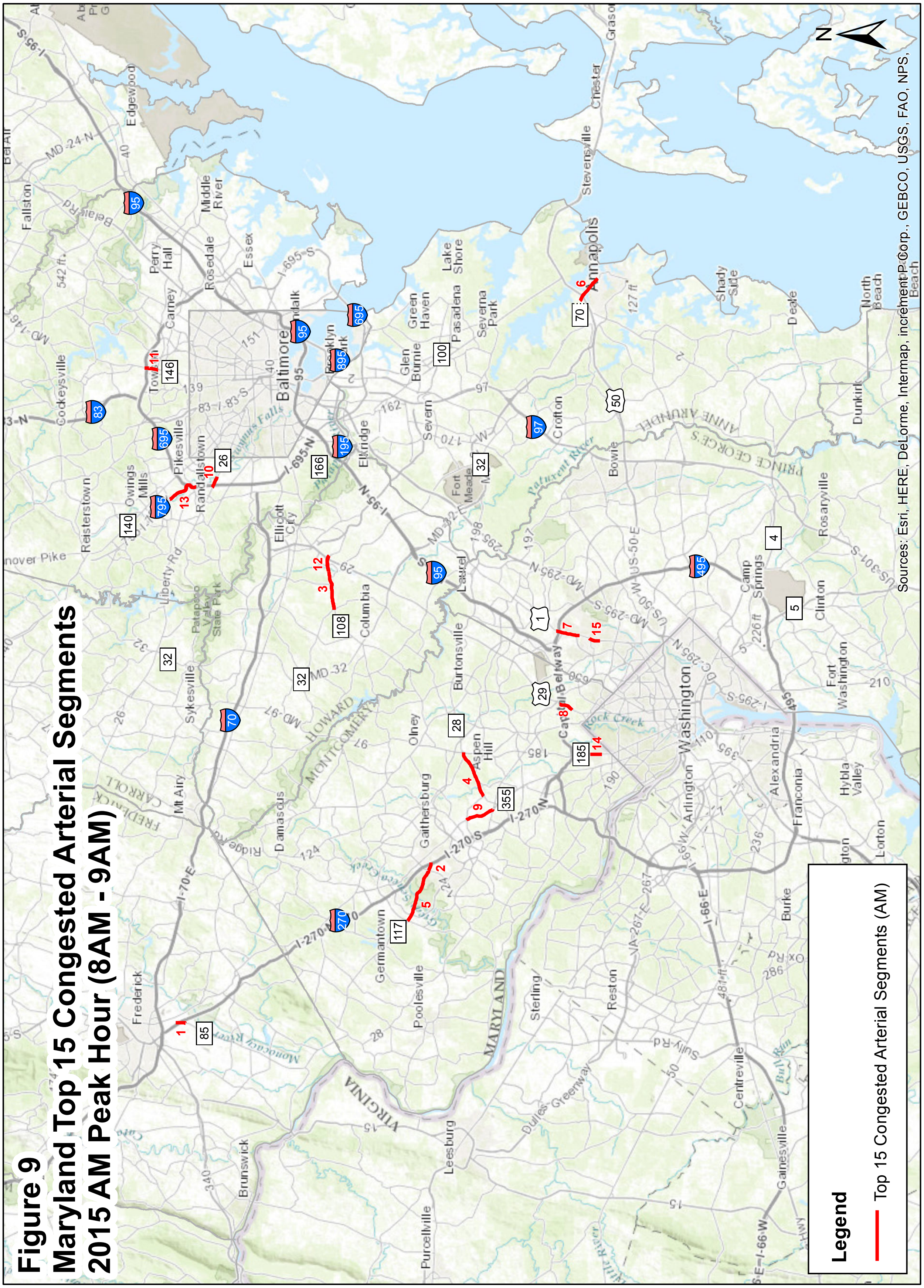


Figure 9
Maryland Top 15 Congested Arterial Segments
2015 AM Peak Hour (8AM - 9AM)
Legend
Top 15 Congested Arterial Segments (AM)
Sources: Esri, HERE, DeLorme, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS,
Baltimore
Washington
Annapolis
Frederick
Columbia
Gaithersburg
Germantown
Laurel
Bowie
Alexandria
Arlington
Leesburg
N

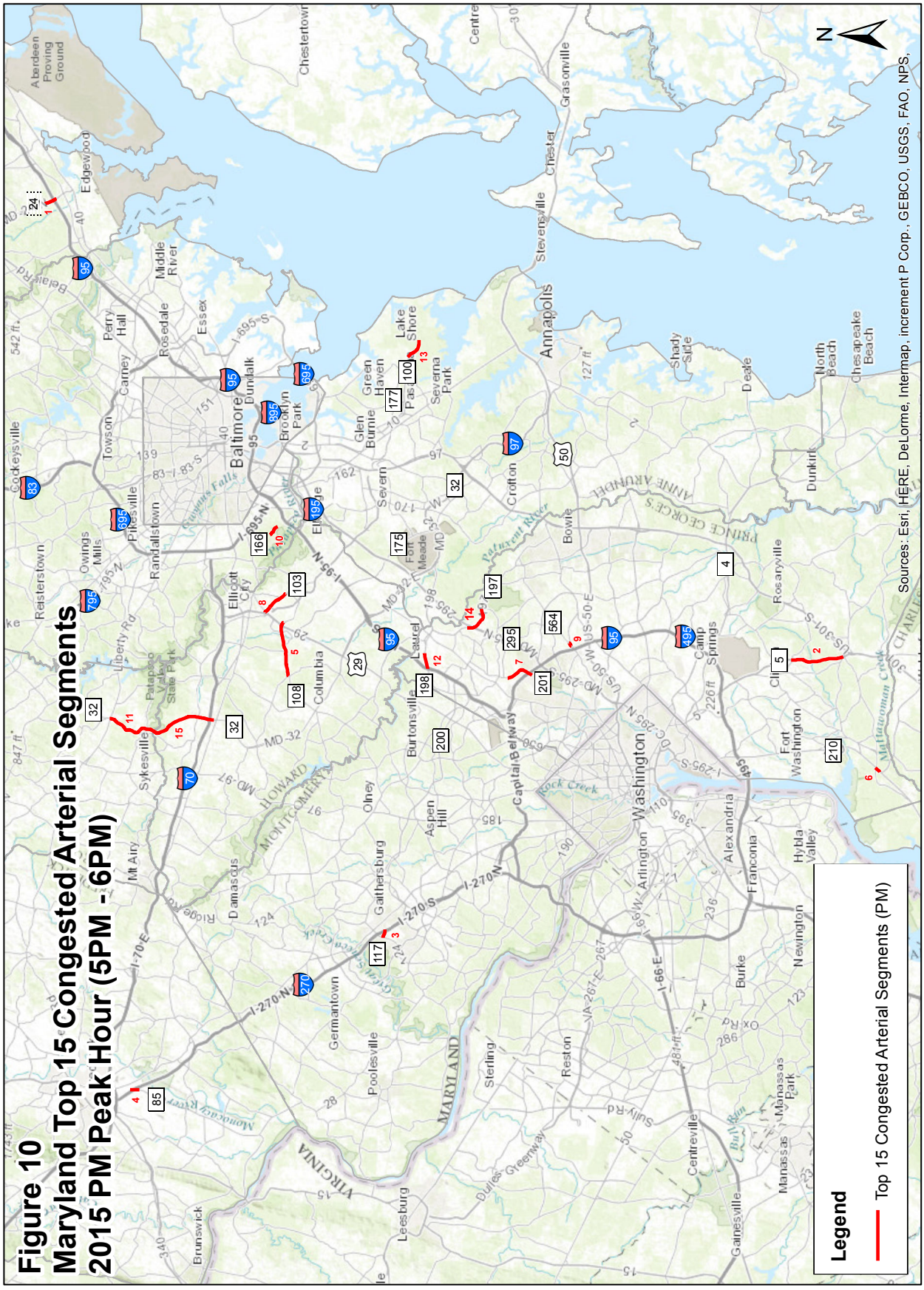


Figure 10
Maryland Top 15 Congested Arterial Segments
2015 PM Peak Hour (5PM - 6PM)
Legend
Top 15 Congested Arterial Segments (PM)
N
Sources: Esri, HERE, DeLorme, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS,

MD 43 @ Honeygo Boulevard

INTERSECTIONS

Mobility along arterial and collector roadways is impacted by waiting at traffic signals through multiple cycles. These intersections are considered to operate at level of service (LOS) "F". These locations are identified for improvements and SHA continues to monitor operations at intersections that operate poorly through its traffic data collection program. This data is collected with equipment and personnel at numerous intersections throughout the state. As part of the traffic counts, analysis is performed to determine levels of service. The following is a list of failing intersections (LOS F). This list is limited to locations counted over the past three years. SHA continues to expand on its data collection program and work with locals to obtain additional information on intersection performance at other locations. The following table identifies the worst performing intersections based on the count data:

LOS "F" INTERSECTIONS

AM PEAK HOUR

Intersection	Volume/Capacity
MD 4 at Dower House Rd	1.32
MD 5 at Brandywine Rd	1.27
MD 210 at Livingston Rd/Palmer Rd	1.22
MD 3 at Millersville Rd	1.21
MD 140 at Dede Rd	1.18
MD 210 at Livingston Rd/Kerby Hill Rd	1.18
MD 637 at Suitland Pkwy	1.17
US 29 at Rivers Edge Rd	1.17
MD 650 at Ramp 7 US 29 WB	1.16
US 29 at Greencastle Rd	1.13
MD 355 at Shady Grove Rd	1.13
MD 45 at Shawan Rd	1.12
MD 119 at Lakelands Dr	1.10
MD 2 at Arnold Rd	1.08
MD 27 at Skylark Rd	1.08
MD 355 at Cedar La	1.07
MD 4 at MD 337/Presidential Pkwy	1.06
MD 97 at Ramp 6 FR IS 495 EB	1.06
MD 235 at MD 237/Maple Rd	1.05
MD 185 at MD 410	1.05
MD 185 at Jones Bridge Rd/ Kensington Pkwy	1.05
MD 28 at MD 97	1.05
MD 185 at MD 192	1.04
US 29 at Blackburn Rd	1.04
MD 210 at Wilson Bridge Dr	1.03
US 40 at MD 144A/Pebble Beach Dr	1.02
MD 5 at MD 373	1.02
MD 355 at E&W Gude Dr	1.02
MD 235 at Town Creek Dr/Taylor La	1.01
MD 187 at Ryland Dr/ Entrance To Church	1.01
MD 2 at Tarragon La	1.00
MD 210 at Md 373/Livingston Rd	1.00
MD 650 at Ramps 2&7 I-495 WB	1.00

MD 24 @ I-95 NB Ramps

MD 4 @ Dower House Road

LOS "F" INTERSECTIONS

PM PEAK HOUR

Intersection	Volume
MD 202 at Brightseat Rd/MD 202E	1.32
MD 197 at Montpelier Dr/Brock Bridge Rd	1.24
US 29 at Rivers Edge Rd	1.23
US 50 at MD 378/N. Division St	1.21
MD 119 at Muddy Branch Rd	1.18
MD 4 at MD 337/Presidential Pkwy	1.17
MD 637 at Suitland Pkwy	1.15
MD 5 at MD 5BU/St. Charles Pkwy	1.15
MD 210 at Livingston Rd/Palmer Rd	1.14
MD 355 at MD 124 (Montgomery Village Ave/Quince Orchard Rd)	1.14
MD 190 at MD 614	1.13
MD 97 at Ramp 6 I-495 EB	1.12
MD 410 at MD 212	1.12
MD 458 at Swann Rd	1.11
MD 355 at Cedar La	1.10
US 301 at MD 725/Marlboro Pike	1.10
US 301 at Harbour Way/Governor Bridge Rd	1.10
US 29 at Stewart La	1.10
US 29 at Greencastle Rd	1.09
MD 3 at Crawford Blvd/Cronson Blvd	1.09
MD 185 at MD 191/Bradley La	1.09
MD 210 at Wilson Bridge Dr	1.08
MD 235 at Shady Mile Dr/Old Rolling Rd	1.08
MD 28 at Riffle Ford Rd/Seurat Dr	1.08

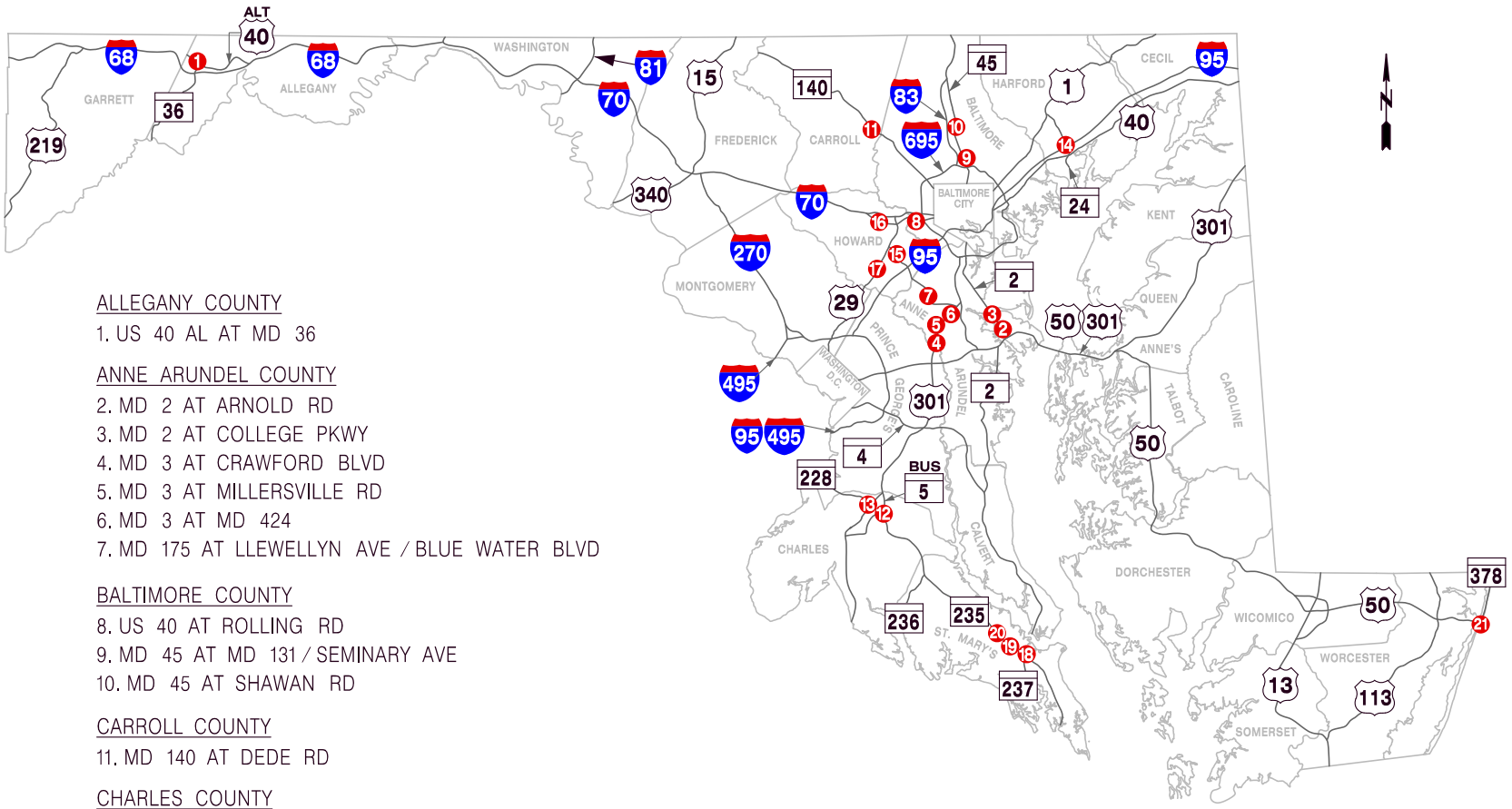
LOS "F" INTERSECTIONS

PM PEAK HOUR

Intersection	Volume
MD 235 at MD 237/Maple Rd	1.07
MD 2 at Arnold Rd	1.06
US 301 at Cedarville Rd/McKendree Rd	1.06
MD 175 at Llewellyn Ave/Blue Water Blvd	1.05
MD 175 at Tamar Dr	1.05
MD 410 at MD 450	1.05
MD 24 at Ramps 4,5&9 to and from I-95 NB	1.05
US 301 at Clymer Dr/Matapeake Business Dr	1.05
MD 4 at MD 4PB/Dower House Rd	1.04
MD 185 at Jones Bridge Rd/Kensington Pkwy	1.04
MD 2 at College Pkwy	1.04
MD 210 at Old Fort Rd (North)	1.04
MD 185 at MD 192	1.03
MD 235 at Town Creek Dr/Taylor La	1.03
MD 191 at Seven Locks Rd	1.03
US 40AL at MD 36 (Mt. Savage Rd)	1.03
MD 210 at Livingston Rd/Kerby Hill Rd	1.02
MD 3 at MD 424/Conway Rd	1.02
MD 45 at MD 131/Seminary Ave	1.02
US 301 at MD 5BU/MD 228	1.01
MD 212 at Adelphi Rd	1.01
MD 185 at MD 410	1.00
US 40 at Rolling Rd	1.00
US 1 at Edgewood Rd/ I-95 Ramp	1.00

These locations are depicted in the following figures.

LEVEL OF SERVICE F INTERSECTIONS



ALLEGANY COUNTY

1. US 40 AL AT MD 36

ANNE ARUNDEL COUNTY

2. MD 2 AT ARNOLD RD
3. MD 2 AT COLLEGE PKWY
4. MD 3 AT CRAWFORD BLVD
5. MD 3 AT MILLERSVILLE RD
6. MD 3 AT MD 424
7. MD 175 AT LLEWELLYN AVE / BLUE WATER BLVD

BALTIMORE COUNTY

8. US 40 AT ROLLING RD
9. MD 45 AT MD 131 / SEMINARY AVE
10. MD 45 AT SHAWAN RD

CARROLL COUNTY

11. MD 140 AT DEDE RD

CHARLES COUNTY

12. MD 5 AT MD 5 BUS / ST CHARLES PKWY
13. US 301 AT MD 228 / MD 5 BUS

HARFORD COUNTY

14. MD 24 AT I-95 NB RAMPS

HOWARD COUNTY

15. MD 175 AT TAMAR DR
16. US 40 AT MD 144A / PEBBLE BEACH DR
17. US 29 AT RIVERS EDGE RD

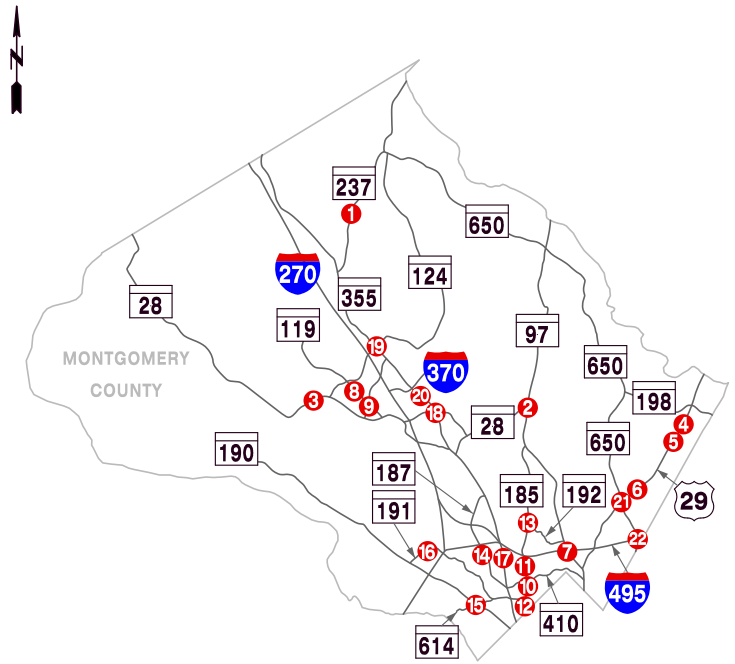
ST. MARY'S COUNTY

18. MD 235 AT MD 237
19. MD 235 AT TOWN CREEK DR
20. MD 235 AT SHADY MILE DR

WORCESTER COUNTY

21. US 50 AT MD 378 / DIVISION ST

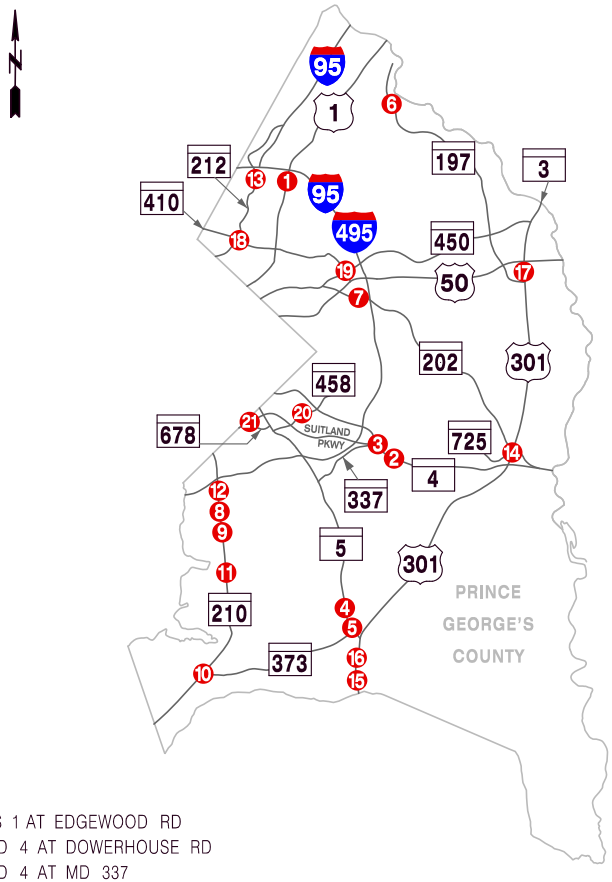
LEVEL OF SERVICE F INTERSECTIONS MONTGOMERY COUNTY



1. MD 27 AT SKYLARK RD
2. MD 28 AT MD 97
3. MD 28 AT RIFFLE FORD RD
4. US 29 AT BLACKBURN RD
5. US 29 AT GREENCASTLE RD
6. US 29 AT STEWART LN
7. MD 97 AT RAMP 6 FROM I-495 EB
8. MD 119 AT LAKELANDS DR
9. MD 119 AT MUDDY BRANCH RD
10. MD 185 AT MD 410
11. MD 185 AT JONES BRIDGE RD
12. MD 185 AT MD 191
13. MD 185 AT MD 192
14. MD 187 AT RYLAND DR
15. MD 190 AT MD 614
16. MD 191 AT SEVEN LOCKS RD
17. MD 355 AT CEDAR LANE
18. MD 355 AT E&W GUDE DR
19. MD 355 AT MD 124
20. MD 355 AT SHADY GROVE RD
21. MD 650 AT RAMP 7 FROM US 29 WB
22. MD 650 AT RAMPS 2 & 7 FROM I-495

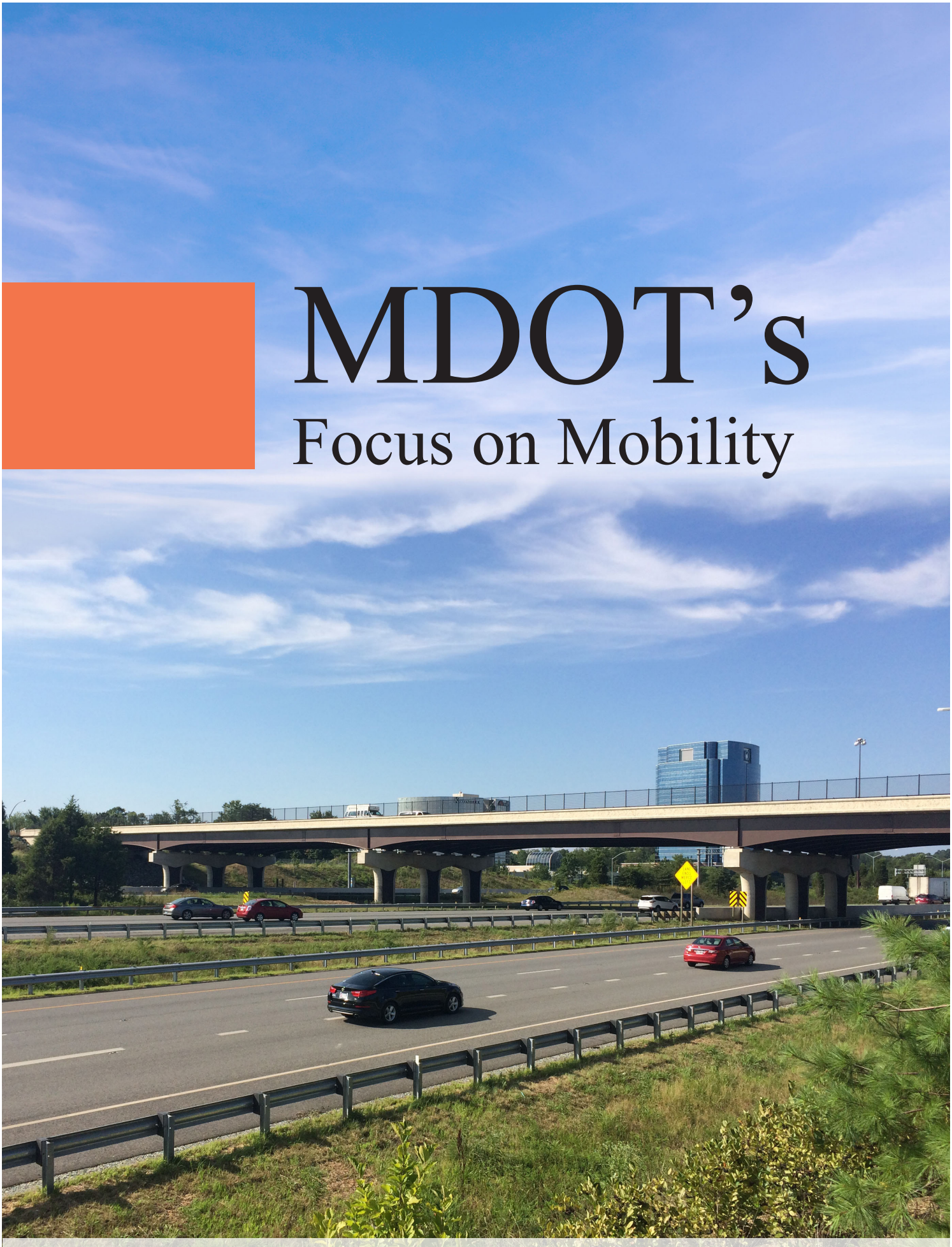
0 10 20 40 60 Miles

LEVEL OF SERVICE F INTERSECTIONS PRINCE GEORGE'S COUNTY



1. US 1 AT EDGEWOOD RD
2. MD 4 AT DOWERHOUSE RD
3. MD 4 AT MD 337
4. MD 5 AT BRANDYWINE RD
5. MD 5 AT MD 373
6. MD 197 AT MONTPELIER DR / BROCK BRIDGE RD
7. MD 202 AT BRIGHTSEAT RD
8. MD 210 AT LIVINGSTON RD / KERBY HILL RD
9. MD 210 AT LIVINGSTON RD / PALMER RD
10. MD 210 AT MD 373 / LIVINGSTON RD
11. MD 210 AT OLD FORT RD
12. MD 210 AT WILSON BRIDGE DR
13. MD 212 AT ADELPHI RD
14. US 301 AT MD 725 / MARLBORO PIKE
15. US 301 AT CEDARVILLE RD / McKENDREE RD
16. US 301 AT CLYMER DRIVE
17. US 301 AT HARBOUR WAY & GOVERNOR BRIDGE RD
18. MD 410 AT MD 212
19. MD 410 AT MD 450
20. MD 458 AT SWANN RD
21. MD 637 AT SUITLAND PARKWAY

MDOT's Focus on Mobility



I-95 @ Konterra Drive

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A. Capital Projects

I-495 East of US 29

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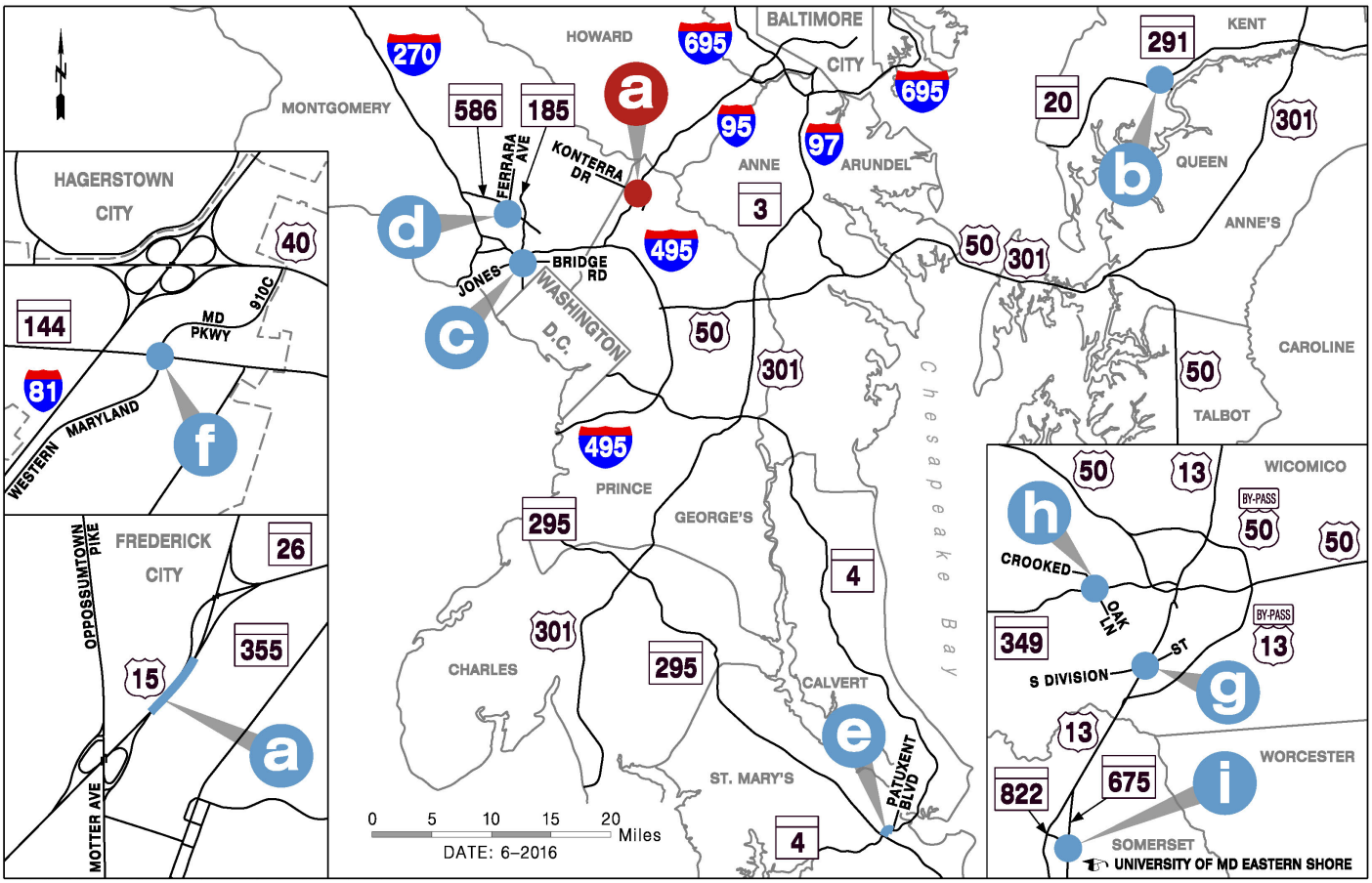
I-695 @ Old Harford Road

Capital Projects

Traffic volumes and congestion continue to increase in Maryland. In order to address these mobility issues, SHA employs a variety of strategies to meet the needs of the traveling public. There are many challenges involved in developing projects including the cost of projects, right-of-way impacts and environmental constraints. SHA constructs major capital projects and uses programs that implement bottleneck solutions in a systematic and responsible manner. This is completed through a performance-based approach to identify and plan/design/construct congestion mitigation solutions from a practical design standpoint.

SHA projects and programs identify both short and long term solutions to address transportation issues. Capital projects can take years to complete to meet the Federal requirements. As a result, a major emphasis in recent years has been on system preservation. In 2015, it was announced that another 13 new major capital projects have been funded to improve mobility. Secondly, but just as important, SHA continues to focus on alleviating congestion hotspots through a variety of lower cost geometric improvements along freeways and arterial roadways, ranging from the reconstruction of interstates to minor geometric improvements such as turn lanes and roundabouts. Other projects include upgrades to the freight network and new pedestrian and bicycle facilities. In order to address mobility issues throughout the State, ten construction projects were opened to traffic in 2015. These projects provide for congestion relief, improve safety, and enhance traffic operations. Of the ten projects, the major element of one of the projects was to improve accessibility. This involved constructing a new interchange on I-95 to improve access to the Konterra area of northern Prince George's County. In addition, two major projects were completed in December 2014 including the final section of MD 200 (Intercounty Connector) and the I-95 express toll lanes.

The location of the mobility and accessibility projects completed in 2015 are depicted on the following map:



MOBILITY PROJECTS

a. US 15 NB from Motter Ave. to MD 26
b. MD 20/High St. @ MD 291
c. MD 185 @ Jones Bridge Rd.
d. MD 586 @ Ferrara Ave.
e. MD 4 from MD 235 to Patuxent Blvd.
f. MD 144 @ MD 910C
g. US 13 Business @ S. Division St.
h. MD 349 @ Crooked Oak Ln.
i. MD 822 @ MD 675

The mobility projects provide $4.25 million in annual user benefits.

ACCESSIBILITY PROJECTS

a. I-95 at Konterra Dr.

1. MOBILITY IMPROVEMENT PROJECTS

Nine mobility improvement projects were completed in 2015. These are as follows:

US 15 Northbound From Motter Ave to MD 26 (Frederick County)

US 15 was configured with a separate acceleration lane for the ramp from Motter Avenue to US 15 northbound and a separate deceleration lane to MD 26. These were approximately 2,000 feet apart. This project consisted of providing a continuous lane to tie in the Motter Avenue on ramp acceleration lane with the MD 26 off ramp deceleratiom lane.

MD 20/High Street @ MD 291 (Kent County)

The intersection of MD 20/High Street and MD 291 is located in Chestertown just to the west of Washington College. It is a three legged intersection with MD 20 the north leg, MD 291 the east leg, and High Street the south leg. The intersection was previously all way stop controlled. Delays were occurring on all three legs of the intersection due to all motorists being forced to stop at the intersection. A single lane roundabout was constructed to reduce delay and improve traffic flow.

MD 185 @ Jones Bridge Road (Montgomery County)

MD 185 (Connecticut Avenue) at Jones Bridge Road/Kensington Parkway is near the Walter Reed National Military Medical Center. The intersection experienced increased traffic volumes due to the Base Realignment and Closure Act (BRAC). The project consisted of widening MD 185 southbound to provide an exclusive right turn lane from the I-495 off ramp to Jones Bridge Road. An additional through lane was constructed on MD 185 northbound from Manor Road that ends at the ramp to I-495 eastbound. Pedestrian upgrades were included in the construction.

MD 586 @ Ferrara Ave (Montgomery County)

This project improved operations and safety at the MD 586/Ferrara Ave intersection. Left turning motorists from MD 586 westbound to Ferrara Ave southbound were at times unable to access the left turn lane or would block through motorists on MD 586. In order to alleviate this congestion, the project extended the left turn lane approximately 150 feet to improve the storage for this movement. The traffic signal phasing was also upgraded.

MD 4 from MD 235 to Patuxent Blvd. (St. Mary's County)

A major point of congestion in the Lexington Park area is along MD 4 from the the MD 4/MD 235 intersection and points north. Through a series of lane drops and merges this reduces MD 4 northbound from three lanes to one lane within 1,200 feet of the MD 235 intersection at Oak Drive. Motorists operate in stop and go conditions along the entire section of MD 4 until they start descending on the Thomas Johnson Bridge over three (3) miles from the MD 235/MD 4 intersection. The congestion along MD 4 also impacts traffic operations along MD 235. This project along MD 4 extended the two northbound lanes from south of Oak Drive to Patuxent Blvd a distance of approximately 4,000 feet to improve operations at the MD 235/MD 4 intersection and along MD 235 northbound. The volume at the Thomas Johnson Bridge is still greater than the capacity of the bridge therefore congestion will still occur along MD 4. Ultimately, MDOT has a separate study to evaluate improvements for the Thomas Johnson Bridge.

MD 144 @ MD 910 C (Washington County)

The intersection of MD 144 (Washington Street) and MD 910 C (Western Maryland Parkway) lies at the western edge of the City of Hagerstown. Originally, MD 910 C was stop controlled for both approaches while MD 144 free flowed through the intersection. There were right turn lanes on all approaches. Since traffic volumes were relatively equal, this made for an ideal location to construct a single lane roundabout.

US 13 Business at South Division Street (Wicomico County)

The US 13 Business/South Division Street intersection is located in the City of Salisbury. US 13 Business is a four lane divided highway and South Division Street is a two lane roadway. Left turn lanes were not provided on US 13 Business. This meant that along US 13 Business left turning motorists would queue in the median area and into the through lanes. This project constructed left turn lanes on both northbound and southbound US 13 Business and signalized the intersection. A bike lane was provided along US 13 Business. Bennett Middle School was just constructed about ¼ mile west of the intersection.

MD 349 @ Crooked Oak Lane (Wicomico County)

The intersection of MD 349 (Nanticoke Road) and Crooked Oak Lane is located in Wicomico County near Salisbury. The northbound and southbound Crooked Lane approaches consisted of a single lane. MD 349 eastbound and westbound had one through lane and one right turn lane. This project also provided a left turn lane on both MD 349 approaches. A left turn lane was added on Crooked Oak Lane southbound and a northbound right turn lane was constructed.

MD 822 @ MD 675 (Somerset County)

MD 822 intersects with MD 675 about a mile from the University of Maryland Eastern Shore campus in Princess Anne. The MD 675 approaches consisted of a single lane entering the intersection while MD 822 (UMES Blvd.) eastbound approach included a single left, through and right turn lane while westbound consisted of a left and through right lane. The intersection was stop controlled for MD 675 motorists. In order to improve mobility and safety a single lane roundabout was constructed at this intersection.

a. Mobility Improvement Project Benefits

Before and after safety and traffic analysis were performed to determine the annual user benefits of the completed mobility projects. The benefits are related to the reduction in delay incurred by motorists and commercial vehicles, the reduction in fuel consumption, the safety benefit anticipated by the improvement, and the benefit provided by increased reliability of the system.

The construction of the nine projects provided the following benefits as depicted in the subsequent chart.

MOBILITY PROJECTS ANNUAL BENEFITS				
Location	**Reduction in Delay**	**Reduction in Fuel Consumption**	**Safety Savings**	**Annual Cost Savings ($ Thousands)**
	$ Savings (Thousands)	$ Savings (Thousands)	$ Savings (Thousands)	
US 15 NB Motter Ave to MD 26	481	9	217	707
MD 20/MD 291/High Street	28	1	27	56
MD 185 @ Jones Bridge Road	1,930	44	30	2,004
MD 586 @ Ferrara Ave	-156	-4	291	131
MD 4 - MD 235 to Patuxent Blvd	243	5	69	317
MD 144 @ MD 910 C	13	<1	44	57
US 13 Business @ S. Division St.	816	18	87	921
MD 349 @ Crooked Oak Lane	9	<1	21	30
MD 822 @ MD 675	4	<1	23	27
Total	**3,368**	**73**	**809**	**4,250**

The nine projects provide for a combined $4.25 million in annual user benefits including $300,000 in savings by truck traffic through these locations.

2. ACCESSIBILITY IMPROVEMENT PROJECTS

MDOT leads several projects to improve access to nearby major roadways to serve existing residents/businesses as well as future economic development. Normally these projects are major investments. In calendar year 2015, one major accessibility improvement project was completed. This was completed in conjunction with the last section of the Intercounty Connector (MD 200) which opened in December 2014.

I-95 @ Konterra Drive

I-95 @ Konterra Drive

I-95/Konterra Drive (Prince George's County)

Along I-95 just north of the Capital Beltway, interchanges are located at MD 198, MD 200 (Intercounty Connector) and MD 212 (from north to south). These interchanges are spaced approximately two (2) miles apart. Since MD 200 is an access controlled facility, the next nearest interchanges are located either one (1) mile to the east or 2.5 miles to the west of I-95. The accessibility to the area of West Laurel was limited to the local roadway network. This area includes several major office/flex complexes, residential developments and the Laurel Regional Hospital. Traffic along I-95 desiring to access these complexes was using local roadways such as Old Gunpowder Rd, Contee Rd, or Virginia Manor Rd which varied in their ability to handle these volumes. To meet existing traffic needs and for future economic development, an interchange was constructed at I-95 at Konterra Dr. In conjunction with the new interchange, collector-distributor roads were constructed along I-95, minimizing the weaving movements along the four mainline travel lanes of I-95 therefore, improving travel speeds along I-95.

Traffic volumes at the I-95/Konterra Dr interchange for the average weekday was approximately 12,000 vehicles per day. This includes approximately 400 vehicles in the peak hour/peak direction.

The construction of this interchange has reduced traffic at the MD 198 interchange. Traffic volumes at the MD 198 ramps have been reduced by about 600-1,600 vehicles per day.

ICC West of MD 97

MD 200 (Intercounty Connector)
(Prince George's County)

Another project that improved accessibility is the final section of MD 200, the Intercounty Connector (ICC) in northern Prince George's County which opened in December 2014. The final section extends approximately 1.5 miles from I-95 to US 1 tieing into the original section between I-370 and I-95. The construction of this final section brings the total length of MD 200 to 19 miles.

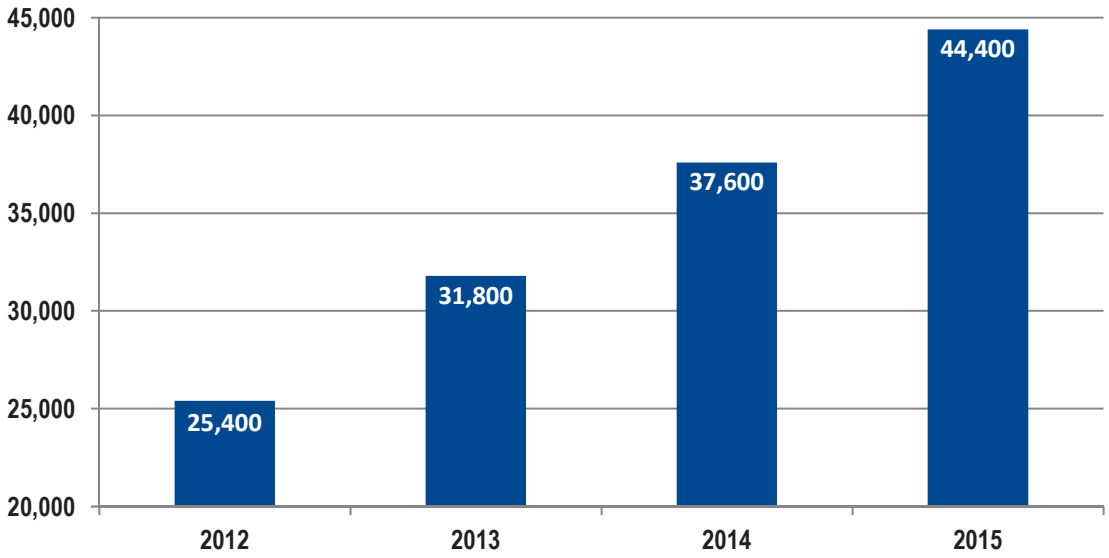
The construction consisted of completing the remaining interchange movements at the I-95 interchange, a new interchange at Virginia Manor Road, an at-grade intersection at US 1 plus construction of the mainline of the ICC. The ICC/US 1 intersection is unique since it is only the second displaced left turn intersection in Maryland.

Traffic volumes, in 2015 along the section of MD 200 from I-95 to US 1 average approximately 7,000 vehicles per day. Volumes along the remaining portion of the ICC are more than 45,000 vehicles per day on sections west of US 29. These volumes have steadily grown over the last four years. The ICC has reduced traffic volumes along I-270, I-495 and I-95 by about 5%. Local roadways such as Shady Grove Road, MD 108, MD 28/MD 198 has seen volumes decrease between 8% and 13% since the opening of the MD 200. The growth in traffic volumes on the ICC is illustrated in the following chart.

3. EXPRESS TOLL LANE PROJECTS

The first express toll lane project on I-95 from south of I-895 to north of MD 43 opened to traffic in December 2014. Motorists have the option of utilizing the four free general purpose lanes or paying a toll using EZ-Pass to travel in the free flow express toll lanes. The project was developed from the I-95 Master Plan which identified potential improvements from south of I-895 to the Delaware State Line. In the first eight miles, referred to

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



as Section 100 of the Master Plan, it was recognized that adding general purpose lanes would solve the existing congestion but the same operational issues would reappear in future years. In order to address future travel demands, two additional barrier separated express toll lanes were constructed on northbound and southbound I-95 for the express toll lanes. The interchanges of I-95 at I-895, I-695 and MD 43 and the I-895 interchange with Moravia Road were reconstructed. The express toll lanes are free for transit vehicles, improving their on-time performance and reliability.

This was the most congested section of I-95 north of the Baltimore City line for AM/PM peak hour traffic. AM volumes southbound and PM volumes northbound exceed 7,000 vehicles per hour. PM peak hour volumes northbound on a Friday evening can approach 8,000 vehicles per hour.

Volumes on the express toll lanes have averaged more than 22,000 vehicles per day. PM peak hour volumes on the express toll lanes in the northbound direction have exceeded 2,000 vehicles per hour Fridays in the summer.

4. DEVELOPER PROJECTS

Throughout the State, various residential, commercial, office and warehouse developments are constructed. This is a positive for economic development in Maryland but these projects can cause impacts to nearby intersections by generating higher traffic volumes. This can cause operational issues including failing intersections or traffic from turn lanes queuing into through lanes. In order to mitigate these additional traffic volumes, SHA works with developers to determine the improvements required to offset the additional traffic the development will generate. The improvements funded by developers range from acceleration and deceleration lanes, to a new traffic signal, to a minor/major intersection enhancement to interchange modifications. Some of the developer related improvement projects completed in 2015 include:

- US 301 @ Croom Road & Osborne Road (Prince George's County)
- MD 6 east of Calvert Street (Charles County)
- MD 24 at Singer Road (Harford County)
- MD 32 @ Raincliffe Road/Sandusky Road (Carroll County)
- MD 32 Westbound @ Cedar Lane (Howard County)
- MD 63 North of I-70 (Washington County)

These projects assist traffic operations by improving travel times and reducing delay. This not only assists motorists going to the developments but other users passing through the intersection.

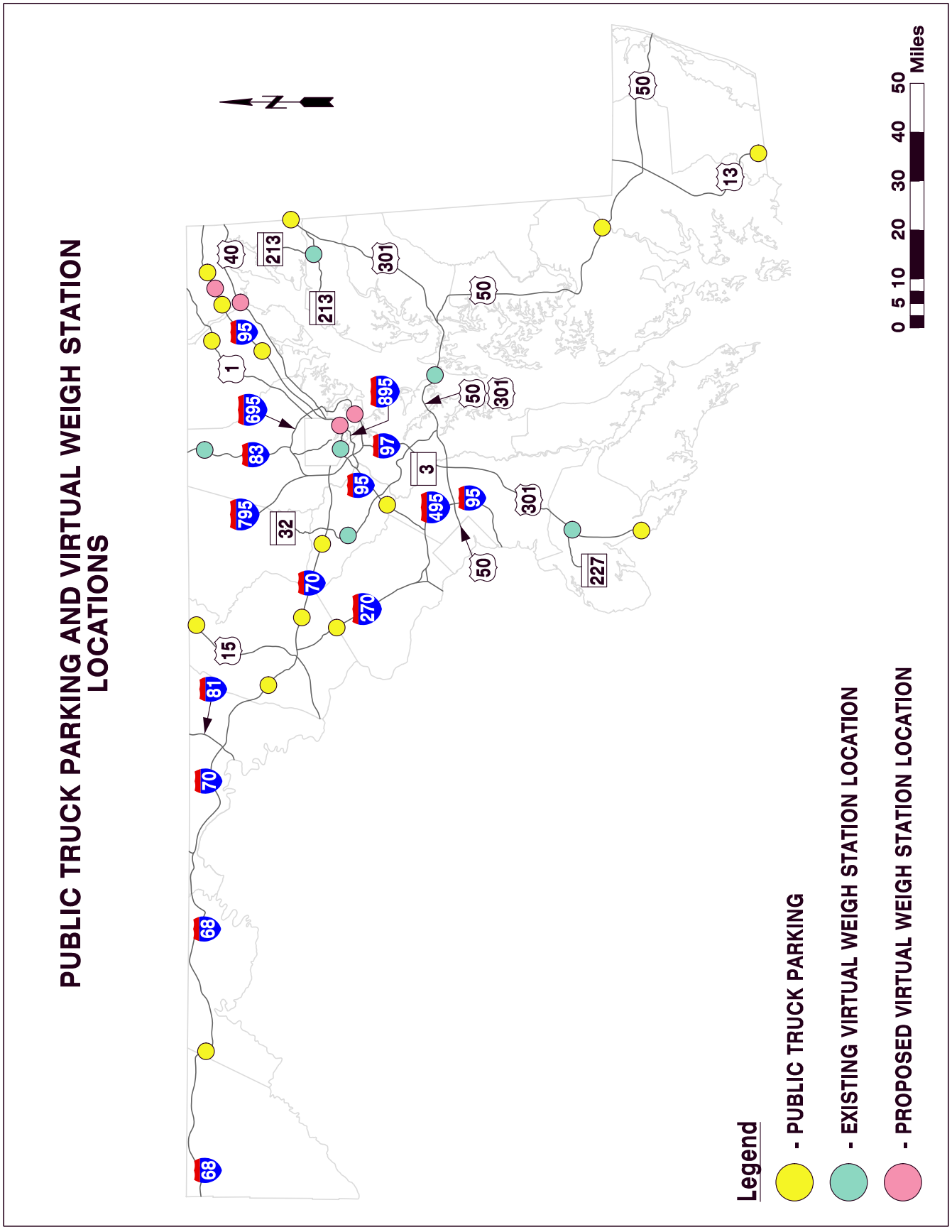
5. FREIGHT PROJECTS

Freight and goods movement are critical to the economic development of the State. The more trucks on the road means the more interaction occurs with autos/bicyclists/pedestrians. This does present challenges to balance maximizing the mobility of truckers with providing safe facilities for all users. This is accomplished through various freight projects/programs.

One of the programs managed by the SHAs' Motor Carrier Division is the Virtual Weigh Station (VWS) program. This program uses technology to protect the reliability of the pavement and keep trucks moving smoothly. Maryland's VWS promotes the goals of safety, freight mobility and infrastructure preservation through an automated system of sensors and cameras that record activity of Commercial Motor Vehicles (CMV) traveling at high speeds. The VWS can record the speed, height, and weight of a commercial vehicle without requiring the vehicle to stop, which reduces delay time for compliant vehicles. Overweight vehicles which damage roads and bridges can be identified for possible educational contact or enforcement action. In addition, each VWS provides a volume and classified count including the image of the vehicle. The analytics feature of the VWS application allows better targeting of enforcement activities with real-time reports identifying traffic volumes, speeds, class, and weight related trends. Currently, there are eight active VWS sites across the state. Three more sites are anticipated to be constructed over the next year with nine additional sites planned in the next three years. Ten of these sites will monitor Maryland Transportation Authority's bridges and tunnels. Once complete, this will allow for a system that electronically checks a majority of CMV's, intercepts the ones that are unsafe or overweight, and minimizes delay to others operating legally.

For vehicles transporting shipments that exceed the legal size and weight limits, the Motor Carrier Division issues special hauling permits. The total weight, axle weight, dimensions, and routes of travel are identified on the application. Previously, permit approval could take hours or days depending upon the request. In May, 2016, the new automated Maryland One permit system became operational. Now, more than 70% of permit applications submitted by our customers are processed in a matter of minutes and without error. Most permits for Superloads up to 200,000 pounds can be issued within two (2) days. Permitting for megaloads which can exceed 1,000,000 pounds will still take months of preparation and coordination by agencies/participants.

Other programs address issues related to truck parking and at grade railroad crossings. Truck parking is both a safety and infrastructure preservation issue. In order to address truck parking, two projects were completed to expand the truck parking capacity. The first was at the I-95 southbound Welcome Center in Laurel. This approximately doubled the number of spaces at this location to 61. In addition, ten spaces were added at the US 301/MD 834 Bay Country Rest Area in Centerville. Public truck parking locations and the location of VMS are depicted on the following map.


PUBLIC TRUCK PARKING AND VIRTUAL WEIGH STATION LOCATIONS
Legend
- PUBLIC TRUCK PARKING
- EXISTING VIRTUAL WEIGH STATION LOCATION
- PROPOSED VIRTUAL WEIGH STATION LOCATION
0 5 10 20 30 40 50 Miles
N
68
81
70
15
270
70
32
795
83
695
1
95
40
213
213
301
50
50
301
895
97
3
95
495
95
50
301
227
50
13

MD 144

6. RAILROAD CROSSING PROJECTS

In Maryland, there are 633 public at-grade rail crossings and 22 separate pedestrian only crossings. These can present a safety issue. Improvements can include a range of possible solutions such as new flashing light signals (with or without gates replacement), updating of components at existing active warning devices, and improved crossing surfaces, both on State roads and County roads. There were approximately eight (8) crossings modified in 2015 including projects along Concrete Road, Fountain Rock Road, Monocacy Boulevard, Connelley Mill Road and Brandywine Road.

7. PEDESTRIAN AND BICYCLE PROJECTS

Projects to improve pedestrian and bicyclists are a key element of a multi-modal transportation system. In February 2016, MDOT announced $14 million in reimbursable grant funding for walking, biking and recreational trail projects. MDOT has allocated $100 million to upgrade these facilities since the start of the various programs.

Pedestrian facility improvements may involve the building of new sidewalks or the rehabilitation of existing sidewalks. Across the State, 11 miles of new sidewalk were installed in 2015 including:

- MD 210 - Ruth B Swann Drive to Wooster Drive (Charles County)
- MD 144 - Wisner Street to King Avenue (Frederick County)
- MD 825 B - South 11th Street to South Oakhall Drive (Garrett County)

MDOT projects in 2015 incorporated upgrades of more than $2 million for dedicated bicycle improvement projects. This along with improvements to bicycle facilities as part of roadway projects are an important part of the Complete Streets philosophy, that involves providing on-street bike lanes or off street facilities to encourage safe bicycle use. In 2015, 12.6 miles of marked bicycle facilities were constructed including:

- MD 170 - MD 648 to MD 762 (Anne Arundel County)
- US 1 - US 1 Alt to Linden Avenue (Baltimore County)

8. PAST PROJECT BENEFITS

A variety of projects have been completed along Maryland's freeway/expressway system in the past four years including rehabilitating existing bridges structures (I-695 at MD 372) while others have provided capacity improvements. Projects such as I-695 at MD 26 were completed but another project (I-695 at Milford Mill Road) is presently on-going which impacts traffic operations in the area. Two projects completed in 2014 that provided benefits to mobility were:

- I-95 - Express Toll Lanes - I-895 to MD 43
- I-70 - East Patrick St to West of South St./Monocacy Blvd.

CONGESTION IMPROVEMENT BY COMPLETED PROJECTS

LOCATION	2011 TTI	2015 TTI	% REDUCTION
I-95 AM SB MD 43 to I-695	1.50	1.00	+33
I-95 AM SB I-695 to I-895	1.59	1.01	+36
I-95 AM SB I-895 to US 40	1.31	1.08	+18
I-95 PM NB US 40 to I-895	1.72	1.03	+40
I-95 PM NB I-895 to I-695	1.33	1.03	+23
I-95 PM NB I-695 to MD 43	1.13	1.04	+8
I-70 PM EB South St to MD 144	1.04	1.00	+4

An evaluation was performed to determine the mobility benefits of these improvements. The Travel Time Index (TTI) was used as a basis for the evaluation. Data from the years 2011 and 2015 were utilized for the comparison. The year 2011 represented the oldest year that INRIX data was analyzed for travel time index. A comparison was made between the peak direction TTI for 2011 and 2015 data which identified the following changes:

The I-95 express toll lanes had a major impact on travel time throughout the corridor. Average travel times were reduced by up to 40% on a segment. In the statewide rankings of all freeway/expressway segments the I-95 express toll lane project provided an approximately 400 place improvement in congestion (e.g. from the 100th most congested segment on Maryland freeways/expressways to the 500th more congested segment). The I-70 widening provided less benefit but still improved travel time.

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B. Programs and Policies

I-270 North of MD 187

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I-95

1. CHART TRANSPORTATION SYSTEM MANAGEMENT AND OPERATIONS

The Coordinated Highways Action Response Team (CHART) is a multi-agency effort to improve mobility for Maryland's highway system through communication, system integration, incident response and management, service patrols, and advanced traffic management systems. CHART's mission is to improve mobility and safety using intelligent transportation systems (ITS) devices and interagency teamwork to address non-recurring congestion. Non-recurring congestion includes crashes, vehicle breakdowns, work zones, special events, and weather events. Non-recurring congestion is estimated to account for more than 50 percent of all delays on roadways. The CHART program is anchored by the state-of-the-art Statewide Operations Center (SOC) in Hanover near BWI Airport. The SOC uses an advanced traffic management system (ATMS) to support CHART's critical functions, including traffic monitoring and incident management. At the SOC, traffic is monitored using a series of ITS devices with personnel managing the data. This information is used in conjunction with reports provided by radio communications, local government communications and traffic signal systems to both detect and respond to incidents. In addition, CHART is one of 26 agencies from Florida to Maine that are part of the I-95 Corridor Coalition working cooperatively to improve inter-regional travel in the northeast. CHART is involved in:

- Emergency Preparedness - Redundant Power and Communication, Decentralized Communications and Department of Transportation Emergency Operations (DOTOPs).
- Emergency Weather Operations - Automatic Vehicle Location Fleet Management System and Resource Tracking System.
- Incident Management - Emergency Traffic Patrols, CHART Operations Centers, and Emergency Response Units.
- Traffic Management - Special Event and Work Zone Management.
- Traffic and Roadway Monitoring - Cell phone #77, CCTV, and Public/Private Partnerships.
- Traveler Information - Maryland 511 Traveler Information System - High-quality, Timely, and Comprehensive Travel Information to Motorists, CCTV Camera Video Sharing with First Responders, and Internet (www.traffic.md.gov).

a. CHART Incident Management

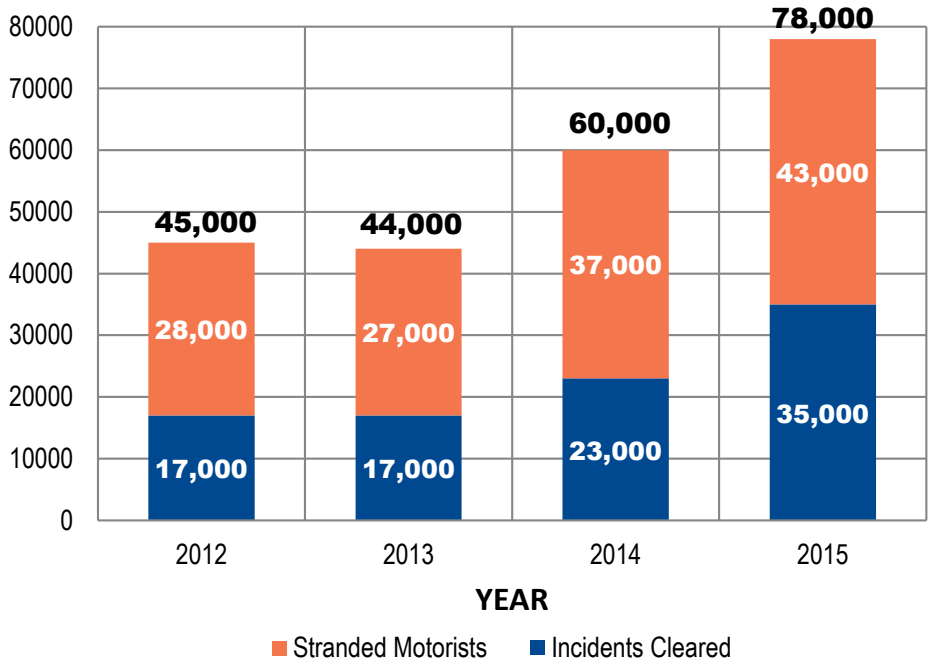
Traffic incident management requires a multi-disciplinary effort to detect, respond and clear collisions or other traffic impacting incidents so traffic operations can be

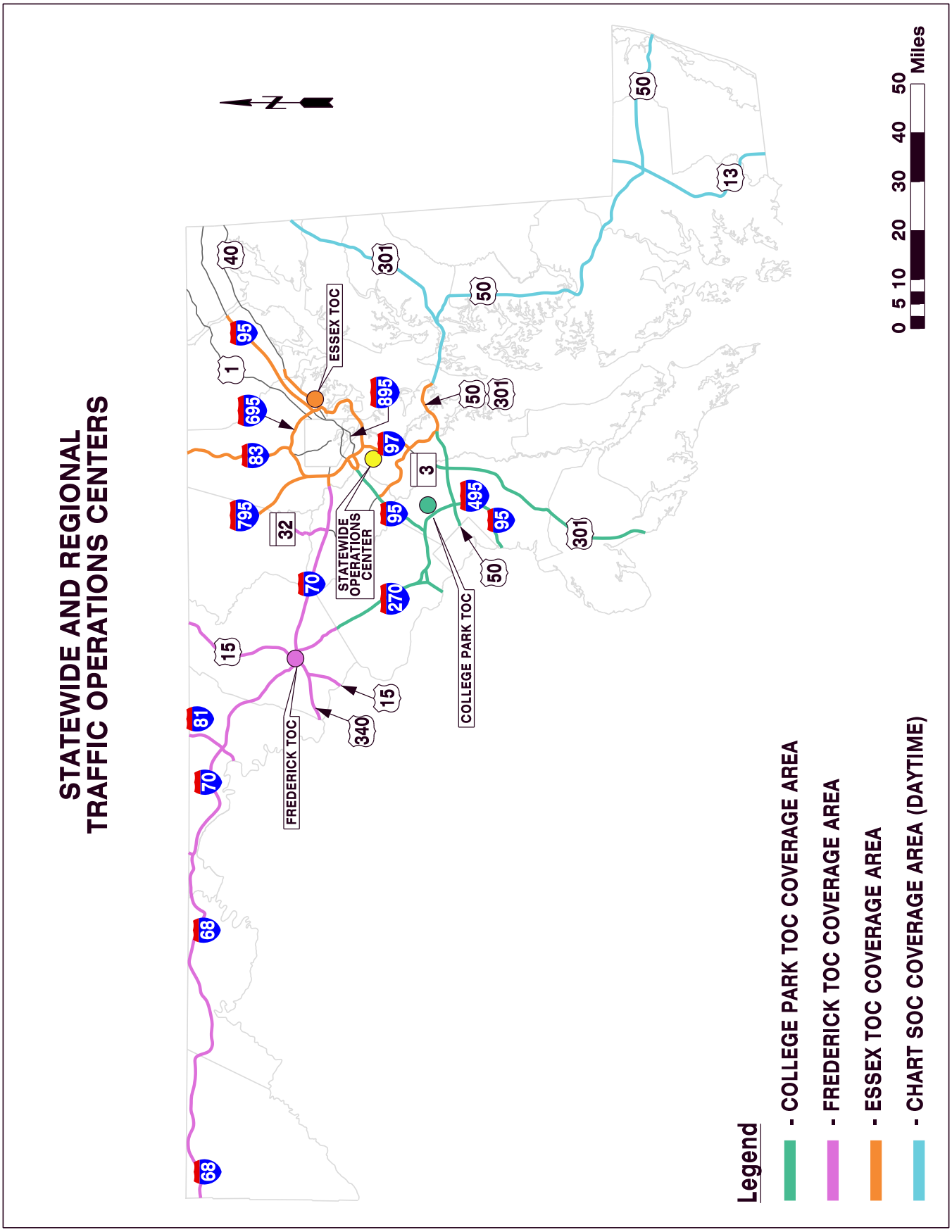
restored as quickly and safely as possible. This is one of the major tasks for which CHART is responsible on Maryland state roadways. Emergency traffic patrols (ETPs) are positioned along major roadways to assist drivers when their vehicles become disabled or when involved in a crash. These ETP's optimize incident response in identified high-volume/high-incident locations. In the summer of 2014, CHART doubled the size of its service patrol fleet and expanded its patrol operations to a 24 hour a day/seven days a week schedule in the metropolitan areas. There are currently 46 full-time ETPs in the Baltimore, Washington, Frederick and Annapolis regions that offer various types of motorist assistance on the freeways. In addition, from May through September, extra patrols are assigned to respond to the increased traffic volume traveling to and from Maryland's Eastern Shore. Traffic is monitored using closed-circuit television (CCTV) cameras, speed sensors, and weather stations at the SOC and at regional Traffic Operations Centers (TOC) located in College Park, Essex and Frederick. The location of the SOC and TOCs along with their coverage areas are shown on the following page. At the time an incident is detected, the necessary information is communicated to emergency service personnel. From the SOC, motorists are then alerted to the incident through the use of dynamic message signs which identify the location of the incident or the travel time along that section of roadway. This allows motorists to make better real time decisions. The use of incident management and traveler information system initiatives result in roadway users saving billions of dollars in delay savings, wasted fuel and emissions.

The CHART program responded to and cleared more than 35,000 incidents and assisted almost 43,000 stranded motorists in 2015. The implementation of full-time service patrols operating 24 hours a day 7 days a week has significantly aided CHART's ability to respond to incidents, emergencies, and general breakdowns on the roadway network. The total number of CHART responses on a yearly basis is illustrated in the following graph.

The success of CHART depends upon the cooperation of numerous agencies working together to achieve the goal of improving mobility and safety. In order to improve mobility, incidents need to be cleared quickly so that lanes can be reopened as soon as possible. The quicker an incident is cleared from the roadway the greater

CHART SERVICE PATROL RESPONSES




STATEWIDE AND REGIONAL
TRAFFIC OPERATIONS CENTERS
N
ESSEX TOC
STATEWIDE OPERATIONS CENTER
FREDERICK TOC
COLLEGE PARK TOC
0 5 10 20 30 40 50 Miles
Legend
- COLLEGE PARK TOC COVERAGE AREA
- FREDERICK TOC COVERAGE AREA
- ESSEX TOC COVERAGE AREA
- CHART SOC COVERAGE AREA (DAYTIME)

I-695

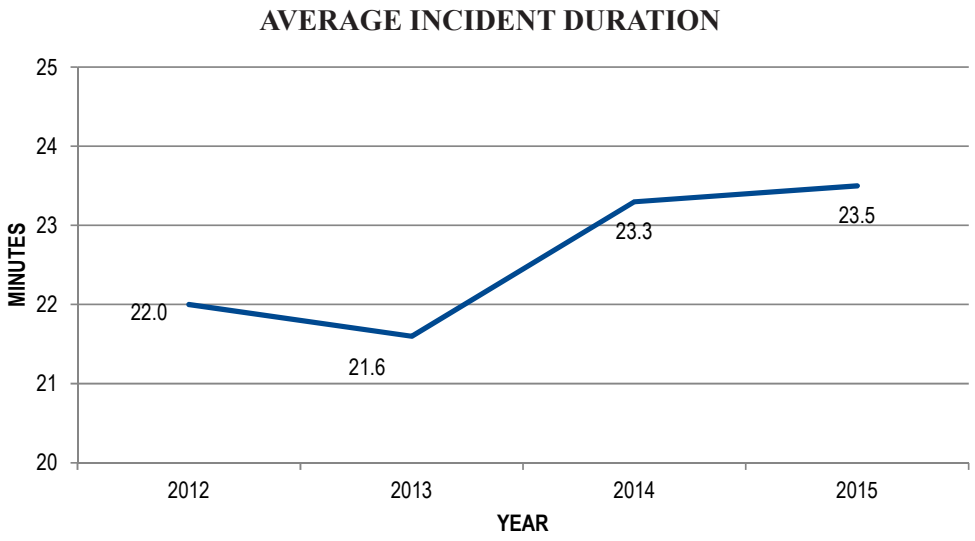
the benefits (reducing delay to the travelling public and minimizing the chance for secondary incidents). Safety is of the utmost importance in protecting those involved in the incident, the emergency personnel responding and other motorists on the roadway. This is accomplished using detailed incident management plans and procedures on how to address different situations and learning from them through continuous interaction and revisions.

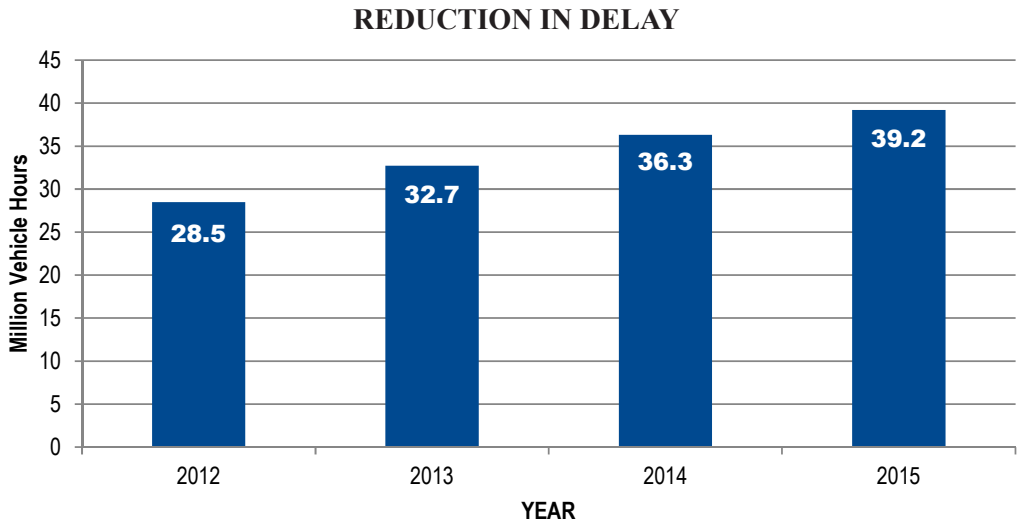
CHART has many different resources dedicated to traffic management that include:

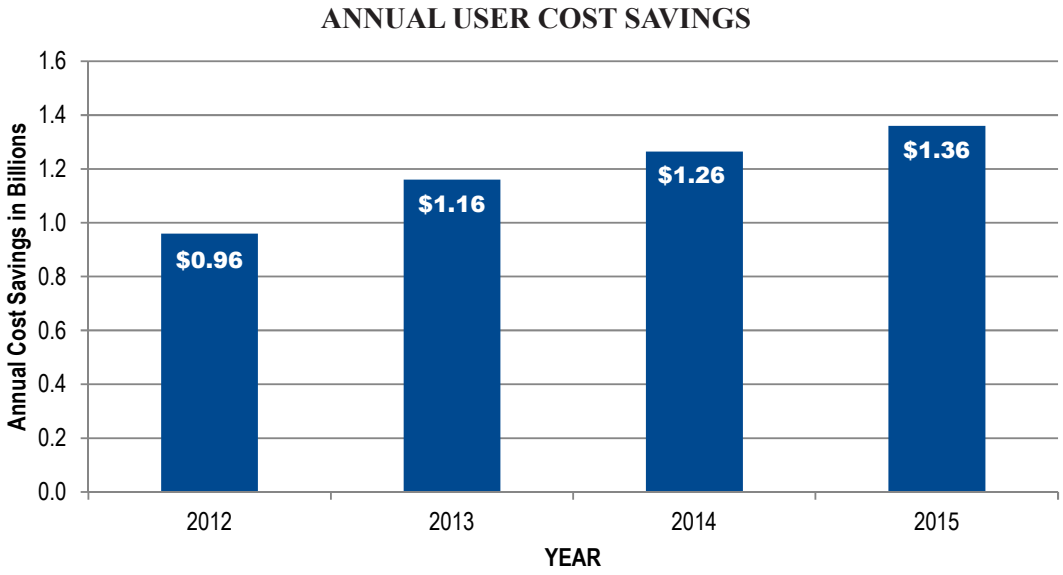
- Emergency Traffic Patrols (ETP's), which are used to provide emergency motorist assistance and to clear disabled vehicles from the travel lanes.
- Emergency Response Units (ERU's), which establish overall traffic control at crash locations.
- Freeway Incident Traffic Management (FITM) plans and response trailers, which are pre-stocked with traffic control tools including detour signs, cones, and trailblazer signs that are used to quickly set up pre-planned detour routes when incidents require full roadway closure.
- A "Clear the Road" policy, which provides direction for the rapid removal of vehicles from the travel lanes rather than waiting for law enforcement or private towing services to remove disabled vehicles which are blocking travel lanes.
- An Information Exchange Network (IEN) Clearinghouse, provided through the I-95 Corridor Coalition workstation at the SOC, which shares regional incident and traveler information to member agencies.

Secondary incidents are a problem that occurs when motorists are caught in stop and go traffic or face reduced lanes due to a breakdown/crash. In order to minimize the impacts of secondary incidents, a shorter time required to clear an incident translates into a reduction in delay. The average response time to an incident in 2015 was 11.8 minutes, and the average incident took 23.5 minutes to clear. This saved almost 39.2 million vehicle hours in delay to motorists. The following graphs depict the trends of average incident duration and reduction in delay for the last five years.

The longer a motorist waits in traffic the higher the cost associated with the delay. CHART, by deploying its resources reduces delay which results in a savings in annual user costs. The following graph depicts that last year $1.36 billion savings was achieved due to the CHART system.


AVERAGE INCIDENT DURATION
MINUTES
25
24
23
22
21
20
22.0
21.6
23.3
23.5
2012
2013
2014
2015
YEAR


REDUCTION IN DELAY
Million Vehicle Hours
45
40
35
30
25
20
15
10
5
0
28.5
32.7
36.3
39.2
2012
2013
2014
2015
YEAR


ANNUAL USER COST SAVINGS
Annual Cost Savings in Billions
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
$0.96
$1.16
$1.26
$1.36
2012
2013
2014
2015
YEAR

b. ITS/511

In order to convey information to motorists, numerous ITS devices are strategically positioned throughout the State. These ITS devices combined for CHART and MDTA include:

- 800+ CCTV Cameras which include video feeds from other agencies.
- 300+ Speed Detectors (including those shared through public/private partnerships).
- 200+ Dynamic Message Signs (DMS).
- 60+ Roadway Weather Information Systems (RWIS).
- 50+ Traveler Advisory Radios.
- 15+ Variable Toll Rate Signs

I-695 North of I-70

Providing clear and easy to understand information to motorists allows them to make better decisions to reduce congestion and increase mobility. Travel time information is made available based on the analysis of INRIX probe data on more than 200 DMS. The Maryland 511 Travel Information System continues to provide useful, high-quality, timely, and comprehensive travel information. Each year the personnel at CHART evaluate the system and based on funding availability expand the system or introduce new features.

2. SIGNAL OPERATIONS

Arterial corridor operations are greatly influenced by the traffic flow at signalized intersections. One of the most cost effective ways to improve mobility is to reduce delay at those locations by optimizing traffic signals to provide better progression. These projects provide improved safety and increased person throughput on arterial corridors, by retiming of signals to be more responsive to traffic flows, thereby reducing delay to motorists and decreasing automobile emissions. In addition, signal retiming can be used to provide a more walkable environment. The benefit cost ratio of improving signal timings ranges up to 40:1 on a nationwide basis as a result improving travel time, reducing the number of vehicles stopped, and fuel consumed.

MDOT/SHA operates the majority of traffic signals in Maryland. There are more than 1,556 coordinated signals in 255 signal systems. This is an increase of five signal systems over the last year. The process of upgrading signal timing includes gathering new traffic volume data, performing traffic modeling, developing adjustments to the timing patterns, and conducting travel time analysis to evaluate the before and after results and performing final iterations to the signal timings. A total of 340 signals were reviewed and 260 signals were proposed to be retimed in calendar year 2015. These signals are part of 43 signal systems and new timings were implemented on 31 systems. The 31 systems

MD 45

was the most ever installed in one year. One of the major emphasis areas of the signal system optimization program projects is to increase the rate of traffic signal timing modifications that were installed in the controllers at the intersections after the analysis was completed. New signal timings were implemented in 61% of the controllers. The signal systems that were reviewed are shown on the following map and table.

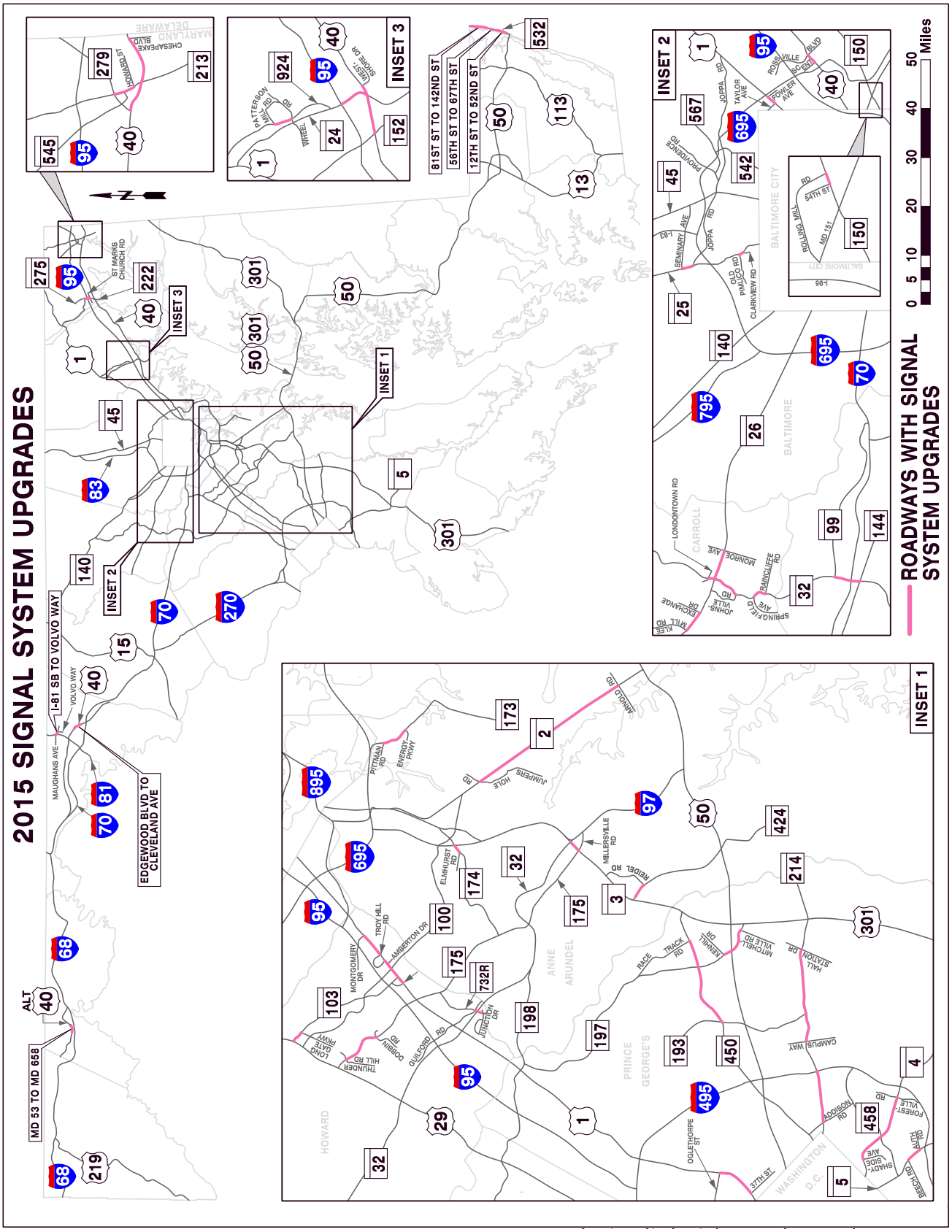
The highest benefits associated with any signal system upgrade from a number of vehicle hours of delay are as follows:

- MD 2 - Arnold Rd to Jumpers Hole Rd
- MD 26 - Johnsville Rd to Monroe Ave and MD 32 Londontown Blvd to Jonesville Rd (one system)
- MD 25 - Joppa Rd to Seminary Ave

All of these locations provide a reduction of more than 50,000 vehicles hours of delay annually. From a percentage standpoint, the following systems provided more than a 20% reduction in delay:

- Maugans Rd - I-81 SB Ramp to Volvo Way
- MD 732 R (Dorsey Run Rd) - Junction Dr to Guilford Rd
- MD 25 - Joppa Rd to Seminary Ave

Overall, signal retiming and optimization modifications provided an estimated reduction of 789,000 hours of delay for motorists and saved nearly 248,000 gallons of gasoline. The fuel, delay and emissions saved resulted in a total annual user cost savings of approximately $29.3 million.


2015 SIGNAL SYSTEM UPGRADES
ROADWAYS WITH SIGNAL SYSTEM UPGRADES
0 5 10 20 30 40 50 Miles
INSET 1
INSET 2
INSET 3
MD 53 TO MD 658
I-81 SB TO VOLVO WAY
EDGEWOOD BLVD TO CLEVELAND AVE
81ST ST TO 142ND ST
67TH ST TO 52ND ST
12TH ST TO 52ND ST
BALTIMORE CITY
BALTIMORE
CARROLL
HOWARD
ANNE ARUNDEL
PRINCE GEORGE'S
WASHINGTON D.C.

2015 NETWORK DELAY SAVINGS FOR SIGNAL SYSTEM UPGRADES

LOCATION	NO. OF SIGNALS	NETWORK DELAY SAVINGS (VEH- HRS)
MD 2 - Arnold Rd. to Jumpers Hole Rd.	14	121,000
MD 26 and MD 32 -Eldersburg (2 systems)	11	81,000
MD 25 - Joppa Rd. to Seminary Ave.	3	54,000
MD 214 - Campus Way to Hall Station Dr.	7	50,000
MD 732R Dorsey Run - Junction Dr to Guilford Rd	4	48,000
MD 214 - Addison Rd. to I-95 Ramp	9	46,000
MD 4 and MD 458(2 systems)	16	45,000
Maugans Rd - I-81 SB Ramp to Volvo Way	4	42,000
MD 24 - US 40 to I-95 Ramp	4	36,000
US 1 - Business Pkwy to Montgomery Rd (2 systems)	10	35,000
MD 424 - Martha Greenleaf Dr. to Reidel Rd.	3	30,000
MD 3/MD 175 Millersville	2	27,000
US 40 - Edgewood Dr. to Cleveland Ave.	5	26,000
MD 175 - Thunder Hill Rd. to Dobbin Rd.	3	25,000
MD 103 - US 29 Ramp to Long Gate Pkwy	4	21,000
US 40 - MD 279 to Chesapeake SC	9	21,000
MD 5 - Auth Rd. to Metro Entrance(2 systems)	17	14,000
US 1- Oglethorpe St. to 37th St.	11	14,000
MD 150 - 54th St. to Rolling Mill Rd.	2	9,000
MD 32 - MD 144 to MD 99	4	9,000
US 40 - Mall Ent. to Ebenezer Rd. (2 systems)	6	8,000
MD 197 - Kenhill Dr. to Mitchellville Rd.	6	7,000
MD 174 - I-97 to Elmhurst Rd.	5	7,000
MD 32 - Raincliffe Rd. to Springfield Ave.	2	7,000
US 40 - MD 152 to West Shore	7	4,000
US 40Alt - Lavale MD 53, MD 658	11	4,000
MD 26 - Klee Mill Rd.	3	3,000
MD 222 - St Marks Church Rd. to MD 275	5	3,000
MD 213 - Howard St. to MD 545	5	2,000
MD 25 - Old Pimlico Rd. to Clarkview Rd.	2	1,000
MD 924 - Patterson Mill Rd. to Wheel Rd.	4	1,000
MD 173 - Pitman Rd. to Energy Pkwy.	4	1,000
US 1 - Taylor Ave. to Fowler Ave.	4	0
Ocean City (3 systems)	42	-12,000
MD 567 - MD 542 to Cowpens Ave.	2	N/A
MD 450 - MD 193 to Race Track Rd.	17	N/A
TOTAL	267	790,000

A major effort in calendar year 2015 related to beginning the implementation of Centracs and adaptive signal system operations that allows for timings to be adjusted to conditions. The first corridor selected was along US 1 in Howard County which was implemented in October. The next corridor for implementation will be at 13 intersections on MD 24 in Harford County in 2016.

Another program is a joint state/county effort to implement transit signal priority. The first project is in Montgomery County on MD 355. A joint state/county policy and criteria for location identification has been developed, and corridors have been screened to determine the most beneficial locations for potential implementation. Future deployment remains unfunded at this time. Initial deployment will be focused on MD 355 between Lakeforest Mall and the Medical Center Metro Station as part of a new limited stop "Ride On Plus" transit service to be launched in Fall of 2017.

MD 25

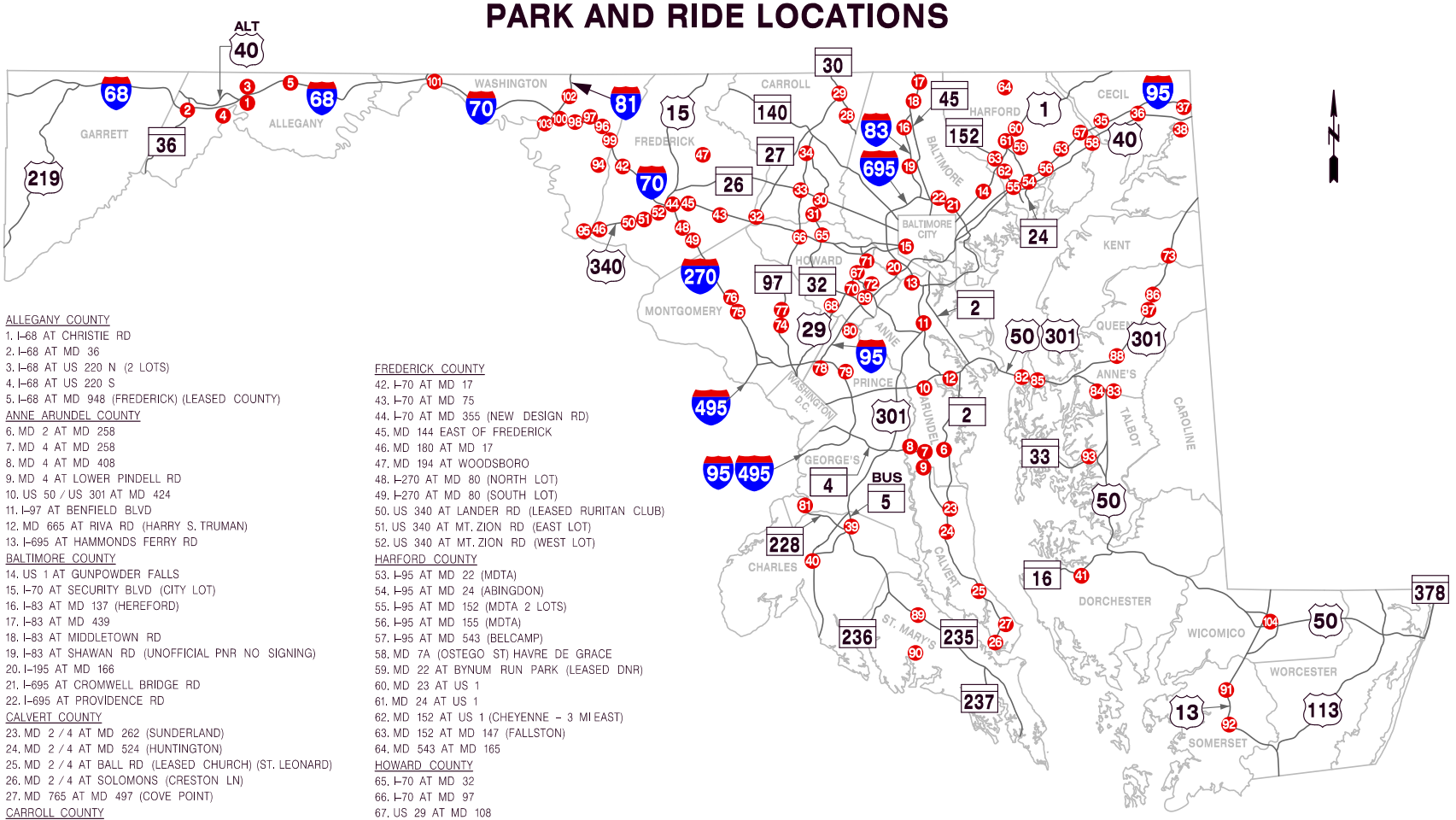
3. MULTI-MODAL

a. Park and Ride

The MDOT has created and maintains a system of park and ride lots throughout the State. These lots reduce single occupant vehicles and encourage transit use and ride-sharing. SHA partners with the Maryland Transit Administration and local transit agencies to encourage transit connections to the lots. The mutually beneficial relationship increases transit trips and reduces congestion. The lots operated by SHA and MDTA include 104 locations in 20 counties providing a total of 13,342 spaces. The number of spaces at the park and ride lots range from less than 15 spaces to more than 800 spaces. The two largest lots are MD 5 in the Waldorf area of Charles County and MD 665 at Riva Road in the Annapolis area of Anne Arundel County. The success of the program has justified funds to be allocated to expand the opportunities to utilize the lots. In 2015, 213 new spaces were constructed at the US 50/301 at MD 424 lot in Anne Arundel County and the number of spaces doubled at the I-70/MD 75 lot from 50 to 100. Also, a new lot opened last year at I-81/MD 68 in Williamsport of Washington County with nearly 50 spaces. It is estimated SHA and MDTA park and ride lot facilities result in a 107 million VMT reduction annually, a savings of approximately $58 million in annual user costs. Other minor adjustments occurred in the number of spaces in the network.

The following map shows the location of all the Park and Ride lots operated by SHA and MDTA in Maryland.

PARK AND RIDE LOCATIONS



ALLEGANY COUNTY
1. I–68 AT CHRISTIE RD
2. I–68 AT MD 36
3. I–68 AT US 220 N (2 LOTS)
4. I–68 AT US 220 S
5. I–68 AT MD 948 (FREDERICK) (LEASED COUNTY)

ANNE ARUNDEL COUNTY
6. MD 2 AT MD 258
7. MD 4 AT MD 258
8. MD 4 AT MD 408
9. MD 4 AT LOWER PINDELL RD
10. US 50 / US 301 AT MD 424
11. I–97 AT BENFIELD BLVD
12. MD 665 AT RIVA RD (HARRY S. TRUMAN)
13. I–695 AT HAMMONDS FERRY RD

BALTIMORE COUNTY
14. US 1 AT GUNPOWDER FALLS
15. I–70 AT SECURITY BLVD (CITY LOT)
16. I–83 AT MD 137 (HEREFORD)
17. I–83 AT MD 439
18. I–83 AT MIDDLETOWN RD
19. I–83 AT SHAWAN RD (UNOFFICIAL PNR NO SIGNING)
20. I–195 AT MD 166
21. I–695 AT CROMWELL BRIDGE RD
22. I–695 AT PROVIDENCE RD

CALVERT COUNTY
23. MD 2 / 4 AT MD 262 (SUNDERLAND)
24. MD 2 / 4 AT MD 524 (HUNTINGTON)
25. MD 2 / 4 AT BALL RD (LEASED CHURCH) (ST. LEONARD)
26. MD 2 / 4 AT SOLOMONS (CRESTON LN)
27. MD 765 AT MD 497 (COVE POINT)

CARROLL COUNTY
28. MD 30 AT MD 482 (HAMPSTEAD)
29. MD 30 AT MD 27 (MANCHESTER)
30. MD 32 AT CIRCLE DR (ELDERSBURG)
31. MD 32 AT SPRINGFIELD AVE (SYKESVILLE)
32. I–70 AT MD 27 (MT. AIRY)
33. MD 97 AT MD 26
34. MD 97 AT MD 32

CECIL COUNTY
35. I–95 AT MD 222 (CRAIGTOWN)
36. I–95 AT MD 272 (NORTHEAST)
37. I–95 AT MD 279 (ELKTON)
38. MD 213 AT FRENCHTOWN RD (ELKTON)

CHARLES COUNTY
39. MD 5 AT MATTAWOMAN / BEANTOWN RD (WALDORF)
40. US 301 AT MD 225 ARMORY (LEASED)

DORCHESTER COUNTY
41. MD 16 AT MD 355

FREDERICK COUNTY
42. I–70 AT MD 17
43. I–70 AT MD 75
44. I–70 AT MD 355 (NEW DESIGN RD)
45. MD 144 EAST OF FREDERICK
46. MD 180 AT MD 17
47. MD 194 AT WOODSBORO
48. I–270 AT MD 80 (NORTH LOT)
49. I–270 AT MD 80 (SOUTH LOT)
50. US 340 AT LANDER RD (LEASED RURITAN CLUB)
51. US 340 AT MT. ZION RD (EAST LOT)
52. US 340 AT MT. ZION RD (WEST LOT)

HARFORD COUNTY
53. I–95 AT MD 22 (MDTA)
54. I–95 AT MD 24 (ABINGDON)
55. I–95 AT MD 152 (MDTA 2 LOTS)
56. I–95 AT MD 155 (MDTA)
57. I–95 AT MD 543 (BELCAMP)
58. MD 7A (OSTEGO ST) HAVRE DE GRACE
59. MD 22 AT BYNUM RUN PARK (LEASED DNR)
60. MD 23 AT US 1
61. MD 24 AT US 1
62. MD 152 AT US 1 (CHEYENNE – 3 MI EAST)
63. MD 152 AT MD 147 (FALLSTON)
64. MD 543 AT MD 165

HOWARD COUNTY
65. I–70 AT MD 32
66. I–70 AT MD 97
67. US 29 AT MD 108
68. US 29 AT MD 216
69. MD 32 AT BROKEN LAND PKWY (EAST LOT)
70. MD 32 AT BROKEN LAND PKWY (WEST LOT)
71. MD 100 AT LONG GATE PKWY
72. MD 175 AT SNOWDEN RIVER PKWY

KENT COUNTY
73. US 301 AT MD 291

MONTGOMERY COUNTY
74. MD 97 AT MD 28
75. I–270 AT MD 117
76. I–270 AT MD 124
77. MD 200 AT MD 197 (MDTA)

PRINCE GEORGE'S COUNTY
78. I–95 TO I–495
79. MD 193 AT B / W PKWY ARMORY (LEASED)
80. MD 198 AT VAN DUSEN RD
81. MD 210 AT MD 373

QUEEN ANNE'S COUNTY
82. US 50 AT MD 8
83. US 50 AT MD 404 (EAST LOT)
84. US 40 AT MD 404 (WEST LOT)
85. US 50 AT PROFESSIONAL ISLAND PARK
86. US 301 AT MD 300
87. US 301 AT MD 302
88. US 301 AT MD 304

ST. MARY'S COUNTY
89. MD 5 AT MD 235
90. MD 234 AT MD 242

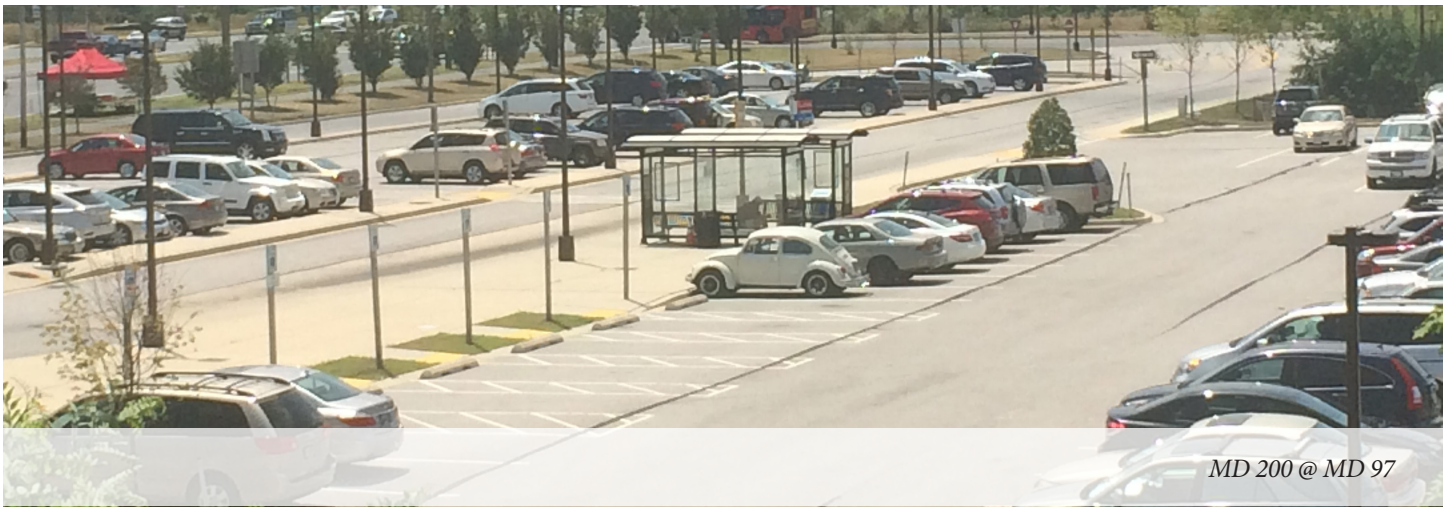
SOMERSET COUNTY
91. US 13 AT MD 362
92. US 13 AT MD 413

TALBOT COUNTY
93. MD 33 AT MD 370

WASHINGTON COUNTY
94. US 40 ALT AT MD 67
95. US 340 AT MD 67 (MD 67D WEVERTON)
96. I–70 AT US 40
97. I–70 AT MD 65 (SHA LOT)
98. I–70 MD 65 SHA LOT AT MVA (LOWER LOT)
99. I–70 AT MD 66
100. I–70 AT MD 632 (LEASED COUNTY)
101. MD 144 AT CENTER ST (HANCOCK) (LEASED DNR)
102. I–81 AT MD 58
103. I–81 AT MD 68 (WILLIAMSPORT) (NEW LOT)

WICOMICO COUNTY
104. US 50 AT PHILIP MORRIS DR

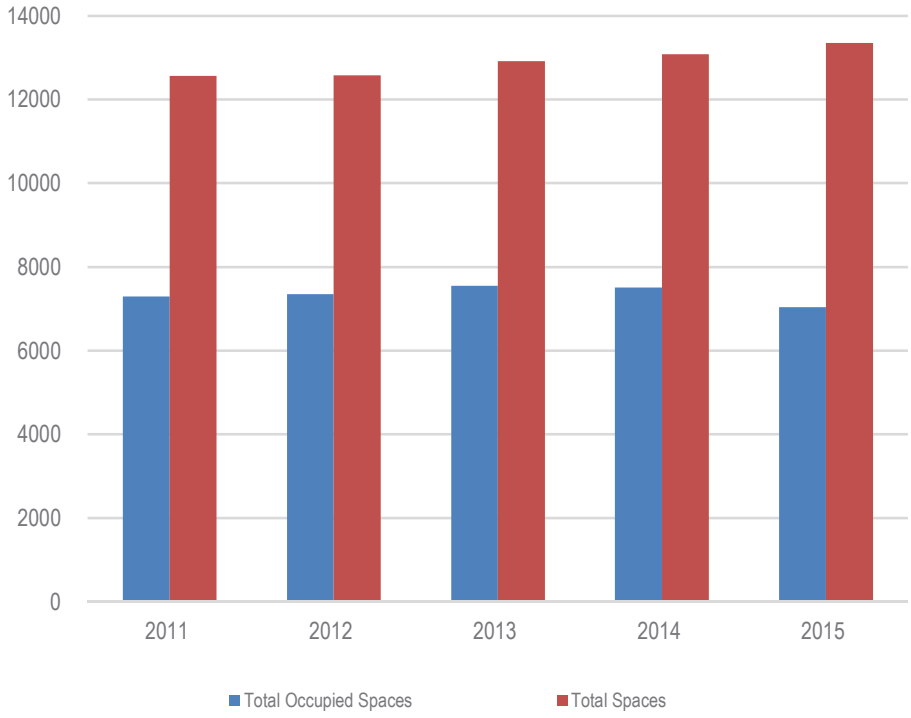
0 5 10 20 30 40 50 Miles



MD 200 @ MD 97

A survey is performed twice a year (spring and fall) at each park and ride to determine usage. Over 7,000 spaces were utilized on a given day accounting for about 55% of the total spaces. The reduction in the price of fuel may have contributed to a reduction in the utilization of the lots as shown in the following figure.

SHA/MDTA PARK AND RIDE LOT SPACES AND USERS



Several lots saw increases in the number of persons utilizing those facilities. The largest increase in usage were at:

- I-270 at MD 124
- I-70 at Security Blvd
- MD 200 at MD 97

Each of these lots had a greater than 10 vehicle increase in usage with the largest being more than 50 additional vehicles parking at the I-270 and MD 124 lot in Montgomery County. The estimated annual user savings over the past four years is shown below.

Several lots experienced capacity constrained conditions with motorists parking on the grass, in unmarked spaces. The following locations exceeded capacity during the survey:

- MD 2/4 @ MD 262 (Calvert County)
- MD 2/4 @ Ball Road (Calvert County)
- US 340 @ Mt Zion Road (East and West Lot) (Frederick County)

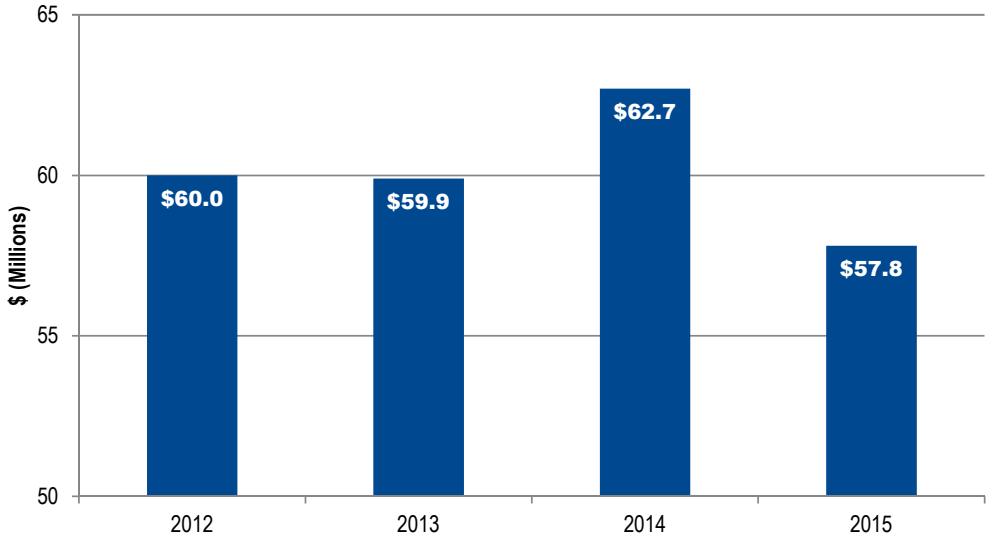
b. HOV Lane Operation (HOV)

High occupancy vehicle (HOV) lane operations provide an effective travel demand management strategy to move people and goods. These lanes maximize person throughput by offering a travel time savings for multiple occupant vehicles over single occupant vehicles. In Maryland, vehicles in HOV lanes must have two or more occupants; transit vehicles, motorcycles or plug-in electric vehicles (permits required) are exempt. This mobility measure allows the HOV lanes to operate near free flow speeds when the general purpose lanes generally experience congestion and lower travel speeds. HOV lanes are located on I-270 in Montgomery County and US 50 in Prince Georges County. The I-270 and US 50 HOV lanes are mostly separated by pavement markings from the general purpose lanes although, a few sections along I-270 have a physical separation between the lanes.

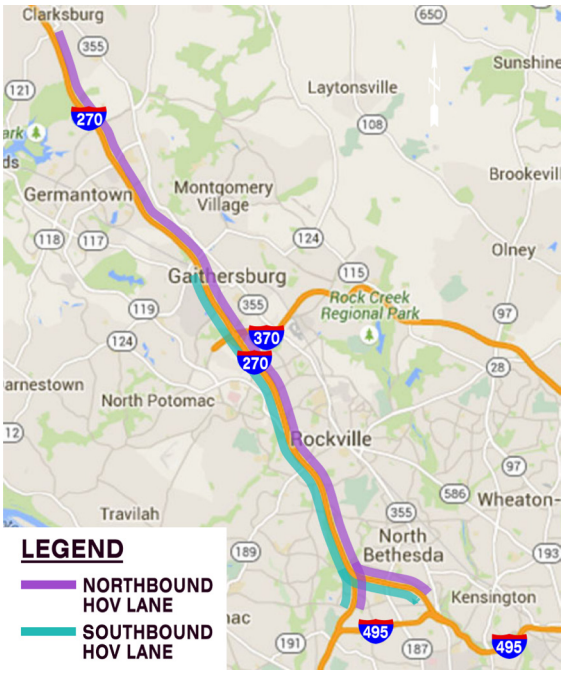
The I-270 HOV lanes operate southbound from 6:00 to 9:00 AM and northbound from 3:30 to 6:30 PM while the US 50 HOV lanes function the entire day. HOV lanes, in combination with park and ride lots, increase person throughput and provide a viable alternative transportation mode for commuters in Maryland. This provides an effective Active Travel Demand Management (ATDM) strategy.

A study was conducted to analyze the performance of the HOV lanes relative to the general purpose lanes. This was accomplished using travel time data from permanent Bluetooth sensors analyzing person throughput, and determining travel time savings. Person throughput evaluates the total number of people moved in each lane versus the total number of vehicles. On I-270 the HOV lanes transported approximately 400 to 1,800 additional people compared to an average general purpose lane.

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

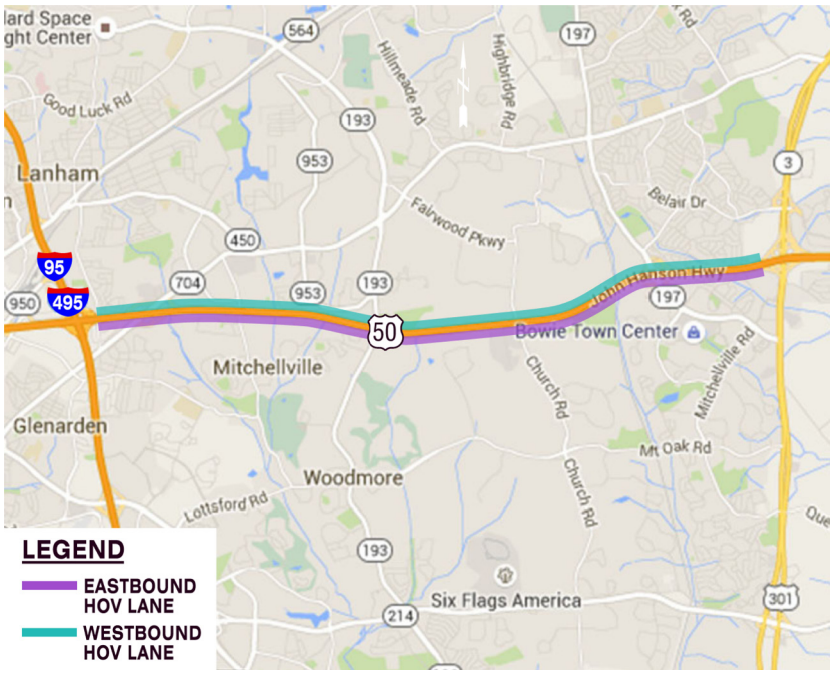


HOV LOCATIONS



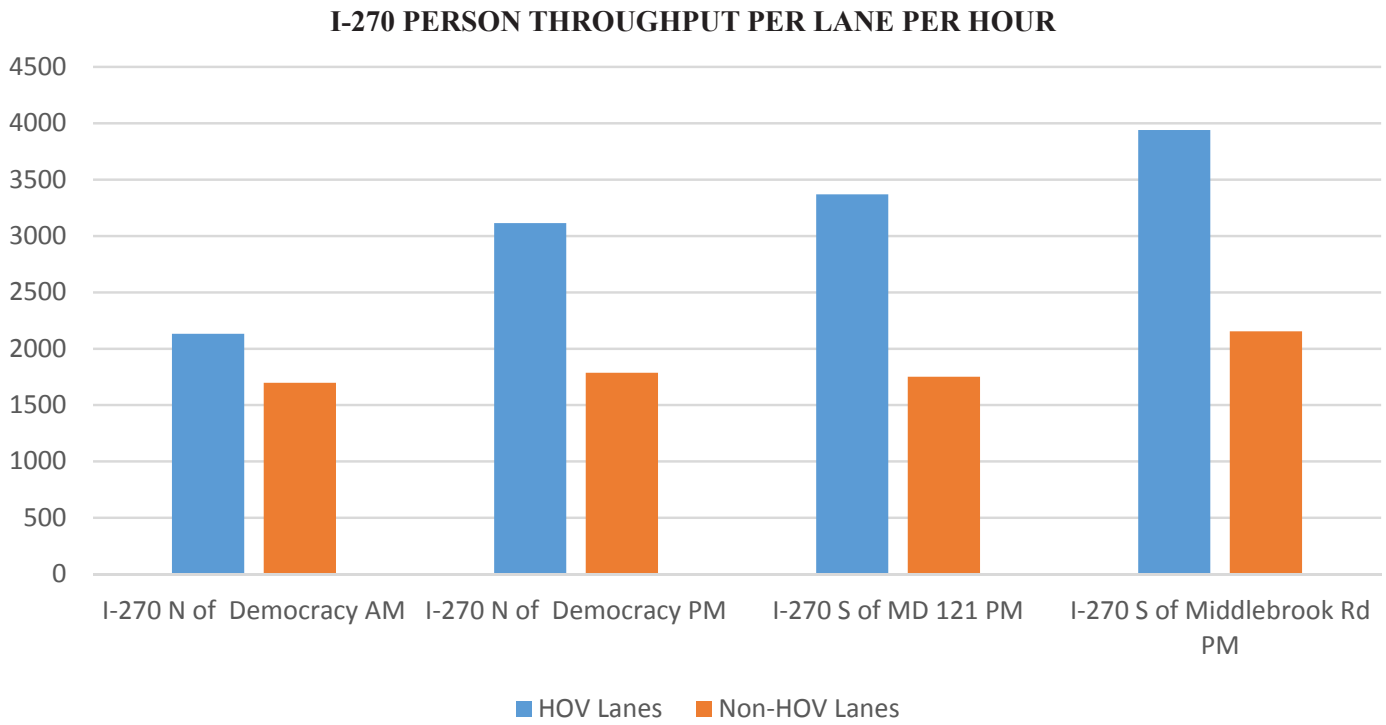
I-270 Northbound I-495 to MD 121 - 16 miles

I-270 Southbound MD 117 to I-495 - 9 miles

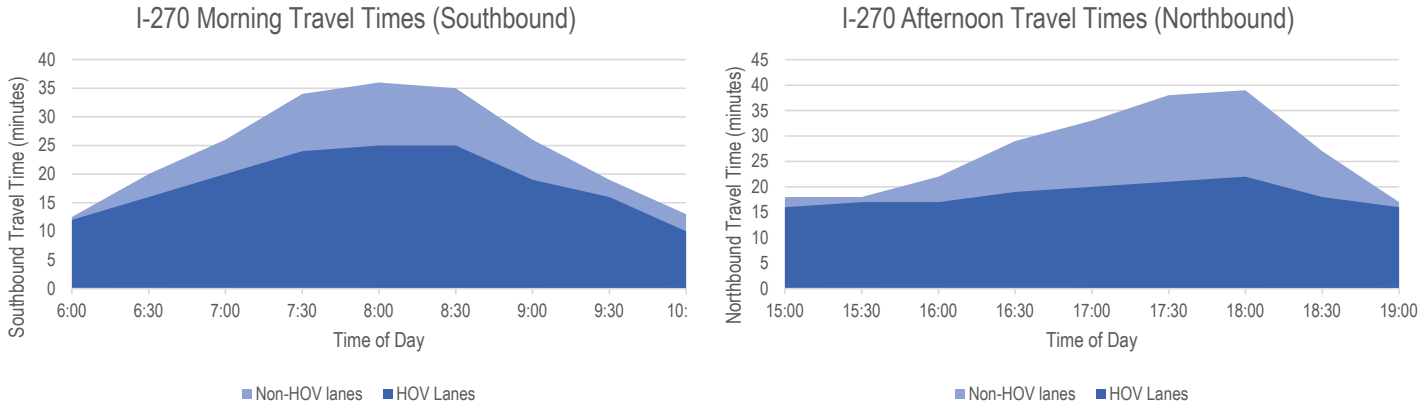


US 50 - US 301 to I-95 - 7.5 miles

The HOV lane carries as many as 3,900 persons per lane per hour as shown in the following chart:



A major advantage that HOV lanes provide is in travel time savings to users of those lanes. Of the two locations with HOV lanes, the I-270 facility experienced a more significant savings in travel time. In the morning peak period, the travel time savings was as much as 11 minutes with an average of six (6) minutes. The afternoon peak period provided even greater travel time savings with a maximum of 17 minutes and an average of eight (8) minutes. In 2015, HOV lane operations on I-270 resulted in 153,000 hours of travel time savings and 186,000 gallons of fuel savings. This amounts to $5.3 million in annual user savings. The average travel time savings on the HOV lanes versus the general purpose lanes during the AM and PM peak period of operation are depicted in the following figure.



The travel time savings on US 50 for the HOV lanes versus the non-HOV lanes is relatively nominal. It is estimated that the HOV lanes on US 50 provide $0.4 million in annual benefits. The total savings for both facilities is estimated to be $5.7 million.

c. Reversible Lane Operation

Reversible lanes is another strategy utilized in selected corridors to improve mobility. The use of reversible lanes allows for increased person throughput and reduced congestion without significant capital investment. This reduces the impact to surrounding residents, businesses and environmental resources. Reversible lanes are limited to corridors with high directional traffic volumes in the peak periods and operate through the use of overhead lane control signals designating the middle lane(s) to alternate with the peak flow of traffic. Reversible lanes are usually limited to certain hours of the day.

Reversible lane operations are in use along:

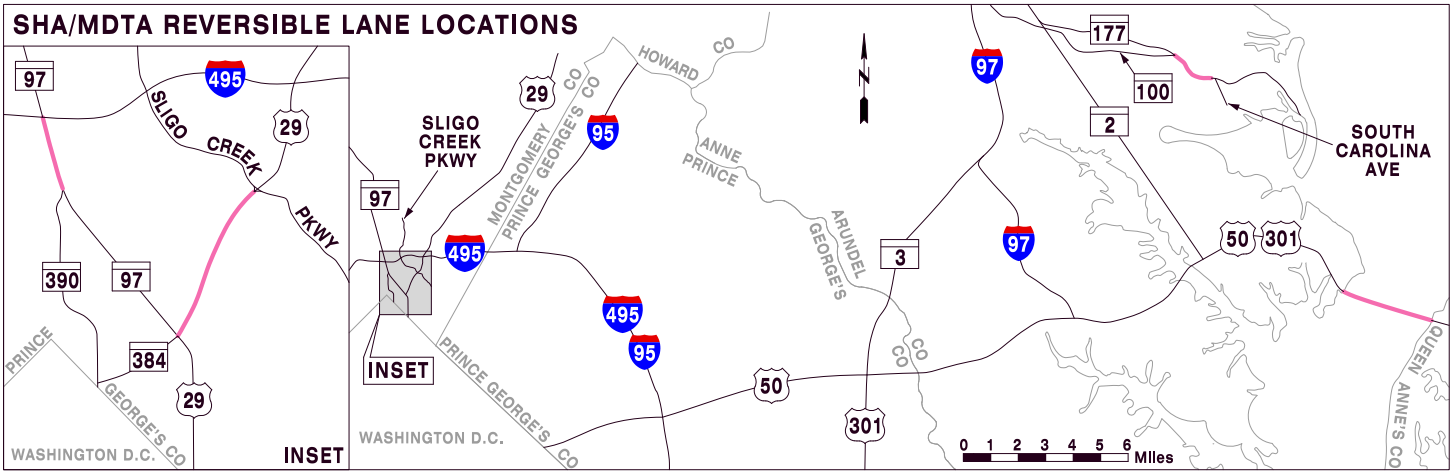
- US 29 from Sligo Creek Parkway to MD 97 (Georgia Ave) (Montgomery County) - 1.0 miles
- US 50/US 301 Chesapeake Bay Bridge (Anne Arundel/Queen Anne's County) - 4.5 miles
- MD 97 from I-495 to MD 390 (16th Street) (Montgomery County) - 0.5 miles
- MD 177 from MD 100 to West of South Carolina Avenue (Anne Arundel County) - 1.6 miles

Motorists statewide are most familiar with the reversible lanes on the US 50/US 301 Bay Bridge. Travellers heading to or from the Eastern Shore and points such as Ocean City normally have two lane eastbound lanes and three westbound lanes across the Bridge. Through the use of overhead lane signing, this alternates to allow for three eastbound lanes and two westbound lanes. The changeover occurs as needed during the PM peak period and on Saturday mornings in the peak travel periods. Outside of Washington DC, US 29 and MD 97 reversible lane operations improve traffic flow into the downtown Silver Spring employment center and access to the WMATA METRO Red Line. The lanes operate southbound in the AM peak period and northbound in the PM peak period. MD 177 (Mountain Rd.) is a three lane roadway in Anne Arundel County that is converted from two lanes westbound in the AM peak period to two lanes eastbound in the PM peak period to respond to the directionality of the traffic between Lake Shore and Gibson Island to Pasadena.

The number of drivers in the peak hour peak direction that utilize the reversible lane or lanes and the other lanes on those particular facilities are as follows:

Location	AM (PM) Volume Traveling in General Lanes (Vehicles Per Hour)	AM (PM) Volume Traveling in Reversible Lane(s) in Peak Direction (Vehicles Per Hour)
US 29	1,575 (1,050)	1,250 (1,325)
US 50/301	N/A (3,000)	N/A (1,600)
MD 97	2,200 (1,650)	600 (650)
MD 177	1,100 (1,275)	375 (450)

There are other reversible lane operations in Maryland not operated by MDOT, along Brightseat Road and Arena Drive near FedEx Field in Prince George's County, along Clara Barton Parkway in Montgomery County and along MD 2 (Hanover Street) over the Patapsco River in Baltimore City. The reversible lane locations for SHA/MDTA facilities are shown on the following map.



d. Bicycles and Pedestrians

The MDOT integrates bicycle and pedestrian facilities into every aspect of our multi-modal transportation network. Pedestrian and bicycle facilities provide numerous benefits including reducing auto emissions, improving public health and enhancing community vitality to encourage more sustainable and livable places. Methods used by the State to achieve these goals are outlined in the Bicycle and Pedestrian Master Plan. One of the initiatives is Cycle Maryland which provides a one-step portal on cycling activities in Maryland.

The planning/design/construction of MDOT projects incorporates a Complete Streets policy to create a transportation system that balances all users of the roadway, including pedestrians, transit, bicyclists, and motorists. This could involve providing new sidewalks, reconstructing existing sidewalks, providing ADA facilities such as ramps and audible pedestrian signals, bike lanes, and upgrades to signing/pavement markings to alert motorists to all users of the facility.

MDOT has developed several programs to implement the planning, design, and construction of bicycle and pedestrian facilities throughout the state, including:

- Sidewalk Retrofit - Sidewalk program to fill in gaps or construct key pieces of the pedestrian network.
- Bicycle Retrofit - Bicycle improvements including signing and marking upgrades, modifying typical sections and creating off road trails to facilitate bicycle mobility.
- Bicycle and Pedestrian Priority Areas (BPPA) - Collaborative approach that designates areas to improve mutli-modal options by better aligning state and local bicycle and pedestrian facilities in areas with high potential for bicycling and walking.
- Transportation Alternatives Program (TAP) - Pedestrian and bicycle improvement program for transportation related community projects to strengthen the intermodal transportation system.
- Recreational Trails Program - Construction of new trails or maintenance/rehabilitation of existing trails.
- Safe Routes to School Program - Program for bicycle and pedestrian routes to school for children in grades K-8.

MD 144

- Americans with Disabilities Act (ADA) Retrofit Program - Upgrades of sidewalks, curb ramps, intersections and driveway entrances to comply with ADA.
- Urban Reconstruction Program - Projects to promote safety and economic developments such as including sidewalks in priority funding areas.

e. Transit Oriented Development

Developments at locations that can be integrated with transit facilities provide a comprehensive multi-modal method to reduce auto dependency, increase pedestrian and bicycle trips, foster safer station areas, offer attractive public spaces, enhance public transportation ridership, and encourage new development or revitalization around the station. MDOT has established 16 such sites throughout the state referred to as Transit Oriented Developments (TODs). TODs increase the mobility of citizens by providing more convenient access to mass transit while reducing fuel consumption, air pollution, greenhouse gas emissions, and local infrastructure costs. State designated TOD projects allows for funds and resources, financing assistance, tax credits, prioritization for the location of State offices, and support from MDOT on access improvements. The sites are located in six (6) counties (Harford, Baltimore, Anne Arundel, Howard, Montgomery, and Prince George's) and Baltimore City as shown by the figure on the following page.

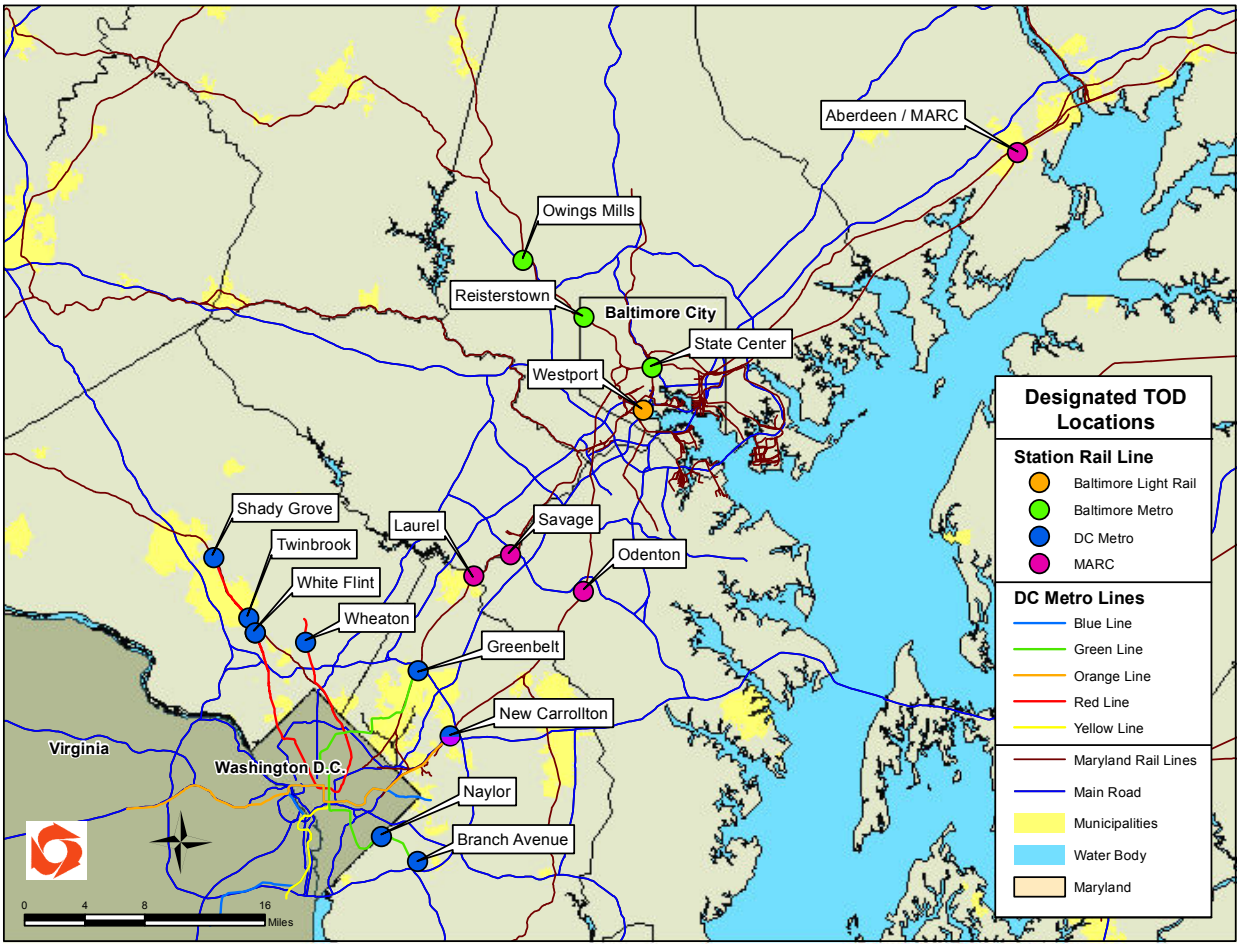
The development of TODs includes partnerships between MDOT and the Washington Metropolitan Area Transit Authority (WMATA). The two agencies are working together at locations such as New Carrollton, White Flint, and Branch Metro stations to develop joint projects.

The 16 current TODs are at different stages of development ranging from the commencing of agreements to occupancy and final construction. Locations including Twinbrook, where 214 apartments and 18,000 sf of retail opened in September 2015 are in the planning stages for additional development. Among the most active presently are shown in the following table.

ACTIVE DEVELOPMENT AT TODs

TOD Location	MULTI-MODAL CONNECTION	ON-GOING DEVELOPMENT
Owings Mills	MTA-METRO	200,000 sf office
Annapolis Junction/ Savage	MARC	100,000 SF office 14,000 SF retail 416 residential units

DESIGNATED TOD LOCATIONS



4. FREIGHT

A balance exists between the movement of freight and the impact to residents that may prefer to prohibit trucks near their homes. In order to direct truckers to the most appropriate routes the Maryland Truck Route System was established consisting of approximately 900 miles of roadways throughout the State. It includes all interstate routes (481 miles), seven segments of U.S. Routes (320 miles) including US 13, US 40, US 50, US 301, US 340, US 13 Business and US 50 Business and seven segments of Maryland state routes (99 miles). The state routes include sections of MD 3, MD 4, MD 10, MD 100, MD 201, MD 295 and MD 702. MDOT is in the process of updating its truck route system in accordance with the FAST ACT, commencing in the fall of 2016. It will evaluate Freight Elements for Critical Rural and Urban Corridors including intermodal movements, truck network gaps, improve connections and identify other routes experiencing a high-severity index related to truck crashes.

Several programs and policies have been developed to improve safety and mobility. These include upgrades to at-grade railroad crossings through the Highway-Rail Crossing Program, programs to construct virtual weigh stations and Commerical Vehicle Information Systems and Networks (CVISN) facilities to the implementation of the Maryland One Hauling Permit System and the continual monitoring of truck parking as part of Jason's Law. Jason's Law provides federal funding toward the construction of safe roadside parking

I-95 @ I-495

lots for truck drivers. This includes assessing truck volumes, developing metrics to measure truck parking, and evaluating the capacity to provide adequate truck parking.

MDOT-SHA has several on-going initiatives related to Jason's Law including identifying welcome centers/rest areas that could be expanded. This includes:

- I-68 Youghiogheny Overlook (Garrett County)
- I-70 Eastbound and Westbound Welcome Areas (Frederick County)
- I-95 Northbound Welcome Center (Howard County)
- I-70 Eastbound Truck Rest Area (Frederick County)

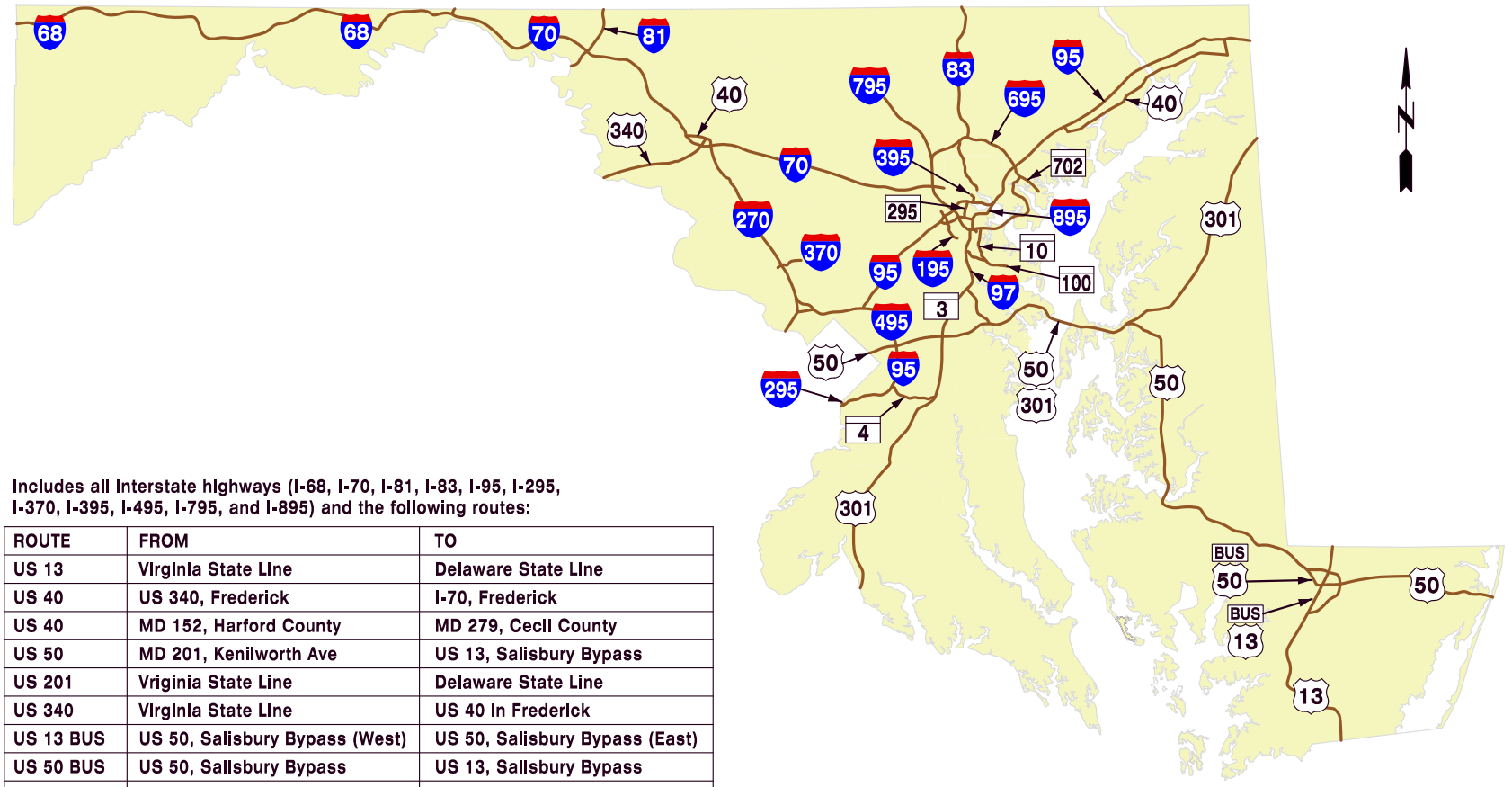
Other methods to increase truck parking being explored include:

- Identifying areas along freight corridors that have sizable right-of-way that can serve as a possible truck holding area.
- Investigating P3 truck parking opportunities with developers.
- Researching the use of Truck Weigh and Inspection Stations for overnight truck parking when the station is closed.
- Reviewing possible expansion of park and ride facilities to include truck parking.

In addition, future studies will delve into a better understanding of the analytics of why truck drivers park at certain locations and then to address them through research and development. Efforts such as the I-95 Corridor Coalitions Truck n' Park pilot project introduce intelligent transportation systems to address these challenges.

An additional element is the incorporation of freight into the highway project planning process. The SHA/MDTA Freight Implementation Plan provides direction for future transportation investments to enhance the safe and efficient movement of commercial vehicle freight.

MARYLAND TRUCK ROUTE SYSTEM



Includes all Interstate highways (I-68, I-70, I-81, I-83, I-95, I-295, I-370, I-395, I-495, I-795, and I-895) and the following routes:

ROUTE	FROM	TO
US 13	Virginia State Line	Delaware State Line
US 40	US 340, Frederick	I-70, Frederick
US 40	MD 152, Harford County	MD 279, Cecil County
US 50	MD 201, Kenilworth Ave	US 13, Salisbury Bypass
US 201	Vriginia State Line	Delaware State Line
US 340	Virginia State Line	US 40 in Frederick
US 13 BUS	US 50, Salisbury Bypass (West)	US 50, Salisbury Bypass (East)
US 50 BUS	US 50, Sallsbury Bypass	US 13, Sallsbury Bypass
MD 3	US 50/US 301, Bowie	I-97
MD 4	I-95	US 301, Upper Marlboro
MD 10	MD 100, Glen Burnie	I-695, Baltimore County
MD 100	MD 607, Jacobsville	I-97
MD 295	I-695, Baltimore County	I-95 north of Baltimore City Line
MD 702	I-695, Baltimore County	Old Eastern Ave

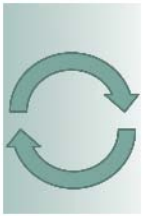
5. MARYLAND TRANSPORTATION SYSTEMS MANAGEMENT AND OPERATIONS (TSM&O) PLAN

Transportation Systems Management and Operations (TSM&O) has emerged in recent years as a formal discipline for state departments of transportation (DOTs) to better assist in operating existing network facilities to their fullest service potential. In 2016, MDOT SHA released the Maryland TSM&O Strategic Implementation Plan that included four key goals, associated objectives, performance metrics, and strategies. This is one of the first TSM&O Plans in the nation that was advanced through FHWA Strategic Highway Research Program (SHRP 2) implementation assistance.

This TSM&O Plan is a strategic effort to institutionalize planning for operations and expand SHA's existing programs to promote:

- More efficient, useful, and personalized traveler information
- Increased safety along freeways, in work zones, and at highway/rail crossings
- Increased mobility at inter-modal transfer points
- More secure and redundant transportation management services
- Safer and quicker management of roadway incidents at multi-jurisdictional locations
- Increased mobility on arterials/surface streets, tolled roadways, and event/work zone locations
- Increased real-time traffic management and traveler information services through use of the latest technology tools
- Increased safety, mobility, and reliability due to coordinated management of commercial vehicles and hazardous material shipped along roadways.

SHA has started implementing key aspects of this TSM&O Plan and expects this program to shape performance based planning and operations at the agency.



Goal 1. Develop and implement a sustainable TSM&O Program at SHA.

Goal 3. Improve travel time reliability for both people and freight on both freeways and arterials.

Goal 3. Develop data-and performance-driven approaches to support TSM&O planning, programming, implementation and evaluation decisions.

Goal 4. Improve the travelling public's experience on Maryland highways by enabling customers with information and choices.

LARRY HOGAN
Governor

BOYD K. RUTHERFORD
Lt. Governor

PETE K. RAHN
MDOT Secretary

GREGORY I. SLATER
MDOT SHA Administrator

FOR FURTHER INFORMATION, PLEASE CONTACT:

GREGORY I. SLATER, ADMINISTRATOR
gslater@sha.state.md.us

SUBRAT MAHAPATRA
MDOT SHA - Office of Planning and Preliminary Engineering
smahapatra@sha.state.md.us

MARYLAND STATE HIGHWAY ADMINISTRATION
707 North Calvert Street, C411
Baltimore, MD 21202

800-323-MSHA
TTY 800-735-2258

roads.maryland.gov

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MARYLAND DEPARTMENT OF TRANSPORTATION
STATE HIGHWAY ADMINISTRATION