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.

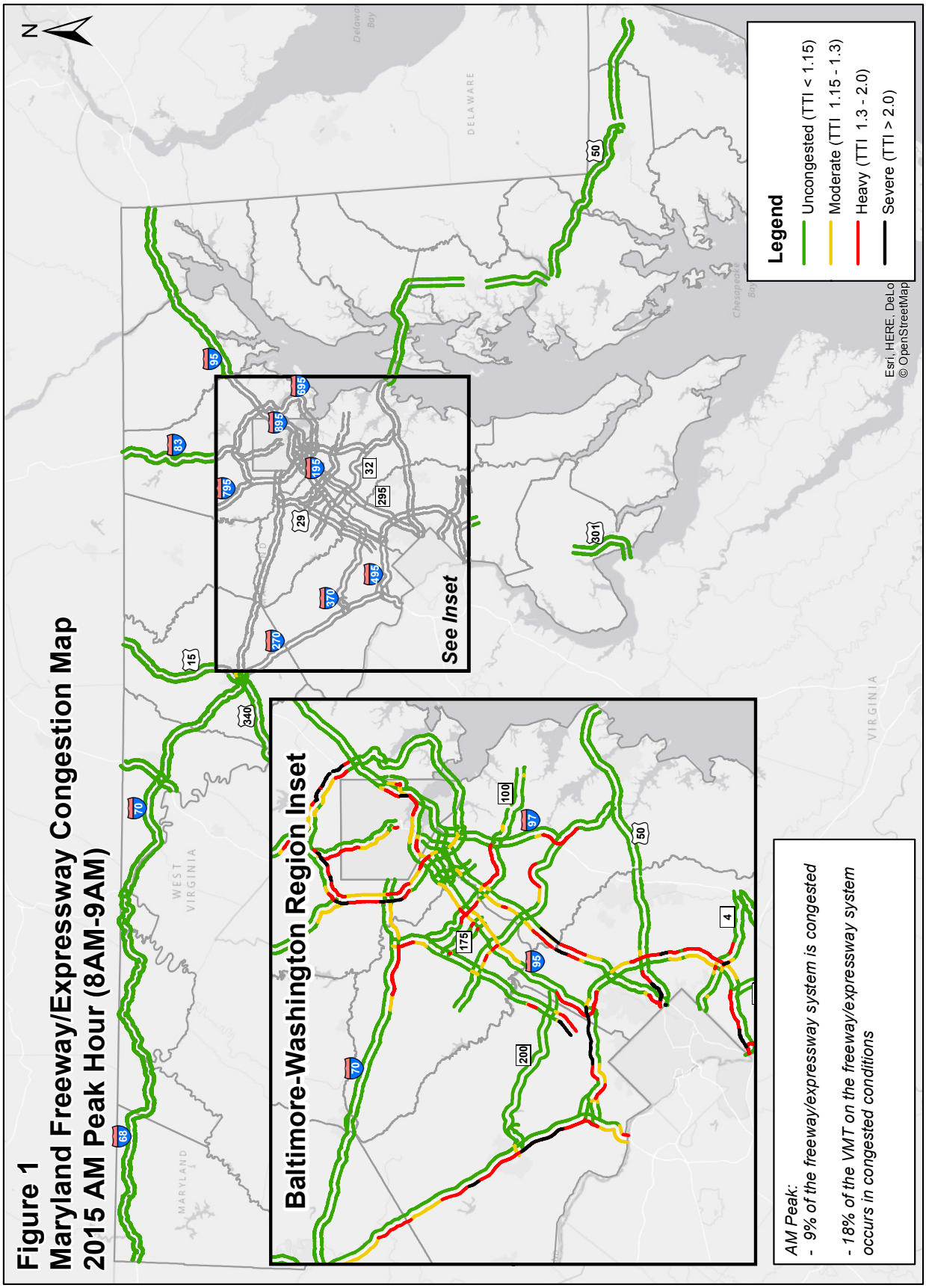
Figure 1
Maryland Freeway/Expressway Congestion Map
2015 AM Peak Hour (8AM-9AM)
Baltimore-Washington Region Inset
See Inset
Legend
Uncongested (TTI < 1.15)
Moderate (TTI 1.15 - 1.3)
Heavy (TTI 1.3 - 2.0)
Severe (TTI > 2.0)
AM Peak:
- 9% of the freeway/expressway system is congested
- 18% of the VMT on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

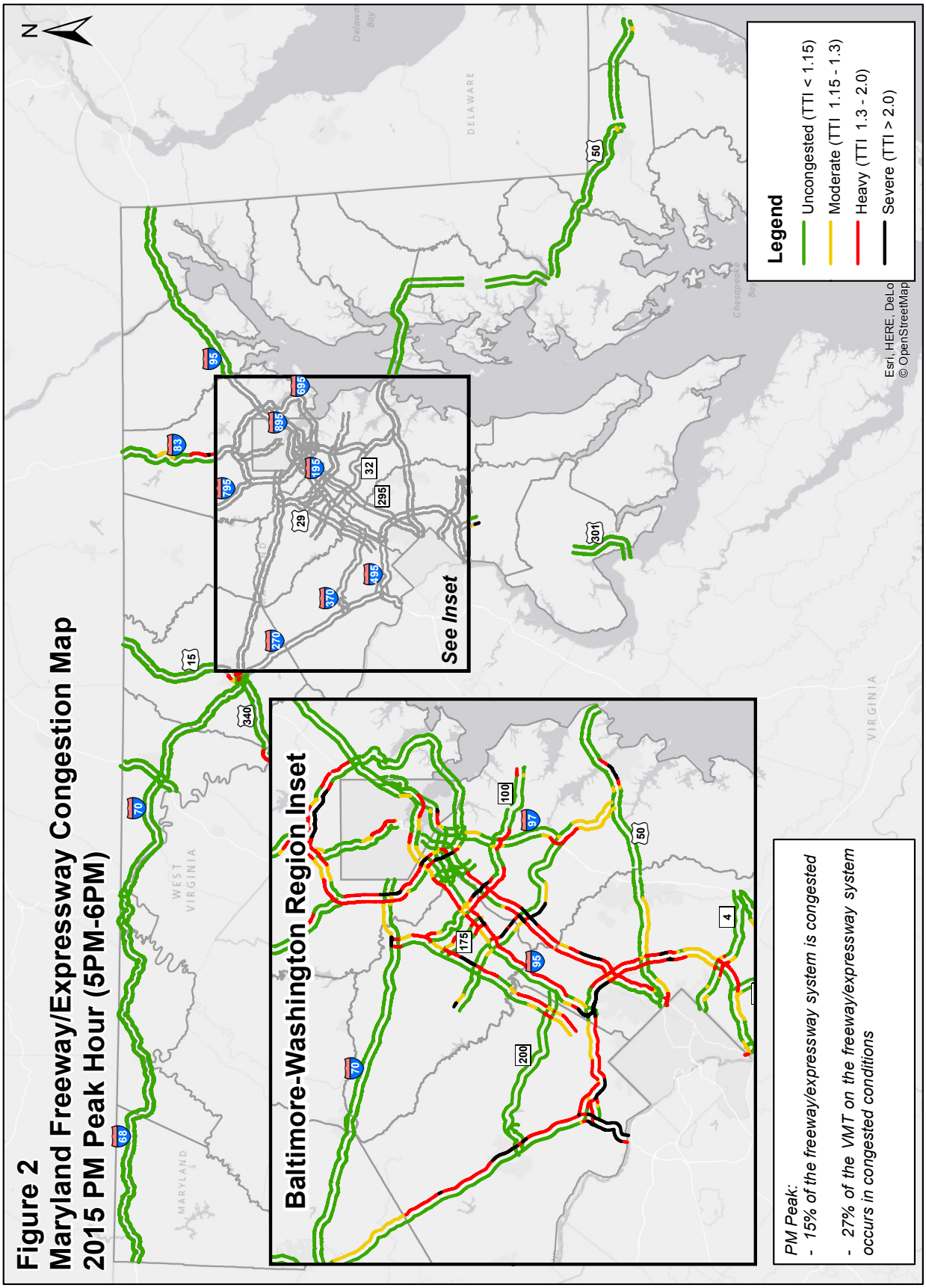
Figure 2
Maryland Freeway/Expressway Congestion Map
2015 PM Peak Hour (5PM-6PM)
Baltimore-Washington Region Inset
See Inset
Legend
Uncongested (TTI < 1.15)
Moderate (TTI 1.15 - 1.3)
Heavy (TTI 1.3 - 2.0)
Severe (TTI > 2.0)
PM Peak:
- 15% of the freeway/expressway system is congested
- 27% of the VMT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

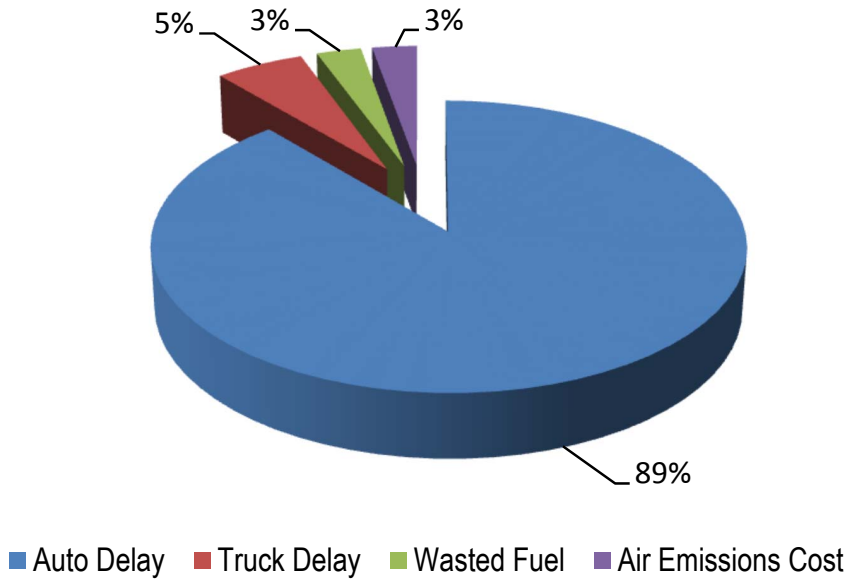
The highest user cost was experienced in the Baltimore - Washington region. It was estimated that congestion cost in the area was $2.028 billion. The cost associated with congestion for the Eastern Shore, Southern and Western Maryland regions is estimated at $24 million. The overall state and region 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:

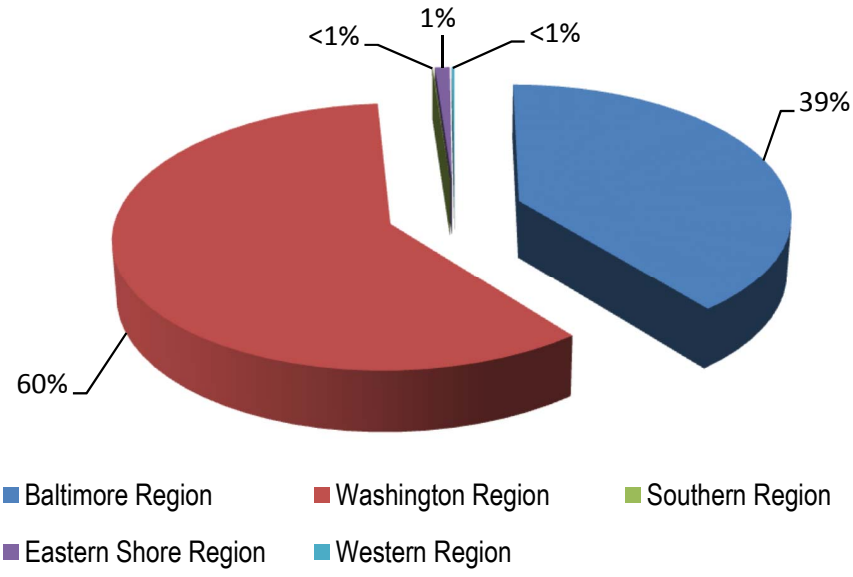
PERCENT OF 2015 STATEWIDE CONGESTION COST BY SOURCE

(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

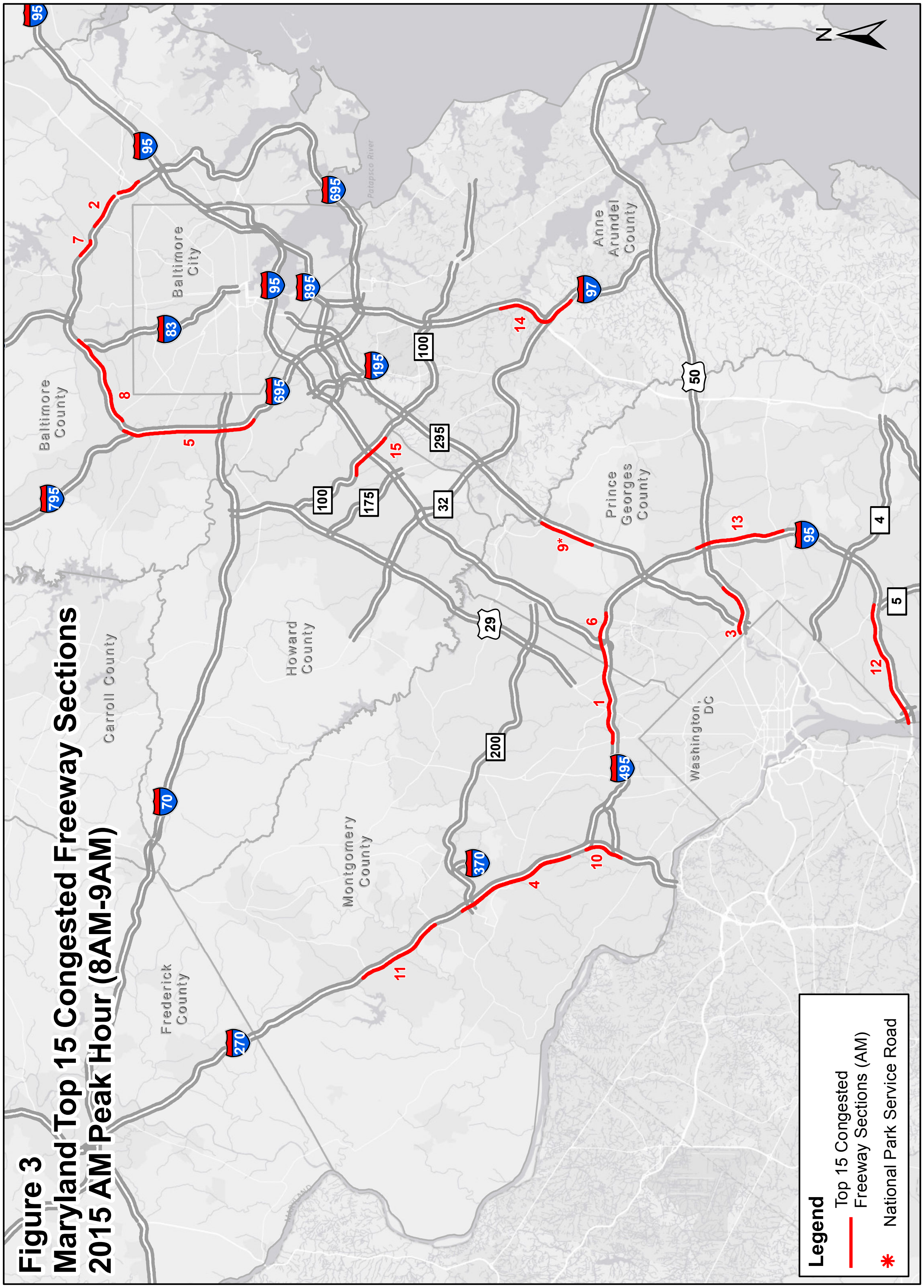


Figure 3
Maryland Top 15 Congested Freeway Sections
2015 AM Peak Hour (8AM-9AM)

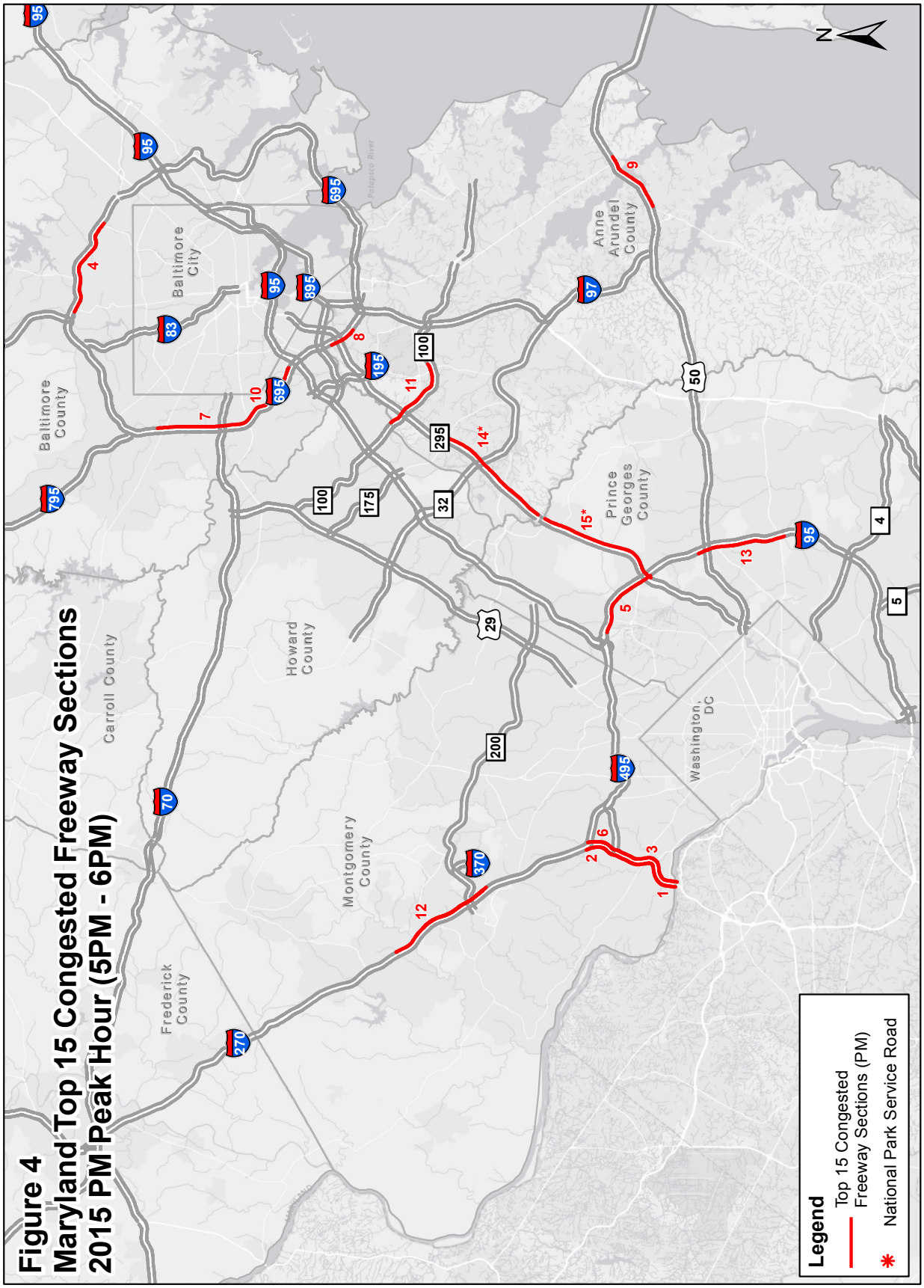


Figure 4
Maryland Top 15 Congested Freeway Sections
2015 PM Peak Hour (5PM - 6PM)
Legend
Top 15 Congested Freeway Sections (PM)
National Park Service Road
N
Baltimore City
Baltimore County
Anne Arundel County
Howard County
Carroll County
Montgomery County
Prince Georges County
Frederick County
Washington,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