

Maryland SHA's Use of Probe Data and Lessons Learned

2015 MWCOG Vehicle Probe Data Users Group

Washington, DC

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MSHA & JMT

Why is SHA interested?

- Maryland is home to **6 million people** with lots of geographic and socio-economic diversity
- SHA operates and maintains the numbered, non-toll routes in MD - **17,000 lane-miles** and **2,576 bridges**
- SHA roadways serve **65% of state VMT** and **85% of truck VMT**

- Performance Management & Data driven decisions at all levels
- Business Plan, Performance Measurement & MAP-21
- Increased focus on Operations
- System Efficiency & Reliability key
- Freight movement & Economy
- Communicating Performance



Mobility/ Reliability Performance Management

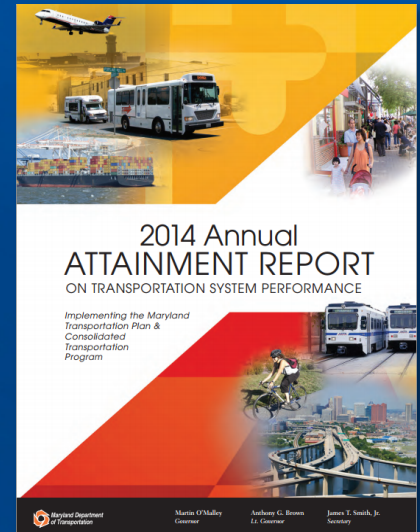
Mobility & Economy is one of six Key Performance Areas (KPAs) at SHA.

Mobility KPA Goal: *Support Maryland's Economy and Communities through enabling reliable movement of people and goods.*

Objectives, performance measures and strategies have been identified to accomplish the goal.

Travel Reliability, Freight Mobility and Travel Information Dissemination are three objectives that use private sector vehicle probe data.

Vehicle probe data feed various performance metrics



Maryland State Highway Annual Mobility Report

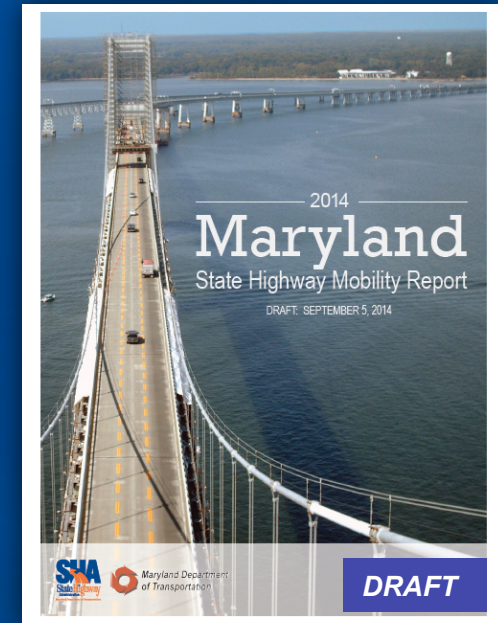
Background

- Developed to document key initiatives at SHA as it relates to Mobility KPA
- Started in 2012...in the third year of publication
- Demonstrates SHA data and performance based decision-making framework
- Built around a theme of:

What's happening?

What is SHA doing?

What is the outcome?



Datasets

- INRIX Vehicle Probe Data on freeways/expressways
- SHA Traffic Count Data
- SHA Signal System Data
- SHA Construction Project Information

Applications

- UMD CATT Lab Vehicle Probe Project (VPP) Suite
- SHA Traffic Monitoring System Application (I-TMS)
- Traffic Simulation Models and Other GIS Applications

General Data Processing Method

Obtain Data via
VPP Massive
Raw Data
Download

Format Data
with MATLAB

Generate PM
values with
MATLAB

Create Report

Vehicle Probe Project Suite

Massive Raw Data Downloader

NJ Trendmap Issue Set	245	alundi@umd.edu
NJ Trendmap Individual	232	alundi@umd.edu
VA07	134	eshragh@umd.edu
Maryland District 4	2180	mvandan@umd.edu
Freight Network 1091 Maryland	1091	eshragh@umd.edu
MD-4	66	RM1car@umd.edu
MD-195	159	lfarokhi@umd.edu
MD-2635	2635	lfarokhi@umd.edu

Your selected roads: MD-4

2. Date Range: 01/01/2014 - 01/31/2014

3. Days of week: Sun, Mon, Tue, Wed, Thu, Fri, Sat

4. Time of day: 12:00 AM - 11:59 PM

5. Fields:

- Speed
- Travel time
- Historic average speed
- Confidence score
- Reference speed
- C-value

6. Averaging:

- Don't average
- 5 minutes
- 10 minutes
- 15 minutes
- 30 minutes
- 1 hour

7. Description: Enter a description...

8. Notification:

- Send me an email when this export is ready

Submit download request

Work performed with support from UMD-CATT

Travel Time Index

- AM and PM Peak Hours
- INRIX Data
- Ratio of Peak Hour Travel Time versus Free Flow Travel Time



Planning Time Index

- AM and PM Peak Hours
- INRIX Data
- Amount of Travel Time a Motorist Should Plan on Allowing to Arrive at Destination on Time Taking into Account Potential Impacts



MSHA Definitions of Congestion and Reliability

Travel Time Index (TTI): (50th Percentile Travel Time/Free Flow Travel Time)

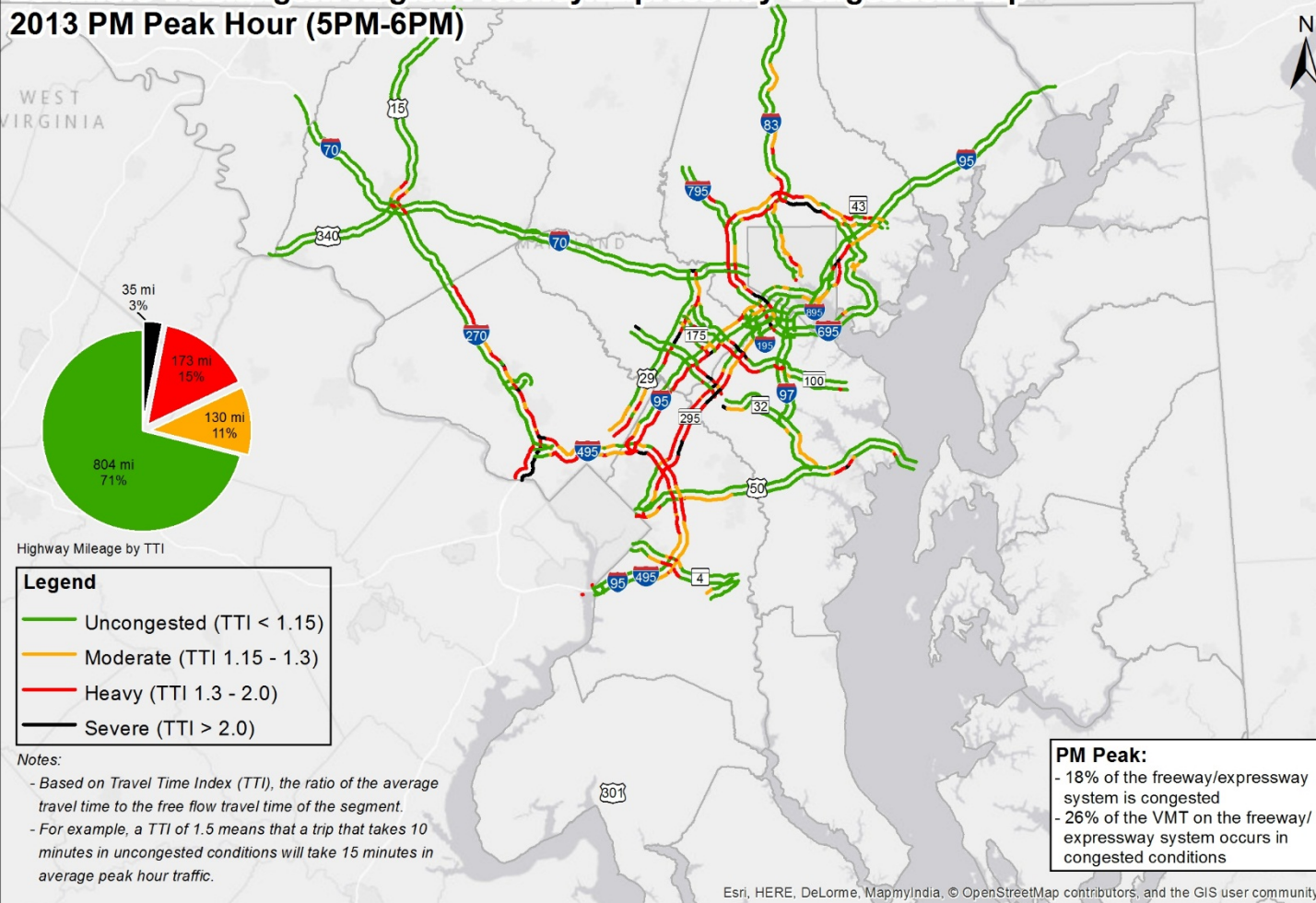
- Uncongested (TTI < 1.15)
- Moderate (1.15 < TTI < 1.3)
- Heavy (1.3 < TTI < 2.0)
- Severe (TTI > 2.0)

Planning Time Index (PTI): (95th Percentile Travel Time/Free Flow Travel Time)

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

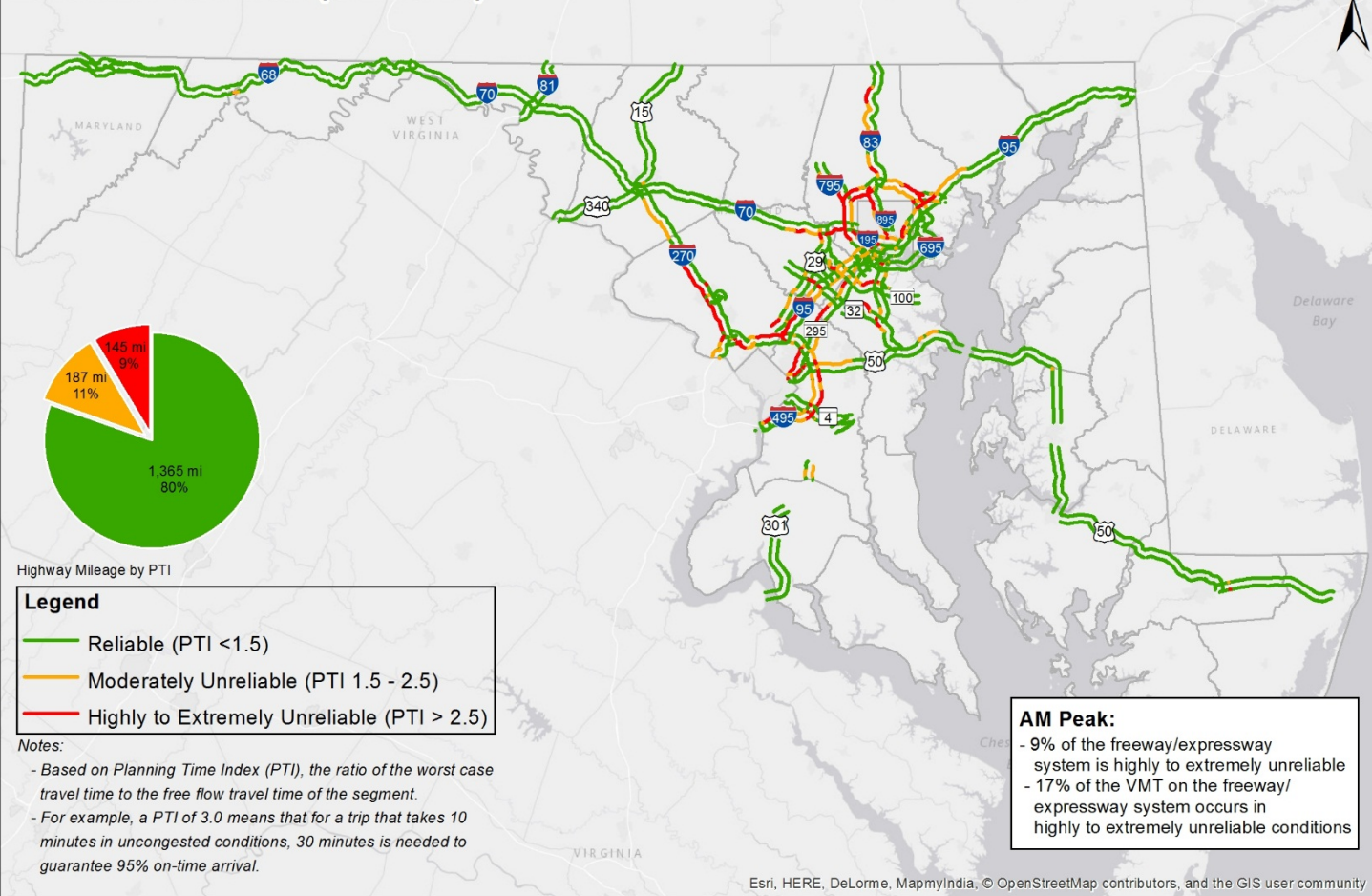
2013 Congestion Map

Baltimore-Washington Region Freeway/Expressway Congestion Map 2013 PM Peak Hour (5PM-6PM)

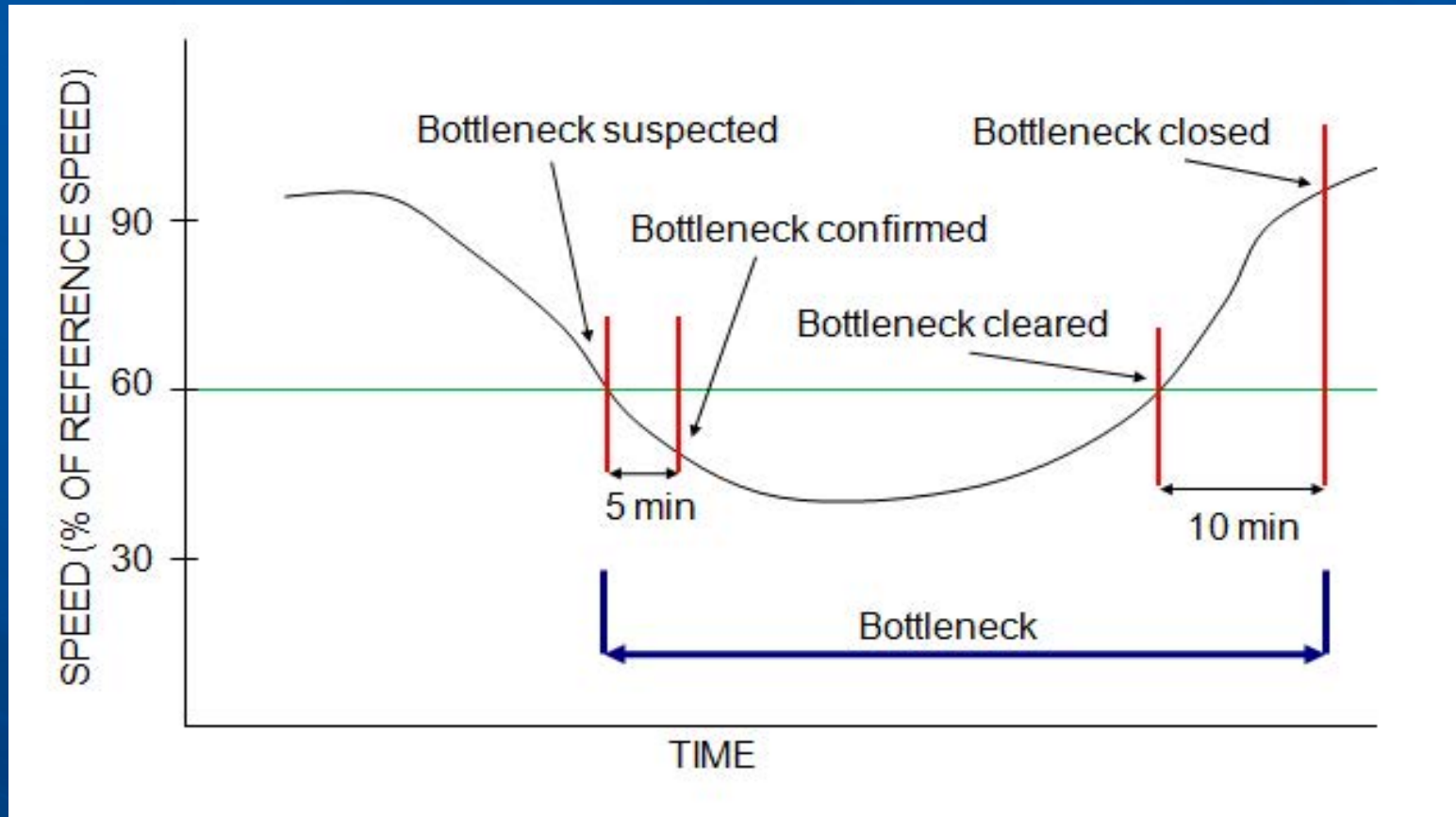


2013 Reliability Map

Maryland Freeway/Expressway Reliability Map 2013 AM Peak Hour (8AM-9AM)



Bottlenecks



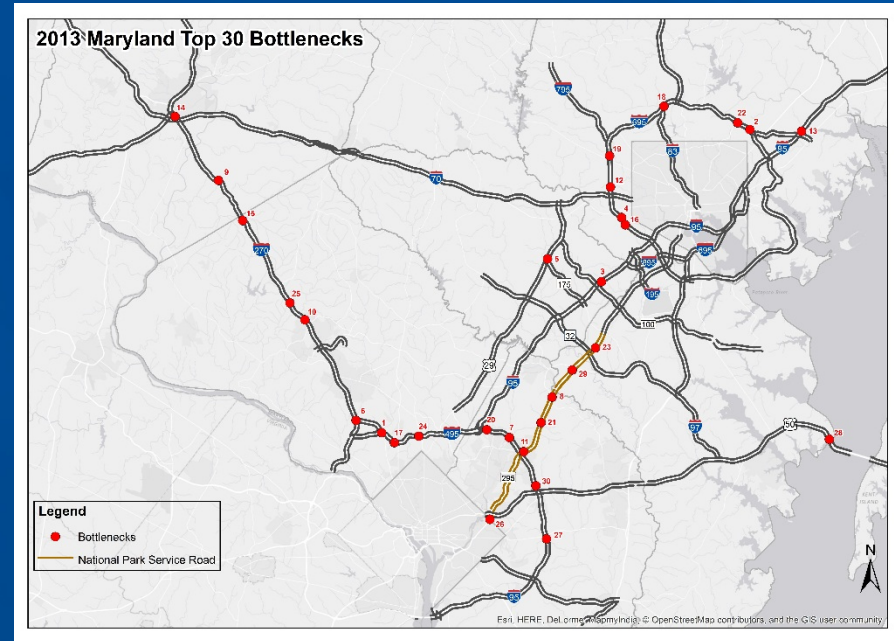
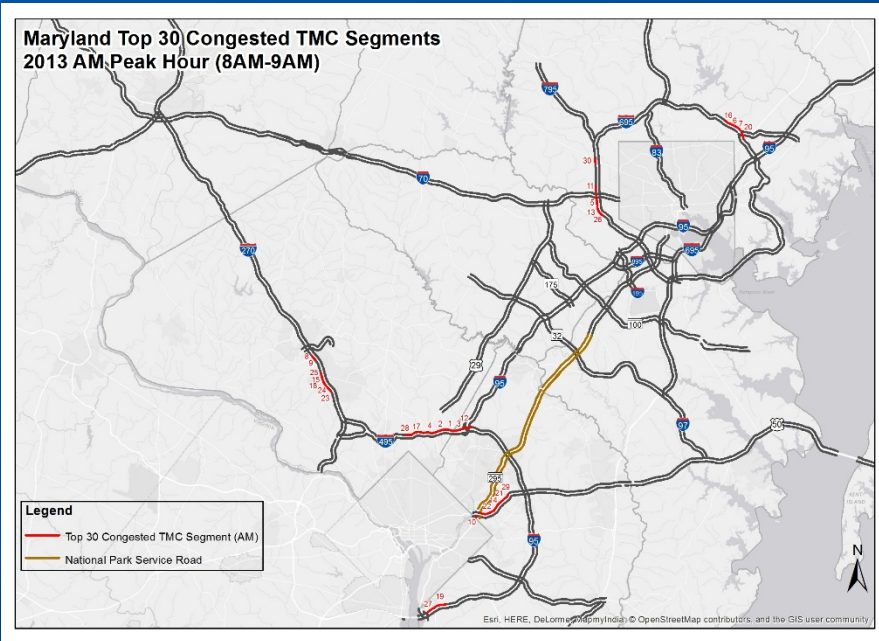
Bottlenecks

Impact Factor

- Based on traffic throughout the entire day
- Number of Occurrences per quarter
- Average Duration per quarter
- Average Queue Length per quarter

Average Duration	Average Max Length	Impact Factor
185.5	13.86	1993724
165.25	10.58	712794
122.5	10.53	699231
128	8.43	696761
139.5	8.84	617074
100.75	7.32	589191
133	10.8	515630

Top 30 Locations

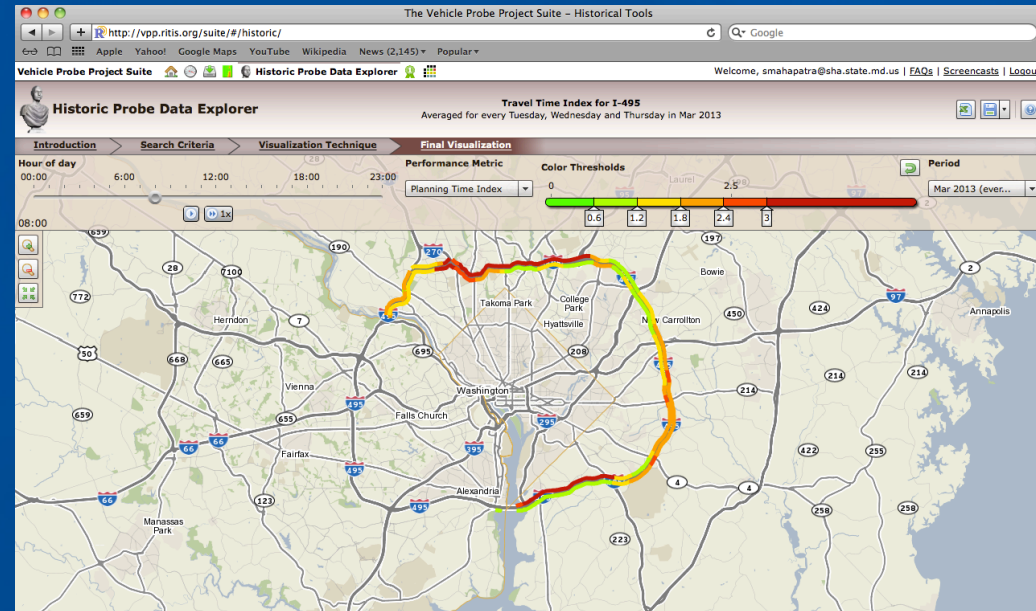


Data Considerations/Model Calibration

- Short Segment Lengths
- Lane Use Variations
- Variable Roadway Functions
- Work Zones
- Weather
- Uphill Segments

Use of Vehicle Probe Data for Project Planning and Design Studies

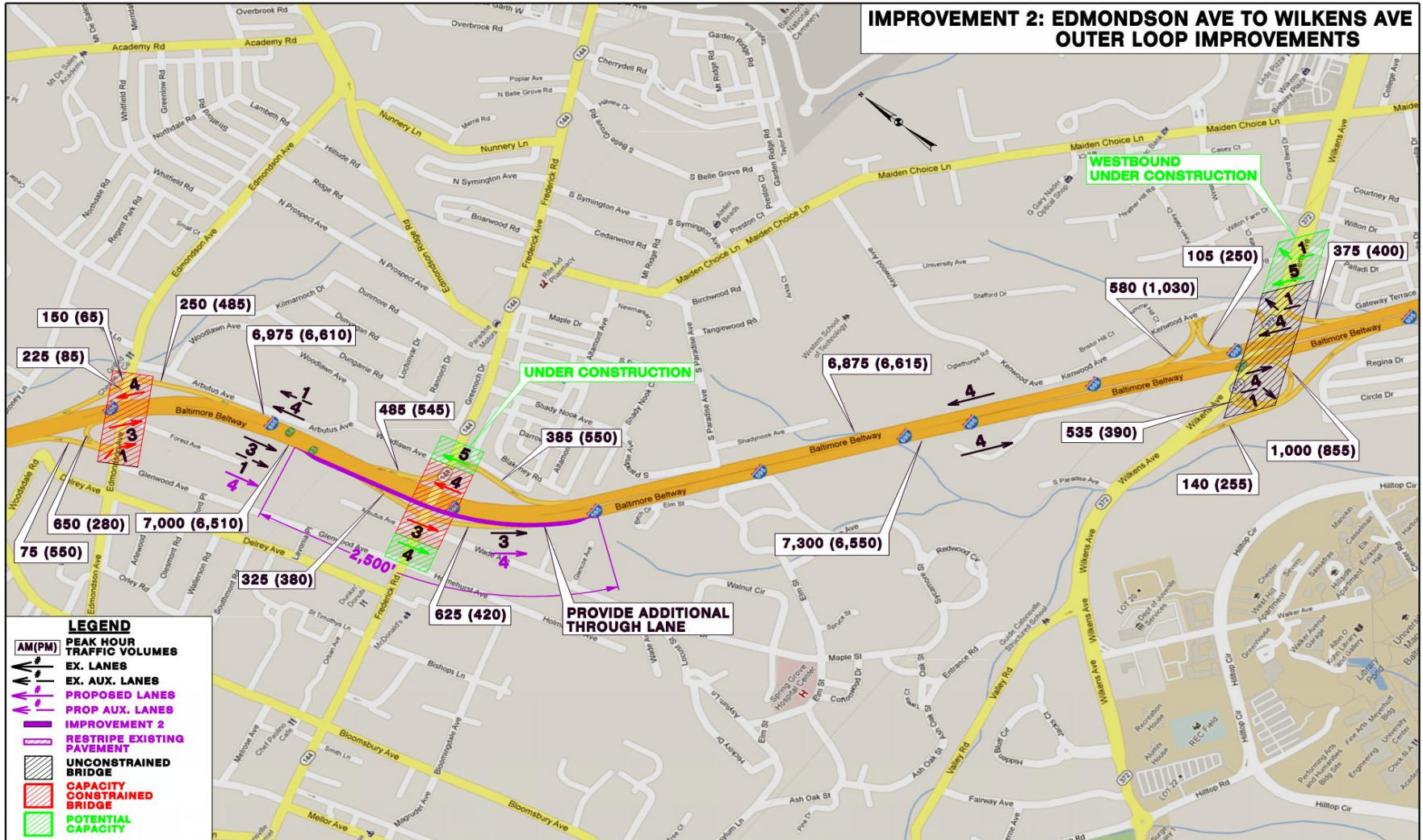
- Use Peak Period INRIX Data
- Identify Congestion Hotspots and Sources
- Develop Traffic Simulation Models – Calibrate with probe speeds
- Evaluate Low Cost Short Term Improvements in a Benefit/Cost Context



Source: UMD CATT Vehicle Probe Project Suite

Process has been implemented on all major freeways of Maryland – I-695, I-495, I-270, I-95, I-70 – Ongoing Congestion Management Program

I-695 Study Example @ MD 144



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Wednesday, May 16, 2012 11:02:31 PM



I-695 Study Example @ MD 144

Project Name:

I-695, Baltimore Beltway

Location of Project:

I-695 Outer Loop: MD 144 (Edmonson Avenue) on ramp continuing to MD 372 (Wilkins Avenue)

Description:

Provide additional through lane from on ramp at Edmonson Avenue to end of acceleration lane from Edmonson Avenue. Project includes widening and restriping of I-695 Outer Loop and removal and placement of retaining wall. Total project length is 2,500 feet.

Total User Cost Savings over 10 Years:

Delay Cost Savings \$ ('000)			Fuel Cost Savings \$ ('000)	Reliability Savings \$ ('000)	Safety Savings \$ ('000)	Total Savings
Auto	Truck	Total Auto/Truck				
11,427	2,722	14,149	1,415	10,612	989	Approx. \$27.2 Million

Total Cost:

\$ 18.2 Million (in 2011 Dollars)

Project Ranking:

I-695 Study Example @ MD 147

- Maryland Mobility Report Results
- VISSIM Modeling
- Highway Safety Manual
- Alternative Development (\$ 2 million)



Mobility Dashboard Features

Mobility & Economy Dashboard – Early 2015 Release



Mobility and Economy Dashboard

Welcome to the Mobility and Economy Dashboard for the State of Maryland!

The Maryland State Highway Administration's (SHA) mobility related efforts are highlighted in this dashboard based on data from the Maryland State Highway Mobility Report. Mobility is a key performance area (KPA) at SHA which aims to "Support Maryland Economy and Communities with Reliable Movement of People and Goods". This dashboard aims to identify successes, challenges, and strategies being utilized to improve the transportation services SHA delivers to Marylanders and the traveling public. This effort aims to drive investment related decisions and make the best use of transportation revenues using data driven performance based approaches.

I would like to explore:

Congestion
What is happening?

Where?

Jurisdiction
Maryland
2013

View ▶

Disclaimer: This application is intended to serve as a public resource for general reference. The data is preliminary and subject to change. SHA provides this information without any warranty of any kind either expressed or implied.

What are the Mobility Trends in Maryland?

Maryland's highway system handles over 56 Billion vehicle miles of travel on an annual basis. SHA has developed comprehensive performance measurement systems. In 2013:



View What's Happening ▶

What is SHA doing to address Mobility Challenges?

SHA implements various projects, programs and policies to enhance mobility on its facilities. Our approach includes:



What is the outcome of SHA's Mobility Initiatives?

The mobility solutions implemented by SHA projects, programs and policies result in user cost savings for automobile and truck travel. In 2013, annual user savings included:



View What SHA is Doing ▶

- Web-based Solution
- Increase Transparency
- Performance Based Approach

Dashboard: What is Happening?

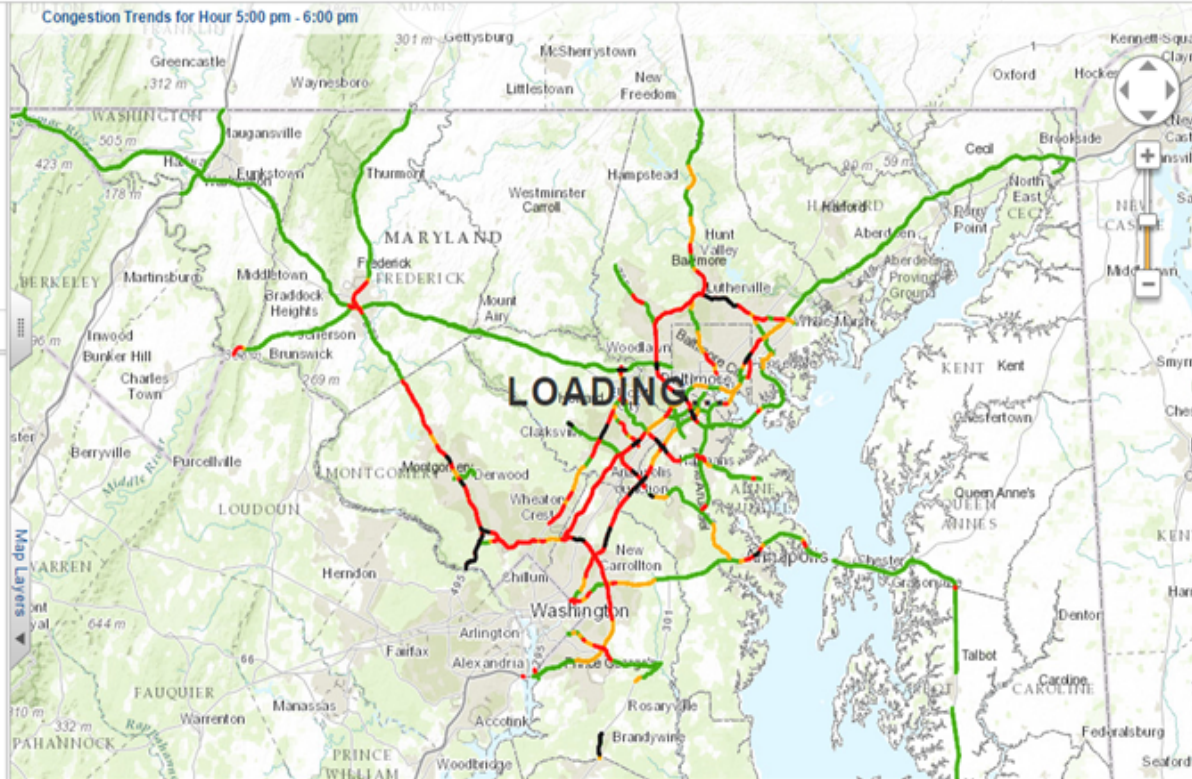
[Take a Tour](#)
Mobility & Economy Dashboard

I would like to explore: Congestion in 2013 by Jurisdiction in Maryland

[What is happening?](#)
[What is SHA doing?](#)
[What has changed over time?](#)

AM PEAK HR
 PM PEAK HR
 MIDDAY
 BEGIN HOUR:

 MIDNIGHT 6 AM 12 PM 6 PM 11 PM



[Hotspot Data](#)
[Congestion Chart](#)
[Page Information](#)

Top 25 Bottlenecks by Hour

RANK	STATEWIDE RANK	ROAD NAME	LOCATION	DIRECTION
1	1	I-495	Cabin John Pkwy/Exit 40	Inner Loop
2	2	I-495	MD-190/River Rd/Exit 39	Inner Loop
3	3	I-695	MD-45/York Rd/Exit 26	Inner Loop
4	4	I-495	MD-190/River Rd/Exit 39	Inner Loop
5	5	MD-32	MD-108	Westbound
6	6	I-695	MD-45/York Rd/Exit 26	Inner Loop
7	7	I-495	Clara Barton Pkwy/Exit 41	Inner Loop
8	8	I-695	MD-139/Charles St/Exit 25	Inner Loop
9	9	I-495	Cabin John Pkwy/Exit 40	Inner Loop
10	10	I-695	MD-146/Dulaney Valley Rd/Exit 2	Inner Loop

Dashboard: What is SHA doing? What is the OUTCOME?

■ Projects

- Major and Minor Projects

■ Programs

- Signal retiming
- CHART/Incident Management
- ITS/511

■ Policies

- Park N Ride
- HOV Users
- Reversible Lanes
- Bicycle & Pedestrian
- Transit Oriented Development
- MDTA Managed Lanes

What is SHA doing to improve Mobility of our highway system?

SHA implements various projects, programs and policies to enhance mobility on its facilities. Our approach includes:

The infographic displays six categories of mobility initiatives, each with an icon: CHART System (a blue and red logo), Capital Improvements (a white hard hat), Signal Systems (a traffic light), MDTA Toll Lanes (a purple and red logo), Freight Policies (a blue truck), and Mode Choices (a person walking, a bicycle, and a car).

What is the outcome of SHA's Mobility Initiatives?

The mobility solutions implemented by SHA projects, programs and policies result in user cost savings for automobile and truck travel. In 2013, annual user savings included:

\$1.16 Bil.	+	\$5.7 Mil.	+	\$39.8 Mil.	=	\$1.206 Bil.
CHART		Capital Improvements		Signal Systems & Multimodal Strategies		Total Savings

Use of Probe Data in Before/ After Studies

- Vehicle probe data has been instrumental in before/ after studies for major projects/ programs
- Study area network evaluated before/ during and after the project/ strategy is implemented
- Evaluation done with various performance metrics:

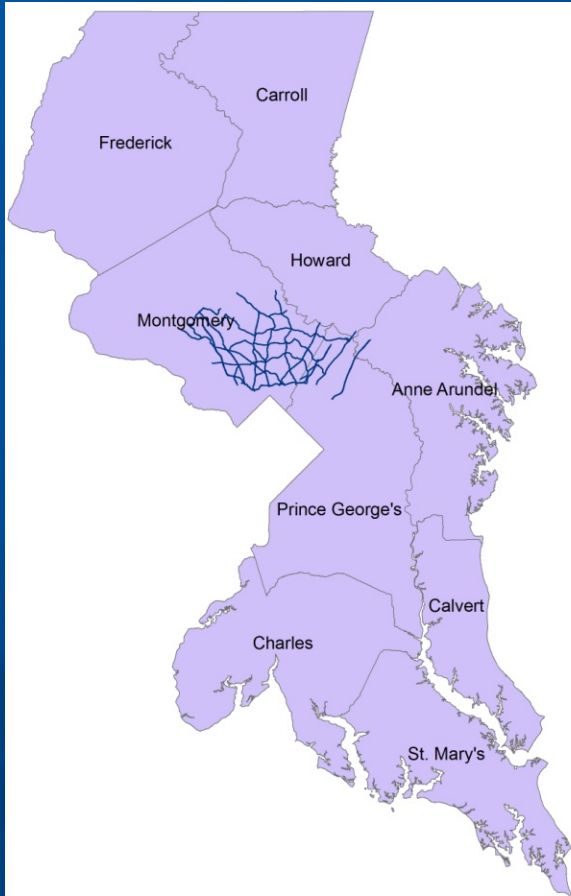
Spatial Extent of Congestion: Percent of Congested Route-Miles

Intensity of Congestion: Travel Time Index

Reliability of Travel: Planning Time Index

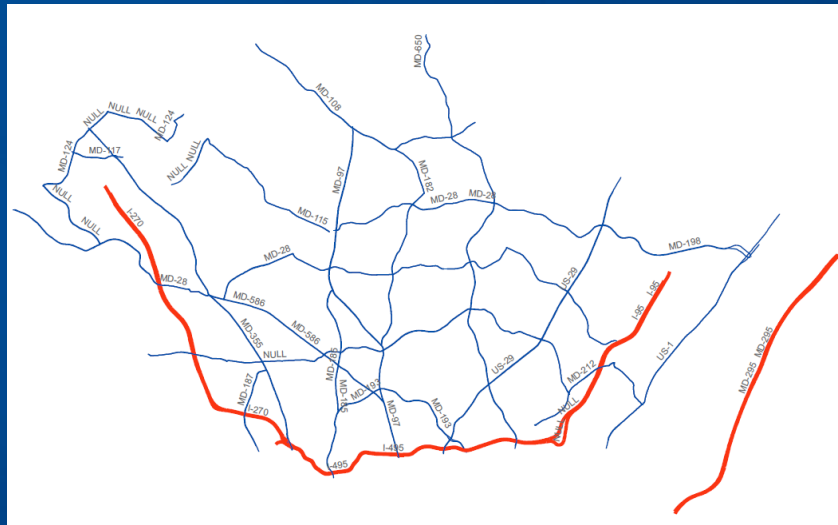
SHA/ MWCOG ICC Before/ After Study is a great demonstration of the usage of vehicle probe data for performance evaluation

ICC Study Area



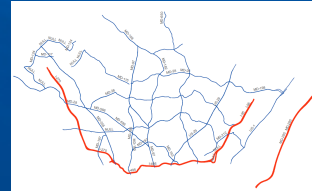
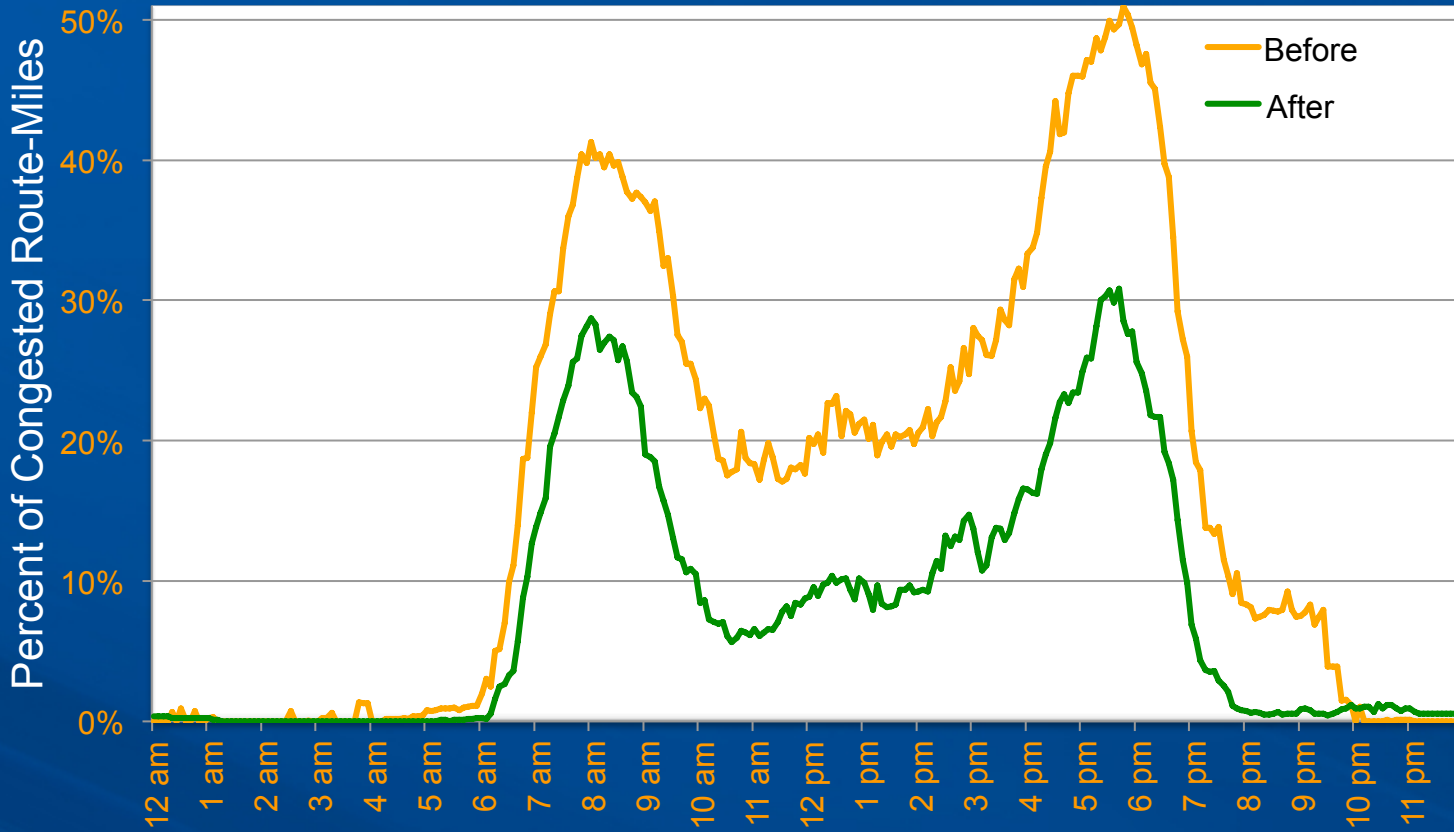
Roadway Segments Studied & Data Coverage:

- 21 Corridors (INRIX data cover all corridors)
- 790 segments (INRIX data provide segment speeds in 5-minute increments)
- 422 directional miles



Spatial Extent of Congestion

Study Area (Typical Weekday)



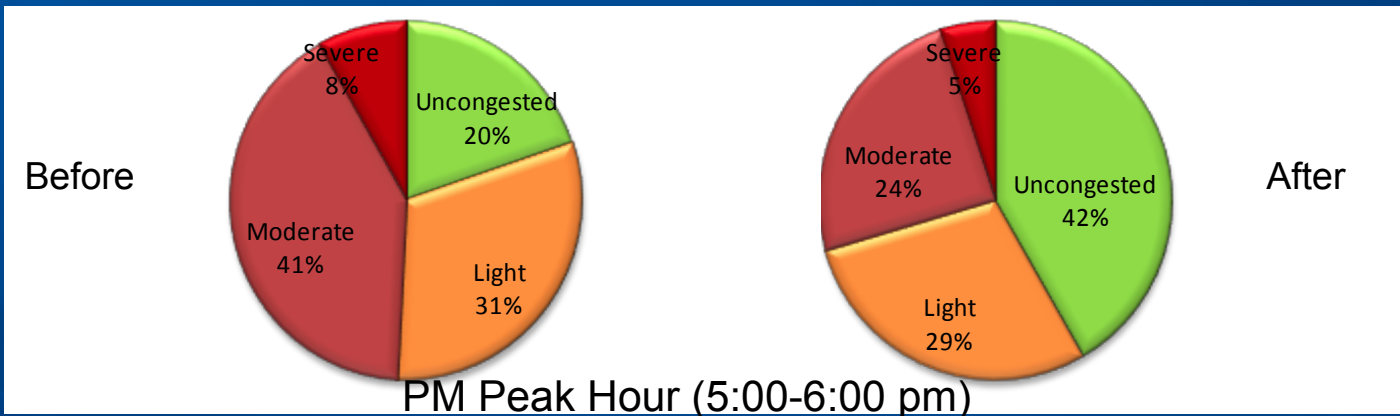
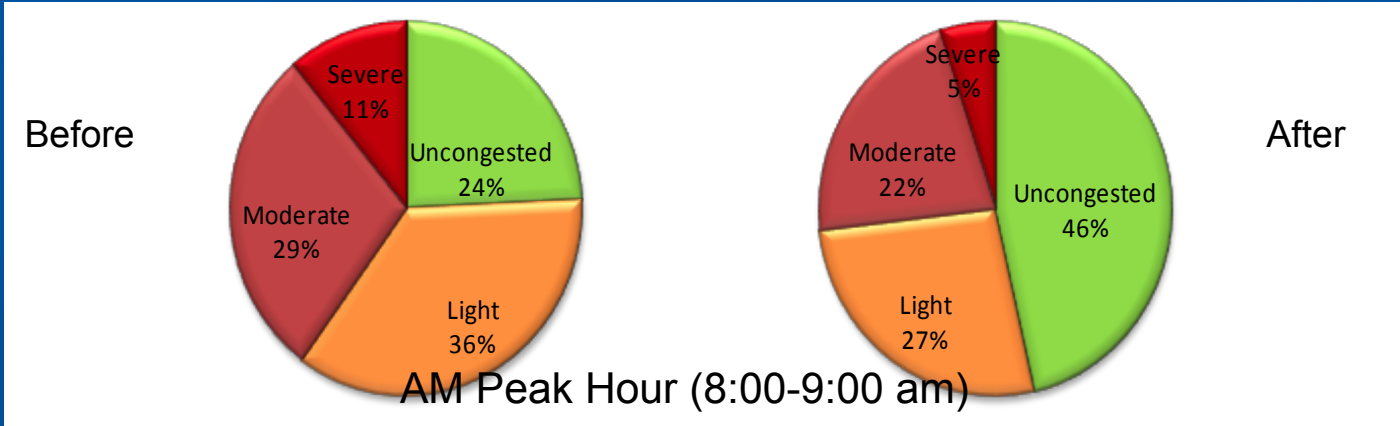
Notes:

Total route-miles (directional): 422

Congestion determination: Travel Time Index (TTI) ≥ 1.3

Spatial Extent of Congestion

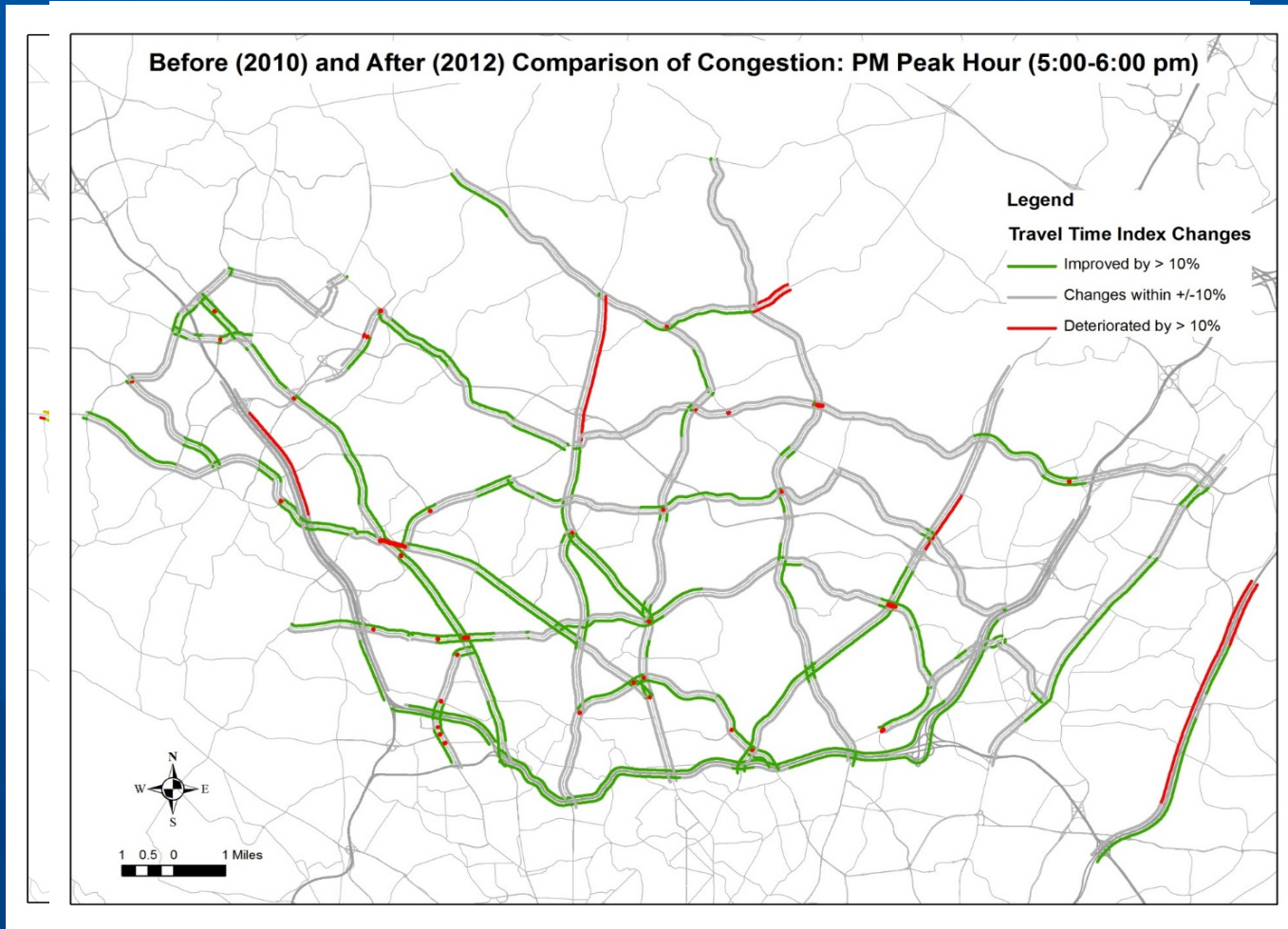
Percent of Route-Miles by Congestion Level (Study Area)



Levels of Congestion:

Uncongested: $TTI < 1.15$; Light: $1.15 < TTI < 1.30$; Moderate: $1.30 < TTI < 2.00$; Severe: $TTI > 2.00$

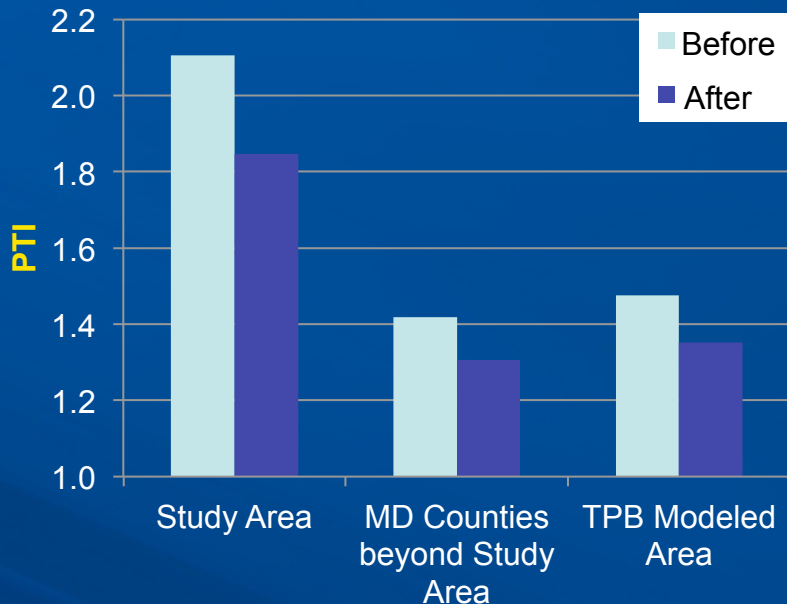
ICC Before/After Study – PM Peak Hour Speed Comparison



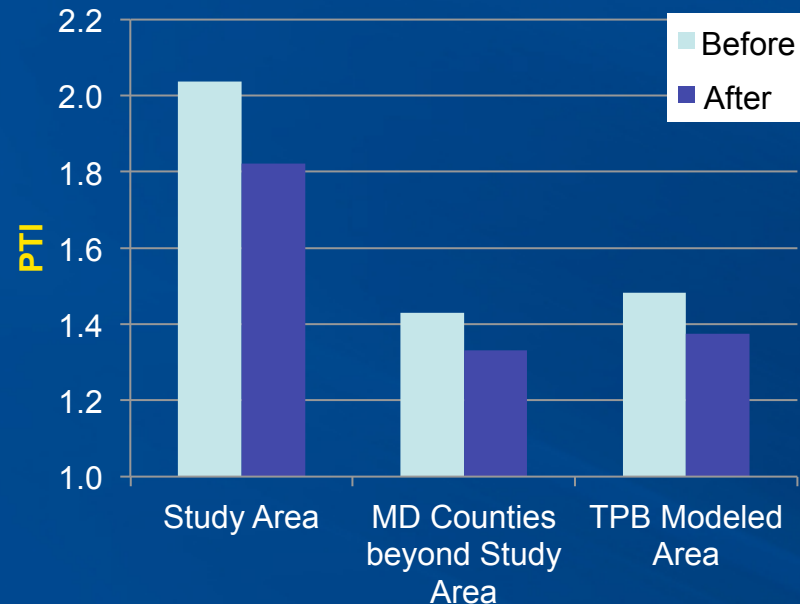
Reliability of Travel (95%)

Planning Time Index (PTI): $\text{Reliable Travel Time}^2 / \text{Free Flow Travel Time}$

AM Peak Hour (8:00-9:00 am)



PM Peak Hour (5:00-6:00 pm)



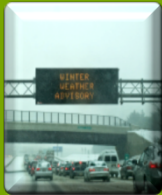
Note:

²Reliable Travel Time here is defined as the travel time that ensures **95% chance of arriving on time**

Reliability Data & Analysis Tools

CAUSES OF UNRELIABILITY

Inclement Weather



Fluctuations in Demand



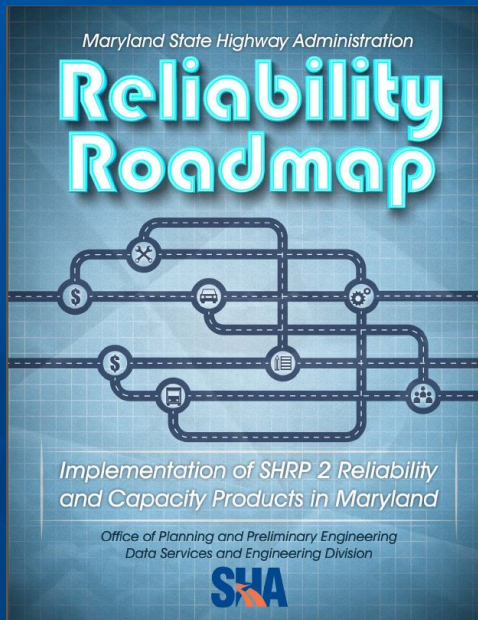
Crashes



Work Zones

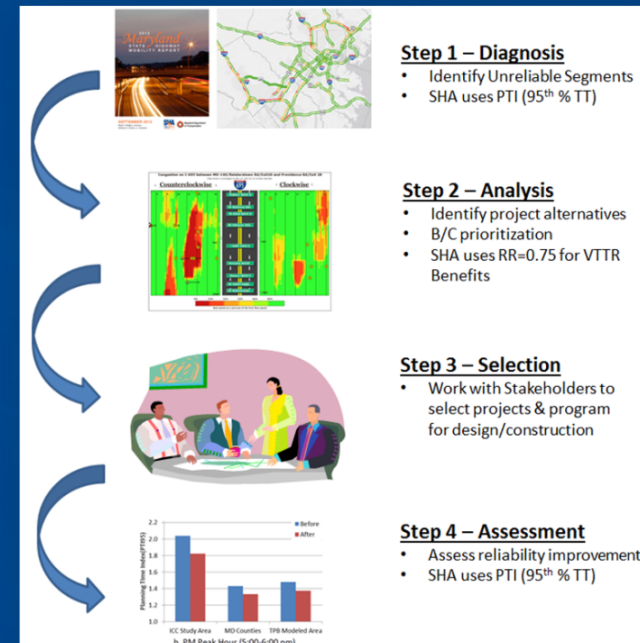


Poorly Timed Traffic Signals



SHA will implement a four step process:

- Diagnosis
- Analysis
- Selection
- Assessment



Phase 1 of Reliability Roadmap Efforts will be implemented under SHRP2 L38

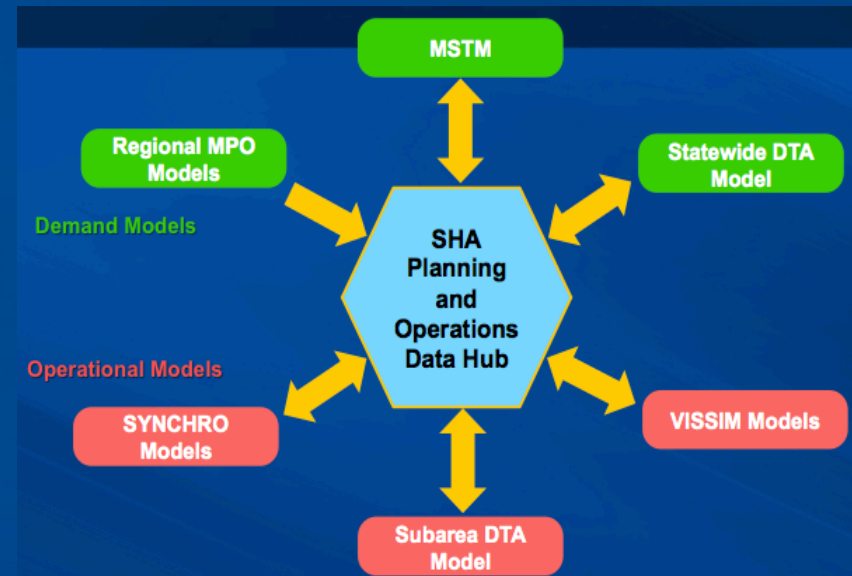
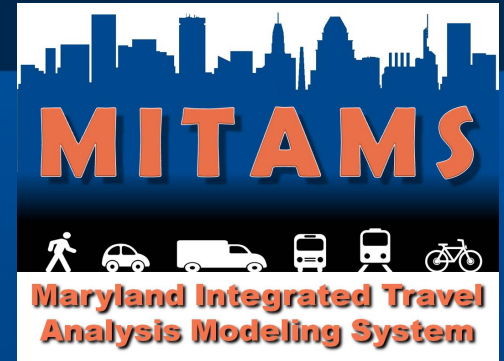
Application of Probe Data in Advanced Travel Analysis Tools

SHA will develop multi-resolution and time-dependent travel demand models for integrated planning and operations.

KEY FEATURES

- Data Hub
- Multi-resolution network
- Statewide Model/DTA
- Corridor/Sub-area AgBM/DTA
- ABM/DTA Integration

Traffic and Demand Management
Non-recurrent Congestion Management
Performance Analysis & Reporting
Planning and Prioritization



How has Vehicle Probe Data shaped Performance Analysis and Decision-Making?

- Great step demonstrating **Performance based Planning** and **Data Driven Decision-making**
- Leads to **funding decisions** – *multiple low cost short term improvements have been identified and implemented*
- Multiple Mid term/ Long term corridor studies have been re-evaluated and initiated
- Better prepared to account for **Freight and Reliability**
- Helps us **communicate our performance** and tell our story

Challenges and Opportunities with Vehicle Probe Data

- **Trip and tour based congestion and reliability metrics** (Origin to Destination) for people and goods movement
- **Lane based performance metrics** (HOV lane or, ETL running next to a general travel lane)
- **Lane based usage** (disproportional use of some lanes over others) to understand operations better
- **Fusing datasets with other data sources** like land use, traffic counts, detectors etc. - Interfacing of navigation networks with state LRS
- **Insights on markets** and trip O/Ds
- **Multi-modal and multi-resolution networks** that can meet both performance management, travel modeling and analysis needs

Contact Information

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