# REGIONAL TWELVE-YEAR BOTTLENECK ANALYSIS

## And Congestion Management Process Update

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Commuter Connections Subcommittee
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Agenda Item 4

National Capital Region
**Transportation Planning Board**

# Preface

- The Commuter Connections Subcommittee has been briefed regularly on the regional Congestion Management Process (CMP), most recently in September 2022 regarding the 2022 CMP Technical Report
    - Thanks again for committee members' input for travel demand management information included in the report
- The 2022 CMP Technical Report had been finalized in July 2022 by the TPB Technical Committee
    - But a follow-up activity was also agreed to at that time, a multi-year bottlenecks analysis
- Today we will discuss results of that bottlenecks analysis, along with context from the CMP Technical Report

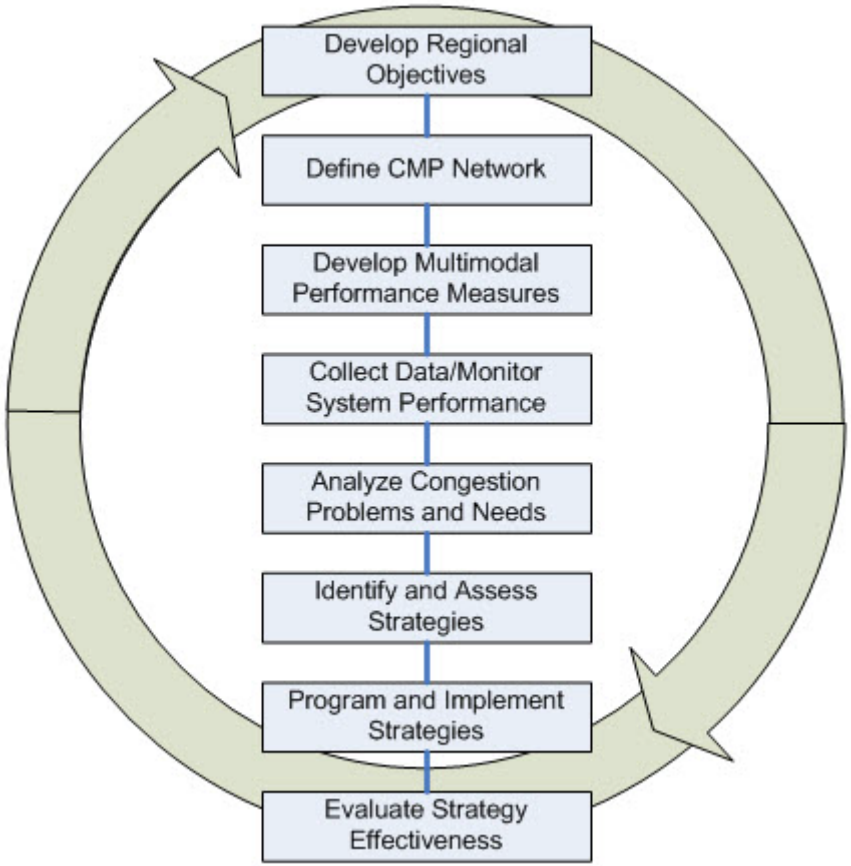
# Introduction

- A Congestion Management Process (CMP) is a requirement in metropolitan transportation planning
    - Many generations of federal regulations for metropolitan planning (including IIJA/BIL) have maintained a CMP requirement
- Our official regional CMP component is wholly integrated into the overall long-range transportation plan (Visualize 2045)
- In addition, a CMP Technical Report has been developed as a supporting document biennially since 2008
- Today's presentation will look at:
    - The overall need for a CMP
    - The 2022 CMP Technical Report
    - The associated 12-year bottlenecks analysis

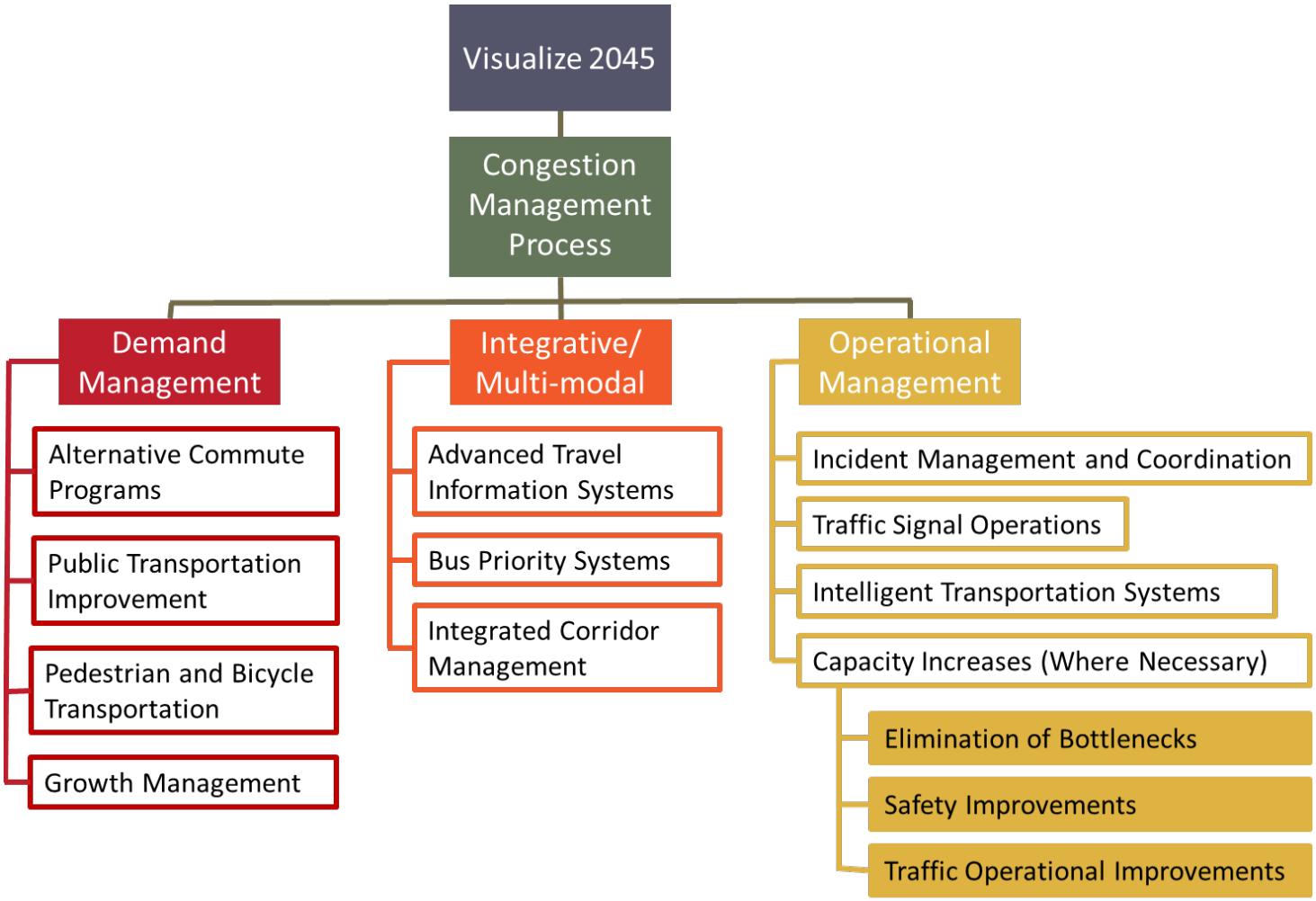
# What Is a CMP?

The transportation planning process in a TMA shall **address congestion management through a process** that provides for safe and effective integrated management and operation of the multimodal transportation system…**through the use of travel demand reduction…job access projects, and operational management strategies**.

- Federal Register Vol. 81, No.103, pp.34152, May 27, 2016.



# Congestion Management Strategies



# Components of the Region's CMP

1. Visualize 2045 comprises the official regional CMP
   - Chapter 8 – Planning for Performance (pp. 193-195)
     - TPB ensures that the plan includes alternatives to SOVs
   - Appendix E – Federal Compliance and Impact on Plan Development
     - The CMP informs the project selection process for the plan and TIP
2. Project-specific CMP addressed in Technical Inputs Solicitation
3. National Capital Region Congestion Reports (quarterly dashboard)
4. Biennial CMP Technical Reports

# Congestion Management Strategies

COMMUTER CONNECTIONS
A SMARTER WAY TO WORK

MATOC

'POOL REWARD$
it pays to rideshare

sv silver line

CHART

REGISTER FOR GUARANTEED RIDE HOME PROGRAM


FLASH

ICC
intercounty connector
MARYLAND
200

95 ExpressLanes

TRANSFORM 66
INSIDE the Beltway
VDOT | DRPT
Investing in Multimodal Solutions

metroway

Purple Line

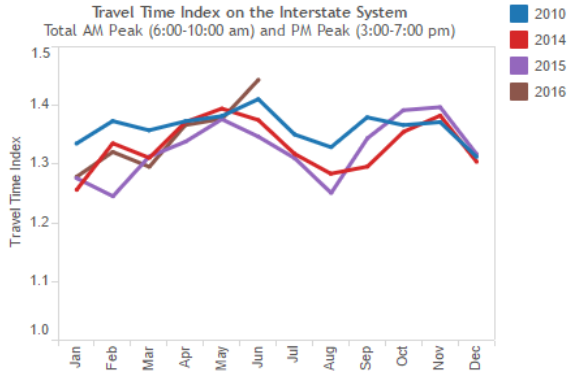
# Dashboard

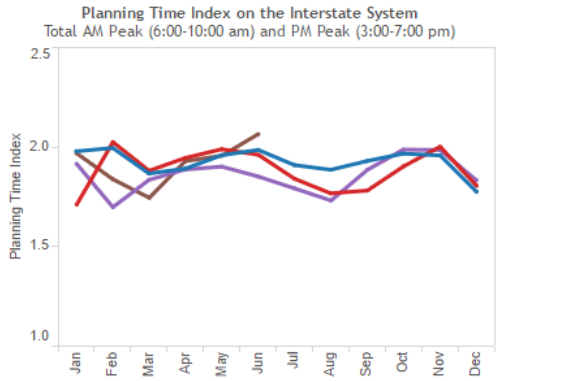
Home > Transportation > Data & Tools > Congestion Dashboard

TRANSPORTATION

## Congestion Dashboard

**Regional Trends**

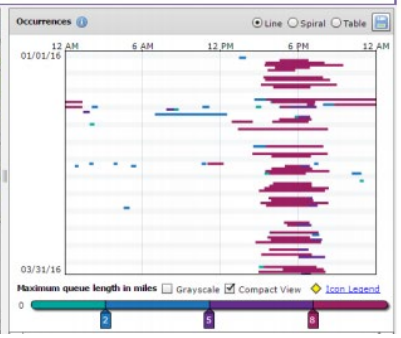


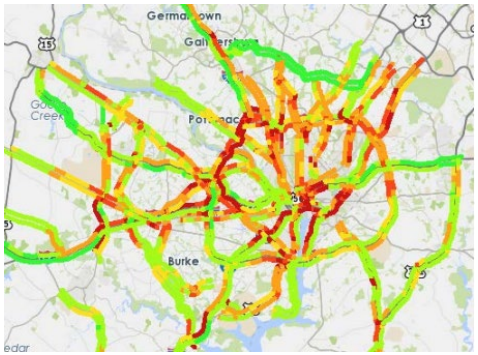




Quarterly updated NCR Congestion Report at:

https://www.mwcog.org/congestion/

| Rank | Location | Average duration | Average max length (miles) | Occurrences | Impact factor* |
|---|---|---|---|---|---|
| 1 | I-66 W @ VA-234/EXIT 47 | 2 h 36 m | 11.23 | 109 | 190,919 |

# CMP Technical Report (June 2022)

CMP Technical Report serves as a background document to the official LRP/CMP, providing detailed information on data, strategies, and regional programs involved in congestion management:

- Compiles information from a wide range of metropolitan transportation planning activities
- Provides some additional CMP-specific analyses, particularly Vehicle Probe Project data-based analyses

# CMP Technical Report Key Findings

1. Congestion analysis
2. Reliability analysis
3. Bottlenecks
4. Travel demand management continues its importance
5. Walking/biking continue to grow
6. Variably priced lanes offer travel options
7. Regional Transportation Operations Coordination (e.g. MATOC)
8. Real-time travel information
9. COVID-19 Pandemic Impacts

# Report Recommendations (1 of 2)

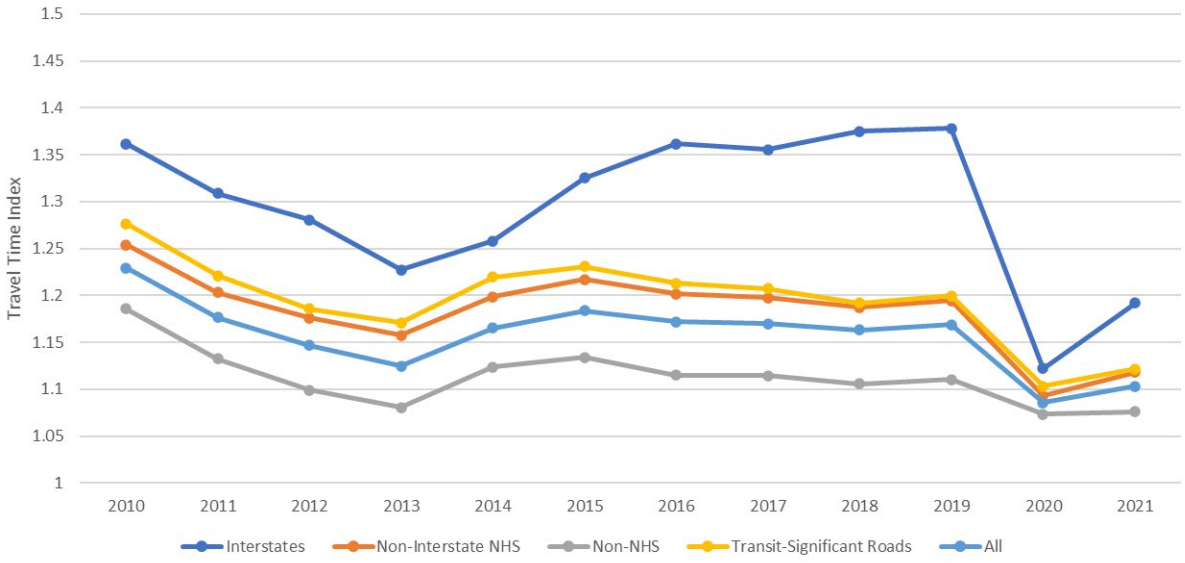
1. Continue the Commuter Connections program
2. Continue the MATOC program
3. Continue to coordinate PBPP with the CMP
4. Encourage integration of operations and travel demand management components of congestion management
5. Pursue sufficient investment in the existing transportation system
6. Consider variable pricing and other management strategies
7. Encourage transit and explore transit priority strategies
8. Encourage congestion management during major construction projects
9. Encourage access to non-auto travel modes

# Report Recommendations (2 of 2)

10. Continue and enhance traveler information
11. Encourage implementation of projects, programs, and processes that support the TPB Aspirational Initiatives
12. Encourage connectivity within and between Regional Activity Centers
13. Continue and enhance the regional congestion monitoring program with multiple data sources
14. Monitor trends in freight, specifically truck travel
15. Participate in collaborative planning connected and autonomous vehicle readiness
16. Monitor impacts of and interactions with shared mobility services
17. Encourage Traffic Incident Management (TIM)

# Peak Period Congestion

- Measured by Travel Time Index (TTI)*
- Impact of COVID-19 pandemic measures on congestion
- Even with COVID-19 impacts, Interstates remained the most congested highway category, followed by Transit-Significant roads**, non-Interstate NHS, and non-NHS.

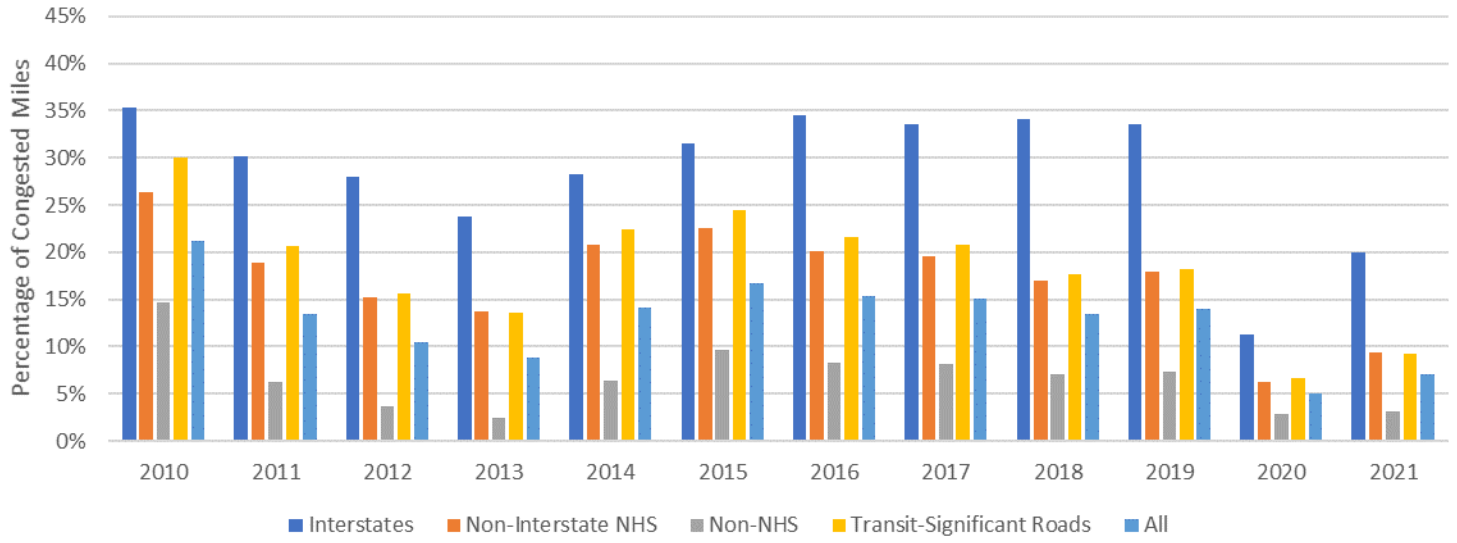



*Travel Time Index = Actual travel time / Free flow travel time.

** Transit-Significant Roads: Directional road segments with at least 6 buses running in the AM peak hour.

# Peak Period Congestion – Percent of Congested Miles

- To capture the spatial extent of congestion*
- On average, this region observed about 7% of all monitored roads congested during peak periods in 2021, and that was a slight increase from 5% in 2020



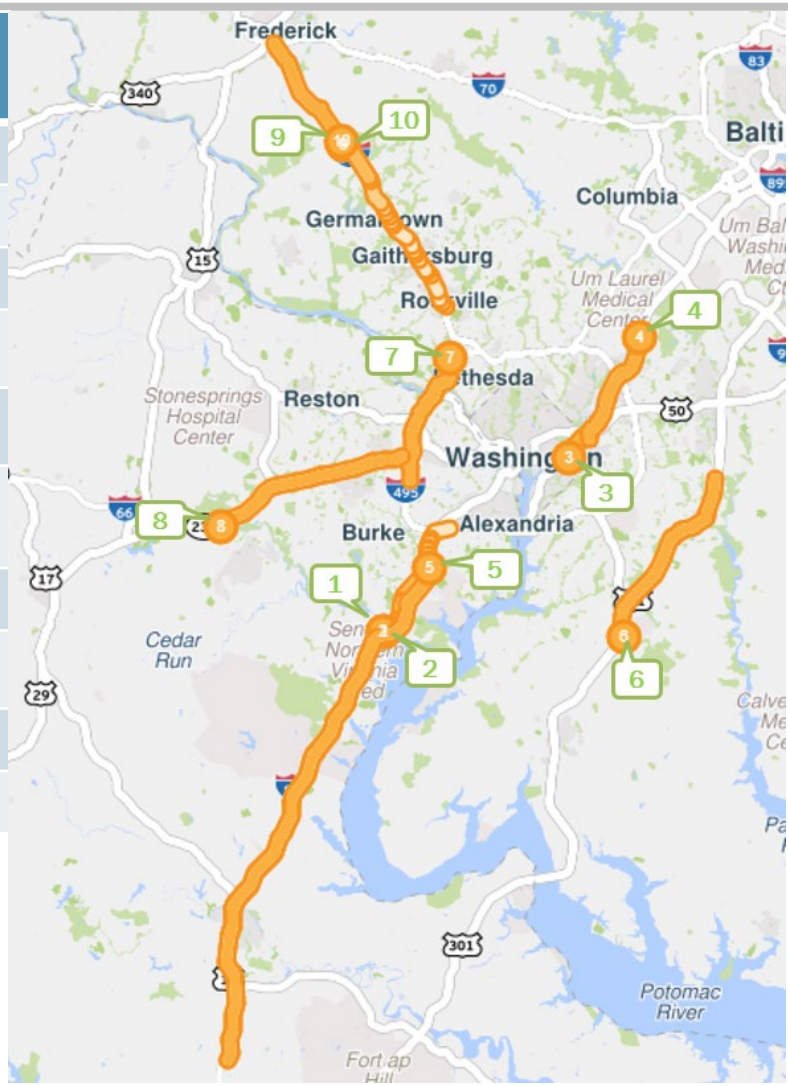

*Congestion is considered when Travel Time Index > 1.30.

# National Comparison

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

# Location of Top 10 Bottlenecks in 2021

| Location | Impact factor* |
|---|---|
| I-95 S @ VA-123/EXIT 160 | 530,457 |
| I-95 N @ VA-123/EXIT 160 | 386,481 |
| DC-295 S @ E CAPITOL ST | 278,813 |
| B/W PKWY N @ POWDER MILL RD | 255,314 |
| I-95 N @ VA-617/BACKLICK RD/EXIT 167 | 216,574 |
| US-301 S @ MCKENDREE RD/CEDARVILLE RD | 196,300 |
| I-495 IL @ I-270-SPUR | 176,892 |
| I-66 W @ VA-234/VA-234-BR/EXIT 47 | 159,189 |
| I-270 S @ MD-109/EXIT 22 | 153,541 |
| I-270 N @ MD-109/EXIT 22 | 146,933 |




*Base impact - the sum of queue lengths over the duration

# Bottlenecks Analysis Notes

- Bottlenecks analysis has long been a feature of CMP Technical Reports
  - Commuter Connections programs have referenced results
- For the 2022 CMP Technical Report, the bottlenecks analysis methodology used was changed vs. previous reports
  - A bottlenecks tool had become available within the University of Maryland's Probe Data Analytics (PDA) Suite (source of our data)
  - Advantages of the new tool: Analysis process was much less time-consuming; commonality with other CMP analyses; facilitated multi-year analyses
  - Disadvantages: Did not allow for peak period analyses, only 24-hour analyses; methodological break with past CMP reports

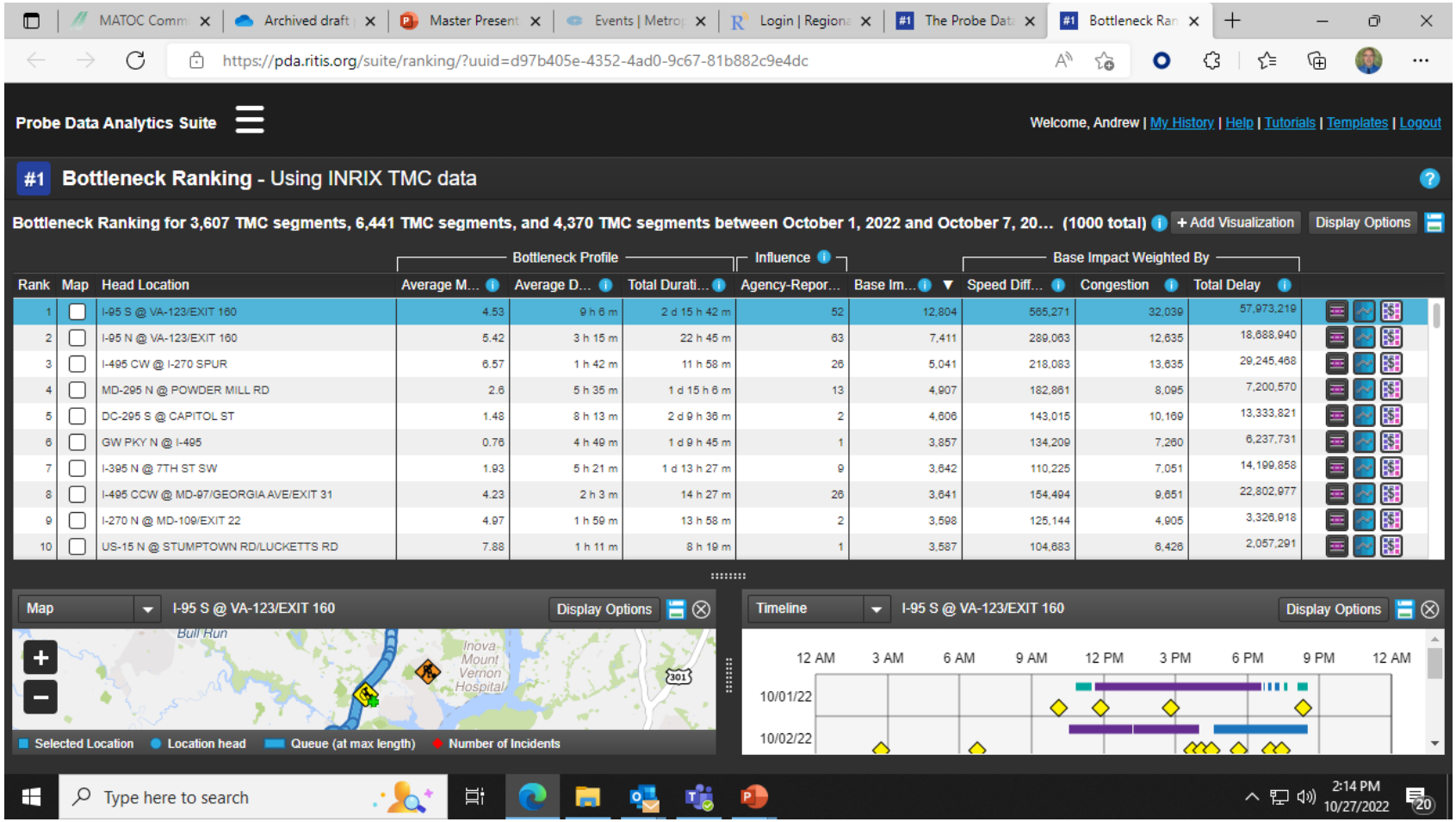
# 12-Year Bottlenecks Analysis Initiation

- The bottleneck results after the methodology change caught the attention of the TPB Technical Committee
- Redoing the analysis with the previous methodology was not feasible, so as an alternative staff agreed to do a multi-year analysis with the current tool to examine long-term trends
- Now we can more easily look at persistent versus short-lived bottleneck locations, comparative severity, and trends

# How the PDA Bottleneck Tool Works

- Uses vehicle probe data (speeds) provided for a set of network links
  - Vehicle probe speed data (from Inrix) available in the PDA Suite back to the year 2010
- We choose links of interest (not trivial – staff uses a saved set of over 14,000 roadway links) and 12 one-year analysis periods (2010 to 2021)
  - Data not available for minor roads/streets
  - Data caveats for certain facilities (e.g., reversible lanes, parallel paid/free/HOV lanes)
- The tool produces a ranking table and maps of bottlenecks
- Examined options within the bottleneck tool for weighting by different factors ("Base Impact" confirmed as the chosen option)

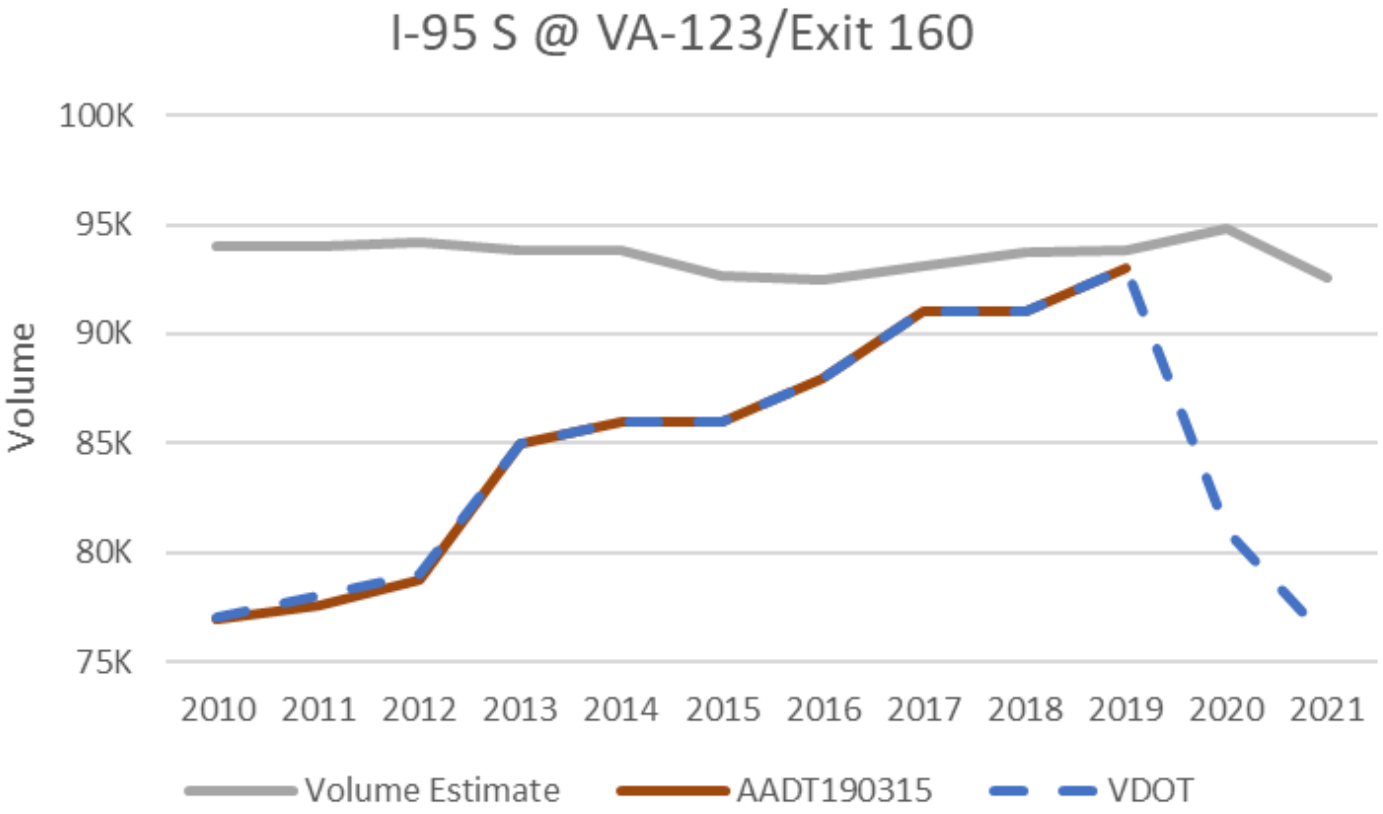
# Example Screenshot from the Tool



# Exploring the Tool's Ranking Factors

- The PDA Suite Bottleneck Tool offers several bottleneck ranking factors using tool-specific methodology:
  - ***Congestion*** (queue length and speed drop) – inclusion of speed drop may increase emphasis on smaller roadways
  - ***Total Delay*** (speed drop weighted by traffic volume) – the database's traffic volumes seem inconsistently derived, and may be a temporal mismatch (e.g., using 2019 volumes to weight 2010 conditions)
  - ***Base Impact*** (queue length and duration) – judged to be most consistent with TPB's historic aerial photography-based analyses; emphasizes major roadways

# Volume Data Caveat



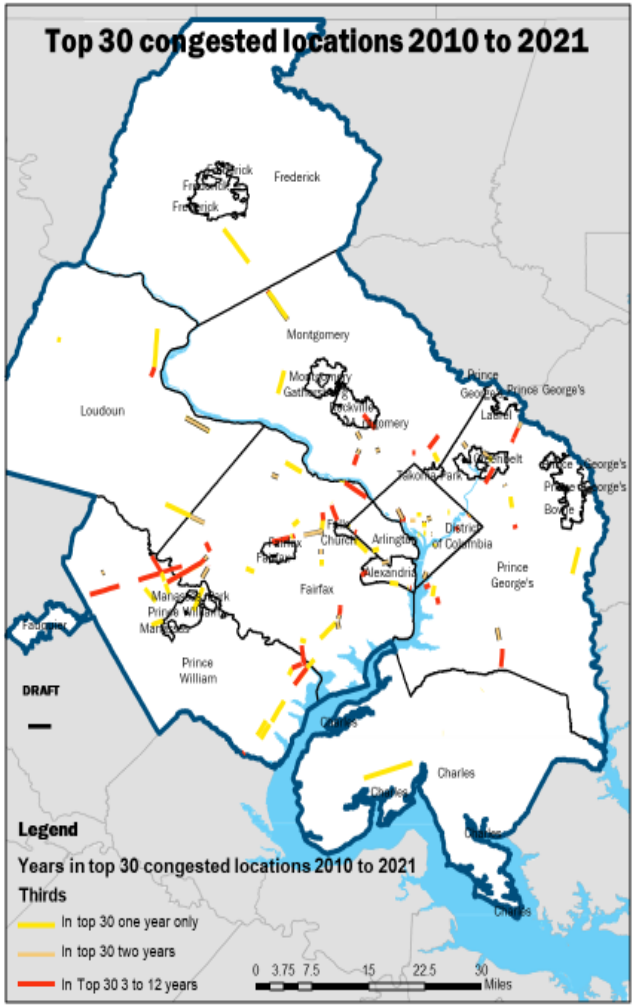

This example shows that PDA Suite traffic volume estimates may not be consistent with DOT or HPMS sources.

# 2021 Bottlenecks by Delay, Max Length

| | Location | Ranked by Base Impact | Ranked by Total Delay | Ranked by Maximum Length of Queue |
|---|---|---|---|---|
| 1 | I-95 S @ VA-123/EXIT 160 | 1 | 1 | 43 |
| 2 | I-95 N @ VA-123/EXIT 160 | 2 | 3 | 27 |
| 3 | DC-295 S @ EAST CAPITOL ST | 3 | 4 | 303 |
| 4 | BALT-WASH PKWY N @ POWDER MILL RD | 4 | 8 | 110 |
| 5 | I-95 N @ VA-617/BACKLICK RD/EXIT 167 | 5 | 5 | 42 |
| 6 | US-301 S @ MCKENDREE RD/CEDARVILLE RD | 6 | 16 | 149 |
| 7 | I-495 INNER LOOP @ I-270-SPUR | 7 | 2 | 9 |
| 8 | I-66 W @ VA-234/VA-234-BR/EXIT 47 | 8 | 9 | 8 |
| 9 | I-270 S @ MD-109/EXIT 22 | 9 | 32 | 47 |
| 10 | I-270 N @ MD-109/EXIT 22 | 10 | 34 | 21 |

# Top 30 Congested Locations 2010-2021

- Persistent bottlenecks were in a relatively limited number of locations
- Other locations appear for only a year or two
- Top bottleneck in the region: I-95 S @ VA-123/Exit 160
  - Ranked #1 all 12 years



# History of 2021 Bottlenecks

*Rankings for each individual year 2010-2021*

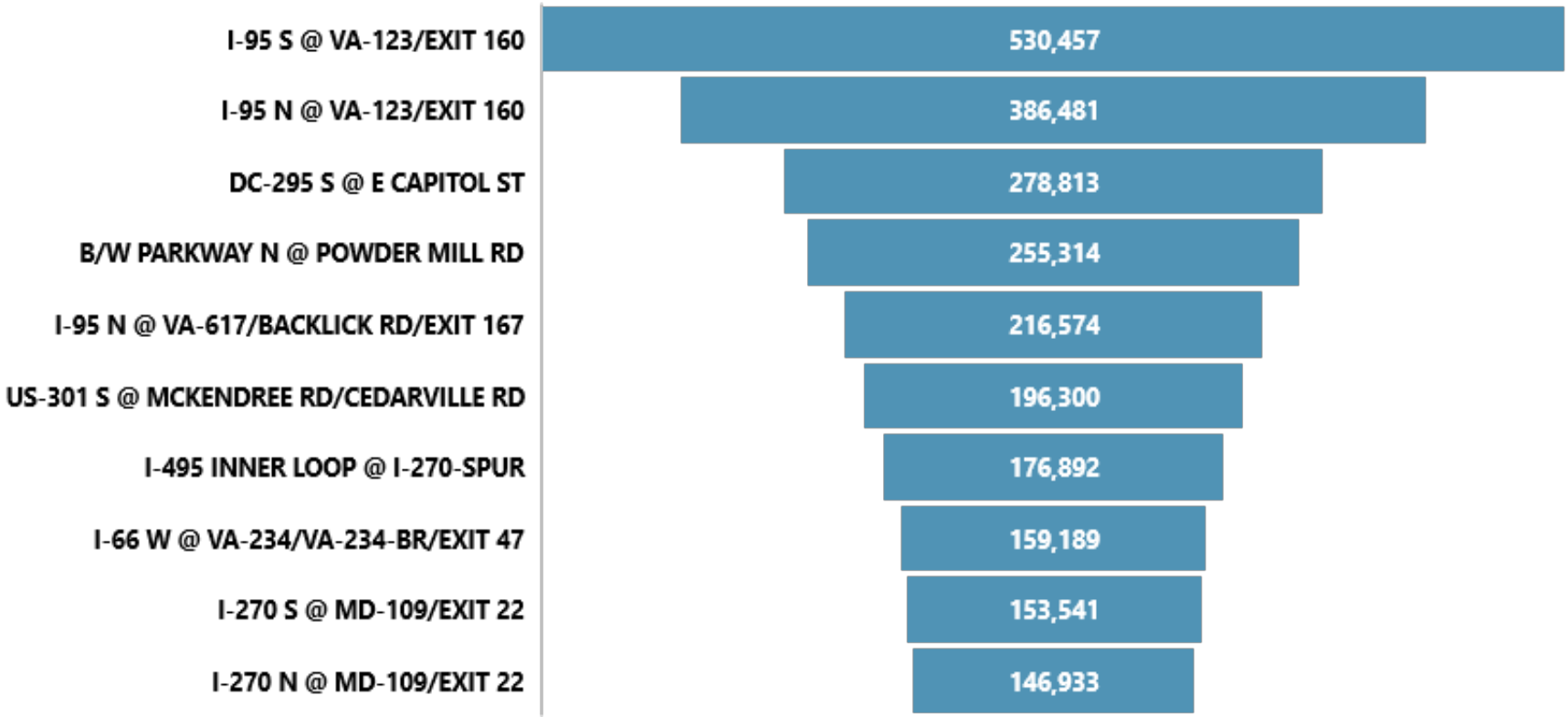
| 2021 Rank | Location | Highest Rank 2010-2021 | Lowest Rank 2010-2021 | Number of Times in Annual Top Ten 2010-2021 |
|---|---|---|---|---|
| 1 | I-95 S @ VA-123/EXIT 160 | 1 | 1 | 12 |
| 2 | I-95 N @ VA-123/EXIT 160 | 2 | >100* | 8 |
| 3 | DC-295 S @ EAST CAPITOL ST | 2 | >100* | 7 |
| 4 | BALT-WASH PKWY N @ POWDER MILL RD | 2 | 6 | 10 |
| 5 | I-95 N @ VA-617/BACKLICK RD/EXIT 167 | 5 | >100* | 1 |
| 6 | US-301 S @ MCKENDREE RD/CEDARVILLE RD | 3 | 31 | 10 |
| 7 | I-495 INNER LOOP @ I-270-SPUR | 2 | >100* | 8 |
| 8 | I-66 W @ VA-234/VA-234-BR/EXIT 47 | 3 | 66 | 3 |
| 9 | I-270 S @ MD-109/EXIT 22 | 9 | 35 | 2 |
| 10 | I-270 N @ MD-109/EXIT 22 | 10 | >100* | 1 |

*Anomalously high values may indicate data glitches for a given year rather than actual conditions.

# Persistent & Past Bottlenecks

| Persistent Bottleneck Locations | Highest Rank 2010-2021 | 2021 Rank | Number of Times in Annual Top Ten 2010-2021 |
|---|---|---|---|
| I-95 S @ VA-123/EXIT 160 | 1 | 1 | 12 |
| BALT-WASH PKWY N @ POWDER MILL RD | 2 | 4 | 10 |
| US-301 S @ MCKENDREE RD/CEDARVILLE RD | 3 | 6 | 10 |
| I-95 N @ VA-123/EXIT 160 | 2 | 2 | 8 |
| I-495 INNER LOOP @ I-270-SPUR | 2 | 7 | 8 |
| DC-295 S @ EAST CAPITOL ST | 2 | 3 | 7 |
| **Past Bottleneck Locations** | **Highest Rank 2010-2021** | **2021 Rank** | **Number of Times in Annual Top Ten 2010-2021** |
| I-66 E @ SYCAMORE ST/EXIT 69 | 2 | >100 | 10 |
| I-495 OUTER LOOP @ MD-97/GEORGIA AVE/EXIT 31 | 4 | 44 | 10 |
| I-95 S @ MCB QUANTICO/EXIT 148 | 2 | >100 | 5 |
| I-66 W @ VADEN DR/EXIT 62 | 3 | >100 | 4 |

# Bottleneck Magnitudes (2021)




2021's top bottleneck (measured in "Base Impact" [integrating queue length and bottleneck duration]) was 37% more impactful than the second-ranked bottleneck, and more than three times as impactful as the 10th-ranked bottleneck

# Why Bottlenecks May Change Over Time

- Temporary impacts of construction zones
- Long-term impacts after construction projects
- Regional and national population and business growth
- Regional and national economic ups and downs
- Year-to-year variations in the impacts of storms and major incidents
- Still-evolving long-term travel demand impacts of the pandemic
- Changes within the PDA Suite tool and its underlying databases

# Some Major Projects 2010-2021

- 2011: MD-200 (InterCounty Connector) (east end connection to US-1 completed 2014); included I-95 interchange
- 2012: 495Express lanes between VA-620 and north of VA-267
- 2012/2013: Woodrow Wilson Bridge approaches (main bridge was completed 2009)
- 2013: 11th Street Bridge
- 2014: Silver Line Metro to Wiehle–Reston East
- 2014: 95Express reversible lanes from VA-294 to VA-610
- 2017: I-66 inside the Beltway converted from HOV to HOV/toll lanes
- 2019: 395Express reversible lanes from Turkeycock Run to Potomac River

# Bottlenecks Context: Range of the CMP

- The context of this bottleneck analysis is the 2022 Congestion Management Process Technical Report (see mwcog.org/cmp)
- Bottlenecks analysis is not the only way that the CMP Technical Report examines the extent of congestion; also reported, based on vehicle probe data speeds, are:
  - Congestion, reported as Travel Time Index (see mwcog.org/congestion for definition)
  - Reliability, reported as Planning Time Index
  - Travel time along defined major commute routes and designated arterial roadways
- The CMP Technical Report also describes the many congestion management strategies pursued in the region, featuring Commuter Connections programs

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