Understanding NPMRDS Usage for Certain Performance Data Needs

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Highway Information Seminar

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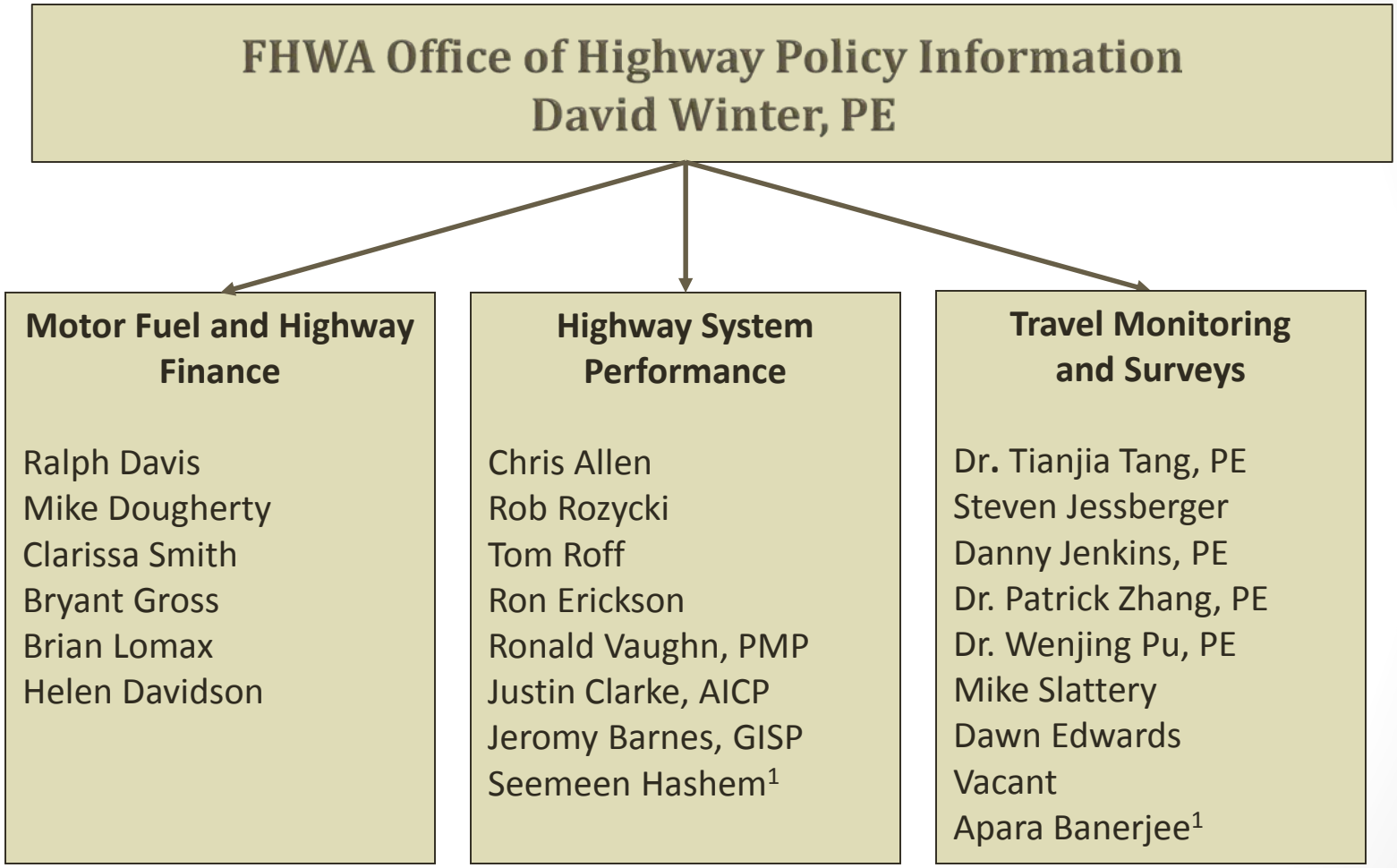
U.S. Department of Transportation
Federal Highway Administration
Office of Highway Policy Information

Office Organizational Chart



1 – Indicates contractor

Outline

1. National Performance Management Research Data Set (NPMRDS)
2. NPMRDS for PM3 (System Performance, Freight, and CMAQ)
3. NPMRDS for Other Applications

What is NPMRDS?

- A package of vehicle probe data procured by FHWA
  - 1st procurement (NPMRDS v1): July 2013
  - 2nd procurement (NPMRDS v2): April 2017
- Archived travel time and speed; AADT (if available) is conflated from HPMS
- Resolution: 5-minute intervals on over 400,000 TMC segments
- Coverage: National Highway System, 26 border crossings
- Travel time and speed by vehicle type:
  - Passenger vehicles
  - Trucks
  - All (passenger vehicles and trucks)

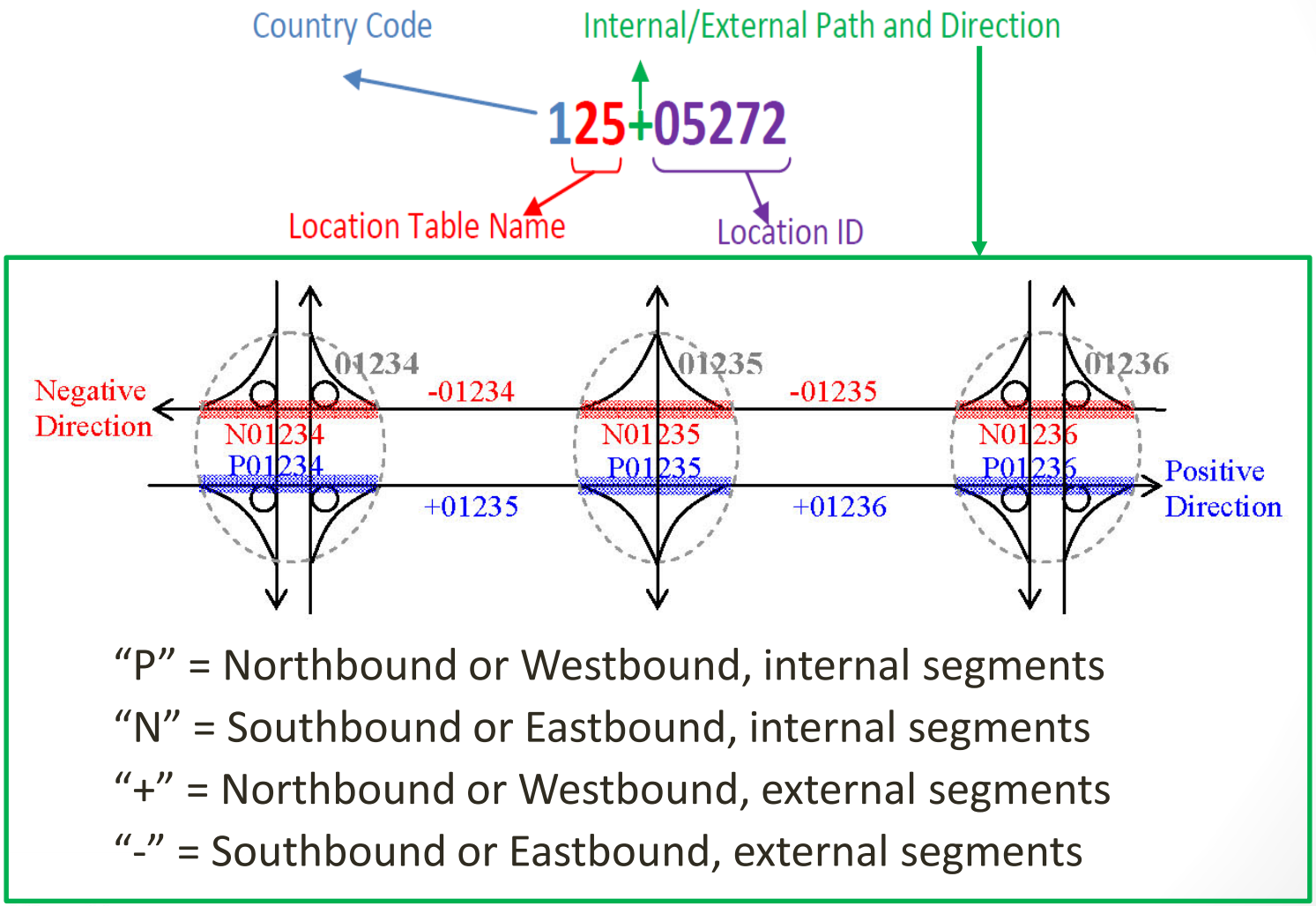
NPMRDS: v1 vs. v2

	V1	V2
Data Vendor	HERE	UMD-INRIX-TTI-KMJ-IDAX
Temporal resolution	5-minute	5-, 10-, 15-, 60-minute
Epoch w/o obs.	Not included in the file	Has the option to include empty (null) values
TMC Path	Combined TMCs	Internal/External TMCs
Path Processing	No	Yes
GIS Shapefile	HERE LinkID TMC Look Up Table	TMC path 15 HPMS Data Items
Data Download	Multi-States/US; large files	Flexible, Customized selection
Temporal coverage	2011 – 1/31/2017	2/1/2017 – (up to 12/31/2021)

What's in the NPMRDS?

1. TMC Shapefile (each state is a separate file)
   https://npmrds.ritis.org/analytics/shapefiles
2. TMC Identification table (.csv)
3. Speed/travel time data table (.csv)

Traffic Message Channel (TMC) Code



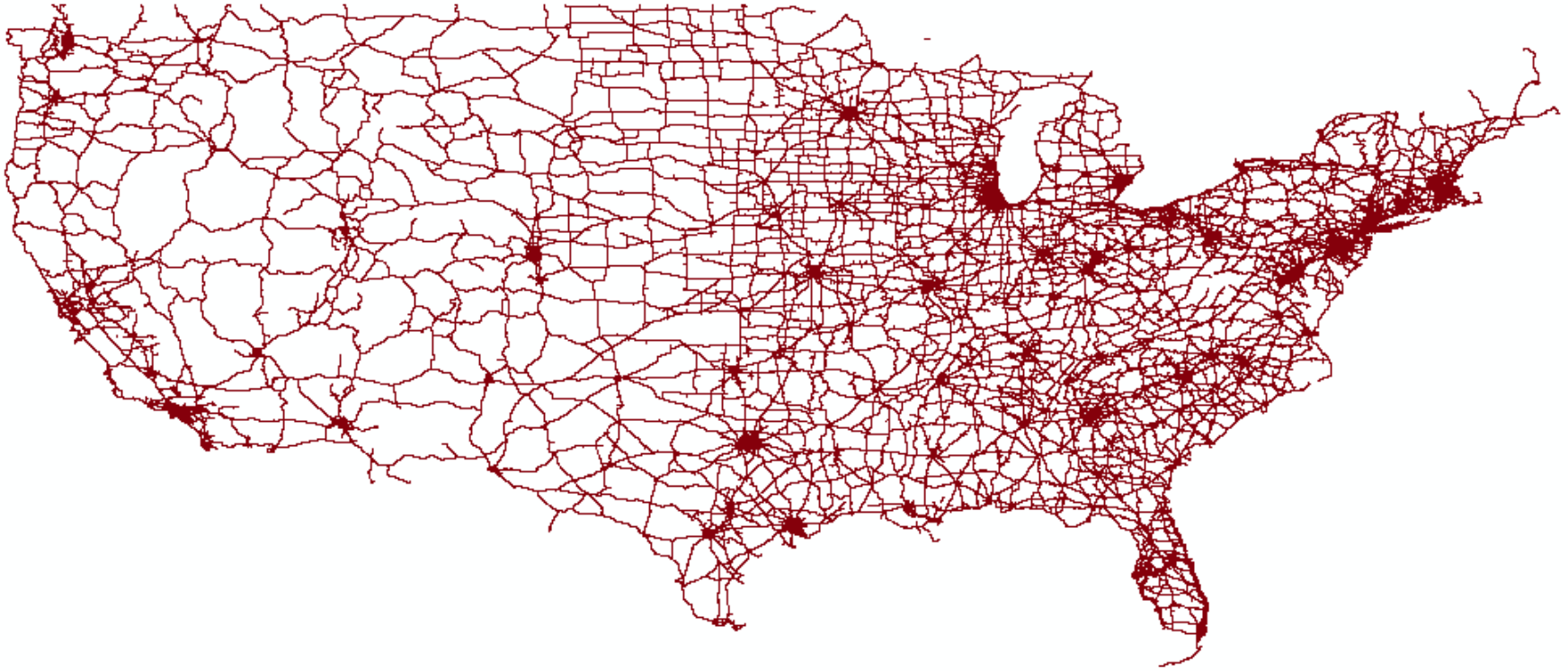
"P" = Northbound or Westbound, internal segments

"N" = Southbound or Eastbound, internal segments

"+" = Northbound or Westbound, external segments

"-" = Southbound or Eastbound, external segments

TMC Shapefile



Note: Alaska, Hawaii, Puerto Rico have TMC shapefiles but not shown here.

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TMC Identification table (.csv)

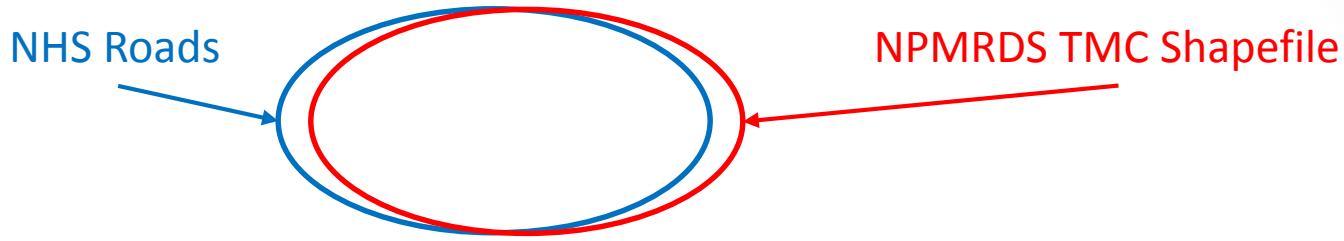
No.	TMC Original	No.	Conflated HPMS
1	datasource	18	border_set*
2	tmc	19	f_system
3	road	20	urban_code
4	direction	21	faciltype
5	intersection	22	structype
6	state	23	thrulanes
7	county	24	route_numb
8	zip	25	route_sign
9	start_latitude	26	route_qual
10	start_longitude	27	altrtename
11	end_latitude	28	aadt
12	end_longitude	29	aadt_singl
13	miles	30	aadt_combi
14	road_order	31	nhs
15	timezone_name	32	nhs_pct*
16	tmclinear	33	strhnt_typ
17	frc	34	strhnt_pct*
		35	truck

** Not HPMS data item; included by vendor*

Speed/Travel Time Data (.csv)

Filed Name	Description
datasource	Indicates all vehicles, passenger vehicles, or trucks.
tmc_code	The unique 9-digit value identifying the TMC segment.
measurement_tstamp	Date and time of data recorded.
speed	Observed average speed in mph for a time interval
average_speed	The historical average speed for the roadway segment for that hour of the day and day of the week in miles per hour.
reference_speed	The calculated "free flow" mean speed for the roadway segment in miles per hour. This attribute is calculated based upon the 85th-percentile point of the observed speeds on that segment for all time periods.
travel_time	Corresponds to the “speed” field; in minutes (or seconds)
data_density	Data density indicator, where: A = 1 to 4 reporting vehicles B = 5 to 9 reporting vehicles C = 10 or more reporting vehicles

NPMRDS Coverage for NHS



- NHS Roads not in TMC Shapefile
  - NHS roads not coded with TMC
  - NHS roads coded with TMC but not in TMC shapefile
- NPMRDS TMC Shapefile
  - Not NHS roads
  - NHS roads
    - A TMC is partially NHS
    - No speed/travel time data in a year
    - Few speed/travel time observations in a year

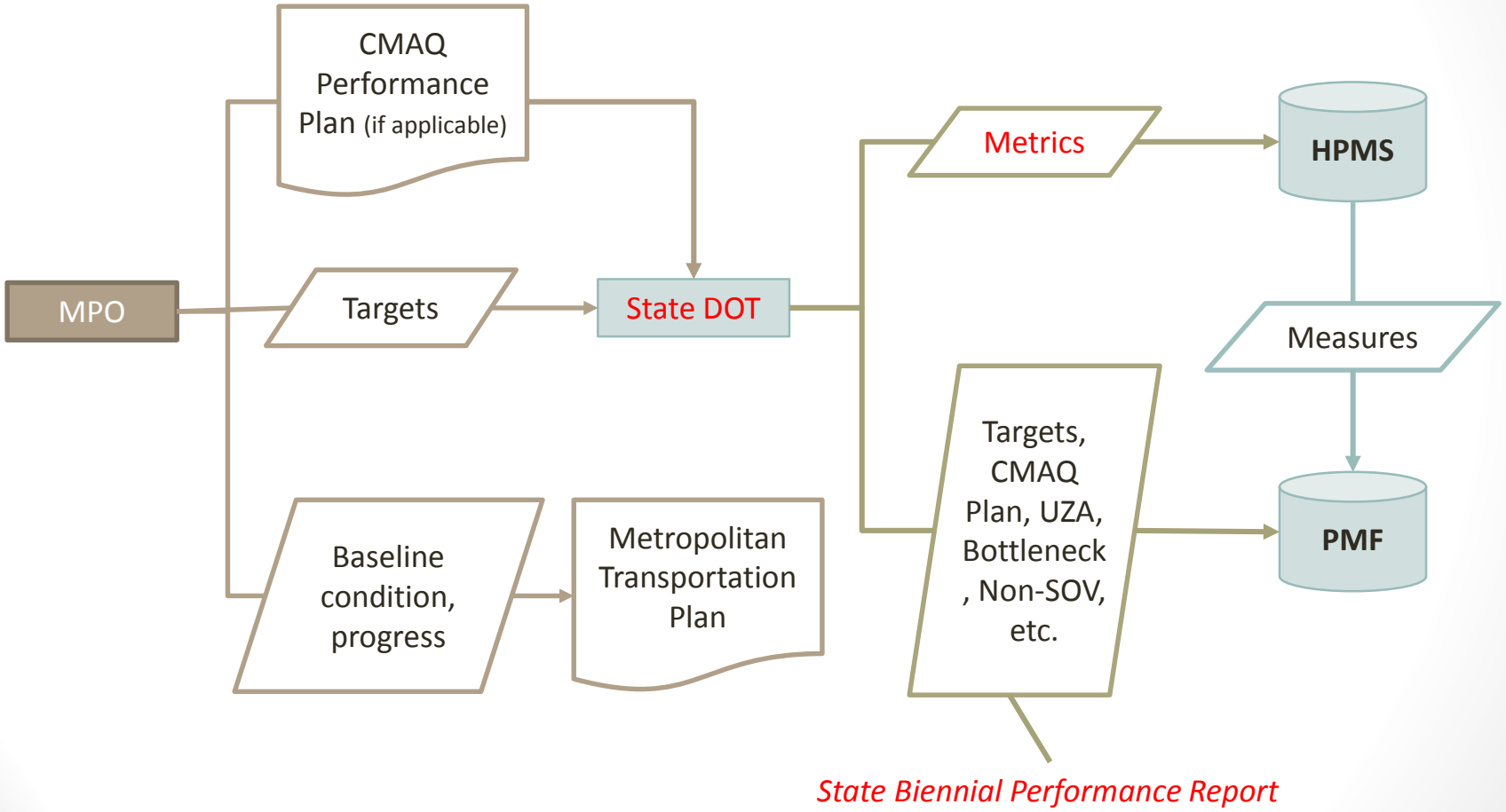
NPMRDS Supports Four PM3 Measures

- Reliability (2)
  - Percent of person-miles traveled on the Interstate that are reliable
  - Percent of person-miles traveled on the non-Interstate NHS that are reliable
- Freight (1)
  - Truck Travel Time Reliability (TTTR) Index
- CMAQ Peak Hour Excessive Delay (PHED)(1)
  - Annual Hours of PHED Per Capita

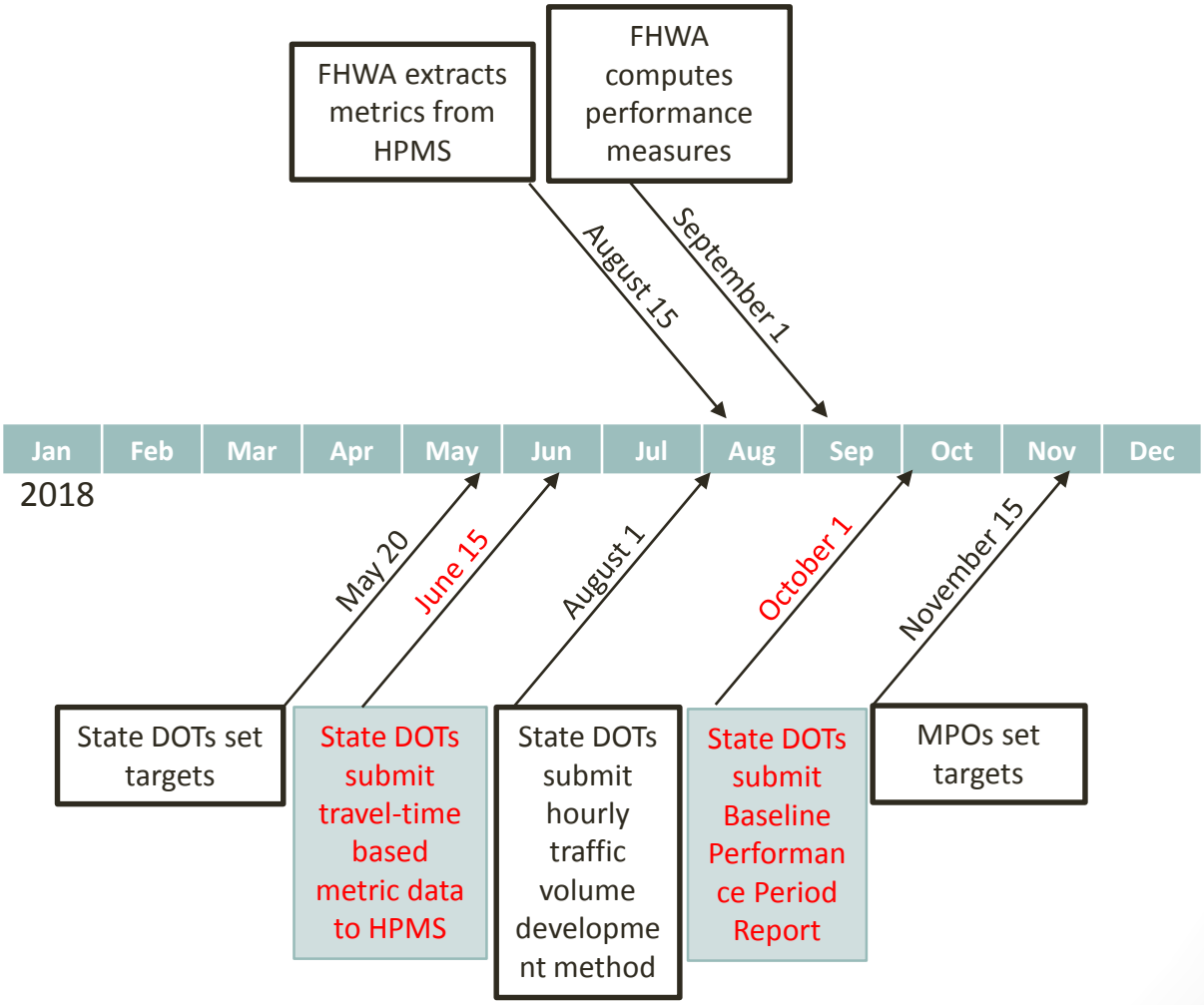
Summary of Travel Time Based 4 Measures

Measure	Applicability	If NPMRDS Used	Metrics to HPMS by 6/15/2018	State to Set Targets by 5/20/2018
Reliability – Interstate	Mainline Interstate	"All Vehicle", 15-minute	LOTTR (=80th TT/50th TT)	2-year, 4 -year
Reliability – Non-Interstate NHS	Mainline non-Interstate NHS	"All Vehicle", 15-minute	LOTTR (=80th TT/50th TT)	4-year
Freight	Mainline Interstate	"Truck" (use "All Vehicle" if "Truck" not available), 15-minute	TTTR = (95th TT/50th TT)	2-year, 4 -year
PHED	Mainline NHS in applicable Urbanized Area	"All Vehicle", 15-minute	Total PHED in person-hours	4-year

MPO and State TPM Reporting



2018 Timeline



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Travel Time Related Metrics to HPMS by June 15, 2018

Performance Measures	Segment-Level Performance Metrics	Number of Metrics*
Reliability (Interstate, non-Interstate NHS)	1. LOTTR 2. 80th Travel Time 3. 50th Travel Time } x 4 time periods 4. Directional AADT 5. Occupancy factor	14
Freight	1. TTTR 2. 95th Travel Time 3. 50th Travel Time } x 5 time periods	15
PHED	1. PHED	1

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** There are other Metrics related data to be submitted to HPMS. Refer to HPMS Field Manual Supplemental Guidance for a full list.*

Data Requirements: Reliability

Relevant Data	Data Source(s)
• **Travel times** • **NHS travel time segments**	• National Performance Management Research Data Set (NPMRDS) , ***OR*** • Equivalent data set
• **AADT/volumes** • **Annual traffic volume** (AADT x 365)	• Highway Performance Monitoring System (HPMS)
• **Occupancy factors**	• Provided by FHWA, likely based on national surveys, ***OR*** • Other allowed data sources

Calculate LOTTR Metric

- Download “all vehicle” 15-minute travel time data from NPMRDS v2
- Group data into 4 time periods for each TMC
  - Weekday 6:00-10:00 am
  - Weekday 10:00 am-4:00 pm
  - Weekday 4:00-8:00 pm
  - Weekend 6:00 am-8:00 pm
- Rank travel times in each group to obtain 80th and 50th travel times for each TMC
- LOTTR = 80th travel time / 50th travel time for each TMC

Level of Travel Time Reliability (LOTTR) Metric (Example)

$$\frac{\text{Longer Travel Time (80th)}}{\text{Normal Travel Time (50th)}} = \frac{\text{\# seconds}}{\text{\# seconds}} = \text{Level of Travel Time Reliability Ratio}$$

Level of Travel Time Reliability (LOTTR) *(Single Segment, Interstate Highway System)*		
Monday – Friday	6am – 10am	LOTTR = $\frac{44 \text{ sec}}{35 \text{ sec}} = 1.26$
	10am – 4pm	LOTTR = 1.39
	4pm – 8pm	LOTTR = 1.54
Weekends	6am – 8pm	LOTTR = 1.31
Must exhibit LOTTR below 1.50 during **all** of the time periods		**Segment is not reliable**

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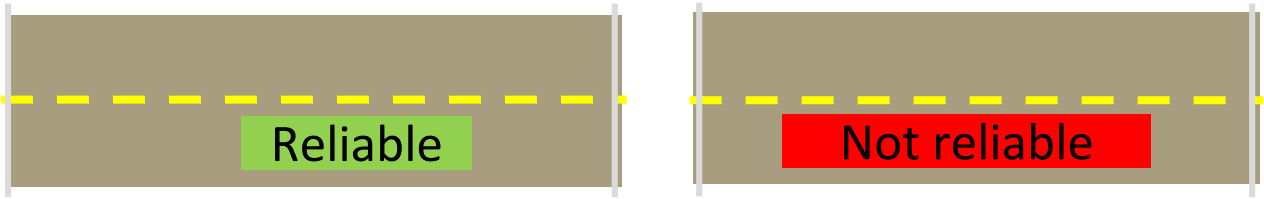
Calculating Travel Time Reliability Measures (Example)



	Reliable	Not reliable
Length	1.000 mi.	0.750 mi.
Annual Traffic Volume	2,000,000 x	3,500,000 x
Occupancy Factor	1.3 persons/vehicle	1.7 persons/vehicle
Segment Total	**Reliable: 2,600,000 person-miles**	**Unreliable: 4,462,500 person-miles**

$$\frac{\Sigma\ (\text{Reliable person-miles})}{\Sigma\ (\text{Total person-miles})}$$

Measure: % of person-miles reliable, for full extent of the system

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Data Requirements: Freight Reliability

Relevant Data	Data Source Options
• Truck travel times • Interstate travel time segments	• NPMRDS, ***OR*** • Equivalent data set

Calculate TTTR Metric

- Download “truck” and “all vehicle” 15-minute travel time data from NPMRDS v2
- **If “truck” speed is empty, use “all vehicle” value, if available**
- Group data into 5 time periods for each TMC
  - Weekday 6:00-10:00 am
  - Weekday 10:00 am-4:00 pm
  - Weekday 4:00-8:00 pm
  - Everyday Overnight 8:00 pm-6:00 am
  - Weekend 6:00 am-8:00 pm
- Rank travel times in each group to obtain 95th and 50th travel times for each TMC
- TTTR = 95th travel time / 50th travel time for each TMC

Freight Reliability Metric (Example)

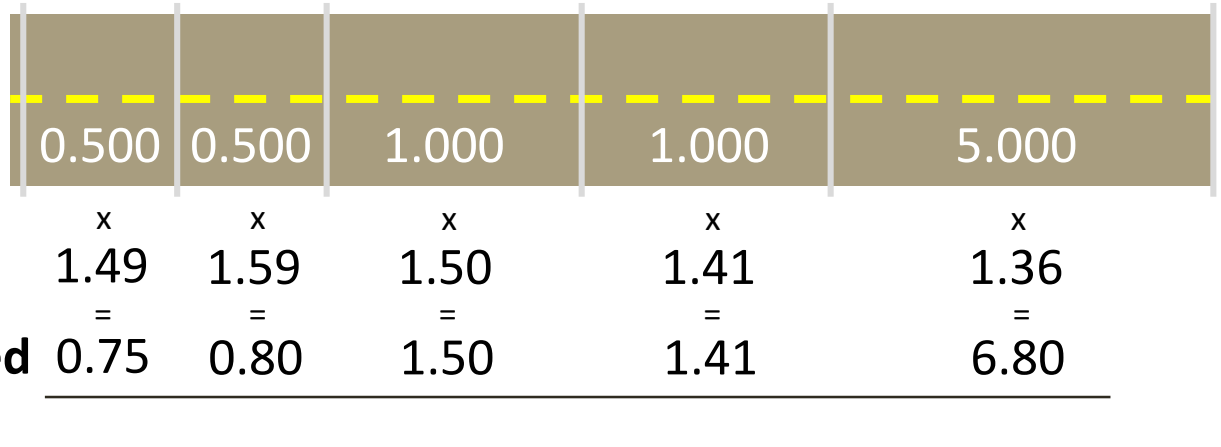
$$\frac{\text{Longer Truck Travel Time (95th)}}{\text{Normal Truck Travel Time (50th)}} = \frac{\text{\# seconds}}{\text{\# seconds}} = \text{Truck Travel Time}$$

Reliability (TTTR) Ratio

Truck Travel Time Reliability (TTTR) (Single Segment, Interstate Highway System)		
Monday – Friday	6am – 10am	$TTTR = \frac{72\ sec}{50\ sec} = 1.44$
	10am – 4pm	TTTR = 1.39
	4pm – 8pm	TTTR = **1.49**
Weekends	6am – 8pm	TTTR = 1.31
Overnight	8pm – 6am	TTTR = 1.20
Maximum TTTR		**1.49**

Calculating Freight Reliability Measure (Example)

$$\text{TTTR Index} = \frac{\sum \text{All segment length weighted TTTR}}{\sum \text{All serment lengths}}$$



$$\textbf{TTTR Index} = \frac{11.25}{8.000\ \text{mi}} = \mathbf{1.41}$$

Measure: TTTR Index, full extent of the Interstate system

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Applicability: PHED

- Areas with the following criteria:

Area Characteristics

- Designated urbanized area,
- Contains NHS mileage, **AND**
- Population over 200,000*

+

Nonattainment or Maintenance Area

- ozone (O_3),
- carbon monoxide (CO), **OR**
- particulate matter (PM_{10} or $PM_{2.5}$)

- **All MPOs and State DOTs** that have NHS mileage that overlaps with an applicable urbanized area must coordinate on a **single, unified target** and report on the measures.

* *Phase In: For the first performance period only, the population criteria applies to urbanized areas with populations over 1 million.*

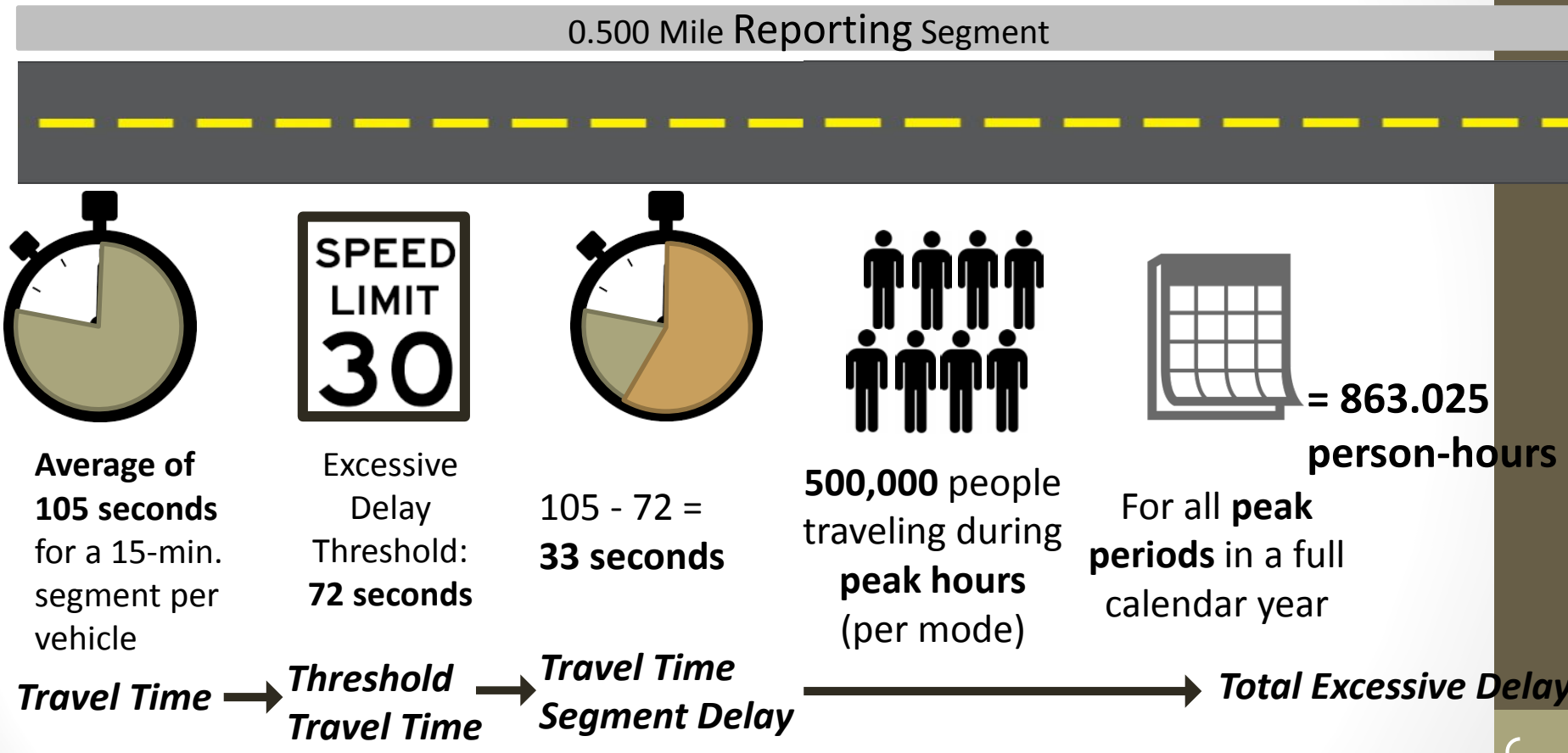
Data Requirements: PHED

Relevant Data	Data Source Options
• **Urbanized Area Boundary**	• US Decennial Census • HPMS
• **Reporting Segment Length**	• NPMRDS, ***OR*** • Equivalent data set
• **Travel Time in 15-minute intervals**	• NPMRDS, ***OR*** • Equivalent data set
• **Hourly Traffic Volume**	• Hourly continuous traffic volume counts, ***OR*** • Derived from AADT reported to the HPMS
• **Annual Vehicle Classification for Buses, Trucks, and Cars**	• Annual traffic volume counts, ***OR*** • AADT, AADT single unit, and AADT combination as reported to the HPMS
• **Annual Vehicle Occupancy**	• Data provided by FHWA, ***OR*** • Alternative estimate that is more specific

Calculate PHED Metric

- Download “all vehicle” 15-minute travel time data from NPMRDS v2
  - Only for Peak Period (weekday 6-10 am; weekday 3-7 pm or 4-8 pm)
- Determine threshold for excessive delay for each (TMC) segment
  - 20 mph, or 60% of posted speed limit, whichever is greater
  - Covert threshold speed to threshold travel time
- Calculate travel time segment delay
  - NPMRDS travel time – threshold travel time (>=0)
- Convert the travel time segment delay to person-hours
  - Hourly volume ÷ 4 (to get vehicle hours of delay)
  - Average Vehicle Occupancy (to get person-hours of delay)
    - Weighted average of occupancy factors for cars, buses, and trucks

PHED Metric (Example)



***HPMS Submittal:** *Starting in 2018, State DOTs report PHED metric for each reporting segment by June 15 of each year, for the previous year's measures*

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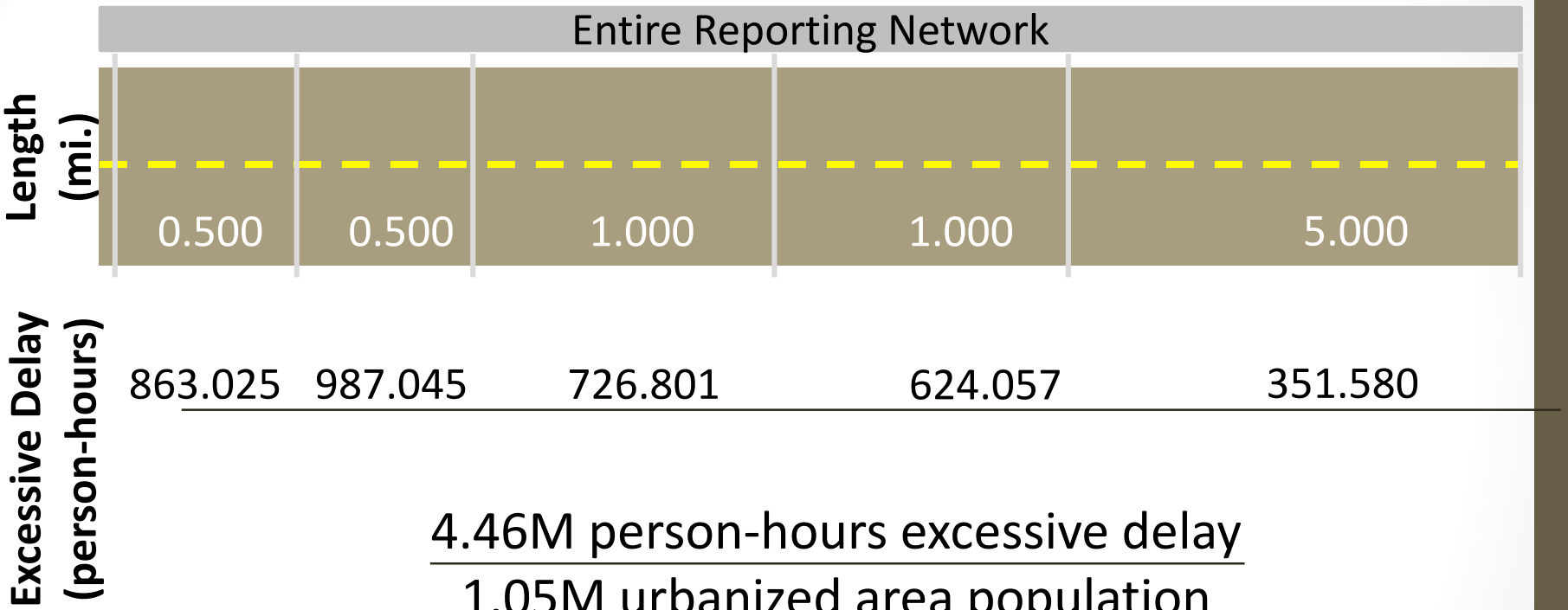
Calculating PHED Measure (Example)



$$\frac{\text{4.46M person-hours excessive delay}}{\text{1.05M urbanized area population}}$$

= 4.3 hours per capita

Measure: Peak hour excessive delay per capita

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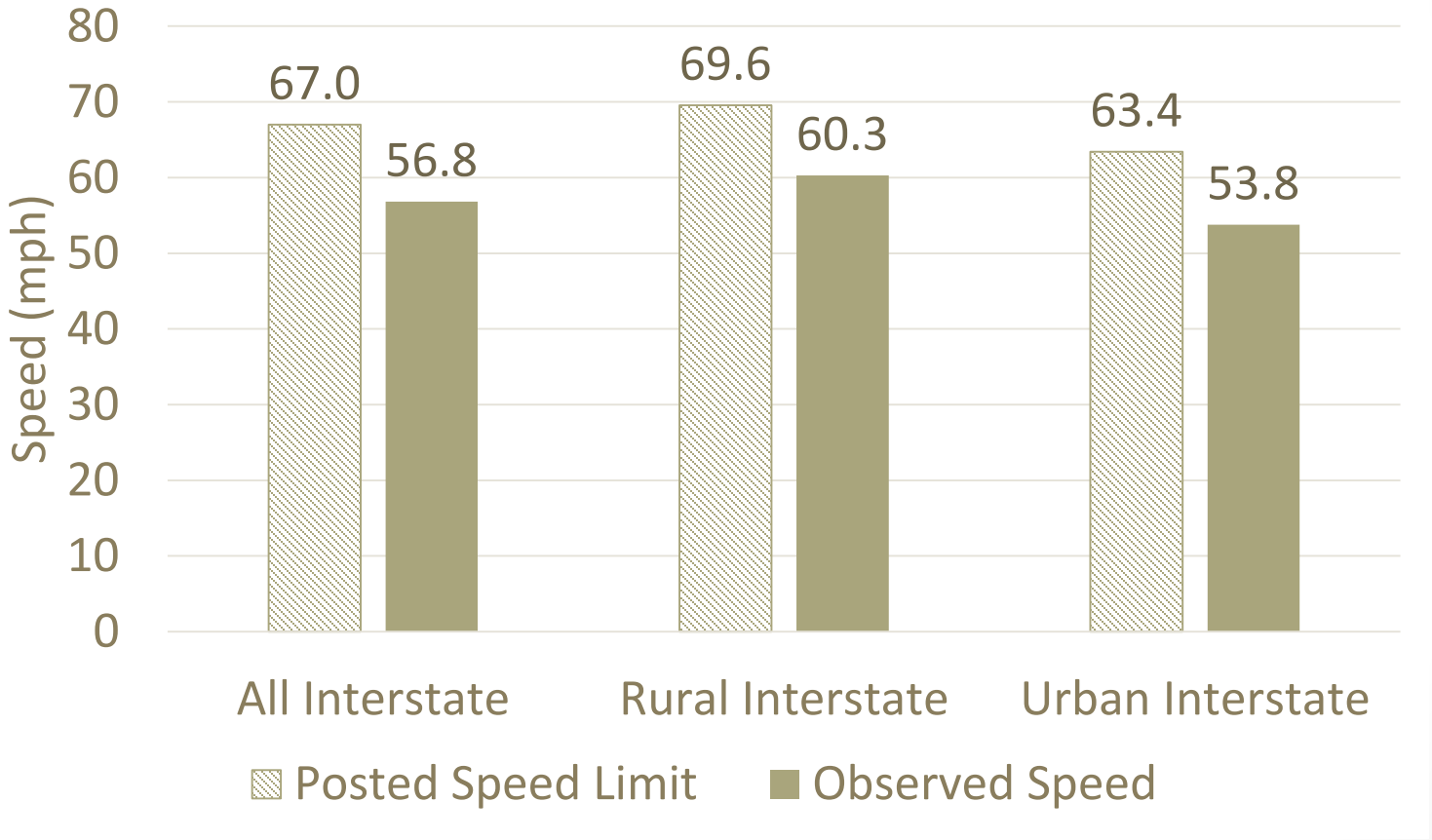
2016 Interstate Speed Profiles: Average Speed



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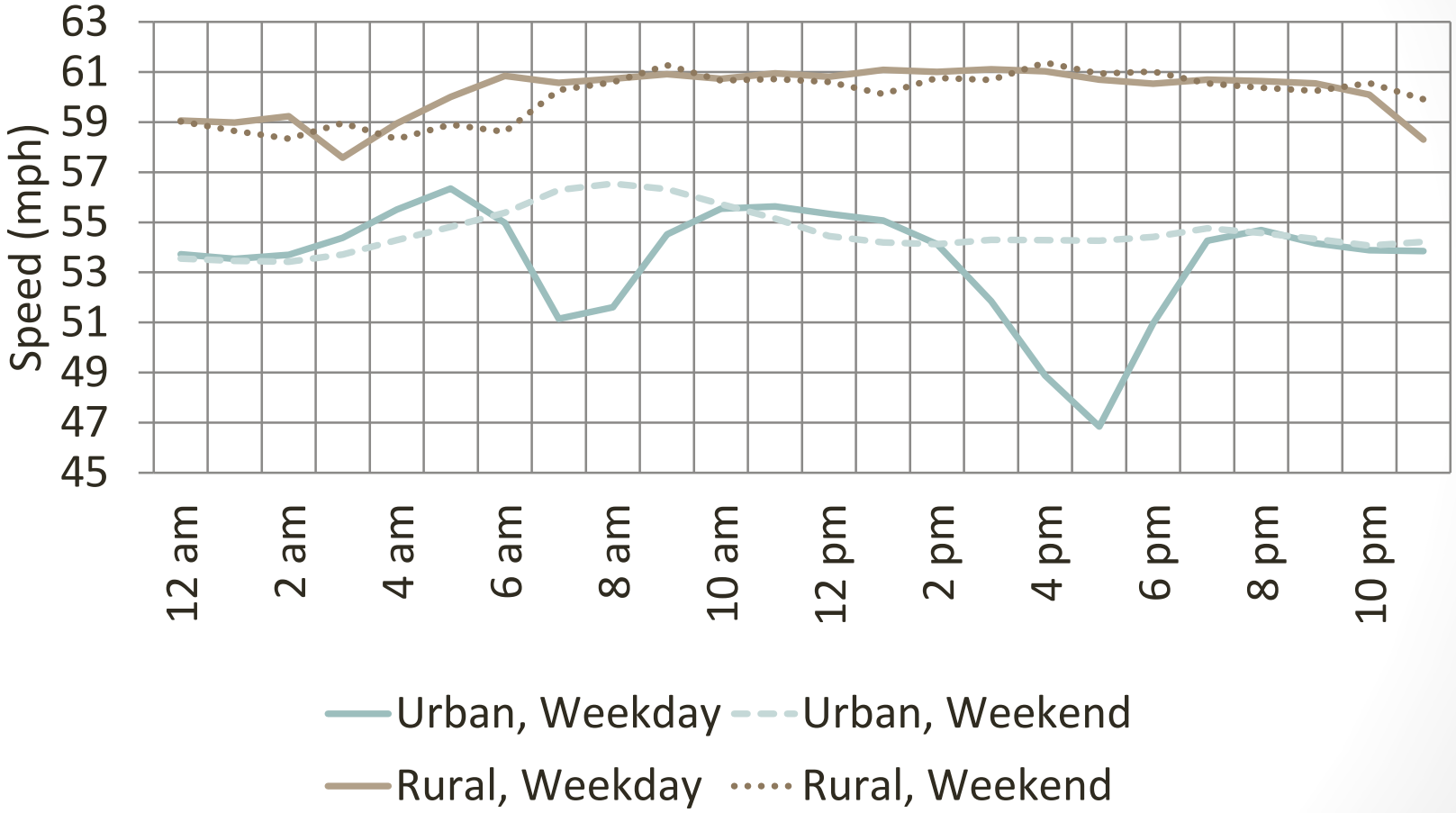
Speed by Hour of the Day



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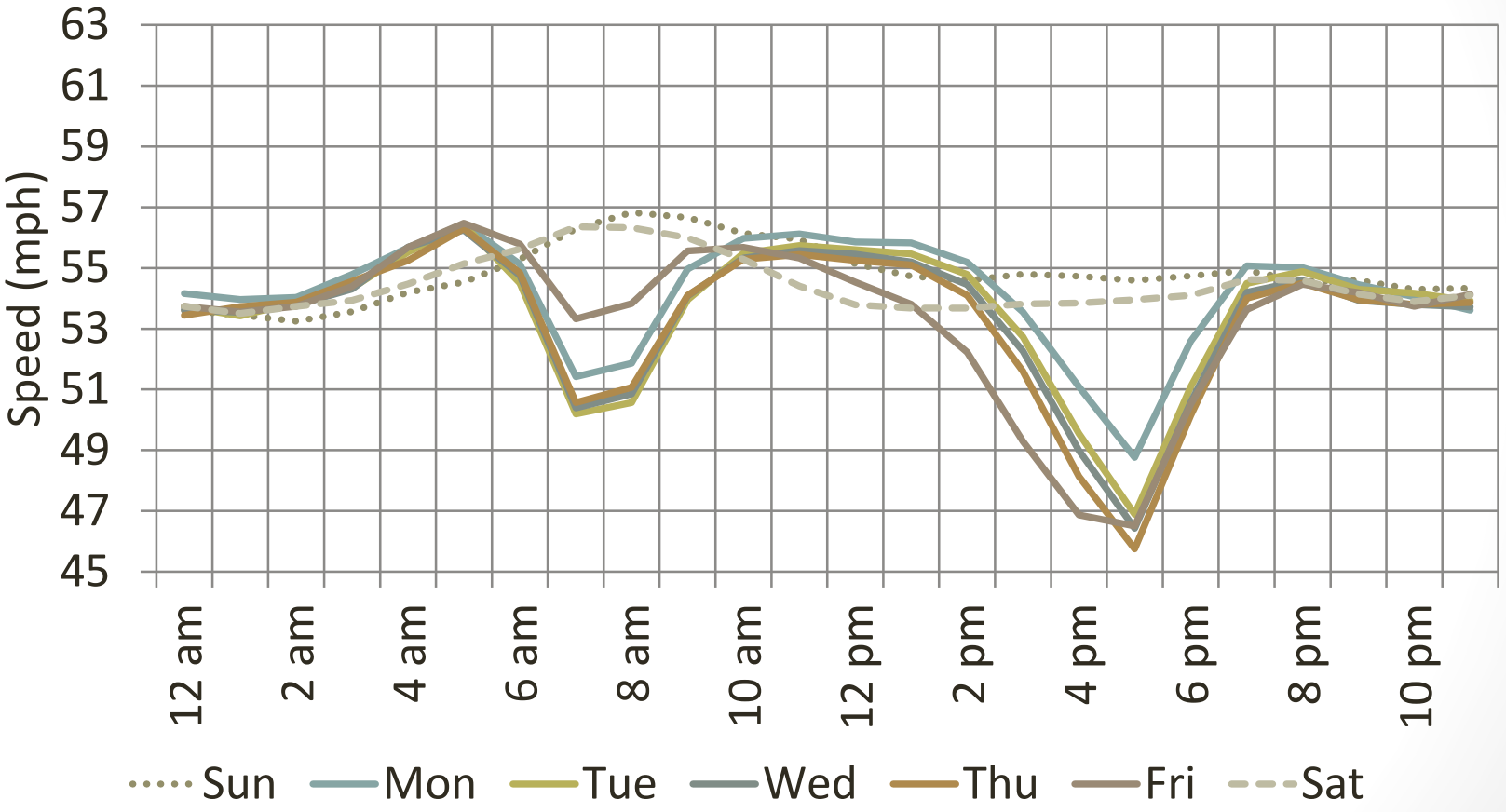
Hourly Speed Pattern by Day of the Week - Urban



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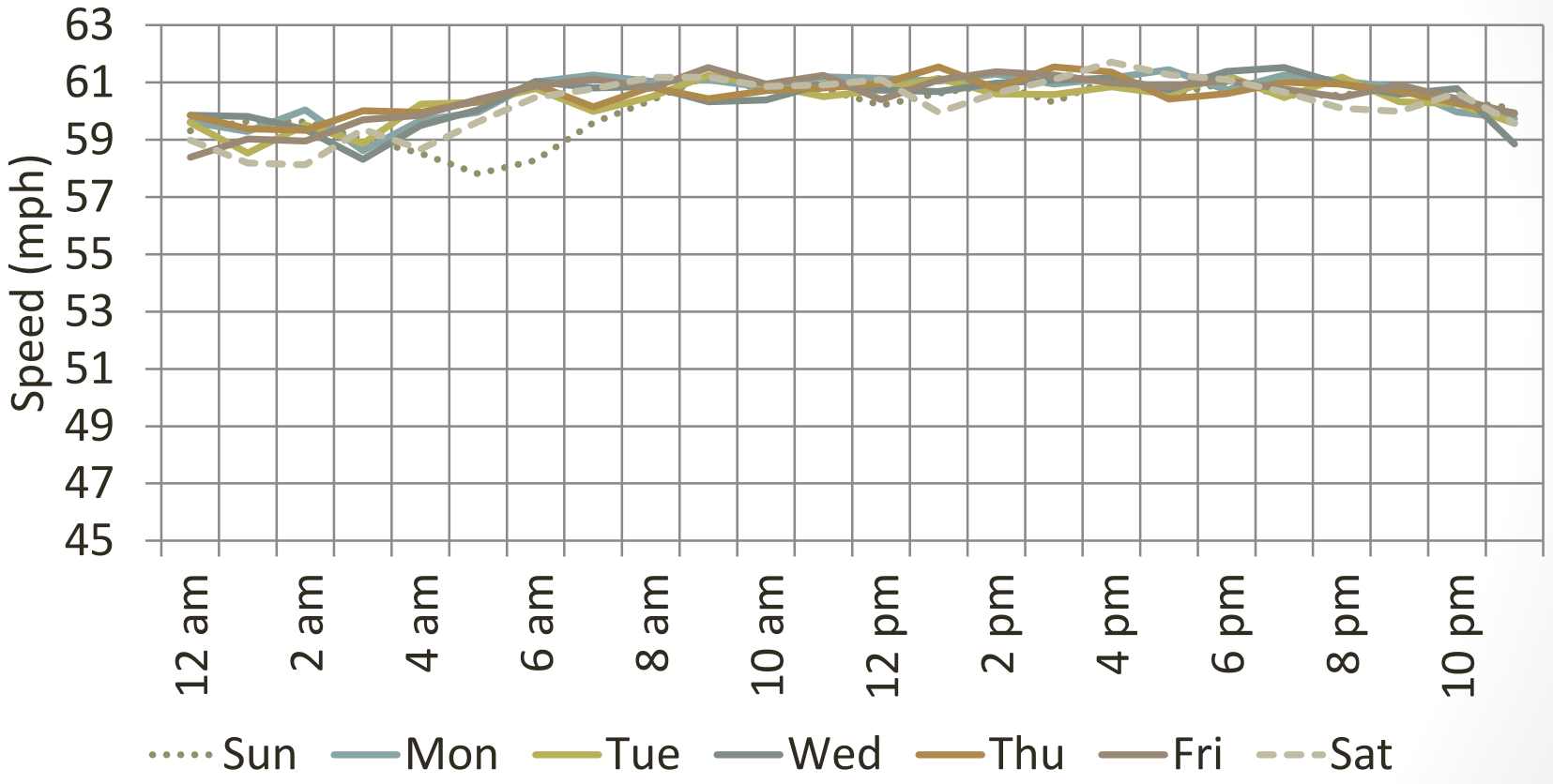
Hourly Speed Pattern by Day of the Week - Rural



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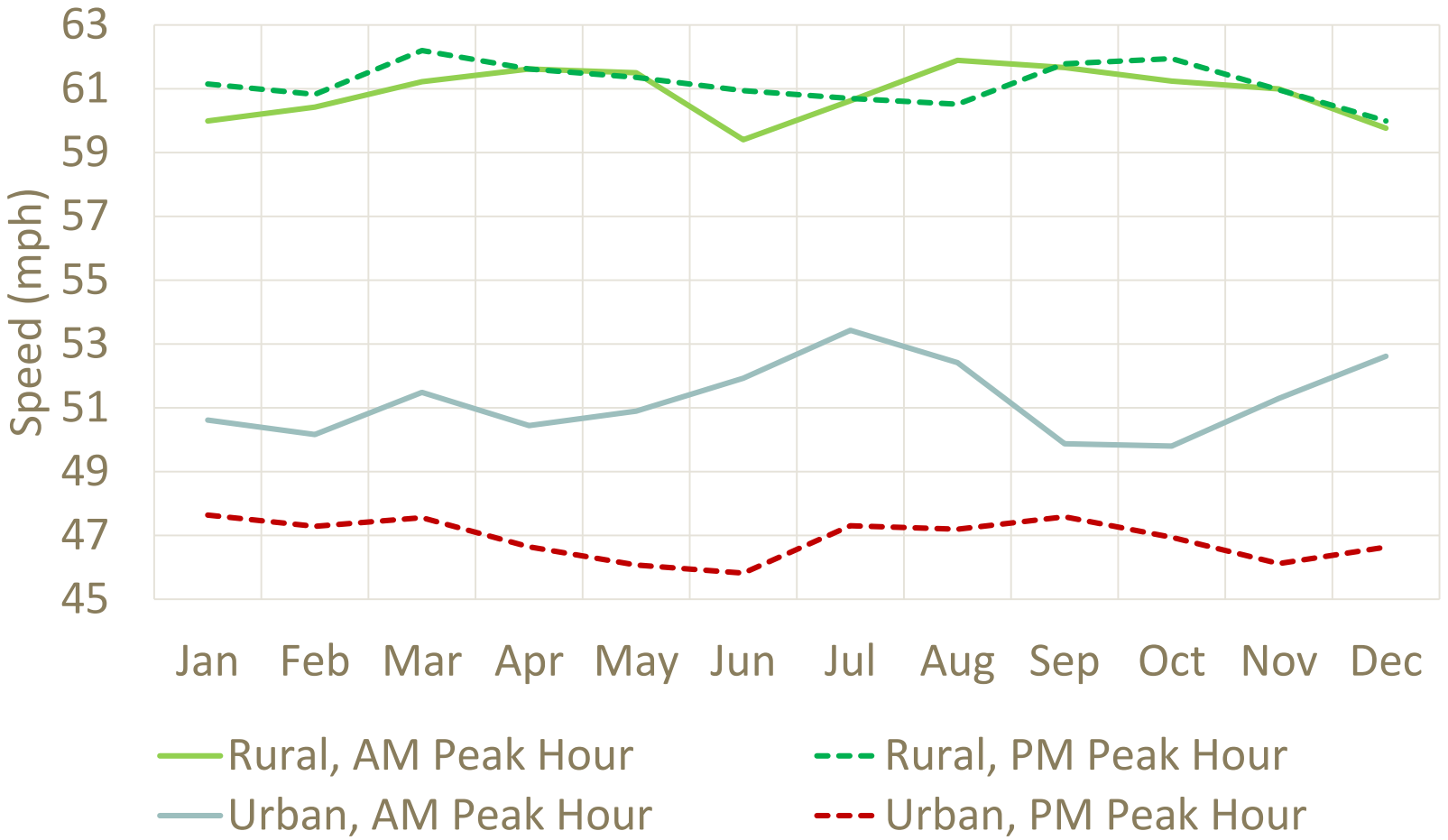
Peak Hour Speed by Month



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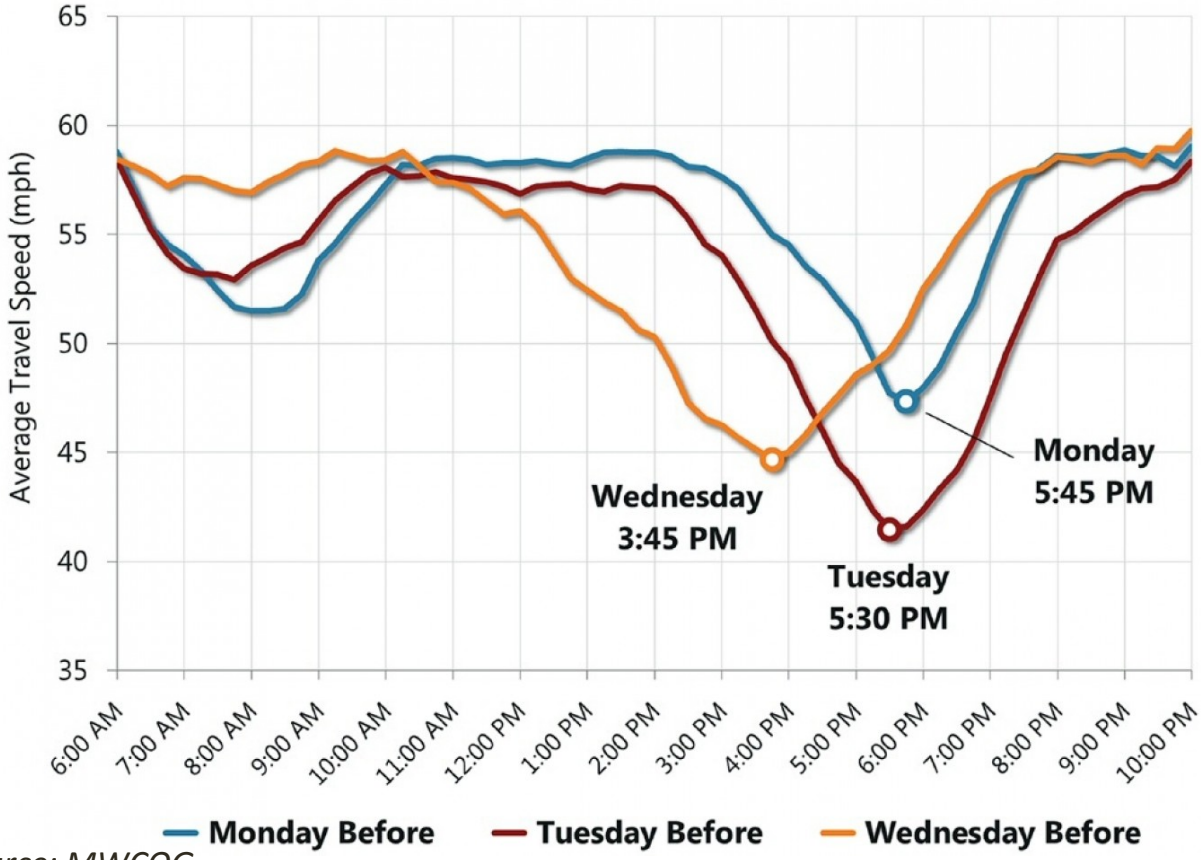
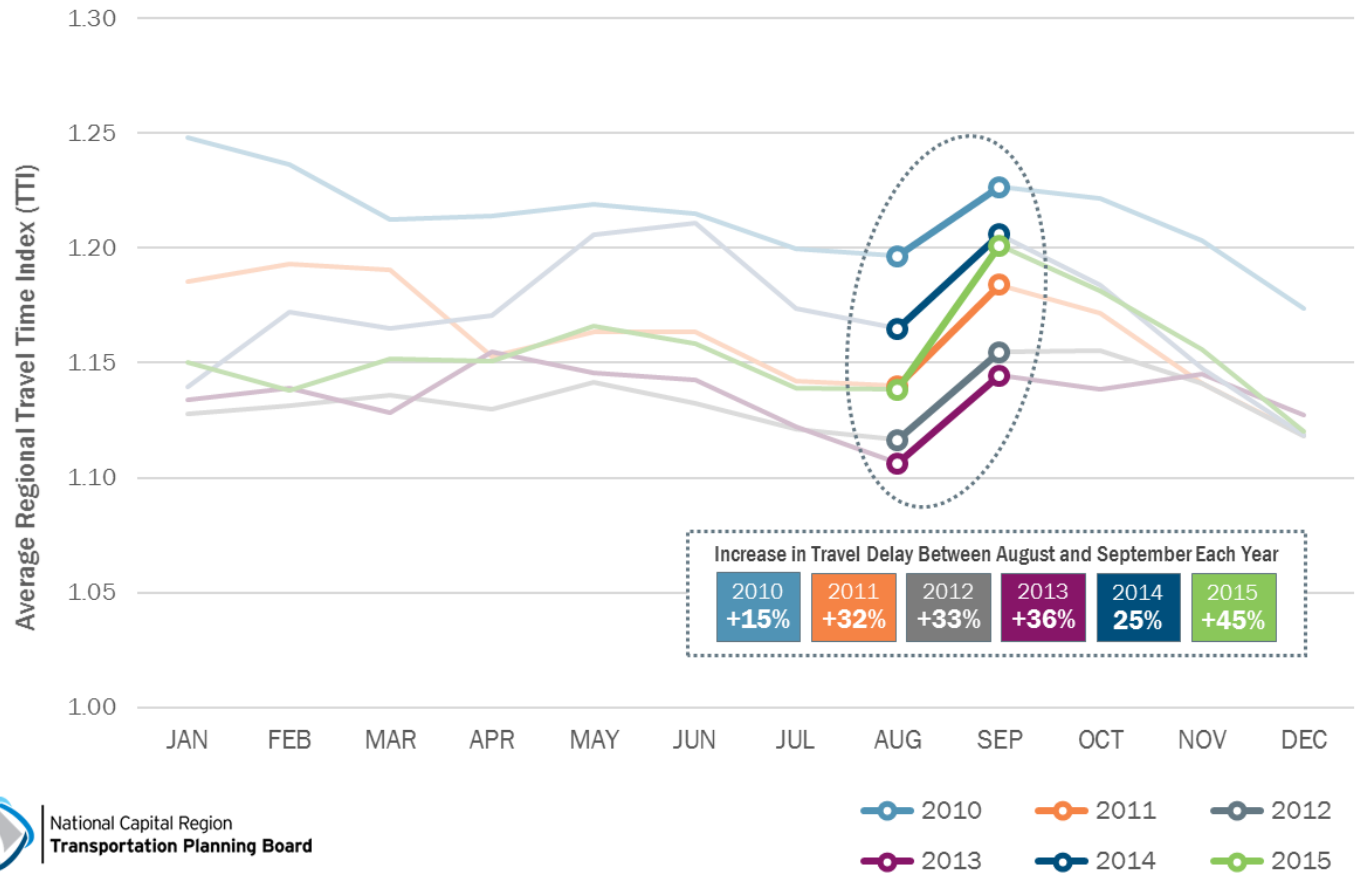
Traffic before Thanksgiving



Source: MWCOG

https://www.washingtonpost.com/news/dr-gridlock/wp/2016/11/22/tuesday-wednesday-afternoons-worst-for-thanksgiving-traffic/?utm_term=.5553a12ac244

Morning Travel Delay Consistently Jumps by 15-45% Between August and September Each Year



National Capital Region
Transportation Planning Board

http://www.tpbne.ws/featured/get-ready-for-traffic-to-pick-back-up-as-part-of-september-shock/

Questions and Comments

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