

Traffic Monitoring Guide (TMG) Basics

2017 Highway Information Seminar (HIS)

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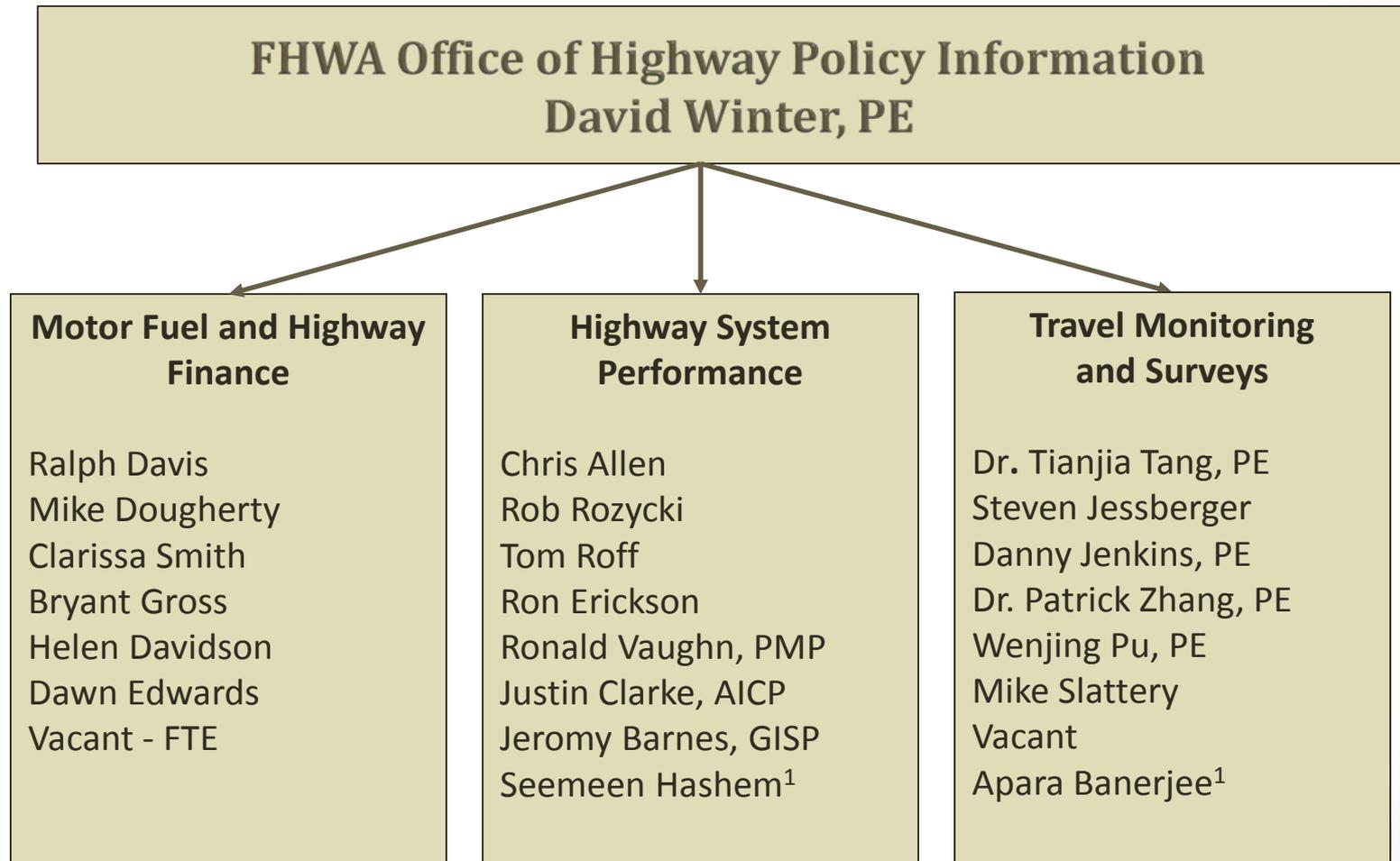
Travel Monitoring and Surveys Section

Monday, November 13, 2017

11/14/2017



Office Organizational Chart



2018 NaTMEC – Irvine, CA

- Abstracts received - 119
- June 10-13, 2018
- More representation on those performing local counting
- 40 exhibit areas
- Outdoor demonstration area – back again
- See www.NaTMEC.org for details and to register



2013/2016 TMG Organization

- Prior to 2001 TMG organization by data type
- 2013 and 2016 done by business need
 - Chapter 1: Traffic Monitoring Theory, Technology and Concepts
 - Chapter 2: Trans. Monitoring Prog. – Business Planning and Design
 - Chapter 3: Traffic Monitoring Methodologies
 - Chapter 4: Nonmotorized
 - Chapter 5: Transportation Management and Operations
 - Chapter 6: Highway Performance Monitoring System
 - Chapter 7: All Formats
 - Appendices A thru R – many new ideas



2013 or 2016 TMG Formats

- Station Data
 - More required fields
 - LRS up to 64 digits
 - No other significant changes
- Volume Data
 - 4 digit year
 - Expanded restrictions field
 - Ability to submit smaller than 1 hour intervals by utilizing speed, classification or per vehicle format
- Classification Data
 - 5, 15, or 60 minute increments
 - From 2 to 15 bins
 - No other significant changes



2013 or 2016 TMG Formats (continued)

- Weight data – (TMG pages 7-43 to 7-47) all now in English units
 - Weight – whole lbs.
 - Length to 1/10th foot
- Per Vehicle Format (PVF) data (TMG pages 7-48 to 7-69)
 - Supports any data type
 - Temperature
 - Left and Right axle weights
 - Vehicle Length – bumper to bumper
 - Inductive Signatures – re-id vehicles
 - Time to 1/100th Seconds
 - Speed by Class reporting, delay and gap ...
 - Dramatically improved QC methods

8 states moving to this more detailed format



2013 TMG Formats (continued)

- Speed data (TMG pages 7-23 to 7-35)
 - 15 to 25 bins (down to 10 mph for first bin)
 - 5 mph bin increments only
 - 5, 15, or 60 minute increments (utilize data from your ITS or TMC)
- Bike and Pedestrian data (TMG pages 7-70 to 7-88)
 - New Station Format (point based data only)
 - Factoring group
 - Lat/Long positioning
 - Location of count
 - Many other features
 - New Station Count Format (nonmotorized volume)
 - See TMG formats
 - Submit in less than 1 hour increments
 - Permanent or portable counts
 - See report of methods to use when using the TMG



2013 or 2016 TMG Factoring

- Classification Factoring on TMG pages 3-46 to 3-49
- Determine your program – inventory and maximum and minimum number of desired sites
- Determine travel patterns and method to use
 - TMG methods – volume, Functional Class or Clustering
 - Geographic patterns
 - Land use and urban boundaries
 - Unique travel patterns (ports, corridor flows, industry, ...)
- Assign counts to patterns
- Adjust and analyze factor groups at least every 5 years
- Minimum of 6 permanent CCS sites per group



Factoring for Class

- Perform factoring for a minimum of 6 vehicle types used for HPMS summary table:
 - Motorcycles: class 1
 - Passenger vehicles: class 2
 - Light duty pick-up truck: class 3
 - Buses: class 4
 - Heavy duty single unit trucks: classes 5-7
 - Combination unit trucks: classes 8-13
- Travel patterns may not be used for all classification sites, you may have sites with unique vehicle class factoring that differ from the grouping used for volume factoring



Class Specific AADT Calculation Example

Date	MC Volume	PC Volume	LT Volume	Bus Volume	SU Volume	CU Volume	AADT
Aug. 14 (Tues)	518	30,705	11,215	58	4,103	4,162	50,761
Aug. 15 (Wed)	494	31,689	11,834	48	3,697	3,469	51,231
Tuesday Factor	1.24	1.02	1.02	1.06	0.88	0.8	
Wednesday Factor	1.23	1.00	1.00	1.03	0.89	0.79	
August Factor By Class	0.95	0.97	0.97	0.81	0.84	0.91	
AADT Based on Tuesday	610	30,380	11,096	50	3033	3030	48,199
AADT Based on Wednesday	577	30,738	11,479	40	2764	2,494	48,092
Average	594	30,559	11,288	45	2898	2,762	48,145
AADT computed from total volume = (50,761 + 51,231) × 0.95 × 0.98 DOW factor) =							47,477
Difference of average computed from total volume minus average computed by class specific factors and then summed							-668
Fraction of Traffic	0.012	0.635	0.234	0.001	0.060	0.057	
Proportional Adjustment (Fraction of Vehicles × Error)	-8	-424	-157	-1	-40	-38	
Final AADT by Class (Volume + Proportional Adjustment)	585	30,135	11,131	44	2,858	2,724	47,477



Factoring – New Areas

- Volume factoring for all roadways
 - FC 6R, 7U and 7R (locals)
 - MIRE – AADT on all paved roadways
 - Special projects, manual counts and consultants
- Nonmotorized data collection factoring:
 - Many MPO and local agencies are collecting nonmotorized data
 - Nobody knows best where to put sites, methods to maintain sites and how to QC the sites data
- Axle Correction Factors (ACF)
 - WIM sites (PVF)
 - Classification Sites (PVF) (portable and permanent sites)
 - Public yearly updates of all ACFs



FHWA Traffic Data Uses

- Office of Highway Policy Information

<http://www.fhwa.dot.gov/policyinformation/index.cfm>

- HPMS/TMAS/TVT
- Safety – denominator for exposure, speed, class data,...
- Pavement – design of pavements
- Transportation Performance Management (TPM 1-3): MAP-21/FAST Act

www.fhwa.dot.gov/tpm

- Model Inventory of Roadway Elements (MIRE)

http://safety.fhwa.dot.gov/legislationandpolicy/fast/ssds_guidance.cfm

- Highway Statistics

<http://www.fhwa.dot.gov/policyinformation/statistics.cfm>

- Highway Cost Allocation – used internationally
- Our Nations Highways – mainly used by media companies
- Conditions & Performance report – every 2 years to Congress
- Freight Analysis Framework



AADT methods and ADT Research

- Assessing Roadway Traffic Count Duration and Frequency Impacts on AADT Estimation: TPF-5(292), led by Steven Jessberger
 - Task 2, 3, 4 and 6 completed
 - 2014 – 2016
 - States on the pooled fund Technical Advisory Committee (TAC)
 - Jennifer Anderson Alaska DOT & Public Facilities
 - Scott Susten Georgia DOT
 - William Morgan Illinois DOT
 - Gene Hicks, Thomas Nelson, Mark Flinner Minnesota DOT
 - Jeremy Freeland, Joseph Pipe Pennsylvania DOT
 - William Knowles Texas DOT
 - Rhonda McDonald Wisconsin DOT



AADT PF: Task 2–AADT Accuracy

- Nearly 500 traffic sites, over 14 years, all volume groups, most functional classes and included data from 44 states
- 45 million records utilized
- Four AADT methods studied
 - Simple average
 - AASTHO
 - AASTHO modified – removed DOW population in month bias
 - HPSJB Method – now the FHWA TMG method
 - Removes DOW population in month bias
 - Allows for less than daily use of data (60, 15, 5 or 1 minute increments)



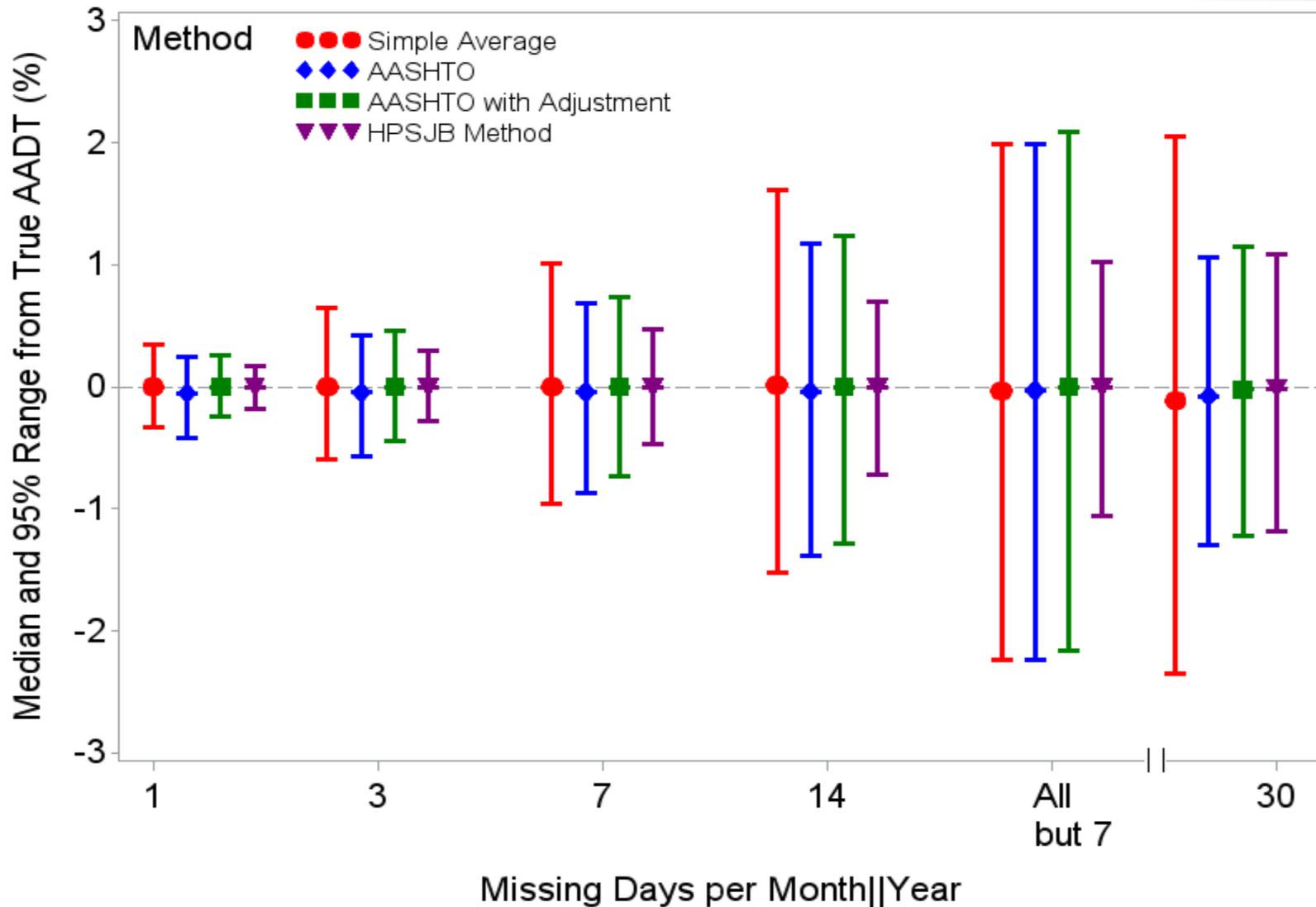
AADT PF: Task 2–AADT Accuracy

New Improved AADT mathematical formula that FHWA now has included in the TMG and is a published paper with TRB and TRR as of 2016. TPF-5(292)

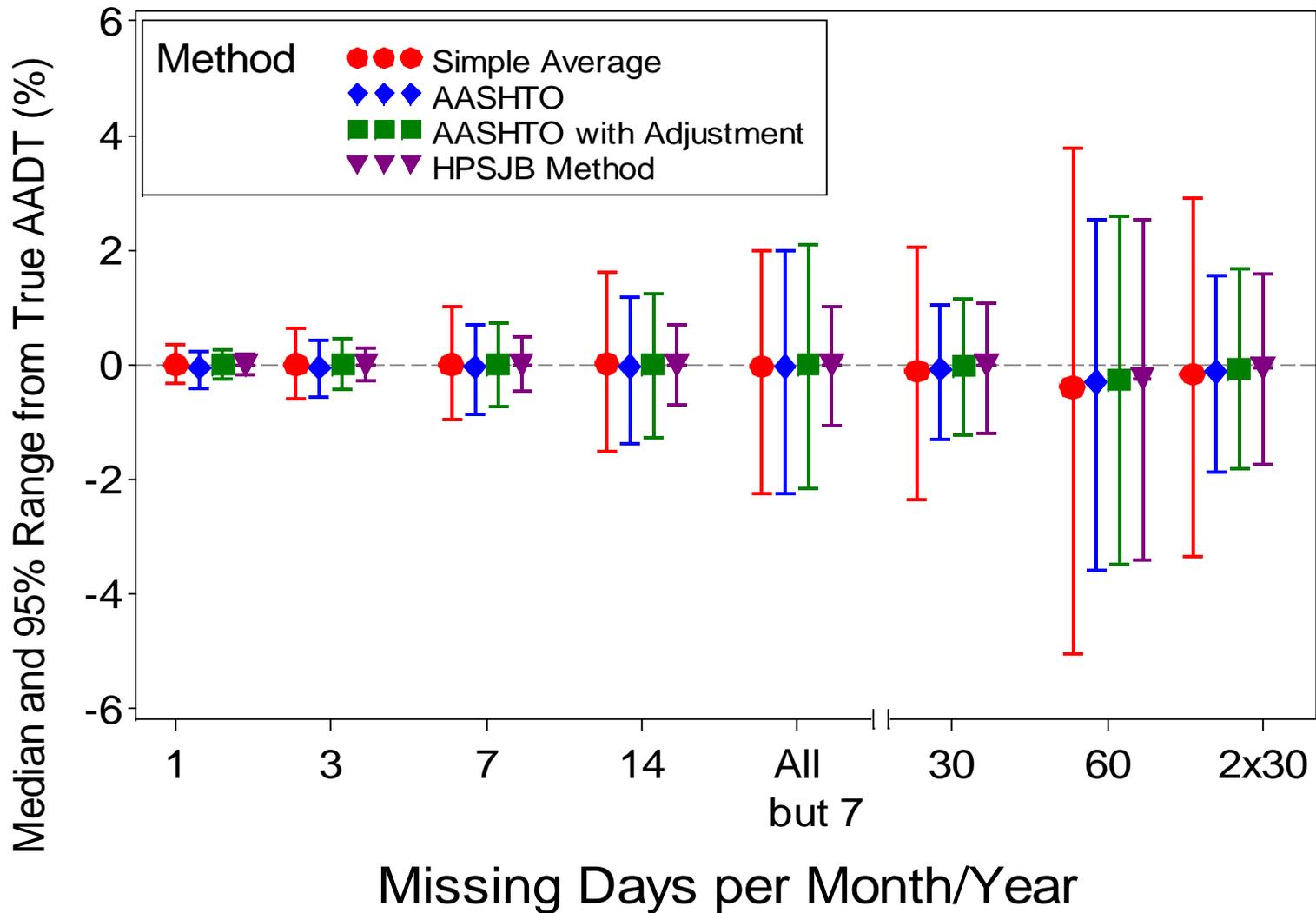
- $$MADT_{FHWA_m} = \frac{\sum_{j=1}^7 w_{jm} \sum_{h=1}^{24} \left[\frac{1}{n_{hjm}} \sum_{i=1}^{n_{hjm}} VOL_{ihjm} \right]}{\sum_{j=1}^7 w_{jm}}$$
- $$AADT_{FHWA} = \frac{\sum_{m=1}^{12} d_m * MADT_{HPSJB_m}}{\sum_{m=1}^{12} d_m}$$



AADT PF: Task 2–AADT Accuracy



New FHWA AADT Method



AADT Methods Compared

Days Excluded	Method 1 – Simple Average		Method 2 - AASHTO		Method 3 – AASHTO Adjusted		Method 4 – FHWA	
	Median Percent Bias	% Increase on Method 2 % Bias CI	Median Percent Bias	95% CI on % Bias	Median Percent Bias	% Increase on Method 2 % Bias CI	Median Percent Bias	% Increase on Method 2 % Bias CI
1/month	0.00	3.07	-0.05	(-0.42, 0.25)	0.00	-23.86	0.00	-46.84
3/month	0.00	25.54	-0.05	(-0.57, 0.42)	0.00	-8.81	0.00	-41.65
7/month	0.00	27.44	-0.04	(-0.86, 0.68)	0.00	-5.10	0.00	-39.16
14/month	0.02	22.79	-0.04	(-1.38, 1.17)	0.00	-1.07	0.00	-44.64
All But 7 per month	-0.03	0.00	-0.03	(-2.24, 1.99)	0.00	0.74	0.00	-50.78
30 days per year	-0.11	86.75	-0.08	(-1.30, 1.06)	-0.02	1.03	-0.01	-3.41



Advantages of the new AADT Method

- Use more of your data even if when you have partial days
 - Do you have every time increment for each DOW?
 - Do you have all 7 days covered for each time increment?
- Directly use data from TMC/ITS systems – add new sites with almost no cost to your office
- Improve your accuracy of AADT and MADT
- Reduce the downward bias from the AASHTO AADT method
- Use sites with only 7 days of data (every DOW) with very little bias or accuracy degradation

- **Disadvantage** – year to year for the same month MADT will not be as consistent



TMG Format Changes (Stations)

2001 TMG

- Year fields: 2 characters
- LRS ID: 12 characters
- LRS location point: 6 characters
- Functional class: 01-09 and 11-19 were codes

2013 TMG

- Year fields: 4 characters (applies to data records too)
- LRS ID: up to 60 characters
- LRS location point: 8 characters
- Functional classification: now codes 1R-7R, 1U-7U (applies to data records too)



TMG Format Changes (Stations)- cont.

- Fields in 2001 TMG format but not included in 2013 TMG format
 - Sample Type for Vehicle Classification (field 12, column 20)
 - Sample Type for Truck Weight (field 17, column 26)
 - Concurrent Route Signing (field 39, column 109)
 - Concurrent Signed Route Number (field 40, columns 110-117)



Other TMG Format Changes – see handout

- Use the 2016 TMG for all nonmotorized collection, storage and reporting to FHWA
- Units changed from 2001 to 2013/2016 formats
- Many technical corrections in the 2016 TMG



Ramp Balancing

- Ramp balancing provides main line data and also the annualized data for the HPMS ramps
- Ramp balancing also insures proper conservation of flow
- Reporting of ramp AADT in HPMS is important and is a significant part of the HPMS GIS review



Duration of Short Term Counts

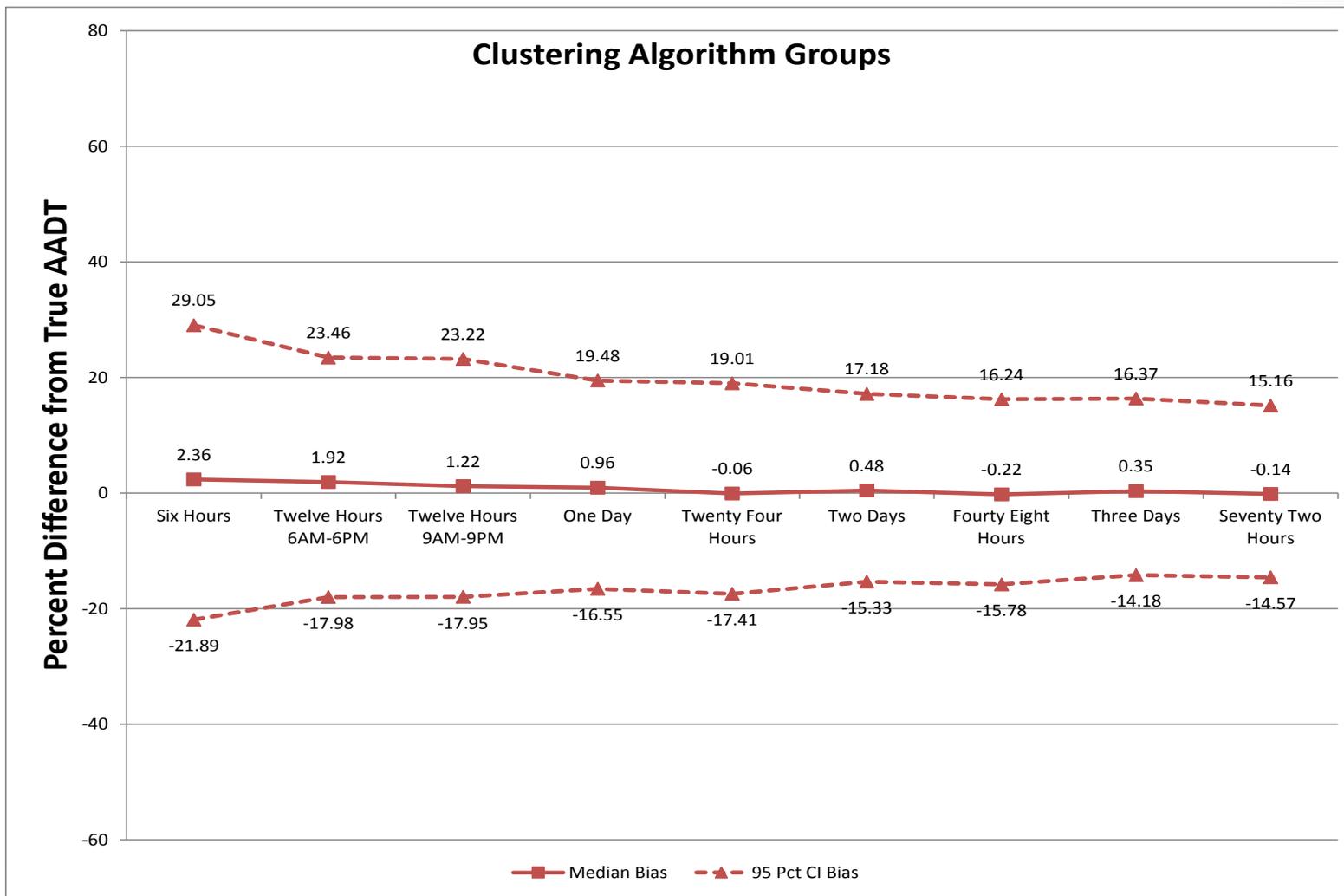
Table 4. Comparison of Median and 95% CI Error on AADT Estimation for Clustering Algorithm Factoring in Comparison to Functional Classification Factoring and Volume Range Factoring, Monday-Thursday Counts, Excluding Holidays.

Duration	Functional Classification		Volume Range		Clustering Algorithm	
	Median	95% CI	Median	95% CI	Median	95% CI
Six Hours	1.89	(-30.36, 39.94)	1.86	(-31.52, 39.54)	2.36	(-21.89, 29.05)
Twelve Hours 6AM-6PM	1.64	(-24.72, 31.87)	1.63	(-26.20, 32.68)	1.92	(-17.98, 23.46)
Twelve Hours 9AM-9PM	1.45	(-26.79, 32.45)	1.63	(-28.04, 33.38)	1.22	(-17.95, 23.22)
One Day	1.35	(-24.31, 30.51)	1.43	(-25.43, 31.39)	0.96	(-16.55, 19.48)
Twenty Four Hours	0.40	(-24.91, 30.46)	0.52	(-25.60, 31.51)	-0.06	(-17.41, 19.01)
Two Days	0.79	(-22.53, 28.28)	0.89	(-23.32, 29.00)	0.48	(-15.33, 17.18)
Forty-Eight Hours	0.13	(-23.19, 27.36)	0.29	(-23.83, 27.96)	-0.22	(-15.78, 16.24)
Three Days	0.67	(-21.48, 26.95)	0.75	(-22.01, 28.12)	0.35	(-14.18, 16.37)
Seventy-Two Hours	0.24	(-21.98, 26.24)	0.32	(-22.46, 25.86)	-0.14	(-14.57, 15.16)

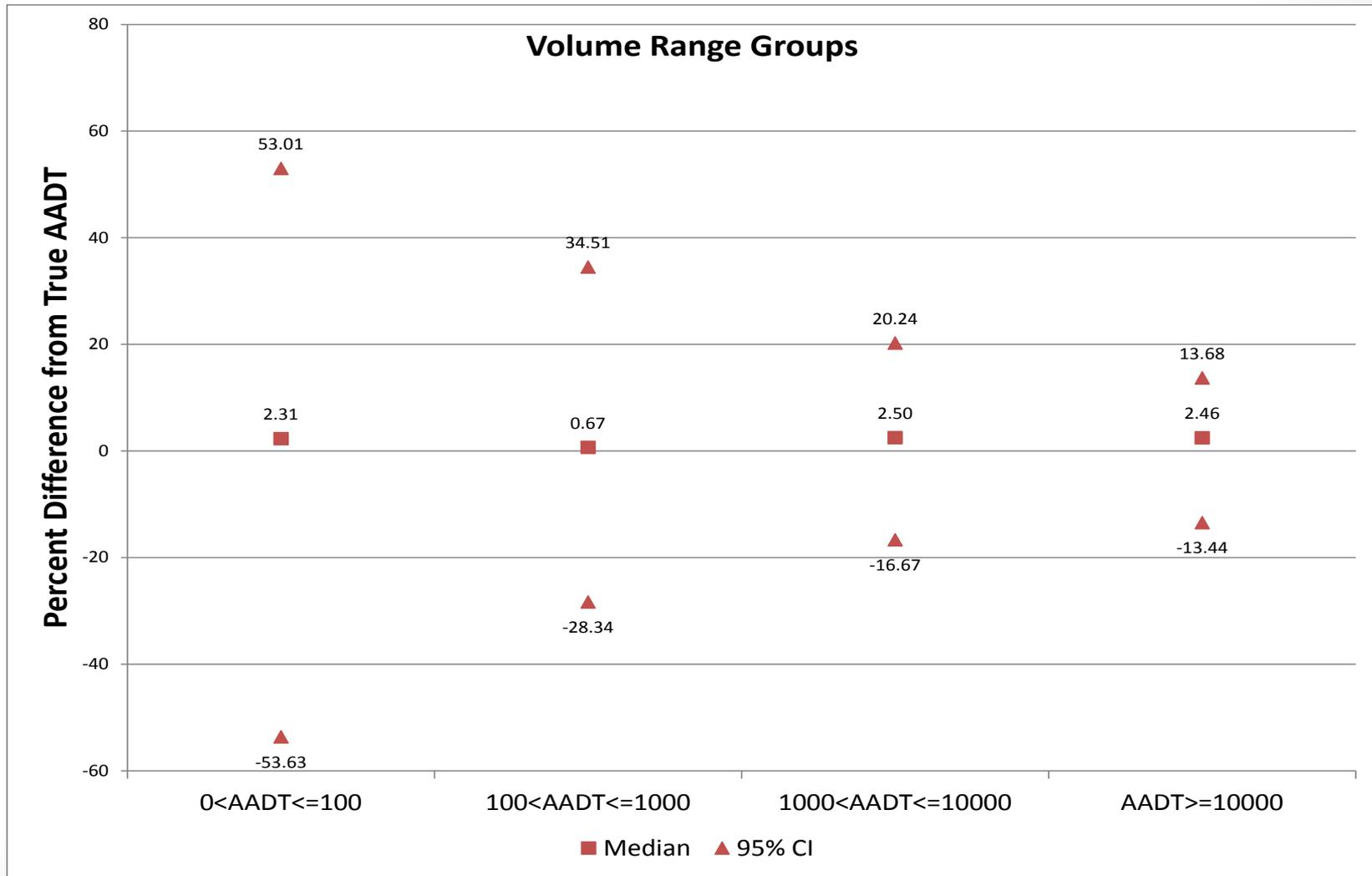
Source: Battelle



National Level Bias by Short-Term Count Duration for Clustering Algorithm Groups, Separate DOW and MOY Factors, Only Mon. – Thurs. Counts, Excluding Federal Holidays (Source: Battelle, based on data from TMAS)



Variance by Volume Groups



Duration by FC Confidence Interval

Table 2. Comparison of Median and 95 Percent Confidence Interval (CI) Error on AADT Estimation for Functional Classification Factoring Between All Days and Monday-Thursday Counts, Excluding Holidays – Reference Figures 5 and 7

Duration	All Days		Monday-Thursday	
	Median	95% CI	Median	95% CI
Six Hours	1.16	(-32.41, 42.97)	1.89	(-30.36, 39.94)
Twelve Hours 6AM-6PM	1.20	(-29.72, 38.92)	1.64	(-24.72, 31.87)
Twelve Hours 9AM-9PM	0.97	(-30.29, 38.90)	1.45	(-26.79, 32.45)
One Day	0.91	(-28.03, 36.06)	1.35	(-24.31, 30.51)
Twenty Four Hours	0.57	(-27.06, 35.27)	0.40	(-24.91, 30.46)
Two Days	0.81	(-24.13, 32.49)	0.79	(-22.53, 28.28)
Forty-Eight Hours	0.70	(-23.53, 31.73)	0.13	(-23.19, 27.36)
Three Days	0.79	(-21.43, 29.61)	0.67	(-21.48, 26.95)
Seventy-Two Hours	0.73	(-21.09, 28.97)	0.24	(-21.98, 26.24)
Seven Days	0.89	(-17.85, 24.12)	N/A	N/A



Portable Traffic Count Durations - HPMS

- All traffic data for HPMS shall be based on a minimum of 48 hours of continuous monitoring for volume and vehicle classification, which is referred to as short term monitoring. **States are permitted to perform counting durations shorter than 48 hours for roadway functional classes Arterial and Interstate.** For functional classes of collector and local roadways , if a State has a duration of monitoring that is less than 48 hours, they must be able to demonstrate no loss in quality of data based on documented statistical analysis provided to FHWA's Office of Highway Policy Information via FHWA's Division Office located in their respective States.



Portable Traffic Count Duration - TMG

- **New TMG recommended duration for short term counts:**

“All traffic data reported for HPMS should be based on a minimum of 24-hour counts for roads with volumes of greater than 5,000 AADT and 48-hour counts for roads where volumes are less than 5,000 AADT. Where volume by vehicle classification is counted, 48-hour counts are recommended. Vehicle classification data should be collected on between 25 and 30 percent of all HPMS sample sections. The 48-hour counts are particularly important for the HPMS because standard data collection periods from all States ensure similar levels of accuracy and precision for all traffic volume data in the HPMS database. Seven day counts are the preferred method when possible.” (2016 TMG page 6-7)



Portable Traffic Count Durations

- Change to allow 24 vs. 48 hour counts for certain portable counts
- Best method for developing and applying factors is utilizing the cluster method
- **7 day counting (every DOW)** is the best method to utilize when you can
- Portable class counts **MUST** still be 48 hours
 - Variability of K and D not known for portable counts
 - Influence of SU and CU AADT unknown for portable counts
 - Change of % Peak SU or CU uncertain for portable counts



Traffic Data and HPMS

Traffic Volume

AADT

K Factor

D Factor

Future AADT

Ramp AADT

Metadata

Vehicle Classification

AADT Single Unit

% Peak Single

AADT Combination

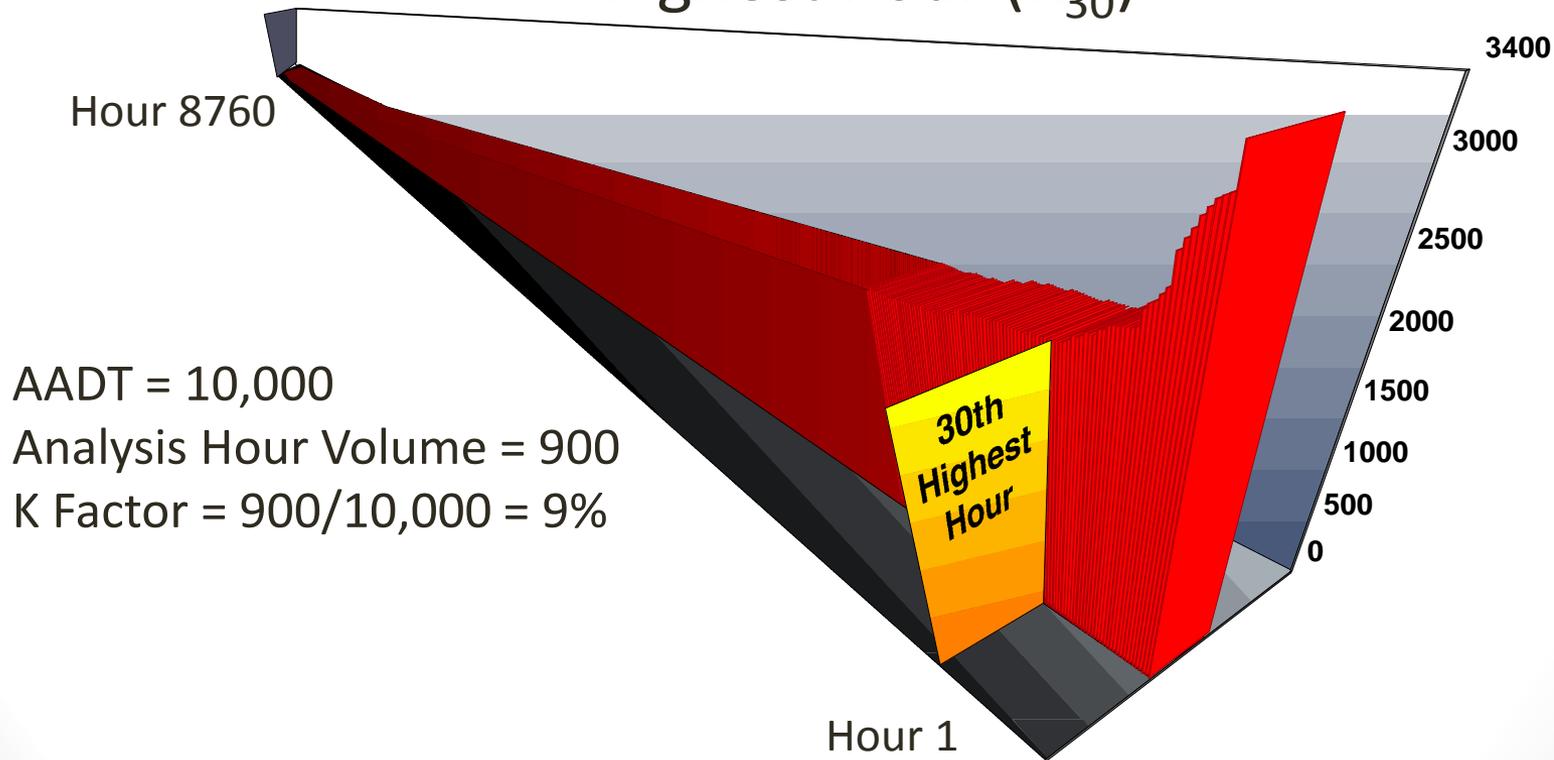
% Peak Combination

Summary Table



K Factor

The proportion of AADT occurring in the analysis hour
– HPMS uses the design hour volume for the 30th
highest hour (K_{30})



D Factor

The proportion of design hour volume
(selected hour) flowing in the peak



Design Hour Volume = 900

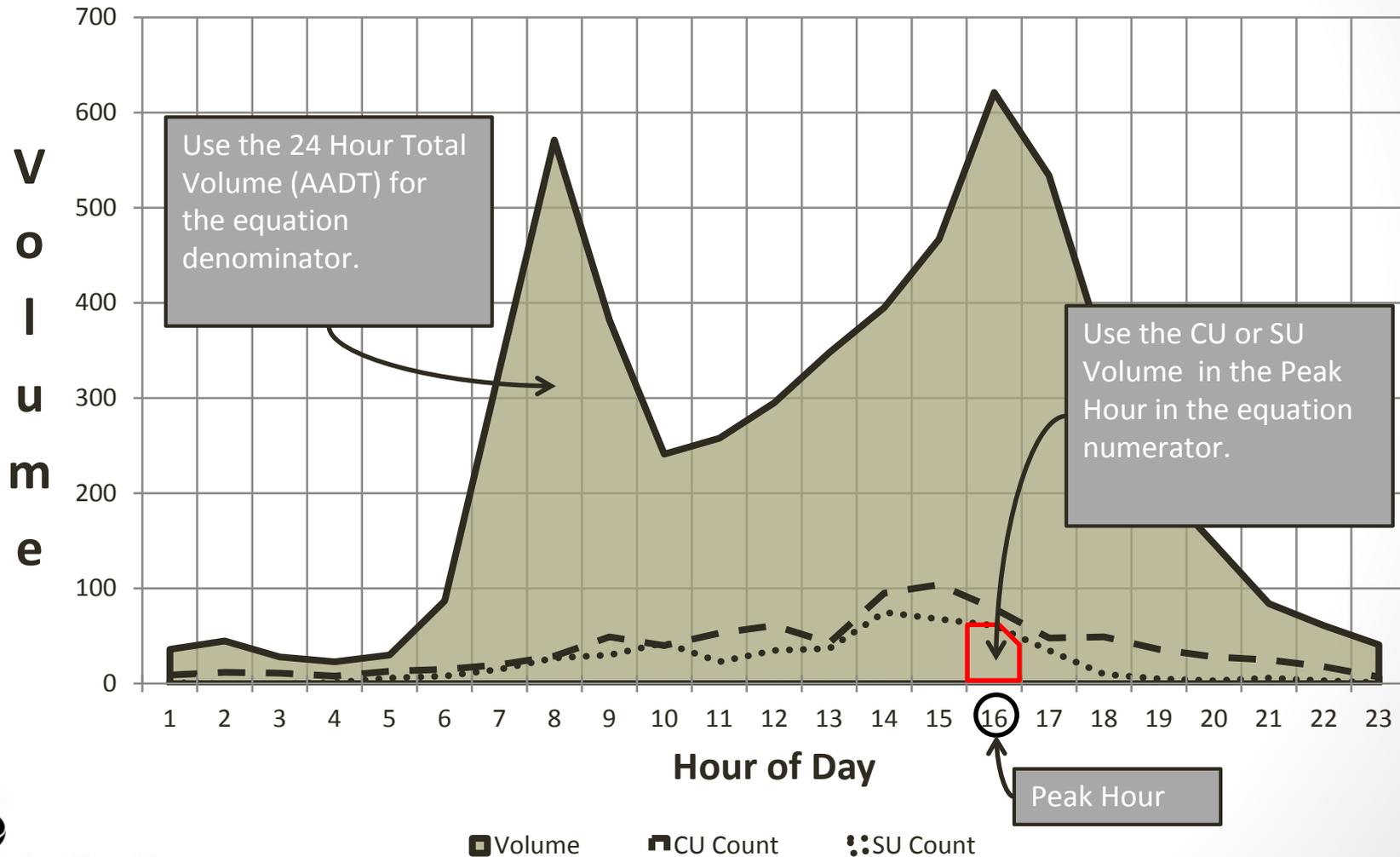
Directional Volumes = 540 EB & 360 WB

D Factor = $540/900 = 0.6$



% Peak SU or CU Calculation

HPMS Percent Peak Calculation Graphic



Any questions or ideas to improve the TMG?

NHI TMG Trainer

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