WORK ZONE MANAGEMENT PROGRAM

BEST PRACTICES IN WORK ZONE PERFORMANCE MANAGEMENT

U.S. Department of Transportation
Federal Highway Administration

Webinar Presenters

- Jawad Paracha – FHWA Office of Operations
  - Work Zone Management Program Manger
- Bill McNary – Wisconsin Department of Transportation
  - AASHTO Work Zone Performance Measurement Survey Program Manager
- Bill Feehan – Ohio Department of Transportation
  - Maintenance of Traffic Engineer
- Mike Fontaine – Virginia Transportation Research Council
  - Associate Director; Safety, Operations, and Traffic Engineering

Webinar Agenda

- Work Zone Performance Management Background
- Findings from AASHTO's 2019 Work Zone Performance Measures Survey
- Ohio DOT's Work Zone Vitals
- Virginia DOT Applications of Probe Data for Work Zone Performance Measurement
- Resources and Future Opportunities

Work Zone Performance Management

Jawad Paracha – Federal Highway Administration

23 CFR Part 630 Subpart J

- "Work Zone Safety and Mobility Rule"
- Encourages States to develop and implement systematic procedures to assess work zone impacts and to manage safety and mobility during project implementation
- States shall use **field observations, available work zone crash data, and operational information to manage work zone impacts** for specific projects during implementation.
- States shall continually pursue improvement of work zone safety and mobility by **analyzing work zone crash and operational data** from multiple projects to **improve State processes and procedures.**
- Effective work zone performance management is necessary for successful implementation.

Work Zone Performance Management

- Metrics to quantify the safety and mobility impacts of work zones on:
  - Roadway users
  - Workers
  - Stakeholders

- Project-specific metrics and program-level metrics

Why Measure and Manage Performance?

- "What gets measured gets managed."
- Allows agencies to:
  - Understand how their work zone management decisions affect safety and mobility.
  - Monitor and improve conditions at an existing work zone.
  - Improve how they make future decisions regarding work zone management.
  - Identify specific problems or issues that may be occurring.
  - Review and improve work zone policies and procedures.
  - "Tell the story" about work zone impacts and efforts to mitigate those impacts.

Performance Measure Categories and Selection

Categories:

- Safety, Mobility, Customer Satisfaction, and Agency/Contractor Productivity-related Performance Measures.

Selection:

- Step 1. Determine performance measurement categories of interest.
- Step 2. Decide which work zones to measure.
- Step 3. Decide what work zone conditions to measure.
- Step 4. Determine data sources to use.
- Step 5. Compute specific measures of interest.

Work Zone Performance Measures

Exposure	
Amount of time, work activity periods, roadway space, and/or vehicle travel that a work zone affects or requires.	
Mobility	**Safety**
• Delay • Queue Length • Travel Time • Throughput • Travel Time Reliability	• Crash Statistics • Fatality Rates • Worker Accidents • Safety Surrogate Data • Frequency of Intrusions

Work Zone Data Sources

Extract data from existing sources, collect it (manually, electronically) or interpolate from existing or collected data.

- Manual Observations:
  - In the field or by Closed Circuit Television/Transportation Management Center staff.
- Electronic Spot Speed Data:
  - Work Zone Intelligent Transportation System (ITS) devices.
  - Portable traffic monitoring devices.
- Electronic Point-to-Point Travel Time Data:
  - License plate readers.
  - Bluetooth readers.
- Probe Data
  - 3rd party providers such as INRIX or Waze.
  - National Performance Management Research Data Set (NPMRDS).

AASHTO Work Zone Performance Measurement Survey Findings

AASHTO Committee on Traffic Engineering
Work Zone Performance Measure Task Force – June 2018

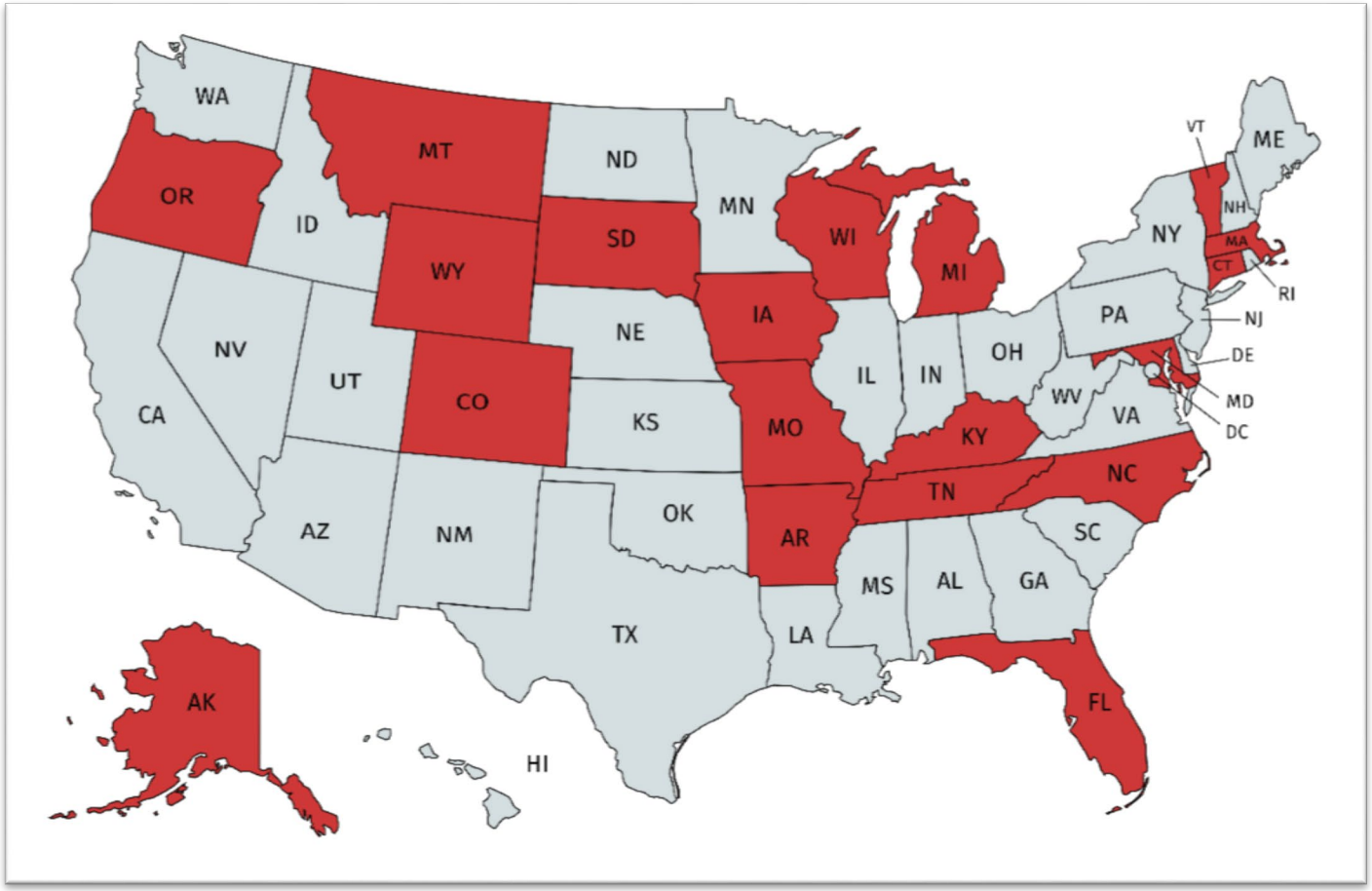
Bill McNary – Wisconsin Department of Transportation

Task Force Workplan

- Update work zone engineer contact information
- Conduct survey of AASHTO members to catalog current and proposed work zone performance measures
- Collaborate with the FHWA work zone data and local data harmonization initiatives
- Develop framework that addresses data needs, tool and performances measure options

Work Zone Performance Measure Survey

20 states have responded so far



Work Zone Performance Measure Survey

- The survey is still available, please submit a response
- http://survey.constantcontact.com/survey/a07efu7vnh5joa5wvl0/start
- Survey categories:
  - Current or Proposed Work Zone Performance Measures
  - Work Zone Activity Data Collected
  - Work Zone Operations Data Collected
  - Operations Data Collection Tools
  - Data Collection Resource Mechanisms
  - Collection method
  - Purchase data?

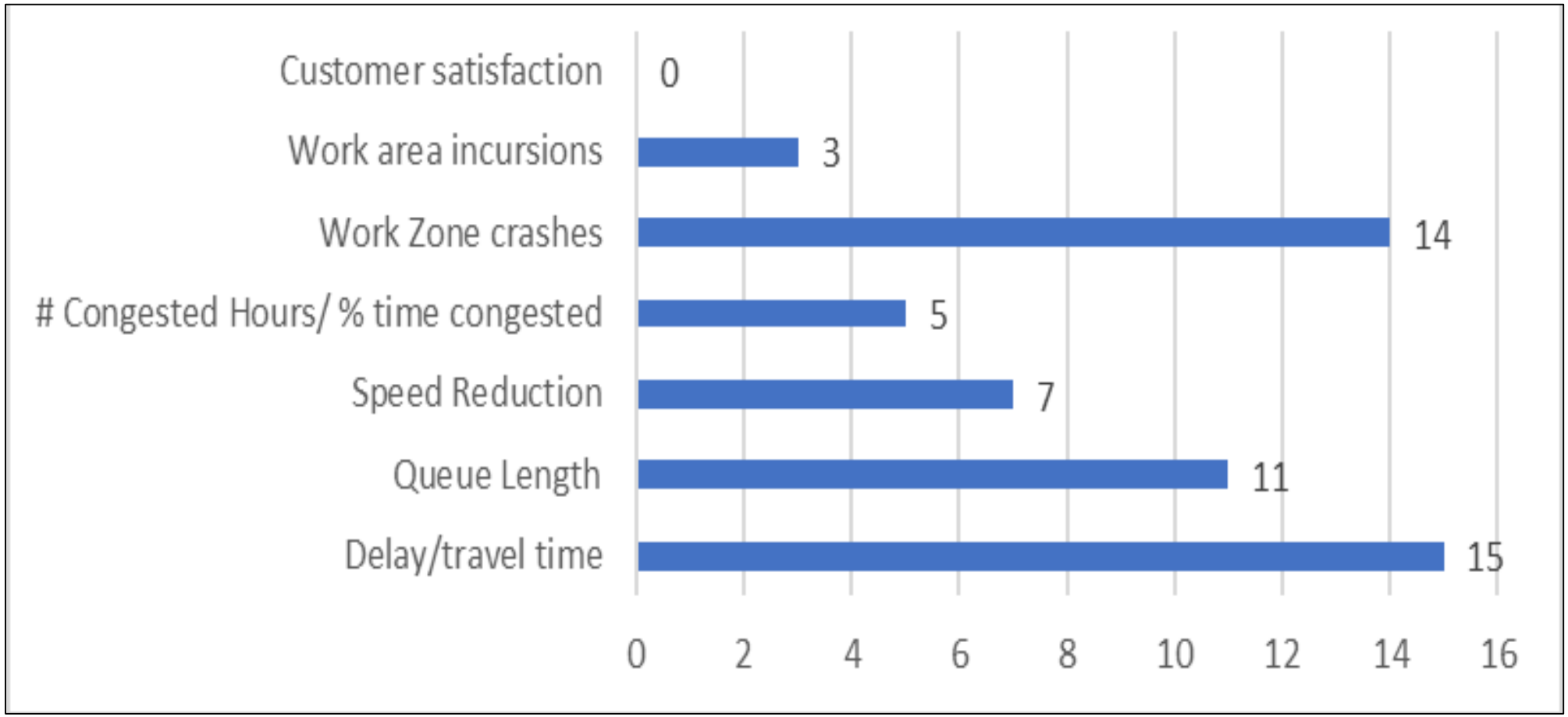
Work Zone Performance Measure Survey

- Survey categories continued:
  - How much WZ delay allowed?
  - Liquidated Damages & Compliance
    - Charge Liquidated damages for non-compliance?
    - How rates determined?
    - Hourly / Daily
    - Monitor compliance?
  - Crash Reporting
    - Does Crash Report include WZ?
    - Verify that crash occurred in WZ

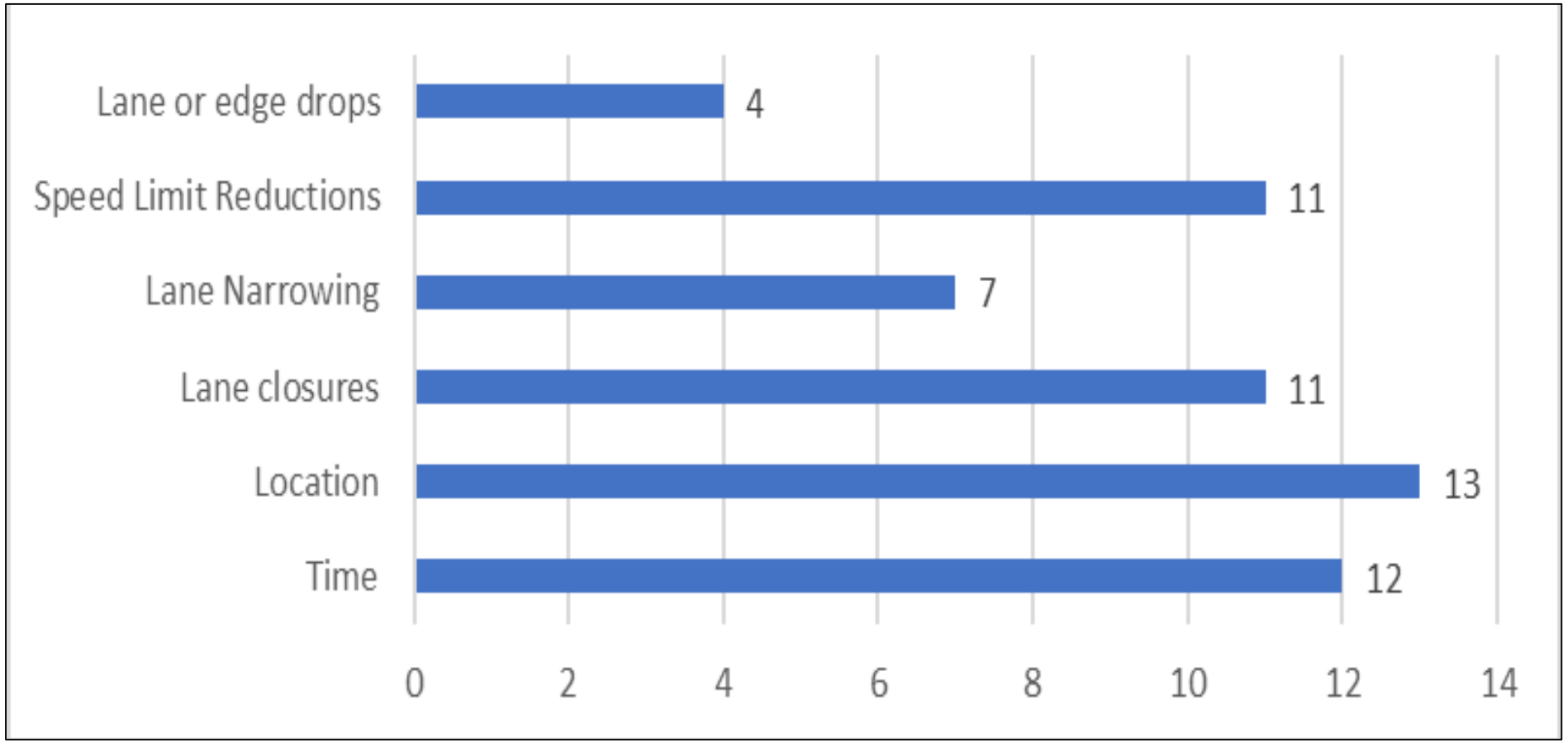
Work Zone Performance Measure Survey

- Survey categories continued:
  - WZ Crash Location
    - After 1st warning sign
    - Only if workers present
    - In the activity area / project limits
    - In a queue approaching WZ
  - Speed limit reduction basis
    - Workers present
    - Under certain conditions
    - Statutory limits
    - Crash history
    - Engineering judgment

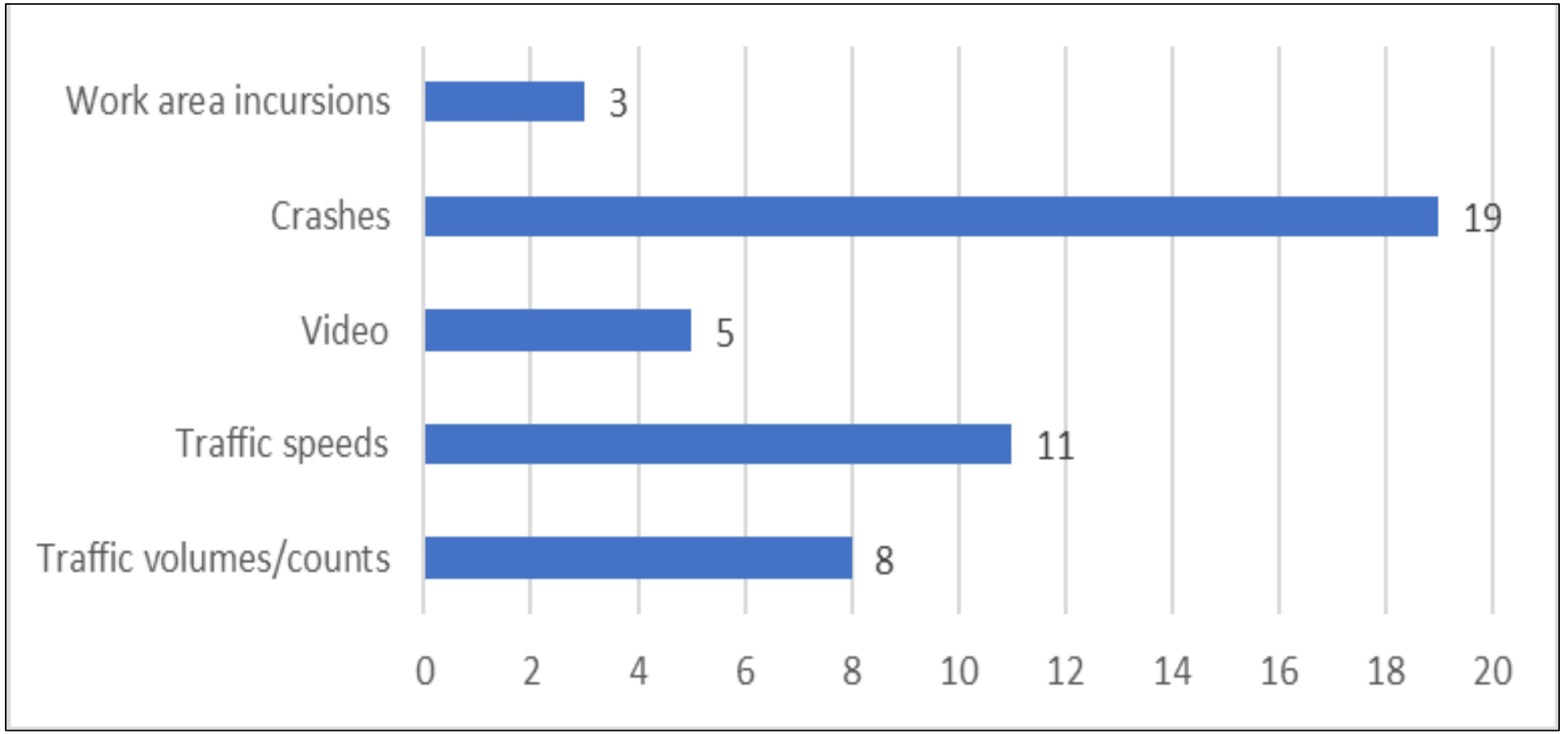
Work Zone Performance Measures Collected



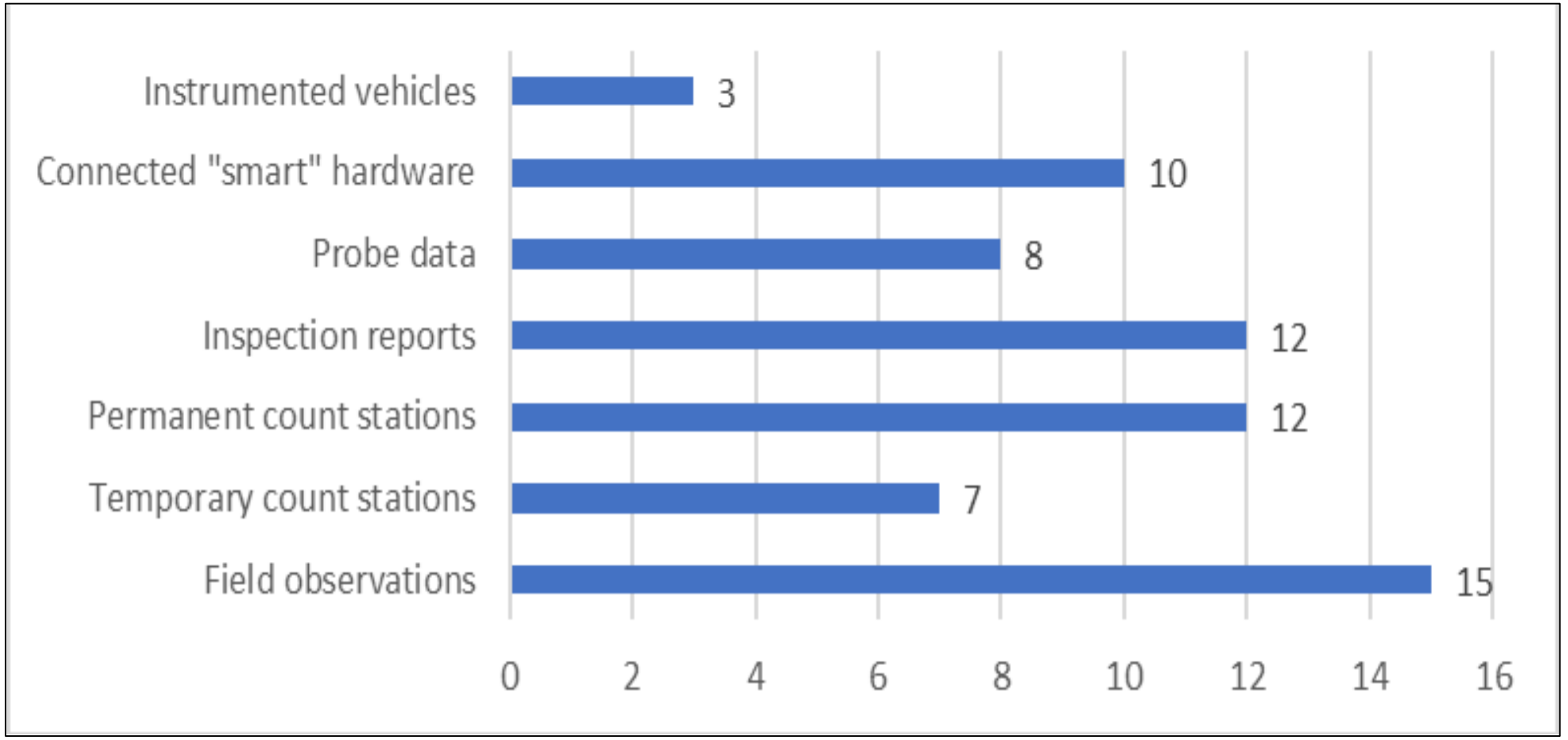
Work Zone Activity Data Collected



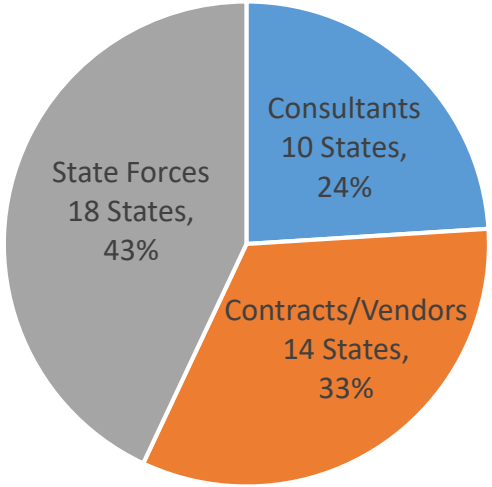
Work Zone Operations Data Collected



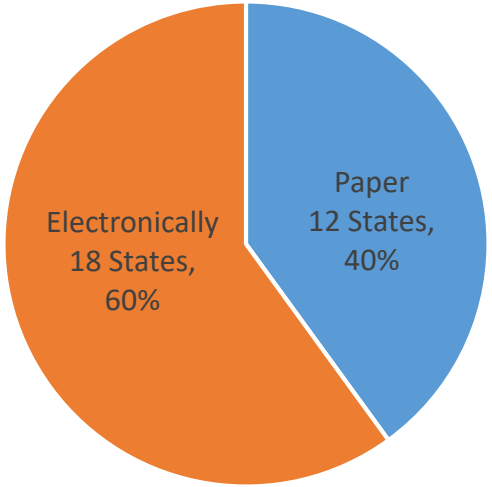
Data Collection Tools Used



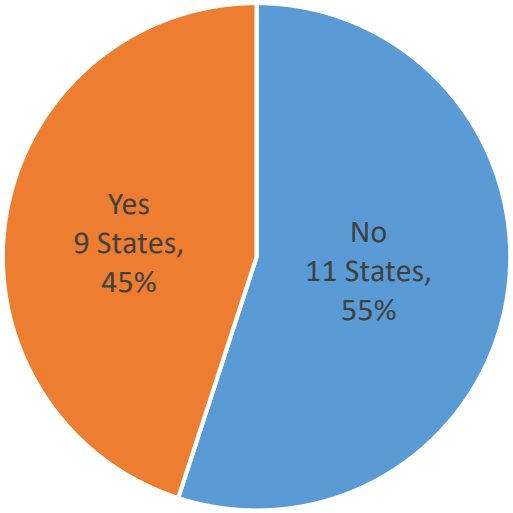
Who Collects Data



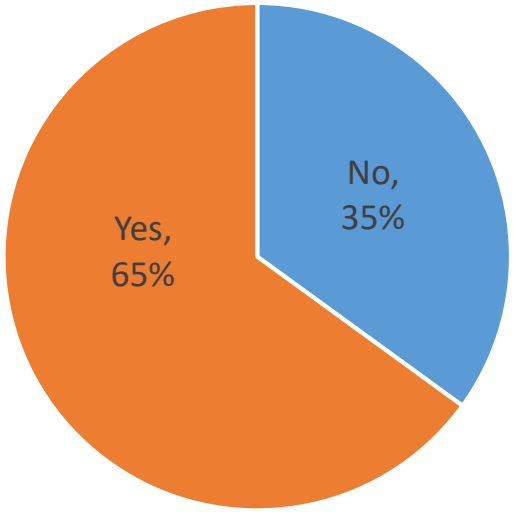
How Data is Collected



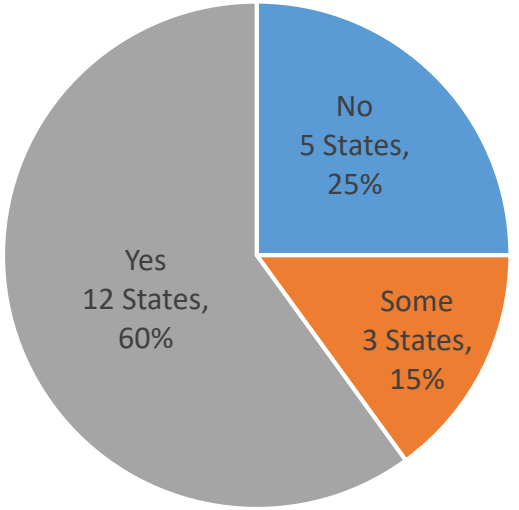
Is Data Purchased?



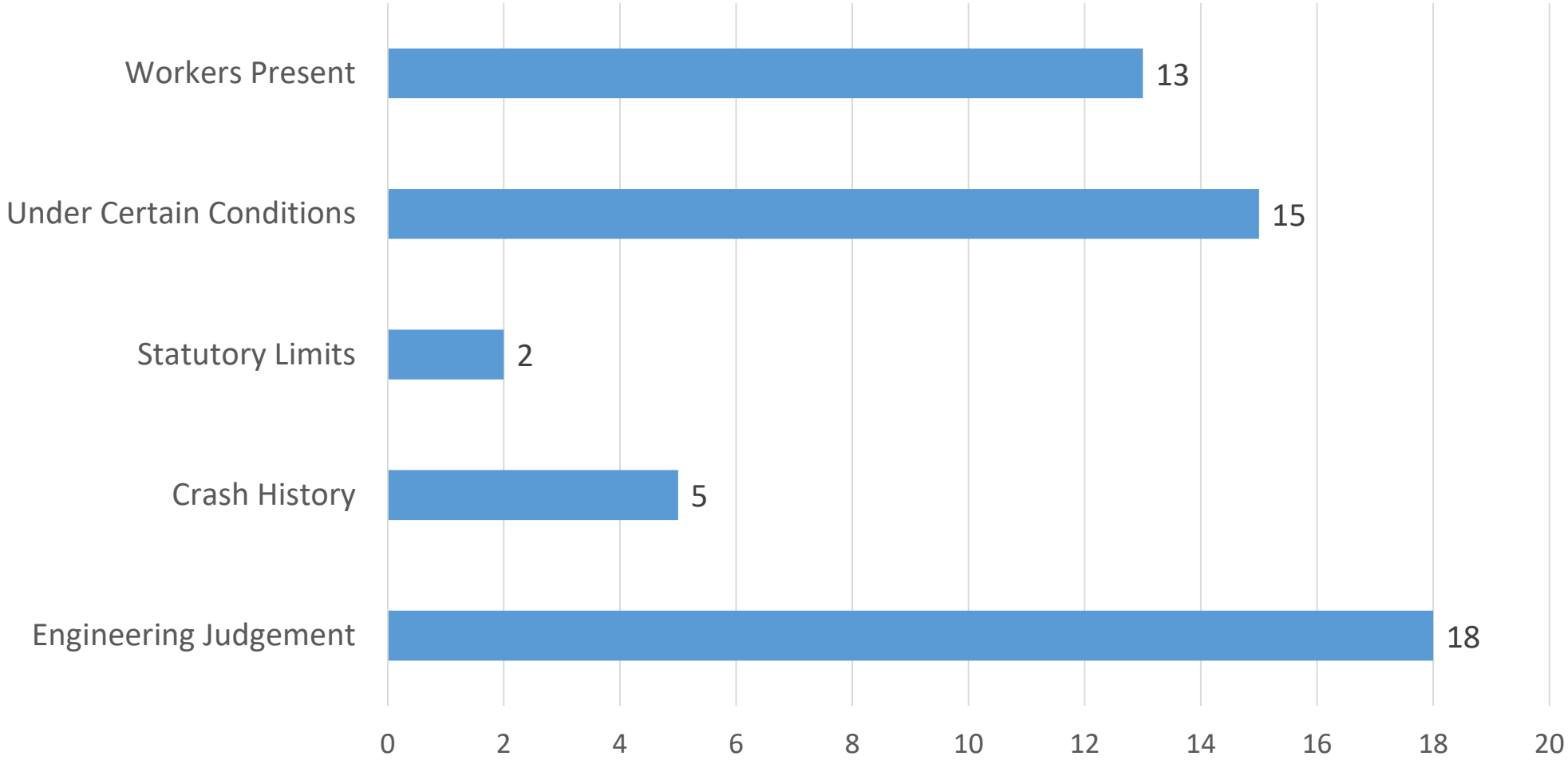
Charge Liquidated Damages?



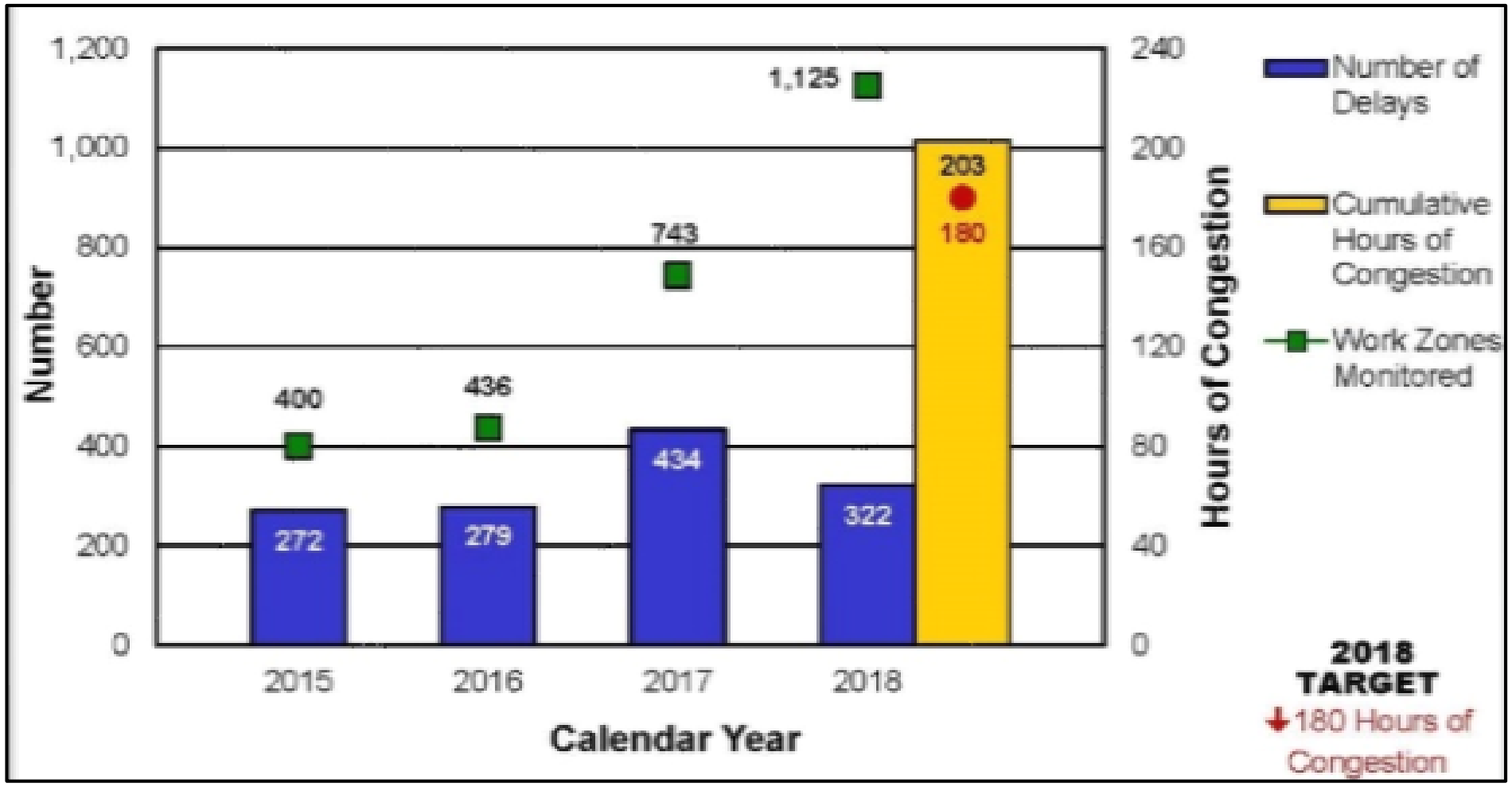
Verify Crash Happened in WZ?



Basis for Establishing Work Zone Speed Limits



Work Zone Delays Greater than 10 Minutes



Contact Information

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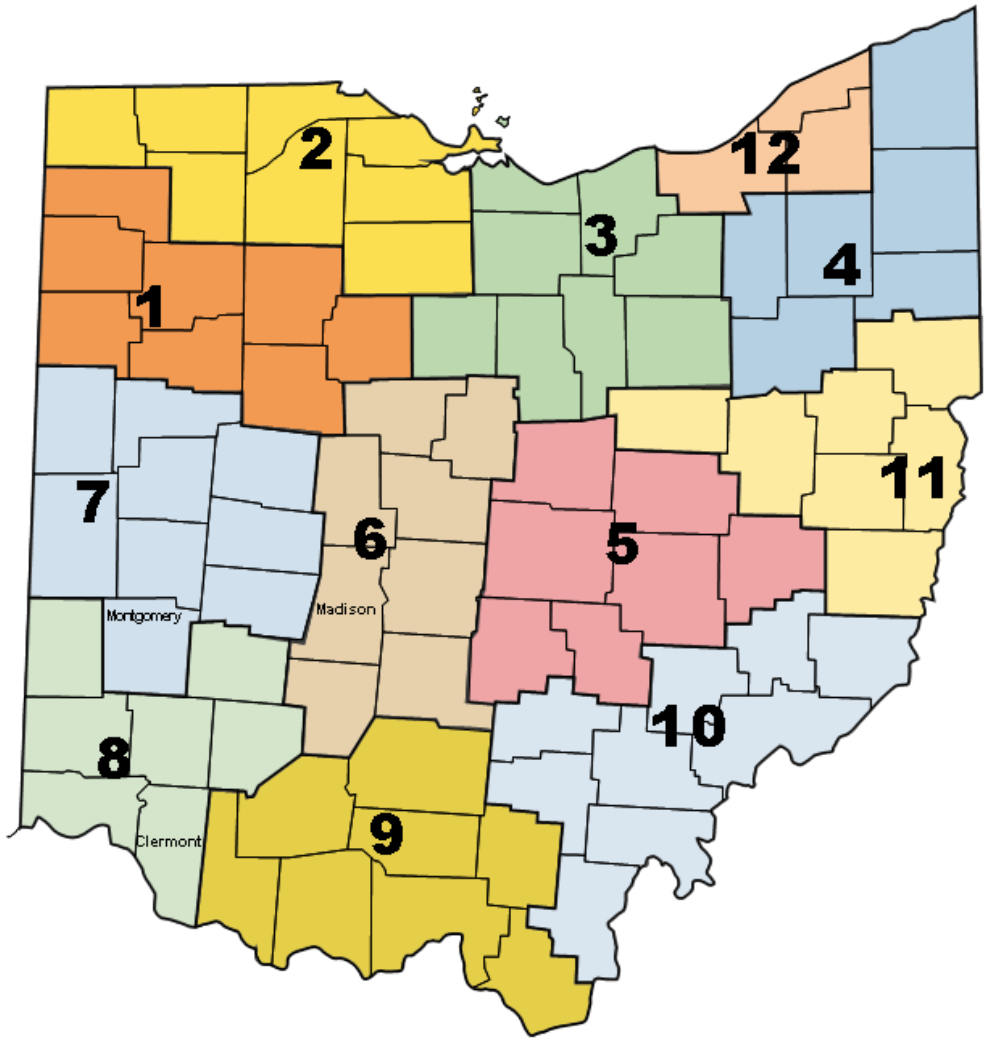
Ohio DOT's Work Zone Vitals

Bill Feehan – Ohio Department of Transportation

OHIO DEPARTMENT OF TRANSPORTATION

ODOT Districts



OHIO DEPARTMENT OF TRANSPORTATION

Work Zone Policy and Standard Procedure

- MOT Standard Procedure 123-001(SP)
  - "ODOT will systematically determine the impacts created by work zones and will eliminate, minimize or mitigate these impacts to the greatest extent practical. Ultimately this will enhance mobility and safety and maintain customer satisfaction while traveling through ODOT work zones."

Work Zone Data

- ODOT has a contract with INRIX to provide historical speed data
- Access to some of RITIS platform
- INRIX Analytics
- Have various volume count data from across the state
- Do not use NPMRDS data set

Volume Data

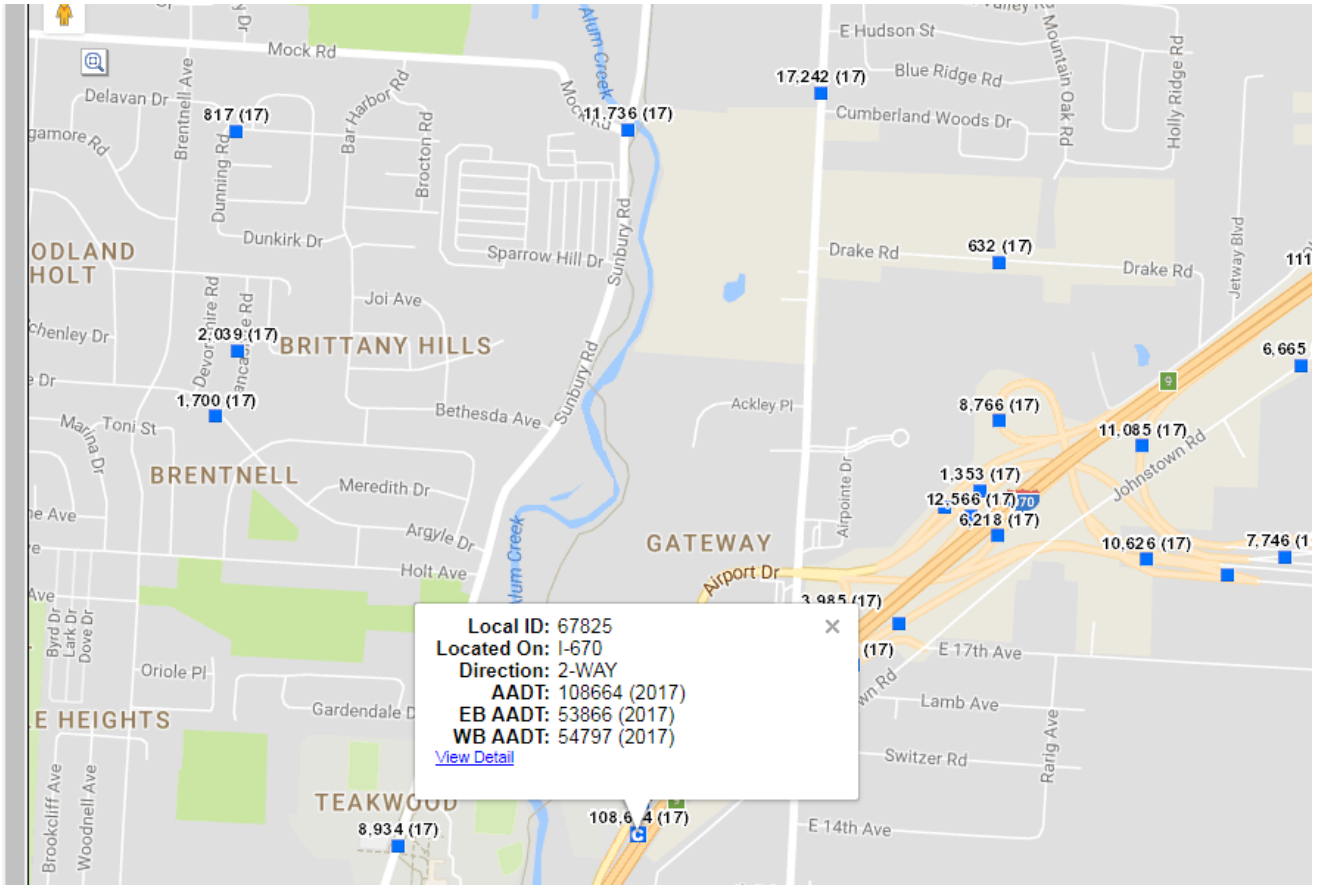
Volume Count Report

LOCATION INFO	
Location ID	67825
Type	SPOT
Fnct'l Class	1
Located On	I-670
Loc On Alias	744
Direction	2-WAY
County	Franklin
Community	COLUMBUS
MPO ID	
HPMS ID	
Agency	ODOT

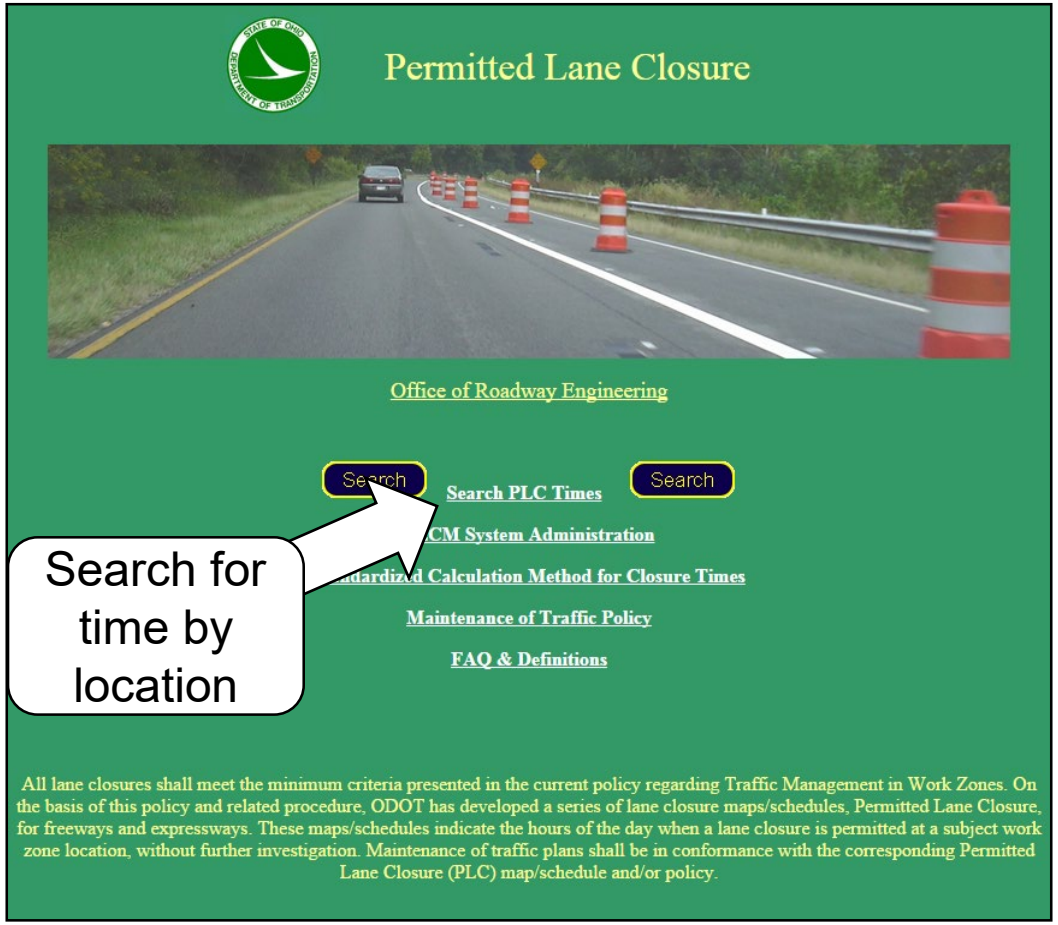
COUNT DATA INFO	
Count Status	Accepted
Start Date	Fri 12/22/2017
End Date	Sat 12/23/2017
Start Time	12:00:00 AM
End Time	12:00:00 AM
Direction	
Notes	
Station	
Study	
Speed Limit	
Description	
Sensor Type	ATR

INTERVAL:15-MIN

Time	15-min Interval 1st	2nd	3rd	4th	Hourly Count
0:00-1:00	454	350	294	278	1,376
1:00-2:00	229	224	232	203	888
2:00-3:00	183	171	154	131	639
3:00-4:00	148	161	174	195	678
4:00-5:00	193	222	343	380	1,138
5:00-6:00	405	552	746	890	2,593
6:00-7:00	942	1,316	1,711	1,684	5,653
7:00-8:00	1,672	1,863	2,205	2,123	7,863
8:00-9:00	1,829	1,998	2,044	1,903	7,774
9:00-10:00	1,679	1,726	1,708	1,764	6,877
10:00-11:00	1,600	1,670	1,736	1,809	6,815
11:00-12:00	1,719	1,874	2,078	1,932	7,603
12:00-13:00	1,924	2,088	2,127	2,099	8,238
13:00-14:00	2,081	2,189	2,193	2,171	8,634
14:00-15:00	2,112	2,348	2,449	2,384	9,293
15:00-16:00	2,216	2,186	2,175	2,095	8,672
16:00-17:00	2,184	2,226	1,974	1,968	8,352
17:00-18:00	1,869	1,970	1,702	1,670	7,211
18:00-19:00	1,639	1,812	1,667	1,433	6,551
19:00-20:00	1,439	1,371	1,244	1,144	5,198
20:00-21:00	1,059	1,107	973	1,131	4,270
21:00-22:00	1,051	1,023	1,039	971	4,084
22:00-23:00	954	928	847	753	3,482
23:00-24:00	764	703	685	584	2,736
Total					126,618
AADT					115,602
AM Peak					07:30-08:30 8,155
PM Peak					14:15-15:15 9,397



Pre-Closure Analysis



Permitted Lane Closure Schedule

- A tool to help identify which hours of the day lane closures should not result in violations of the policy.
- Updated annually by Central Office/District personnel.
- If work can be done in the hours allowed, then a queue analysis and/or exception request are NOT required.
- Must be used for ALL construction and maintenance work, except in case of emergency.

Permitted Lane Closure Schedule

ODOT Permitted Lane Closure — Print

District: 3	County: ASD	Route: IR-71	DIR: BOTH	Calculation Year: 2012	Section: US 30 (Ric Co) to US 250

COUNTY BEGIN LOG	0.000	Calculation Method	A	ATR-Actual Hourly Breakdowns with ADT	
COUNTY END LOG	7.940	Road Class	RURAL	(Urban or Rural)	
STATE BEGIN LOG	178.760	Terrain	LEVEL		
STATE END LOG	186.700	Lanes per direction	3		

ATR#	608
ATR Year	2011
Percent Trucks	31
Annualized ADT	0

Seasonal Traffic Adjustment

	Weekday	Weekend	
ATR	49297	58197	Summer
ATR	45950	58386	Spring/Fall
ATR	39588	50721	Winter
Capacity	1330		per lane

There shall be no lane closures on Holidays or Holiday weekends. The following are considered holidays. Memorial Day, Fourth of July, Labor Day, Thanksgiving, Christmas , New Years, Easter. No lane closures are allowed after 12 noon on the day preceding a holiday. For holiday weekends no lane closures are allowed after 12 noon on the day preceding the Holiday weekend until 6 am the day after the holiday weekend. Ex. Holiday falls on a Monday then no lane closures from 12 noon on Friday until 6 am Tuesday.

Ratio of Lanes 3:2 — Traffic Volume per open lane

Season	Summer Weekday	Summer Weekend	Spring/Fall Weekday	Spring/Fall Weekend	Winter Weekday	Winter Weekend
Hour of the Day	MON-THU	FRI-SUN	MON-THU	FRI-SUN	MON-THU	FRI-SUN
0-1AM	155	181	131	184	119	147
1-2AM	128	126	109	145	101	115
2-3AM	111	118	105	128	94	115
3-4AM	113	128	109	137	92	116
4-5AM	158	165	148	152	131	139
5-6AM	242	241	225	221	195	197
6-7AM	379	379	369	340	315	296
7-8AM	563	517	541	479	480	463
8-9AM	630	603	567	530	535	509
9-10AM	676	697	605	615	526	547
10-11AM	696	802	606	757	520	617
11-12PM	724	845	646	786	541	667
12-1PM	743	888	641	841	569	702
1-2PM	777	956	746	973	589	838
2-3PM	839	1080	787	1043	705	925
3-4PM	894	1114	855	1118	737	1009
4-5PM	939	1159	881	1166	792	1073
5-6PM	796	1055	720	1217	726	1048
6-7PM	692	972	632	1085	550	981
7-8PM	560	780	625	889	456	739
8-9PM	538	636	477	655	384	538
9-10PM	427	493	400	493	302	396
10-11PM	311	343	320	378	252	271
11-12AM	235	272	242	266	188	235

Legend

* = Lane Closure(s) Not Permitted

3:2 : Ratio Of Lanes
3 : Available Lanes
2 : Lanes Open

Season	Period
Summer	June 1 - Aug 31
Spring/Fall	Mar 1 - May 31 & Sept 1 - Nov 30
Winter	Dec 1 - Feb 29

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Ratio of Lanes 3:1 — Traffic Volume per open lane

Season	Summer Weekday	Summer Weekend	Spring/Fall Weekday	Spring/Fall Weekend	Winter Weekday	Winter Weekend
Hour of the Day	MON-THU	FRI-SUN	MON-THU	FRI-SUN	MON-THU	FRI-SUN
0-1AM	311	362	261	369	237	294
1-2AM	256	252	219	290	202	230
2-3AM	222	236	209	256	188	230
3-4AM	226	256	218	274	184	231
4-5AM	315	331	296	304	262	279
5-6AM	485	481	451	441	390	395
6-7AM	757	758	739	681	629	592
7-8AM	1126	1035	1083	957	960	925
8-9AM	1260	1205	1134	1059	1070	1018
9-10AM	* 1353	* 1395	1210	1231	1051	1094
10-11AM	* 1392	* 1603	1212	* 1513	1040	1234
11-12PM	* 1449	* 1690	1292	* 1573	1083	* 1334
12-1PM	* 1486	* 1776	1282	* 1681	1138	* 1404
1-2PM	* 1555	* 1912	* 1493	* 1946	1178	* 1677
2-3PM	* 1678	* 2161	* 1574	* 2087	* 1410	* 1850
3-4PM	* 1788	* 2228	* 1710	* 2236	* 1474	* 2018
4-5PM	* 1879	* 2318	* 1762	* 2333	* 1583	* 2146
5-6PM	* 1592	* 2110	* 1439	* 2435	* 1453	* 2096
6-7PM	* 1384	* 1945	1265	* 2170	1099	* 1963
7-8PM	1120	* 1559	1251	* 1778	912	* 1478
8-9PM	1075	1272	955	1310	769	1076
9-10PM	855	987	800	985	605	791
10-11PM	621	686	641	756	505	543
11-12AM	470	544	484	532	376	471

3.01: *For any Maintenance lane(s) closure or any Construction project lane(s) closure, outside of plan note times, a Lane Closure Application request form must be submitted to the Work Zone Traffic Manager and the Highway Management Administrator for approval.*
3.02: *3.01 cont.(a) The request must be submitted, in writing, three(3) working days in advance of the lane(s) closure. Traffic flow must be monitored and lanes re-opened if any backup begins to occur.*
3.03: *3.01 cont.(b) In addition a copy of the request form must be submitted to the Roadway Services Manager for ODOT maintenance work or to the Construction Engineer for construction projects. See Special Notes for Holidays or Special Events info.*

Lane Closure Queue Analysis

Ohio Department of Transportation

Lane Closure Queue Analysis Tool

PROJECT INFORMATION

Date:	3/4/16
PID:	SJN 134719
CFS:	Evaluation of Queuing and Road User Cost Tools Applied to Work Zones
Analyst:	E. Willis
MOT scenario:	Demonstration Scenario

TRAFFIC VOLUME DATA

Type of volume data to be used for analysis	Hourly
For hourly based evaluation:	
1) Enter estimated hourly volumes (column B)	
For AADT based evaluation:	
1) Enter Average Annual Daily Traffic value	
2) Select type of hourly and directional distributions	
Hourly distribution	
Direction of travel	
3) Enter/review distribution values on AADT sheet	
Enter base proportion of trucks and buses, P_t (%)	4.0
Adjust base P_t (%) value for each time interval (column G)	
Diversion threshold (passenger cars per hour)	1000
Enter the percent of the hourly passenger car volume over the diversion threshold expected to divert (column K)	

PRE-LANE CLOSURE CONDITION

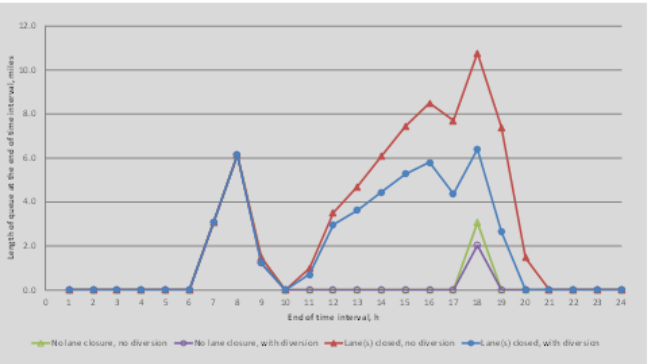
Number of lanes (one direction), N	3 lanes
Type of terrain	Level
Passenger car equivalent for 1 truck or Bus, E_t	1.5
Base free flow speed (BFFS)	75.4 mph
Adjustment for lane width, f_{LW}	0 mph
Width of lanes (min 10 ft)	12 ft
Adjustment for lateral clearance, f_{LC}	1.8 mph
Lateral clearance on the right side (max 6 ft)	2 ft
Adjustment for ramp density	0 mph
Number of ramps within 3 miles (max 6)	0
User defined adjustment	20 mph
Calculated free flow speed (FFS)	53.8 mph
2010 HCM basic freeway segment capacity	2250 pcphpl

LANE CLOSURE CONDITION

2010 HCM work zone capacity, pcph	$c_{work\,zone} = \{(1600 + I + U) \times N_{open}\} - R$
Work intensity adjustment, I, ranging from -160 to +160 pcphpl (column O)	
Calibration of base capacity, U	-400 pcphpl
Number of lanes (one direction) closed, N_{closed} (column M)	
Number of lanes (one direction) remaining open, N_{open} (see column N)	
Adjustment for presence of on-ramps within taper, R (column P)	

QUEUE INFORMATION

Average minimum headway of passenger cars in queue, h	20 ft
Queue length highlighted based on Policy No. 21-008(P) criteria	Q x 0.75
Q <= 0.75	



DETERMINISTIC QUEUE ANALYSIS

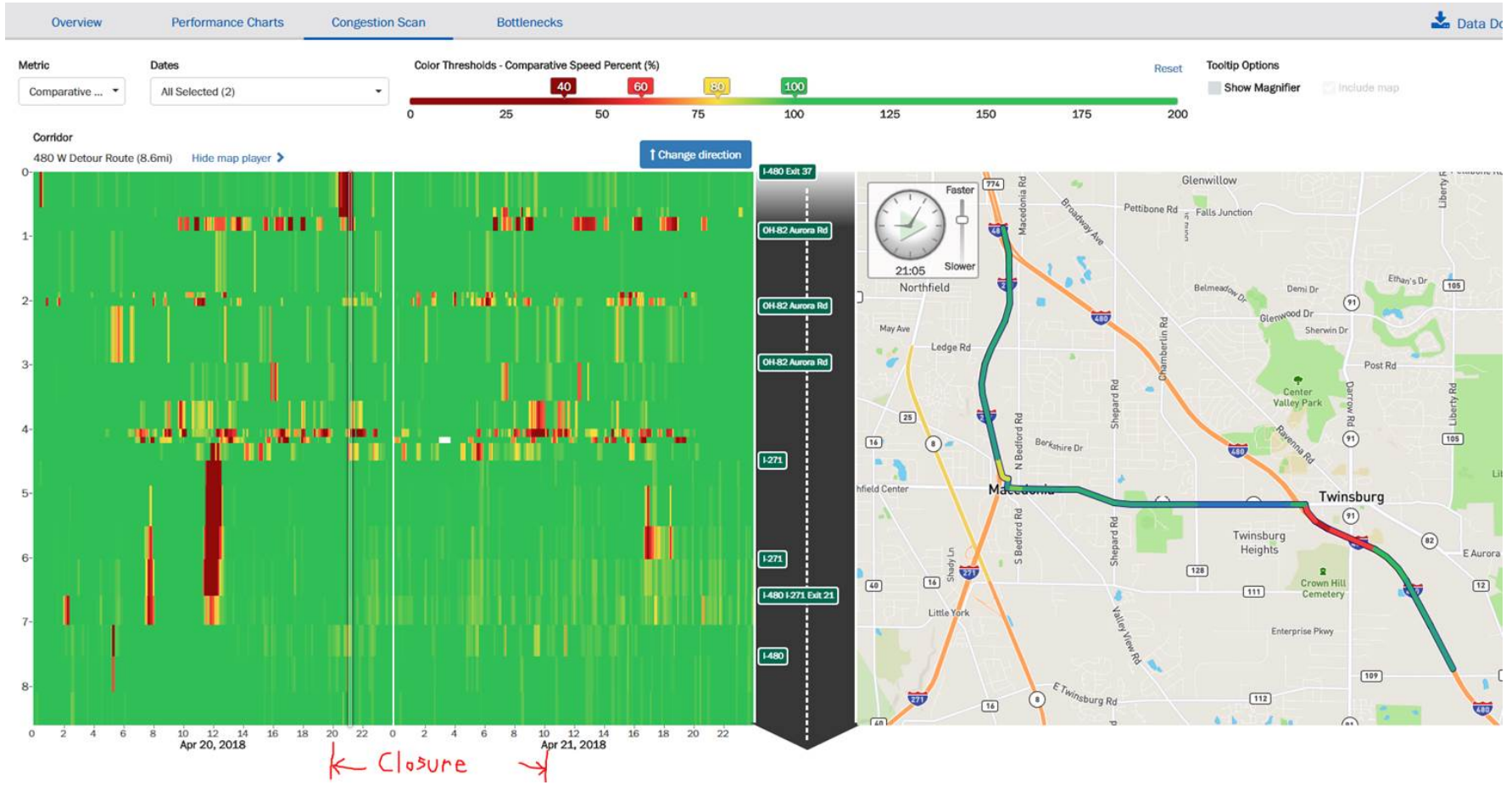
TIME INTERVAL	Demand: Estimated hourly volumes (vph)	AADT Distribution: Hourly (%)	Directional: UP (%)	Directional: DN (%)	AADT based volumes (vph)	P_t (%): adj.	P_t (%): total	Heavy vehicle adj. f_{HV}	Volumes: for analysis (pcph)	Diversion: Percent over threshold	Diversion: Work zone volume (pcph)	Supply: Number of lanes closed N_{closed}	Supply: Number of lanes open N_{open}	Supply: Work intensity adj., I (pcphpl)	Supply: On-ramp volume adj., R (pcph)	Capacity with N_{closed} (pcph)	No lane closure, no diversion: Size N_Q (pc)	No lane closure, no diversion: Length Q (miles)	No lane closure, no diversion: Delay $N_Q \Delta t$ (hrs)	No lane closure, with diversion: Size N_Q (pc)	No lane closure, with diversion: Length Q (miles)	No lane closure, with diversion: Delay $N_Q \Delta t$ (hrs)	Lane(s) closed, no diversion: Size N_Q (pc)	Lane(s) closed, no diversion: Length Q (miles)	Lane(s) closed, no diversion: Delay $N_Q \Delta t$ (hrs)	Lane(s) closed, with diversion: Size N_Q (pc)	Lane(s) closed, with diversion: Length Q (miles)	Lane(s) closed, with diversion: Delay $N_Q \Delta t$ (hrs)
0:00-1:00							4.0	0.95	0		0		3				0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0
1:00-2:00							4.0	0.95	0		0		3				0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0
2:00-3:00							4.0	0.95	0		0		3				0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0
3:00-4:00	3000						4.0	0.95	3060		3060		3				0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0
4:00-5:00	4000						4.0	0.95	4080		4080		3				0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0
5:00-6:00	6000						4.0	0.95	6120		6120		3				0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0
6:00-7:00	9000						4.0	0.95	9180		9180		3				2450	3.1	607.5	2450	3.1	607.5	2450	3.1	607.5	2450	3.1	607.5
7:00-8:00	9000						4.0	0.95	9180		9180		3				4860	6.1	4252.5	4860	6.1	4252.5	4860	6.1	4252.5	4860	6.1	4252.5
8:00-9:00	8000						4.0	0.95	8160	10	2856		3	50	50		1170	1.5	2677.5	964	1.2	2420.0	1170	1.5	2677.5	964	1.2	2420.0
9:00-10:00	5000						4.0	0.95	5100	10	2856		3	50	50		0	0.0	292.5	0	0.0	241.0	0	0.0	292.5	0	0.0	241.0
10:00-11:00	5000						5.0	9.0	5355	10	2922	1	2	0	50	2250	0	0.0	0.0	0	0.0	0.0	765	1.0	196.5	572	0.7	142.9
11:00-12:00	5000						6.0	10.0	5350	10	2935	2	1	0	50	1150	0	0.0	0.0	0	0.0	0.0	2765	3.5	1677.5	2357	3.0	1305.5
12:00-13:00	5000						7.0	11.0	5365	20	2732	1	2	-50	20	2220	0	0.0	0.0	0	0.0	0.0	3730	4.7	4415.8	2869	3.6	3662.8
13:00-14:00	5000						6.0	10.0	5350	20	2720	1	2	-160	20	2060	0	0.0	0.0	0	0.0	0.0	4620	6.1	5667.5	3529	4.5	4467.8
14:00-15:00	5000						5.0	9.0	5355	20	2705	1	2	-160	20	2060	0	0.0	0.0	0	0.0	0.0	5835	7.4	7498.8	4177	5.3	5454.8
15:00-16:00	5000						4.0	0.95	5060	20	2648	1	2	-50	20	2220	0	0.0	0.0	0	0.0	0.0	6735	8.5	9052.5	4605	5.8	6371.8
16:00-17:00	6000						4.0	0.95	6120	10	3606		3	-50	50		0	0.0	0.0	0	0.0	0.0	6105	7.7	8115.0	5465	4.4	5479.3
17:00-18:00	9000						4.0	0.95	9180	10	5362		3	0	50		2450	3.1	607.5	1612	2.0	403.0	5535	10.8	9765.0	5075	6.4	5596.8
18:00-19:00	4000						4.0	0.95	4080	10	3772		3	0	50		0	0.0	607.5	0	0.0	403.0	5865	7.4	9465.0	2097	2.6	5639.3
19:00-20:00	2000						4.0	0.95	2040	10	1936		3	50	50		0	0.0	0.0	0	0.0	0.0	1155	1.5	2910.0	0	0.0	524.1
20:00-21:00	1000						4.0	0.95	1020		1020		3				0	0.0	0.0	0	0.0	0.0	0	0.0	268.8	0	0.0	0.0
21:00-22:00	1000						4.0	0.95	1020		1020		3				0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0
22:00-23:00	900						4.0	0.95	918		918		3				0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0
23:00-24:00	800						4.0	0.95	816		816		3				0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0
																	total delay (hr)		9048.0	total delay (hr)		8327.0	total delay (hr)		66280.0	total delay (hr)		44435.8
																	FC delay (hr)		8582.2	FC delay (hr)		7983.9	FC delay (hr)		65921.5	FC delay (hr)		43537.4
																	T&S delay (hr)		581.8	T&S delay (hr)		553.1	T&S delay (hr)		4358.5	T&S delay (hr)		2876.3
																	avg delay (hr)		0.11	avg delay (hr)		0.11	avg delay (hr)		0.84	avg delay (hr)		0.57

Notes: 1 2 3

Maintenance of Traffic Exception Request

Predicted Queue Length	Allowance
≤ 0.75 miles	Unlimited duration allowed
> 0.75 miles	Not allowed for any duration- Must do an Exception Request

Maintenance of Traffic Exception Request



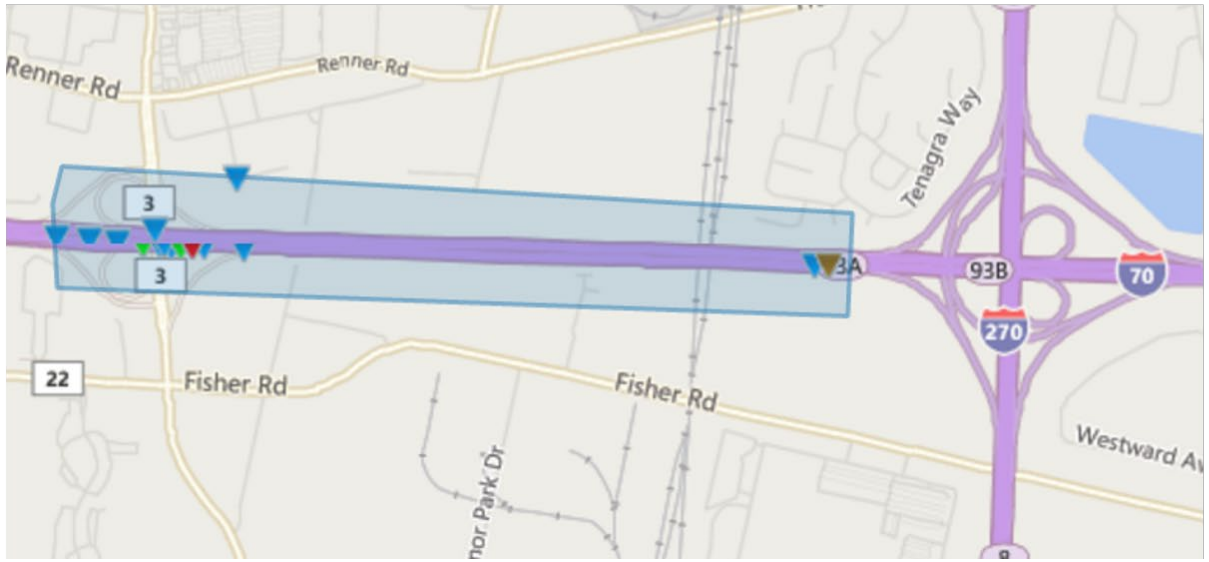
Work Zone Crashes

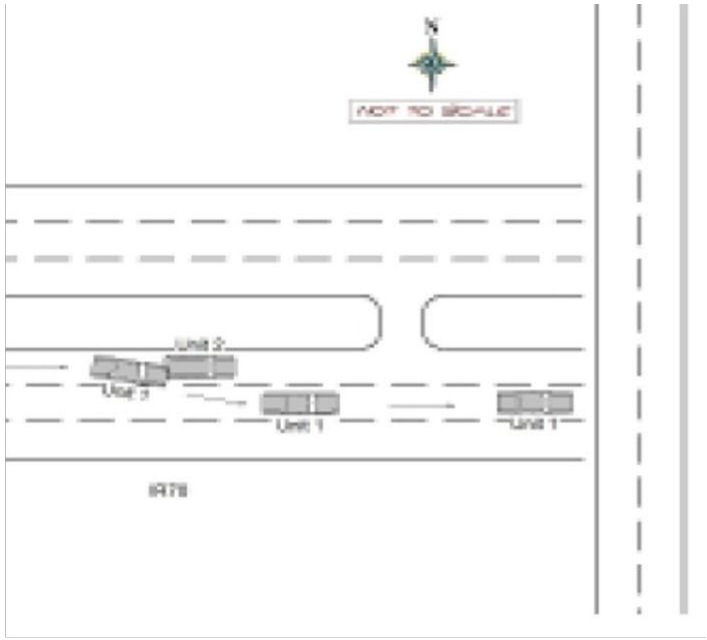
Emphasis Area	2015			
Fatalities	Grand Total:	1,110	Work Zone Total:	30
Alcohol Related Involvement	346	31.17%	6	20.00%
Bicycle Involvement	26	2.34%	1	3.33%
Drug Related	153	13.78%	3	10.00%
Fixed Object	396	35.68%	7	23.33%
Head-on/SS Meeting	176	15.86%	3	10.00%
Roadway Departure	563	50.72%	11	36.67%
Intersection	242	21.80%	4	13.33%
Motorcycle Involved	163	14.68%	5	16.67%
Older Driver Involvement (65 or Older)	260	23.42%	12	40.00%
Pedestrian Involvement	120	10.81%	3	10.00%
Rear-end crashes	73	6.58%	7	23.33%
Speed Related Involvement	336	30.27%	6	20.00%
Young Driver Involvement (15-25)	364	32.79%	4	13.33%
Commercial Motor Vehicle Involvement	185	16.67%	14	46.67%
Restraints Not Used Driver/Occupants	404	36.40%	7	23.33%

Work Zone Crashes

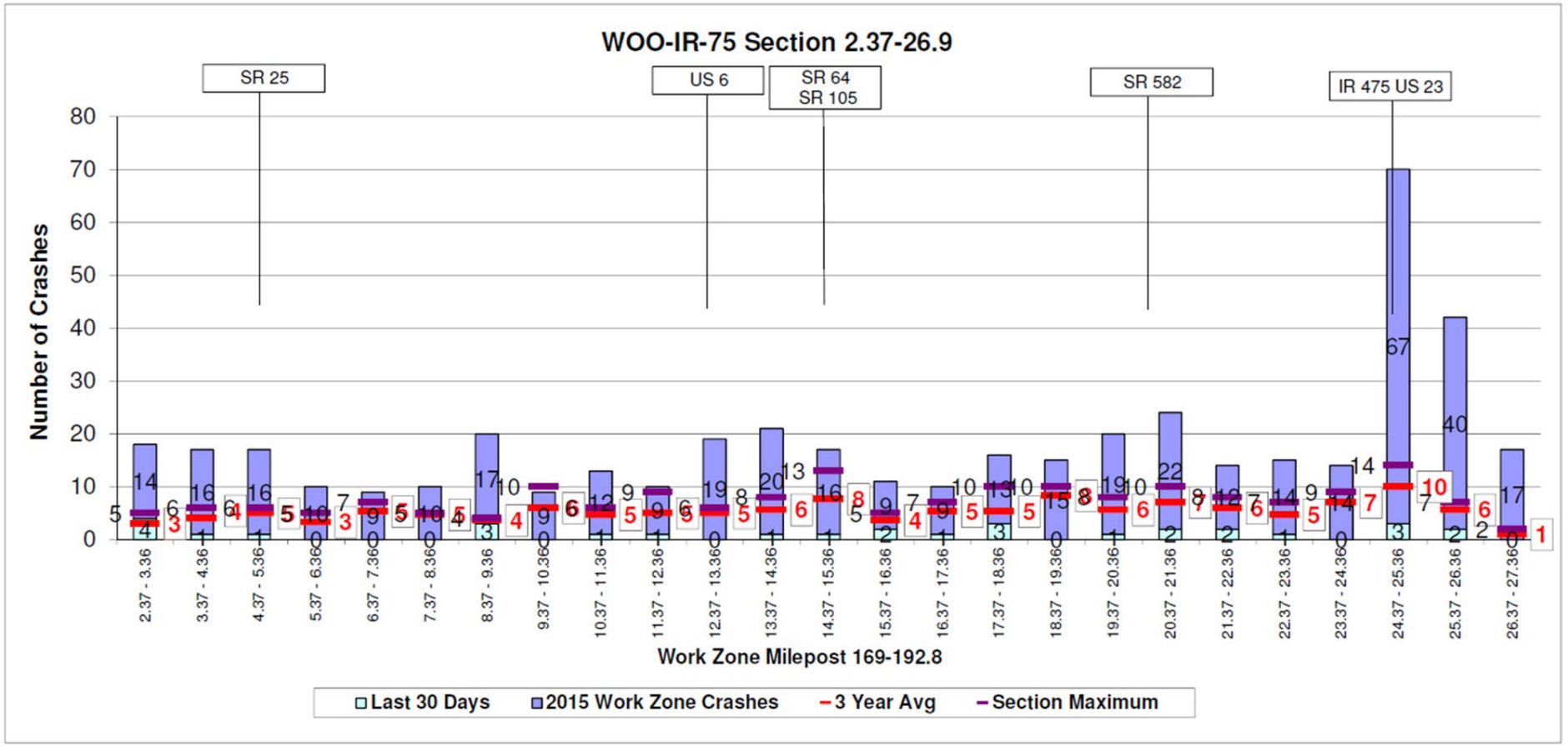
GIS Crash Analysis Tool

GCAT
GIS Crash Analysis Tool

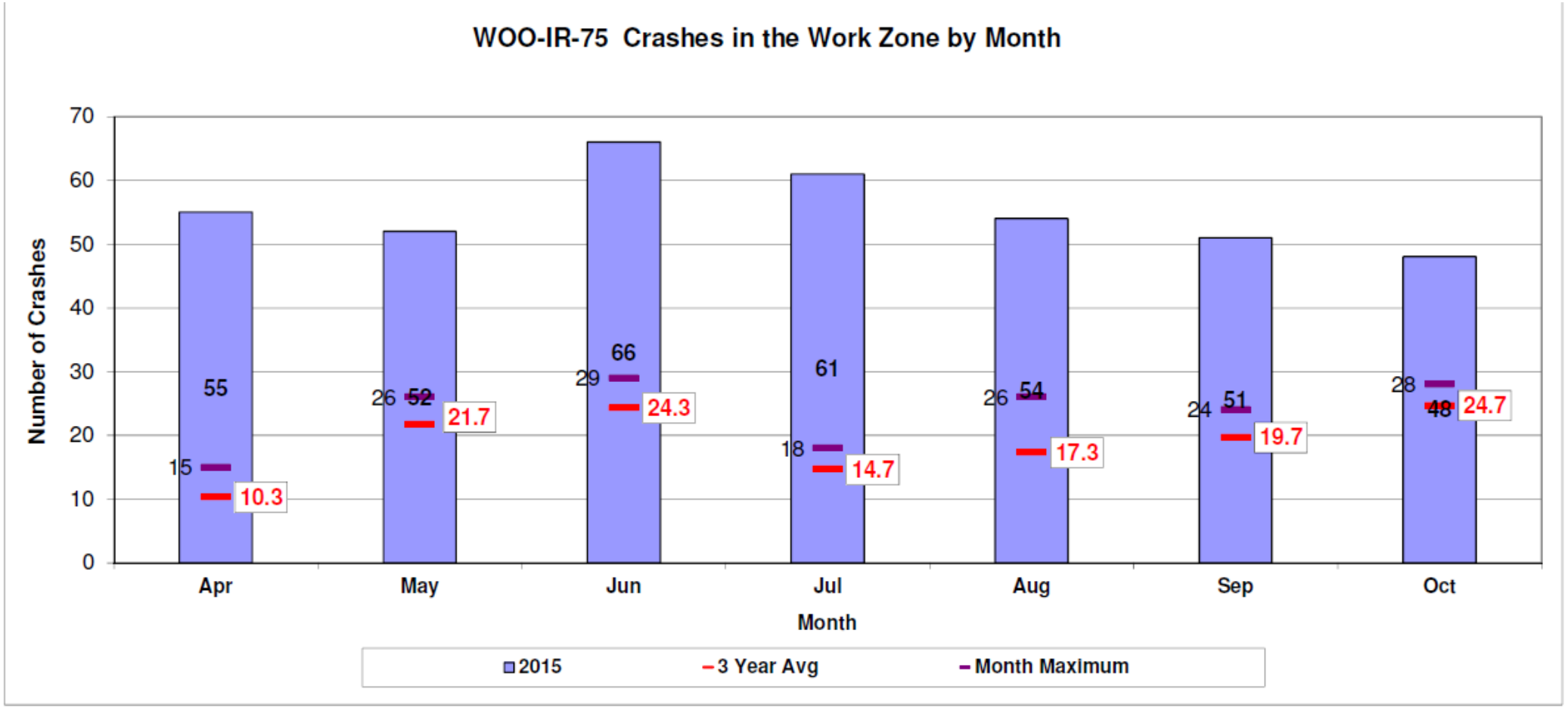




Work Zone Crash Database



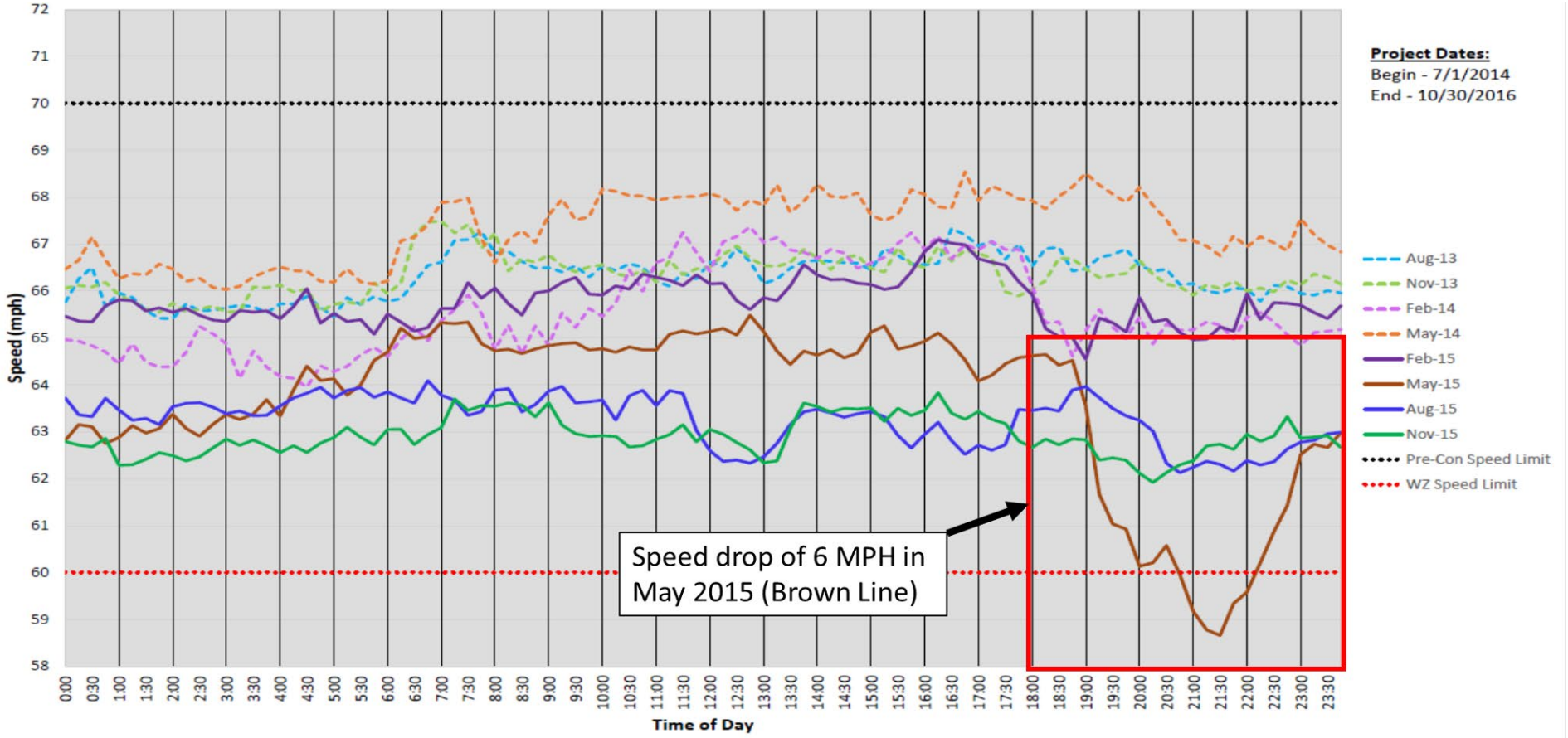
Work Zone Crash Database



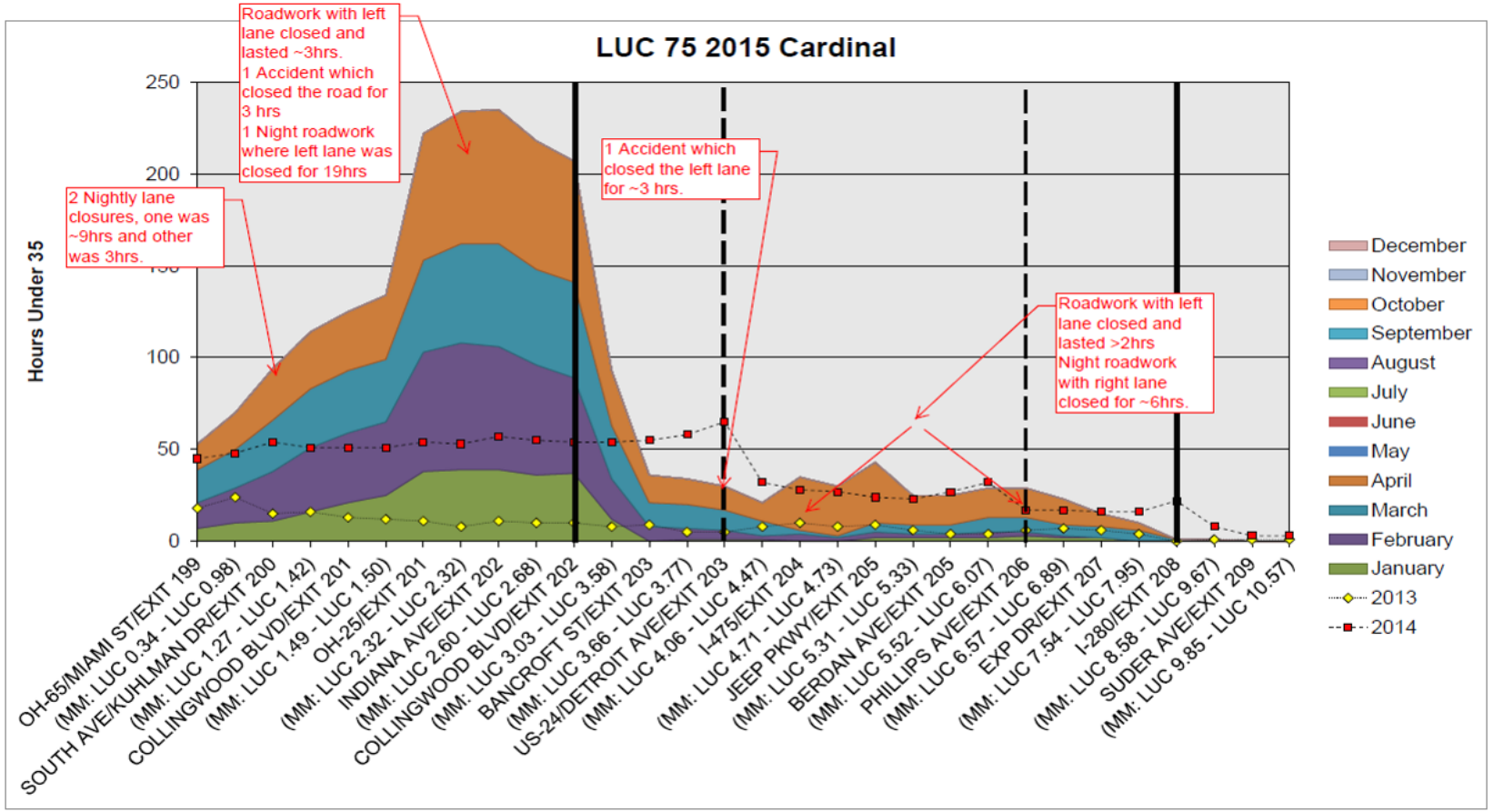
Work Zone CMF Report

Expected vs Actual Work Zone Crashes April-September 2018													
District	County	Route	Begin Log	End Log	PID	AADT	Lanes in one direction?	Pre-WZ Crashes	WZCMF	Expected Crashes	Actual Crashes	Difference between Actual and Expected	% Difference
1	HAN	75	13.89	20.38	87005	48,214	3	60	1.48	89	72	-17	-19%
2	LUC	75	0.6	3.25	93594	80,877	3	36	1.35	48	47	-1	-2%
2	LUC	75	3.99	6.2	77254	99,327	2	63	1.26	79	111	32	41%
3	LOR	90	11.56	14.51	83449	66,735	2	22	1.30	29	54	25	86%
4	SUM	76	0	6.12	93501	71,694	2	74	1.29	96	91	-5	-5%
4	SUM	76	9.4	11.6	77269	124,926	3	111	1.24	138	90	-48	-35%
5	MUS	70	7.9	11.29	88965	38,040	2	19	1.36	26	21	-5	-19%
5	GUE	77	17.2	23.44	93017	18,757	2	10	1.45	15	17	2	14%
6	FRA	71	9.47	15.18	104799	108,730	3	140	1.28	179	154	-25	-14%
6	FRA	270	8.65	17.59	76469	107,638	3	188	1.28	241	202	-39	-16%
6	FRA	33	23.76	26.62	98111	73,430	2	34	1.29	43	38	-5	-13%
8	HAM	71	1.47	8.42	82975	Do not have a CMF for 8 lane sections							
8	HAM	71	8.42	14.35	82975	147,284	3	181	1.21	218	144	-74	-34%
8	HAM	75	12.1	15.8	82288	119,125	3	155	1.26	194	206	12	6%
8	HAM	275	39.31	41.6	84492	77,685	3	33	1.36	45	47	2	4%
8	WAR	71	3.1	6.3	93964	76,284	3	33	1.36	45	35	-10	-23%
12	CUY	271	0	7	80418	125,660	3	118	1.24	147	213	66	45%
12	CUY	90	25.66	27.74	87628	Do not have a CMF for 8 lane sections							
12	CUY	480	21.91	25.2	89168	Do not have a CMF for 8 lane sections							
12	CUY	77	13.3	15.24	82388, 13567	95,938	3	51	1.30	66	58	-8	-12%

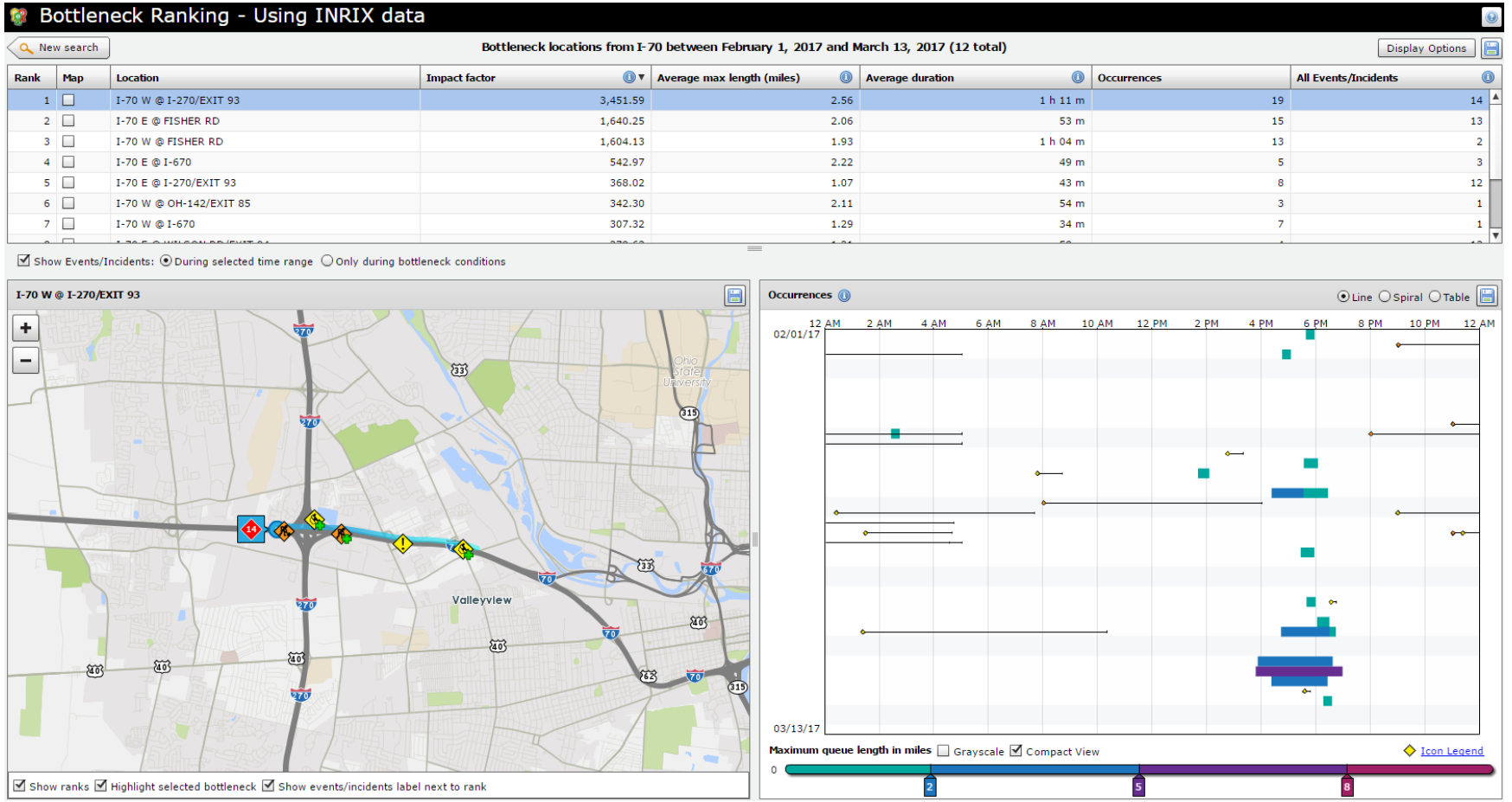
Work Zone Speed Comparisons



Work Zone Mobility



Weekend Bottleneck Reports



TMC Notifications

ROAD WORK TRAFFIC IMPACT

COURTESY NOTIFICATION

Hello DWZTM,

The Statewide Traffic Management Center observed a significant traffic impact related to road work. Video of the backup can be seen from the traffic camera listed below. Please reach out to Bill Feehan (William.Feehan@dot.ohio.gov or 1.614.644.5873) with any follow up questions.

Respectfully,
ODOT Statewide TMC

District:	Location:
12	Northbound I-271 at Broadway Ave
Date/Time:	**Camera(s):**
1/4/2017 5:00:00 PM	Camera #3060 I-271 at SR-14/Broadway

Additional Comments:

Roadwork has all lanes closed except right lane on Northbound I-271 at Broadway Ave.

Contact Information

Bill Feehan

Ohio Department of Transportation

William.Feehan@dot.ohio.gov

Virginia DOT's Applications of Probe Data for Work Zone Performance Measurement

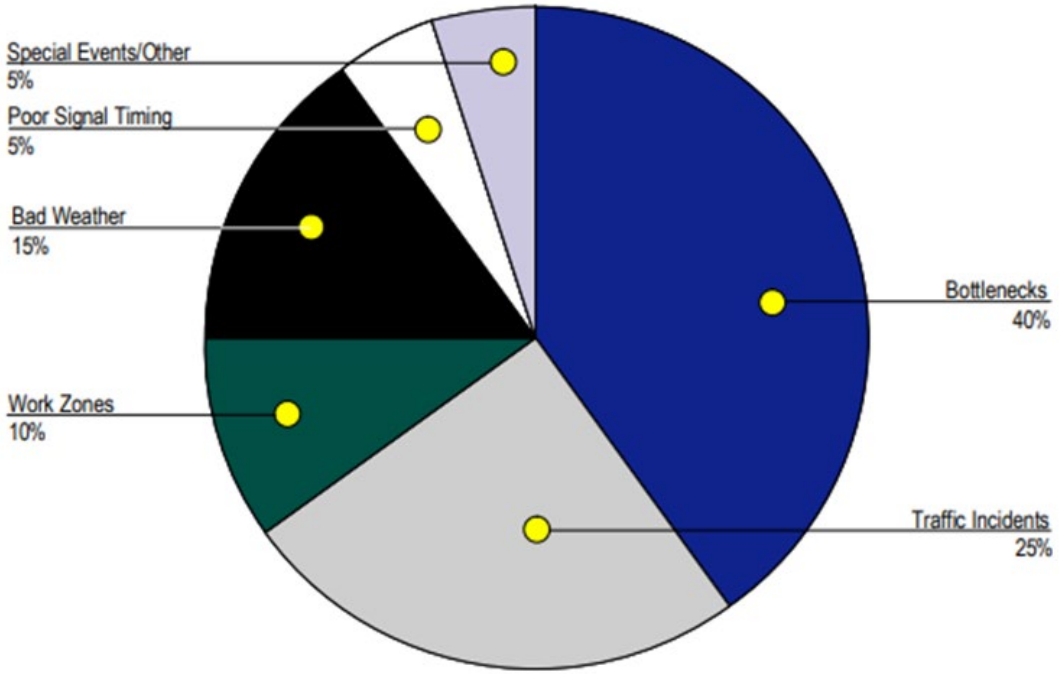
Mike Fontaine – Virginia Transportation Research Council

Examples from Virginia

- Macroscopic level:
  - Analysis of work zone contribution to system vehicle hours of delay by DOT district, route, and segment
- Microscopic level:
  - Project level impacts on queuing

Programmatic Level Analysis

- Goal: Identify magnitudes of recurring and non-recurring delay on interstates in Virginia, including work zone impacts
- Tools/Data:
  - RITIS: Vehicle Hours of Delay
  - VATraffic:
    - Lane-blocking incidents
    - Work zone data
    - Road condition data
  - National Weather Service:
    - 75 weather stations in VA
  - Data pulled into Tableau



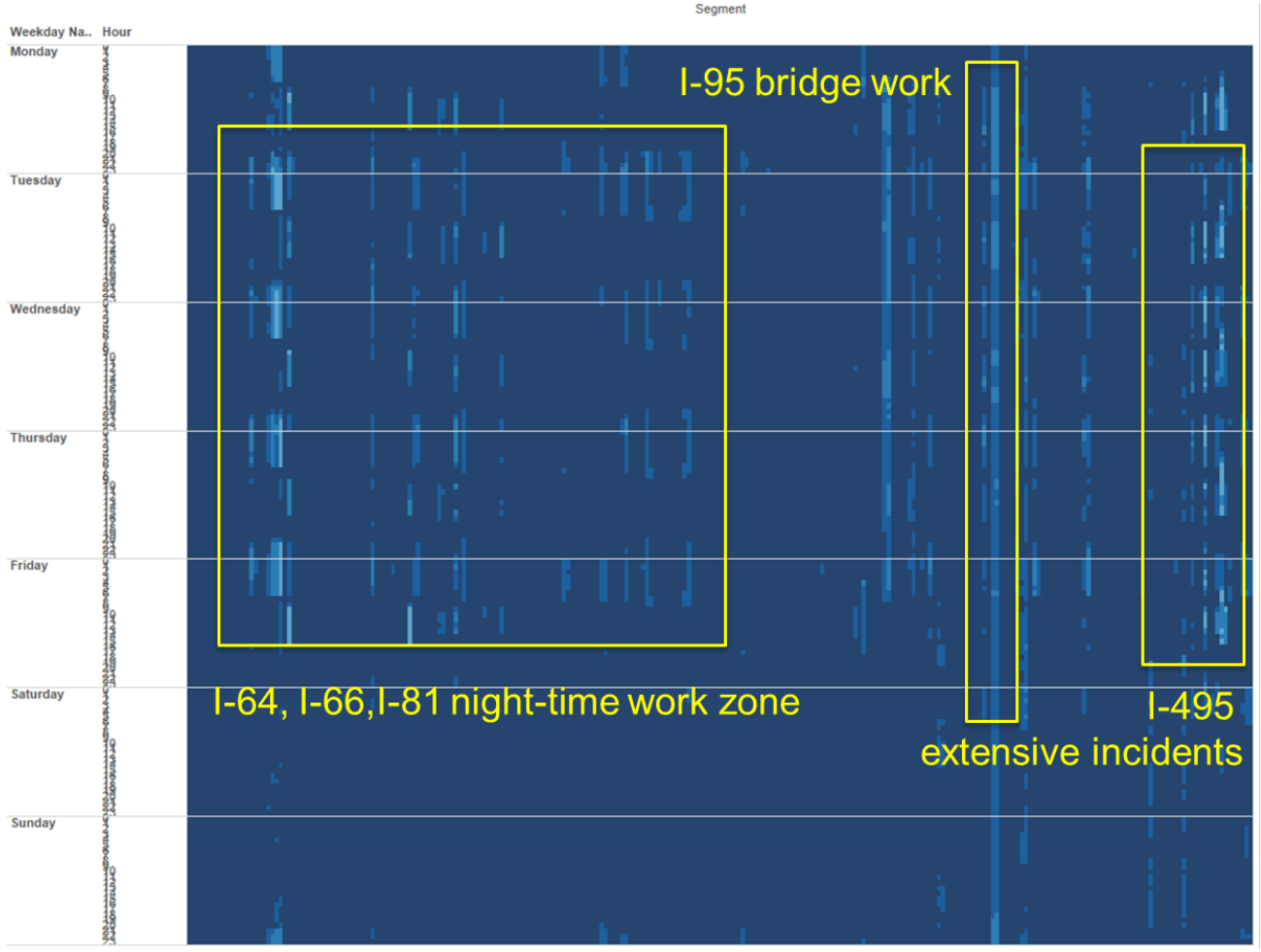
Interstate Event Data (2016-2017)

- Incidents
  - 15,488 events (7,806 in 2016; 7,683 in 2017)
- Work Zones
  - 19,600 events (8,413 in 2016; 11,187 in 2017)
- Weather
  - 4,186 events
  - Precipitation > 0.25 in/hr: 1,940 in 2016, 1,532 in 2017
  - Icy/Snow Road: 507 in 2016, 207 in 2017

Work Zone Data Challenges

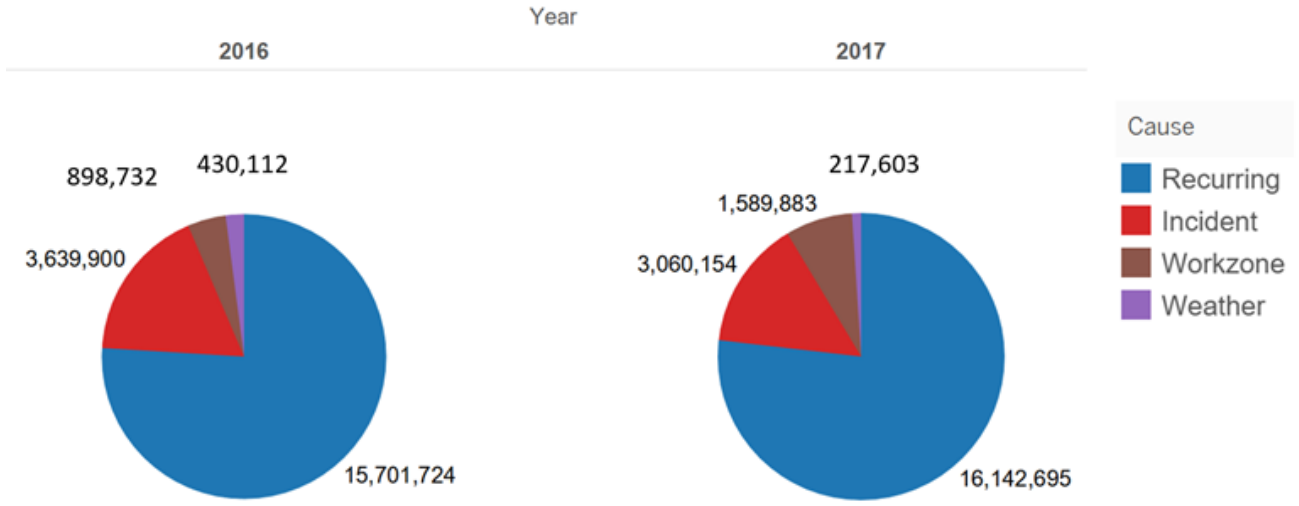
- VDOT has 5 Traffic Operations Centers that cover the entire interstate system
- Work zone events are entered by operators
- Data challenges:
  - Differing practices for entering lane closure information
  - “Point” work zones
  - Work zone start times/end times are the same
  - Disentangling delays due to incidents/weather/pre-existing recurring congestion
  - RITIS VHD calculations does not use real time volumes

Distribution of "Event Free" Days



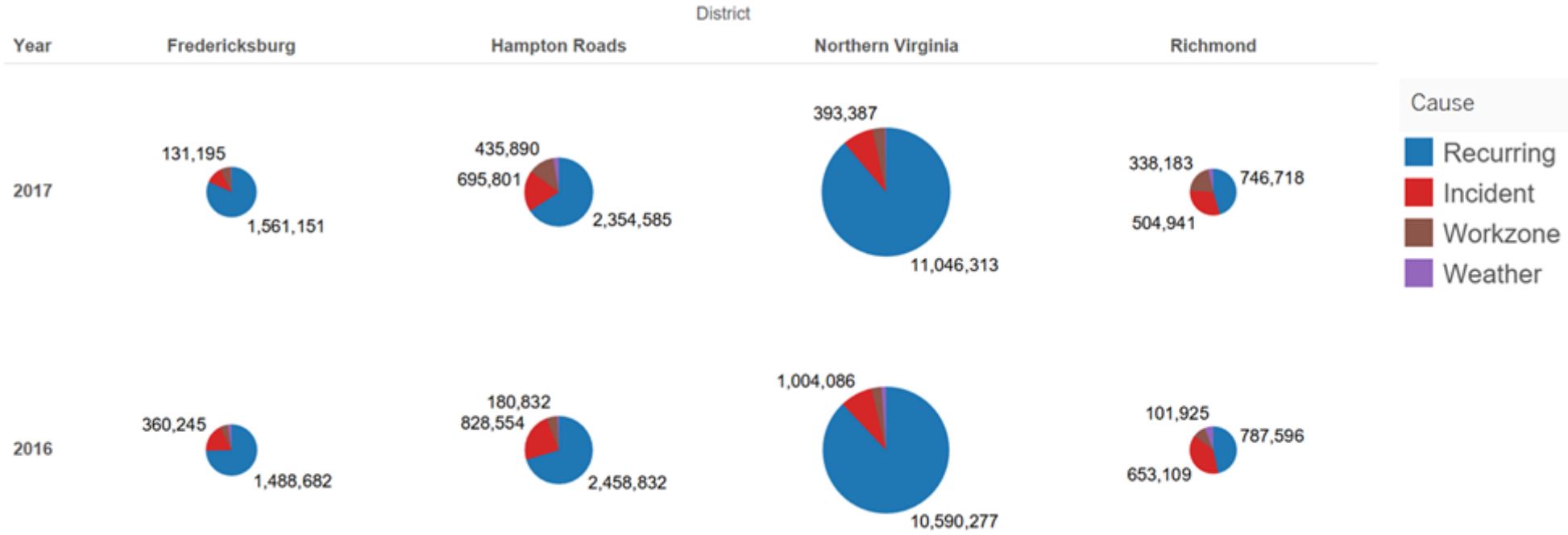
Work Zone Data Challenges

- Work zones contributed an estimated 4.3% (2016) and 7.6% (2017)of total delay in Virginia



	2016	2017	Grand Total
Non-Recurring Delay	4,968,745	4,867,640	9,836,384
Recurring Delay	15,701,724	16,142,695	31,844,419
Total Delay	20,670,468	21,010,335	41,680,803

Work Zone Data by District – Urban Districts



Large increase in work zone delay in Hampton Roads District related to major capacity expansion project (increase from 5.2% to 12.5% of vehicle hours of delay).

Work Zone Delay as % by Corridor

District/ Interstate	Year	Bristol	Culpeper	Fredericksburg	Hampton Roads	Northern Virginia	Richmond	Salem	Staunton	Total
64	2016		6%		<5%		<5%		8%	<5%
	2017		13%		12%		10%		7%	11%
66	2016		12%			<5%			20%	<5%
	2017		<5%			<5%			<5%	<5%
77	2016	15%						6%		10%
	2017	23%						<5%		13%
81	2016	9%						8%	13%	10%
	2017	41%						20%	13%	20%
85	2016						13%			13%
	2017						21%			21%
95	2016			<5%	38%	<5%	10%			<5%
	2017			6%	58%	<5%	23%			7%
264	2016				<5%					<5%
	2017				<5%					<5%
395	2016					<5%				<5%
	2017					<5%				<5%
495	2016					<5%				<5%
	2017					<5%				<5%

Microscopic Queuing Analysis

- Time/space extent of queuing delay is often a major concern in work zones
- Probe data TMC network topology often does not align with work zone boundaries
- If links are too long or do not align with WZ end points, impacts could be missed or washed out

Probe Data Network Segmentation

	Network	# of Segs	Total Length (mi)	Mean Length (mi)	Min Length (mi)	Max Length (mi)
Freeways	TMC	3,208	3,514.4	1.10	0.003	11.29
	XD	6,787	3,387.3	0.50	0.003	0.99
Arterials	TMC	13,789	17,270.1	1.25	0.002	18.09
	XD	68,860	30,598.1	0.44	0.002	0.99

Sub-XD Data

- INRIX can dynamically produce sub-XD links with a resolution up to 250 meters (0.16 mi)
- Sub-XD links are generated when they have a detected speed substantially different from the parent link
- Must be defined ahead of time, not archived by INRIX

Data Sample

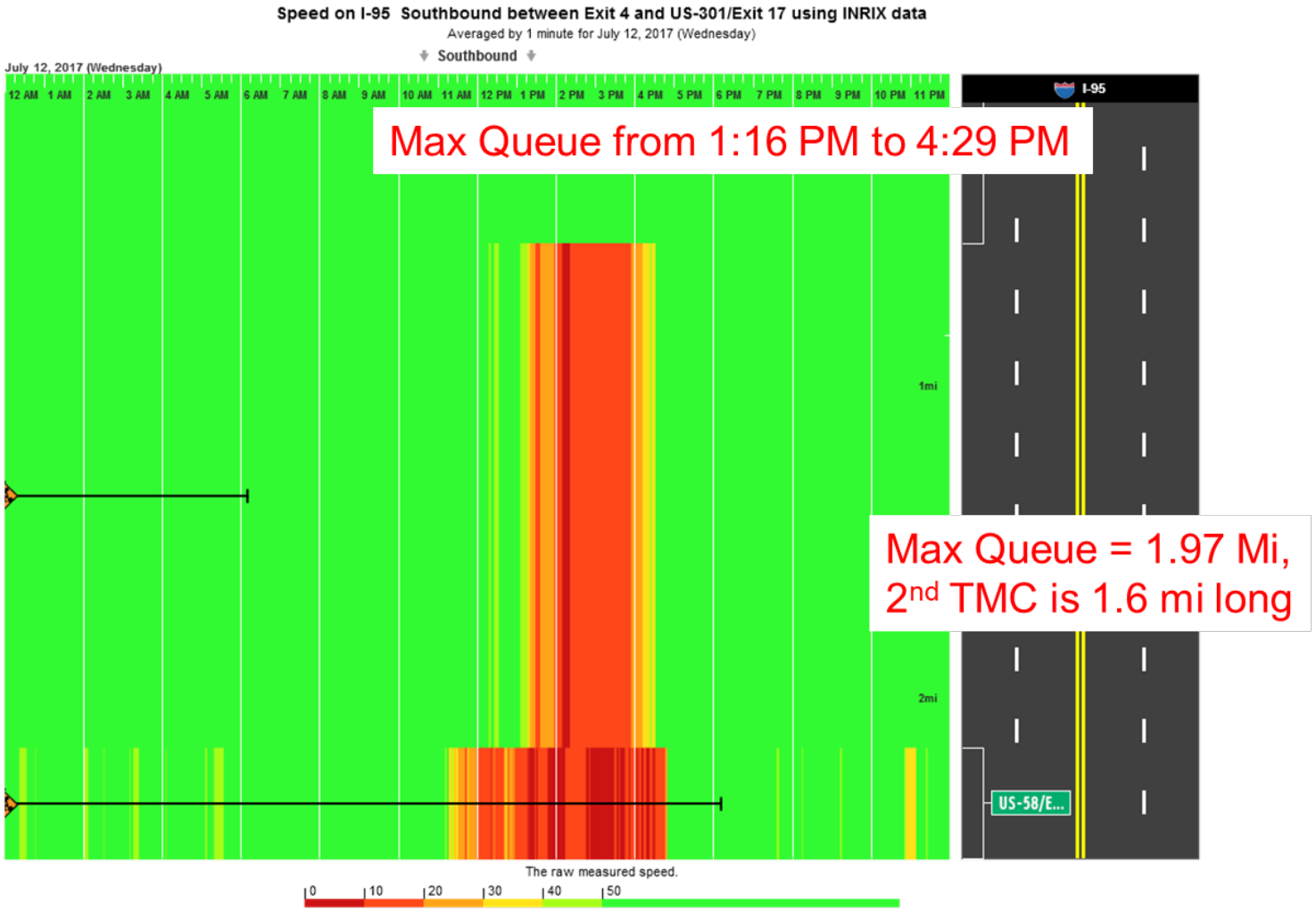
Timestamp	XD Link	Link Type	Speed	Confidence	C-Score	Start Sub XD	End SubXD	Length	Parent Speed
9/10/2017 19:33	1310304617	XDS	43	30	7	\N	\N	0.5350	\N
9/10/2017 19:33	1310304617	subXDS	36	30	\N	0	0.1335	0.13359	43
9/10/2017 19:33	1310304617	subXDS	48	30	\N	0.2671	0.4007	0.13359	43
9/10/2017 19:33	1310304617	subXDS	51	30	\N	0.4007	0.5350	0.13421	43

- "Parent" XD segment listed first
- SubXD segments show where speeds differ from parent
- "Gap" from 0.13359 to 0.2671 means that speed=Parent

Example: Measuring Queues with Sub-XD Data

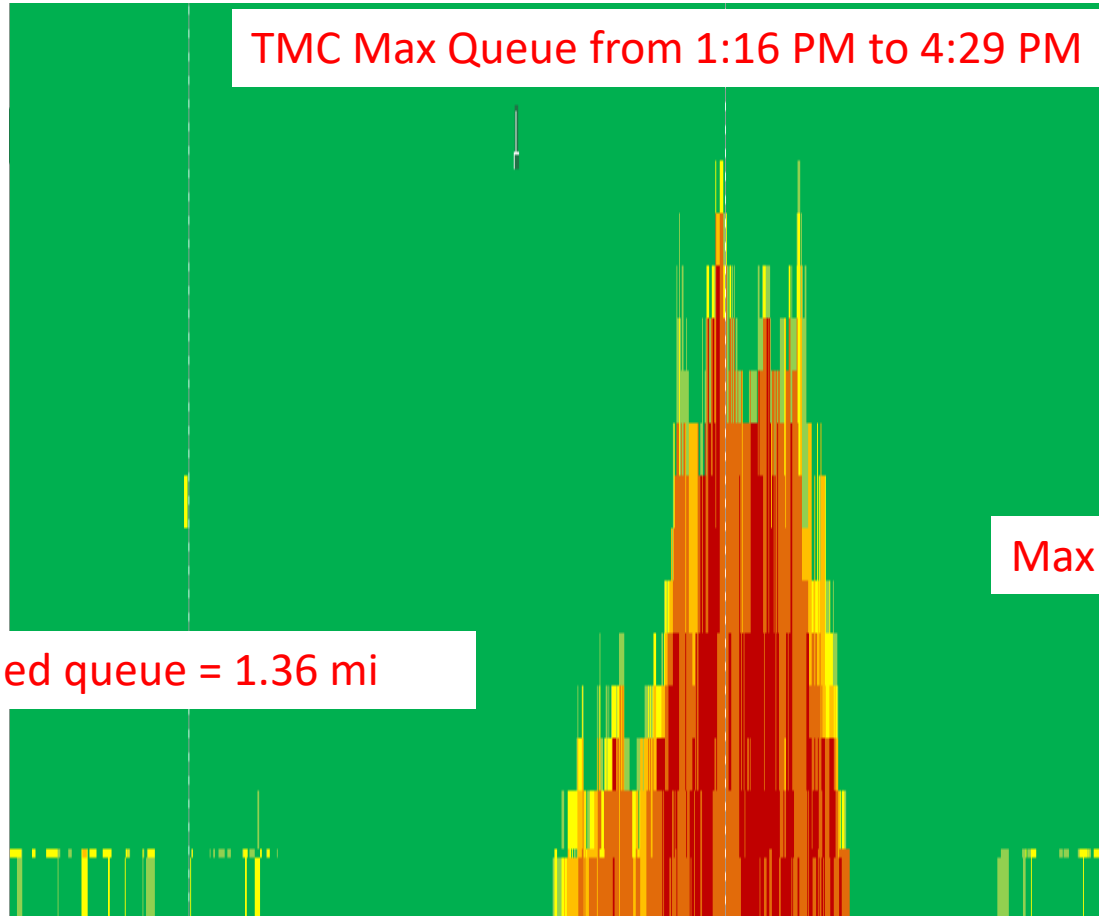
- VDOT deployed a Smart Work Zone on I-95 SB in Emporia, VA
- Installed a number of radar sensors to measure traffic speeds
- Queue warning messages were triggered when speeds dropped below 40 mph

RITIS Congestion Scan TMC Data – 7/12/17

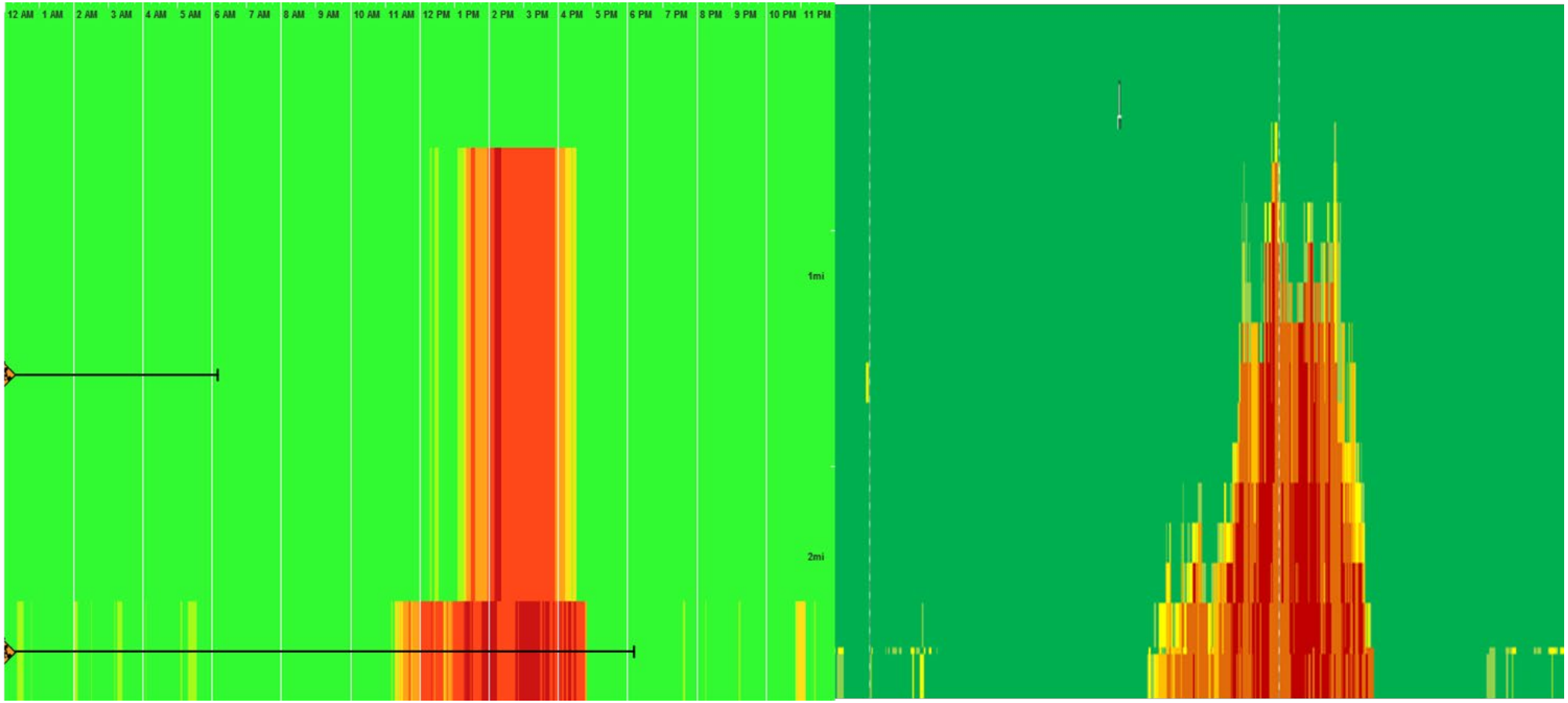


Sub-XD Queuing

- Longest link is 0.17 mi



Comparison


12 AM
1 AM
2 AM
3 AM
4 AM
5 AM
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8 AM
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10 AM
11 AM
12 PM
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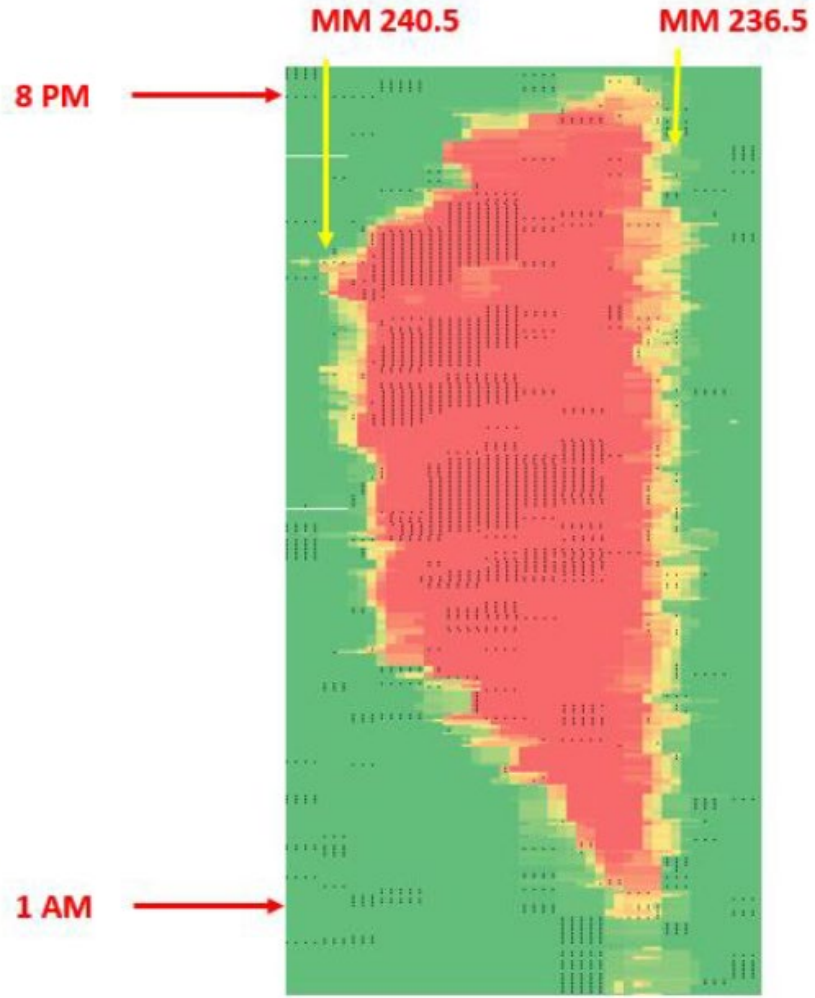
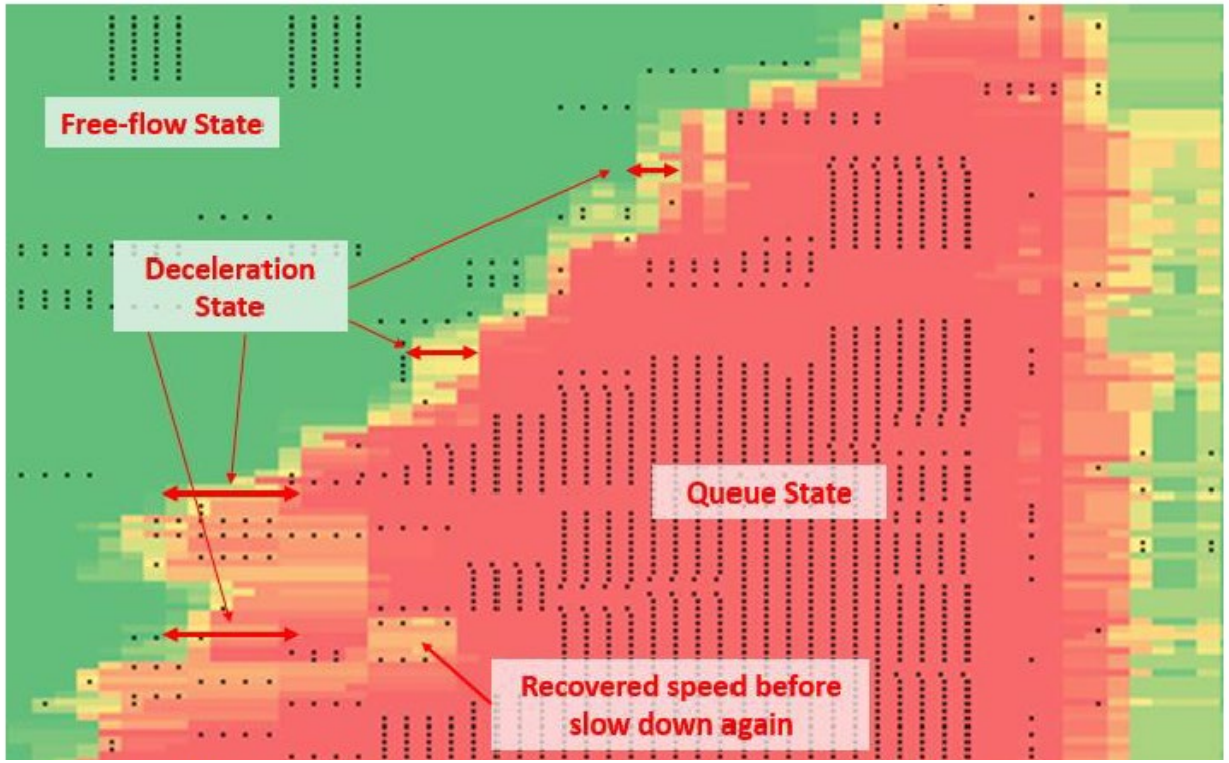
10 PM
11 PM
1mi
2mi

Assessing Queue Management Techniques for Paving



Assessing Queue Management Techniques for Paving



Contact Information

Mike Fontaine

Associate Director

Virginia Transportation Research Council

Michael.Fontaine@vdot.virginia.gov

Resources and Upcoming Opportunities

FHWA Work Zone Management Program Resources

- **A Primer on Work Zone Safety and Mobility Performance Measurement**
  - https://ops.fhwa.dot.gov/wz/publications/fhwahop11033/
- **Guidelines on Data Needs, Availability, and Opportunities for Work Zone Performance Measures**
  - https://ops.fhwa.dot.gov/wz/resources/publications/fhwahop13011/
- **A Policy-driven Approach for Work Zone Mobility Performance Measurement – ODOT**
  - https://ops.fhwa.dot.gov/publications/fhwahop19034/
- **Utilizing Probe-Vehicle Data for Work Zone Mobility Performance Measurement – VDOT**
  - To be Posted: https://ops.fhwa.dot.gov/wz/
- **Comprehensive Work Zone Mobility Performance Management across Project Stages - Caltrans**
  - To be Posted: https://ops.fhwa.dot.gov/wz/

- Additional resources available at https://ops.fhwa.dot.gov/wz

Upcoming Webinar

- Using the NPMRDS for Work Zone Performance Management
  - Information and resources for using the FHWA-provided NPMRDS for Work Zone Performance Management
  - Learn how State DOTs are actively using the NPRMDS to measure work zone performance
  - Mid-August, 2019
  - Invite to be distributed through FHWA WZM Program E-Blast

Upcoming Resources and Opportunities

- NPMRDS and Work Zone Performance Management Tech Brief.
- Using the NPMRDS for Work Zone Performance Management: I-10 Case Study.
- Work Zone Performance Management Training Modules.
- Work Zone Performance Management Training Workshops.
- Work Zone Performance Management Demonstration Site Visits.

Additional Resources

- **National Work Zone Safety Information Clearinghouse**
  - Training courses and guidance documents.
  - https://www.workzonesafety.org/
- **FWHA Smarter Work Zones Toolkit**
  - Webinars, fact sheets, case studies, site visits, training workshops, peer exchanges.
  - https://www.workzonesafety.org/swz/

Contact Information

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Work Zone Management Program

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THANK YOU!

Questions?