Safely Implementing Rolling Roadblocks for Short-Term Road Work

U.S. Department of Transportation
Federal Highway Administration

FHWA Work Zone Management Program
April 23, 2019

Webinar Purpose

- Background on Rolling Roadblocks.
- Safely Implementing Rolling Roadblocks.
- Example State Policies for Safely Implementing Rolling Roadblocks.
- Additional Information and Resources.

Webinar Speakers

- **Jawad Paracha** – Federal Highway Administration
  - Program Manager – Work Zone Management Program
- **Larry Haas –** Colorado Department of Transportation
  - Traffic Operations Engineer – Northeast Region
- **Dan Smith –** Missouri Department of Transportation
  - Traffic Management and Operations Engineer

What is a Rolling Roadblock?

Rolling Roadblocks

- Also referred to as traffic breaks, temporary road closures, pacing operations, or traffic pacing.
- Temporary Traffic Control (TTC) technique to temporarily slow or stop traffic in order to provide a gap in the flow of traffic in advance of downstream road work activities.


Source: Raleigh News and Observer

Rolling Roadblocks (Continued)

- Enables the completion of short-term road work where a long-term closure using standard TTC is not needed:
  - Bridge construction and replacement.
  - Placing and removing overhead lights or sign structures.
  - Overhead utility work.
  - Blasting for rock excavation.

- Allows for faster completion of road work activities by allowing workers full access on and above a roadway, and a safer work environment by completely removing vehicles that would normally be in close proximity to workers.

Rolling Roadblocks (Continued)

Highly effective TTC technique, but…

The use of rolling roadblocks for short-term road work activities can pose safety hazards to the traveling public if not implemented safely.

Safely Implementing Rolling Roadblocks

Rolling Roadblock Policies

- A recent scan of State DOT usage of rolling roadblocks and associated policies found:
  - 23 of 28 responding agencies use rolling roadblocks.
  - Of the 23 States using rolling roadblocks, 16 do so routinely, but five of those States do not have policies governing their use.
  - More than 40% of responding States that use rolling roadblocks do not have standard policies or procedures for their implementation.

- As a best practice, **transportation agencies are encouraged to have policies and procedures** in place for the safe use of rolling roadblocks.

Rolling Roadblock Policies (Continued)

- Policies and procedures governing the use of rolling roadblocks vary by State.
- Policies should be documented in a project's Transportation Management Plan (TMP) and specifications, and in every encroachment permit involving a roadblock in the State.

Best Practices for Rolling Roadblocks

Establishing a rolling roadblock policy:

- Specify the type of work activities, times of day, and days of the week where the use of rolling roadblocks are permitted and/or required, and clearly detail these points in TTC plans and/or technical specifications.
- Require the development of an emergency plan to handle traffic should unforeseen circumstances occur.
- Specify whether the policy varies if the work is being performed by a contractor or the agency's own employees.

Best Practices for Rolling Roadblocks (Continued)

Prior to the start of a rolling roadblock:

- Require an advance planning meeting with all stakeholders to define responsibilities and ensure activities required for successfully executing a rolling roadblock will be completed, including notifying fire stations and other emergency response agencies.
- Require a final meeting among stakeholders before the rolling roadblock is executed to ensure all requirements have been implemented.

Best Practices for Rolling Roadblocks (Continued)

Notifying the public prior to the start of a rolling roadblock:

- Require issuing press releases to radio and television stations, newspapers, the agency's website, and agency social media sites.
- Require advising the public in advance as to when the rolling roadblock will be performed, including using:
  - Portable changeable message signs (PCMS) to display appropriate messages to the public at least a week in advance of the roadblock.
  - PCMS on the day of roadblock to alert users that the operation will be happening that day, including the hours during which the roadblocks will occur.

Best Practices for Rolling Roadblocks (Continued)

During and after the rolling roadblock:

- Specify appropriate advance warning signing to alert traffic to the downstream presence of a slow or stopped traffic condition.
- Require using any permanent changeable message signs (CMS) boards within the activity area for public notification.
- Considering the use of queue warnings systems to provide drivers with advanced notification of downstream queues.
- Ensure that traffic queue formations and their dispersals are monitored.
- Ensure that a rolling roadblock not be started until traffic from a preceding rolling roadblock has been cleared.

Colorado Department of Transportation's Use of Rolling Roadblocks

Larry Haas – Traffic Operations Engineer

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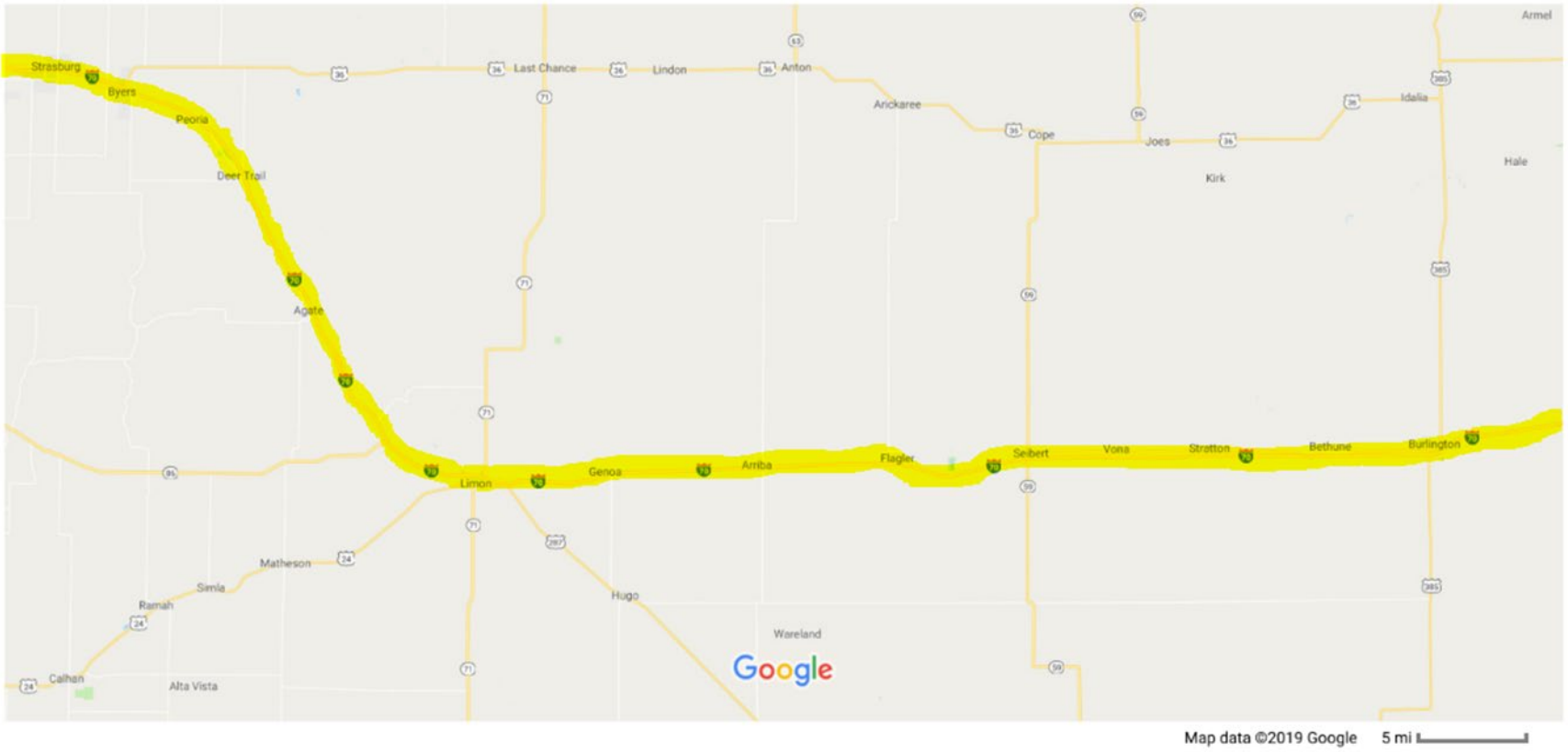
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Arriba
Flagler
Seibert
Vona
Stratton
Bethune
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Matheson
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Wareland
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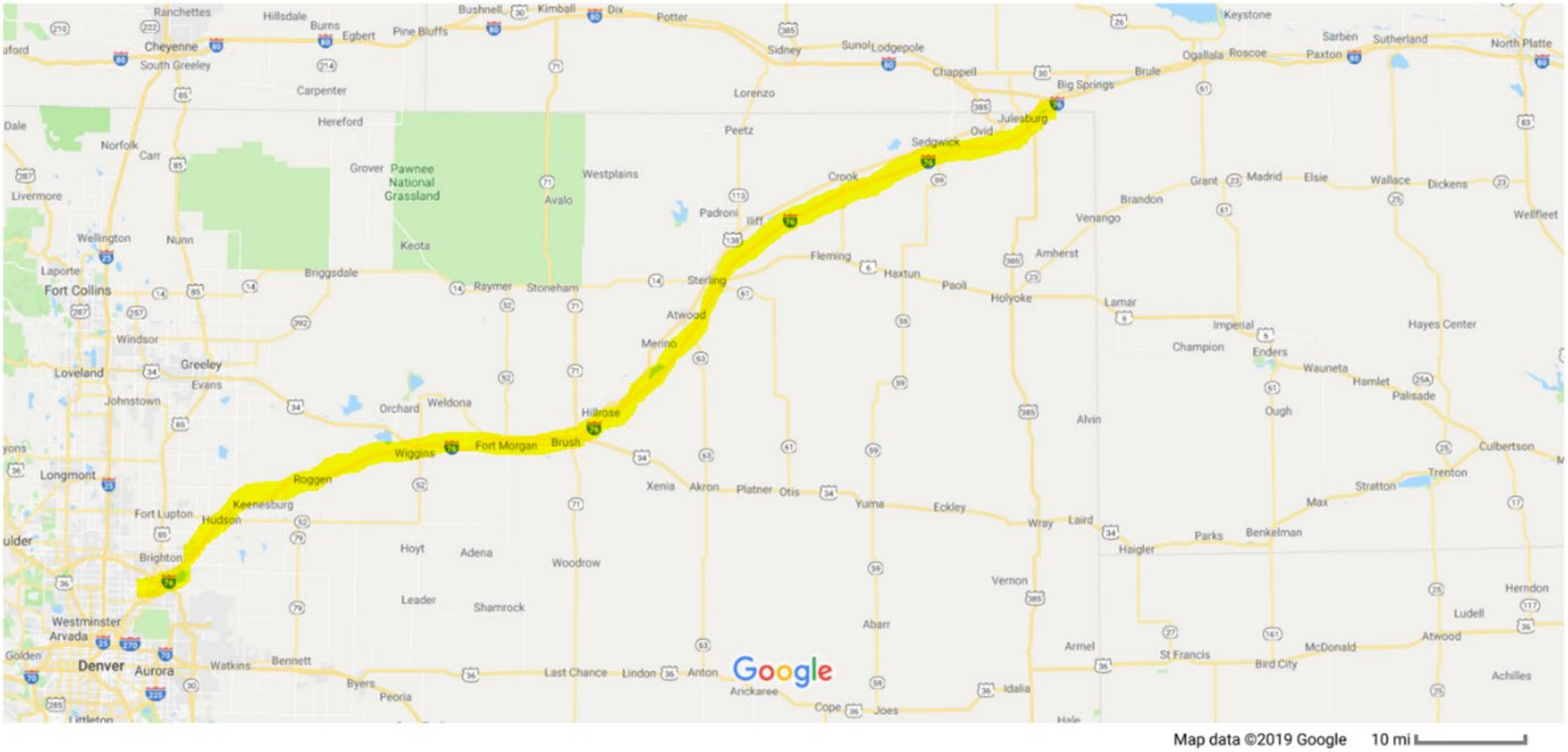
STOPPED
TRAFFIC
2 MILES

I-76


Cheyenne
South Greeley
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Hereford
Norfolk
Carr
Grover
Pawnee National Grassland
Westplains
Avalo
Keota
Briggsdale
Livermore
Laporte
Fort Collins
Wellington
Nunn
Windsor
Loveland
Greeley
Evans
Johnstown
Orchard
Weldona
Hillrose
Fort Morgan
Brush
Wiggins
Roggen
Keenesburg
Hudson
Fort Lupton
Longmont
Brighton
Hoyt
Adena
Woodrow
Leader
Shamrock
Westminster
Arvada
Golden
Denver
Aurora
Watkins
Bennett
Byers
Peoria
Last Chance
Lindon
Anton
Arickaree
Cope
Joes
Idalia
Abarr
Vernon
Armel
St Francis
Bird City
McDonald
Atwood
Ludell
Herndon
Achilles
Haigler
Parks
Benkelman
Wray
Laird
Yuma
Eckley
Xenia
Akron
Platner
Otis
Alvin
Ough
Champion
Enders
Imperial
Lamar
Holyoke
Paoli
Haxtun
Fleming
Amherst
Sterling
Atwood
Merino
Raymer
Stoneham
Padroni
Iliff
Crook
Sedgwick
Julesburg
Ovid
Peetz
Sidney
Sunol
Lodgepole
Chappell
Big Springs
Brule
Ogallala
Roscoe
Paxton
Sarben
Sutherland
North Platte
Keystone
Lorenzo
Dale
Venango
Brandon
Grant
Madrid
Elsie
Wallace
Dickens
Wellfleet
Hayes Center
Wauneta
Hamlet
Palisade
Culbertson
Trenton
Stratton
Max
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STOPPED
TRAFFIC
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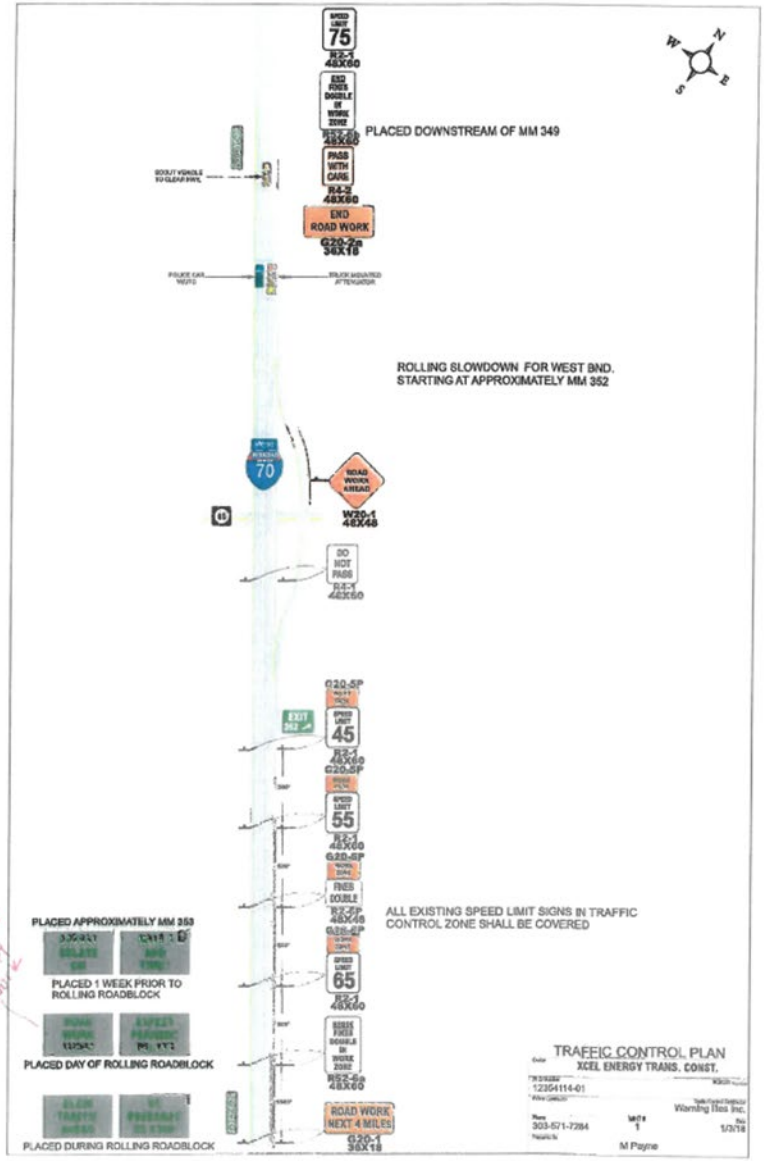
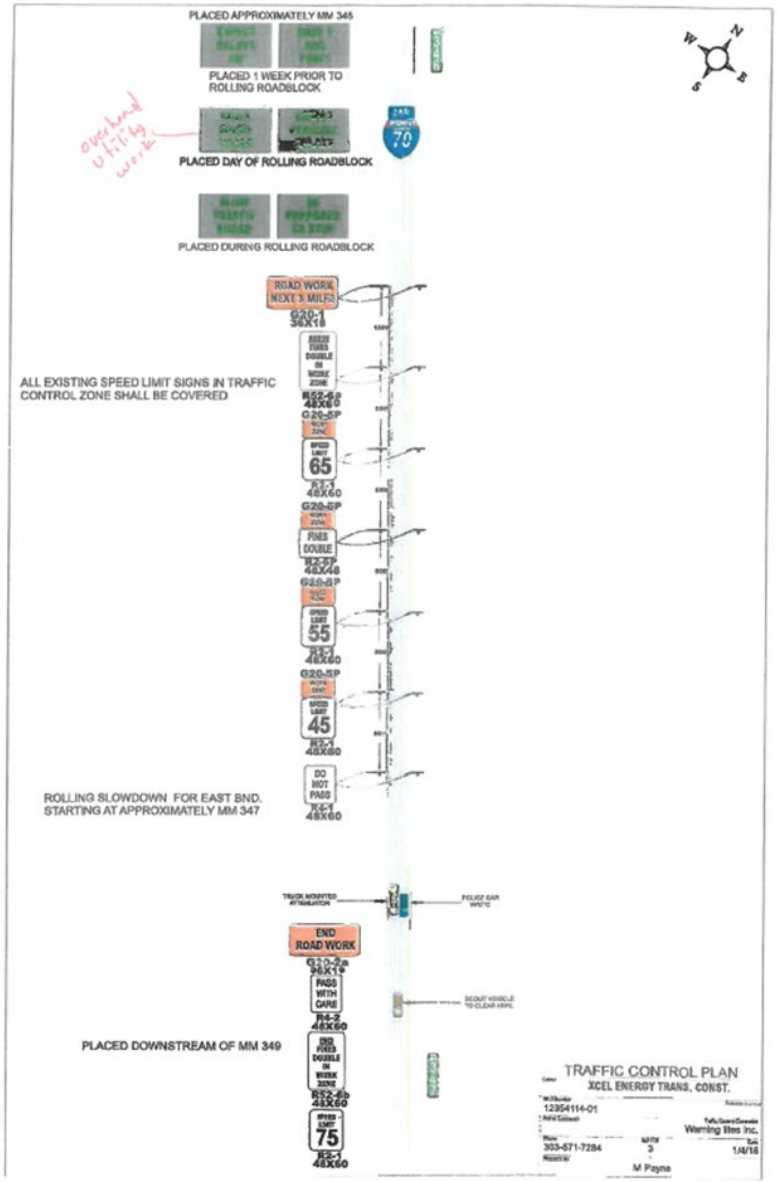
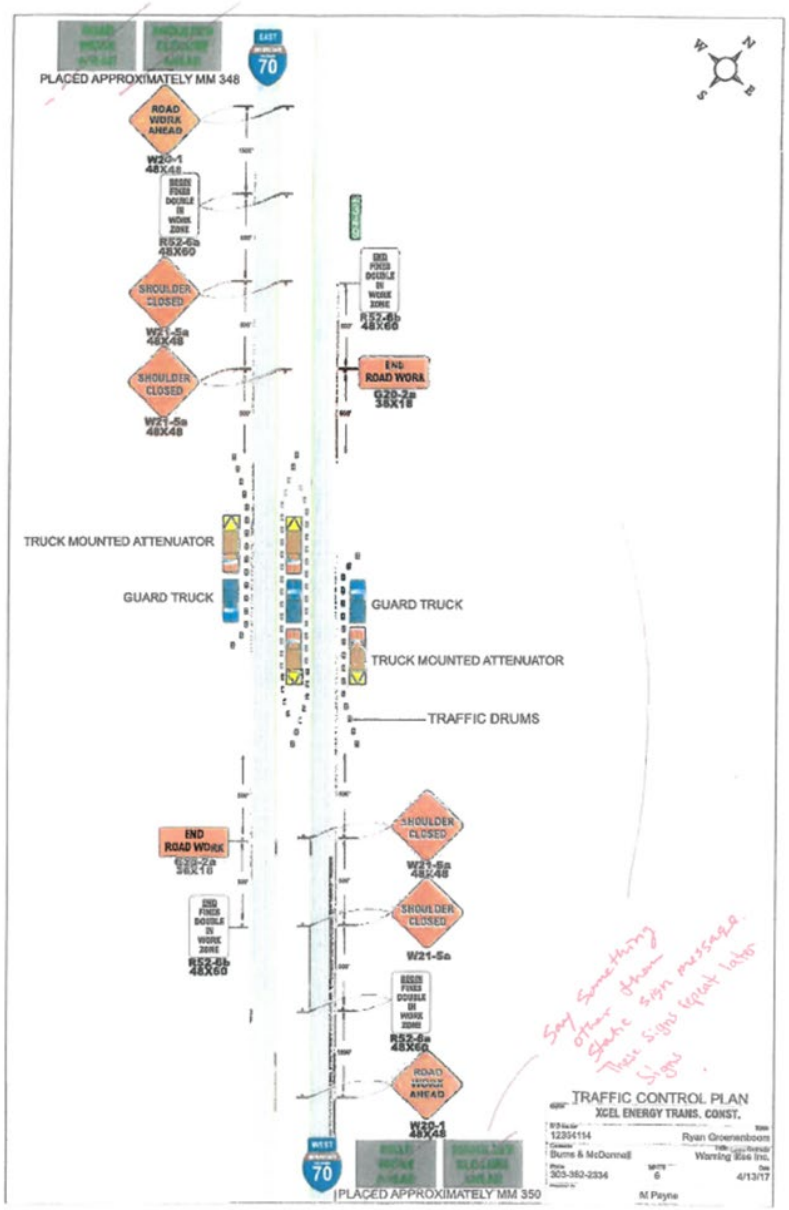

SPEED LIMIT 75
R2-1 48X60
END PASS DOUBLE IN WORK ZONE
R2-5bp 48X60
PASS WITH CARE
R4-3 48X60
END ROAD WORK
G20-2a 36X18
PLACED DOWNSTREAM OF MM 349
ROLLING SLOWDOWN FOR WEST BND. STARTING AT APPROXIMATELY MM 352
70
ROAD WORK AHEAD
W20-1 48X48
DO NOT PASS
R4-1 48X60
G20-5P
EXIT 353
SPEED LIMIT 45
R2-1 48X60
G20-5P
SPEED LIMIT 55
R2-1 48X60
G20-5P
PASS DOUBLE
R2-5P 48X48
G20-5P
SPEED LIMIT 65
R2-1 48X60
PASS DOUBLE IN WORK ZONE
R2-5bp 48X60
ROAD WORK NEXT 4 MILES
G20-1 36X18
ALL EXISTING SPEED LIMIT SIGNS IN TRAFFIC CONTROL ZONE SHALL BE COVERED
PLACED APPROXIMATELY MM 353
PLACED 1 WEEK PRIOR TO ROLLING ROADBLOCK
PLACED DAY OF ROLLING ROADBLOCK
PLACED DURING ROLLING ROADBLOCK
TRAFFIC CONTROL PLAN
XCEL ENERGY TRANS. CONST.
123541114-01
Warning Illss Inc.
303-571-7284
1/3/18
M Payne


STOPPED
TRAFFIC
2 MILES


PLACED APPROXIMATELY MM 345
PLACED 1 WEEK PRIOR TO ROLLING ROADBLOCK
overhead utility work
PLACED DAY OF ROLLING ROADBLOCK
PLACED DURING ROLLING ROADBLOCK
ROAD WORK NEXT 3 MILES
G20-1 36X18
ALL EXISTING SPEED LIMIT SIGNS IN TRAFFIC CONTROL ZONE SHALL BE COVERED
R52-6P 48X60
G20-5P
SPEED LIMIT 65
R2-1 48X60
FINES DOUBLE
R2-5P 48X48
SPEED LIMIT 55
SPEED LIMIT 45
DO NOT PASS
R5-1 48X60
ROLLING SLOWDOWN FOR EAST BND. STARTING AT APPROXIMATELY MM 347
TRUCK MOUNTED ATTENUATOR
POLICE CAR W/STO
END ROAD WORK
G10-2a 36X18
PASS WITH CARE
R2-2 48X60
PLACED DOWNSTREAM OF MM 349
SCOUT VEHICLE TO CLEAR HWY.
SPEED LIMIT 75
TRAFFIC CONTROL PLAN
XCEL ENERGY TRANS. CONST.
12354114-01
Warning Sites Inc.
303-671-7284
3
1/4/18
M Payne


STOPPED
TRAFFIC
2 MILES


PLACED APPROXIMATELY MM 348
EAST
70
ROAD WORK AHEAD
W20-1
48X48
BEGIN FINES DOUBLE IN WORK ZONE
R52-8a
48X60
SHOULDER CLOSED
W21-5a
48X48
SHOULDER CLOSED
W21-5a
48X48
END FINES DOUBLE IN WORK ZONE
R52-8b
48X60
END ROAD WORK
G20-2a
36X18
TRUCK MOUNTED ATTENUATOR
GUARD TRUCK
GUARD TRUCK
TRUCK MOUNTED ATTENUATOR
TRAFFIC DRUMS
END ROAD WORK
G20-2a
36X18
END FINES DOUBLE IN WORK ZONE
R52-8b
48X60
SHOULDER CLOSED
W21-5a
48X48
SHOULDER CLOSED
W21-5a
BEGIN FINES DOUBLE IN WORK ZONE
R52-8a
48X60
ROAD WORK AHEAD
W20-1
48X48
WEST
70
PLACED APPROXIMATELY MM 350
Say something other than these signs are saying
Signs
TRAFFIC CONTROL PLAN
XCEL ENERGY TRANS. CONST.
12304114
Ryan Groenenboom
Burns & McDonnell
Warning Elec Inc.
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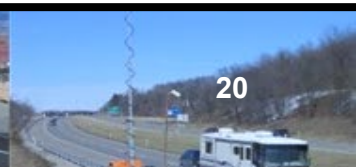
STOPPED
TRAFFIC
2 MILES



Colorado Contact

Larry Haas

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Traffic Operations Engineer

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Missouri Department of Transportation Traffic Pacing Worksheet

Dan Smith – Traffic Management and Operations Engineer

Traffic Pacing/Rolling Roadblock

- Before 2013, Missouri DOT did not have traffic pacing guidelines.
- MoDOT's Southwest District reviewed several states guidance for traffic pacing.
- Florida DOT had design standards for traffic pacing.
- MoDOT Southwest District developed an excel spreadsheet to calculate the pacing speed, pacing length, max. queue, total work time allowed, and hours allowed to work.

Innovations Showcase

2012-13 District Winner
PrOMo Challenge
http://wwwi/intranet/cr/SolutionsAtWork/Innovations.htm

April 2013
Prepared by Customer Relations
Missouri Department of Transportation

Traffic Pacing Guidelines

Hour	AM Traffic Volume	Hour	PM Traffic Volume
24 - 1	261	12 - 13	755
1 - 2	208	13 - 14	832
2 - 3	160	14 - 15	930
3 - 4	184	15 - 16	915
4 - 5	202	16 - 17	948
5 - 6	324	17 - 18	938
6 - 7	428	18 - 19	677
7 - 8	535	19 - 20	541
8 - 9	637	20 - 21	572
9 - 10	725	21 - 22	521
10 - 11	812	22 - 23	370
11 - 12	773	23 - 24	347

Description

This process was developed to effectively evaluate whether a Traffic Pacing operation should be allowed; if so, when it can be allowed. It also will tell you the length of the queue that will develop and where the Traffic Pacing operation should begin to allow for the short amount of time needed to do the work without having traffic congestion time.

Benefits

Efficiency: This process quickly lets you know whether Traffic Pacing is an acceptable alternative to a full road closure. When and where practical, there can be substantial savings in both time and money for a contractor or MoDOT to utilize the Traffic Pacing process.

Cost: N/A

Quality: Since MoDOT currently has no policy or guidance on Traffic Pacing, this process provides for an enormous improvement in the quality of an existing process. Furthermore, the process only takes about a half hour to accomplish so long as Hourly Traffic Volumes are available.

Organizational Impact: There is a need to do all work zone activities in a safe and timely manner while minimizing the delay to the traveling public. This process allows MoDOT to better manage and/or operate Traffic Pacing in a safe and efficient manner for both the traveling public and for the service provider.

Safety: This process has been utilized by a Utility Company to safely manage a major power line crossing over IS 44. The process ensured that all access points were covered properly, appropriate advance warning was provided to the traveling public, and all traffic control personnel were in constant contact with each other to ensure the process was a success.

Environmental: There are no negative environmental impacts with this innovation.

Team Member

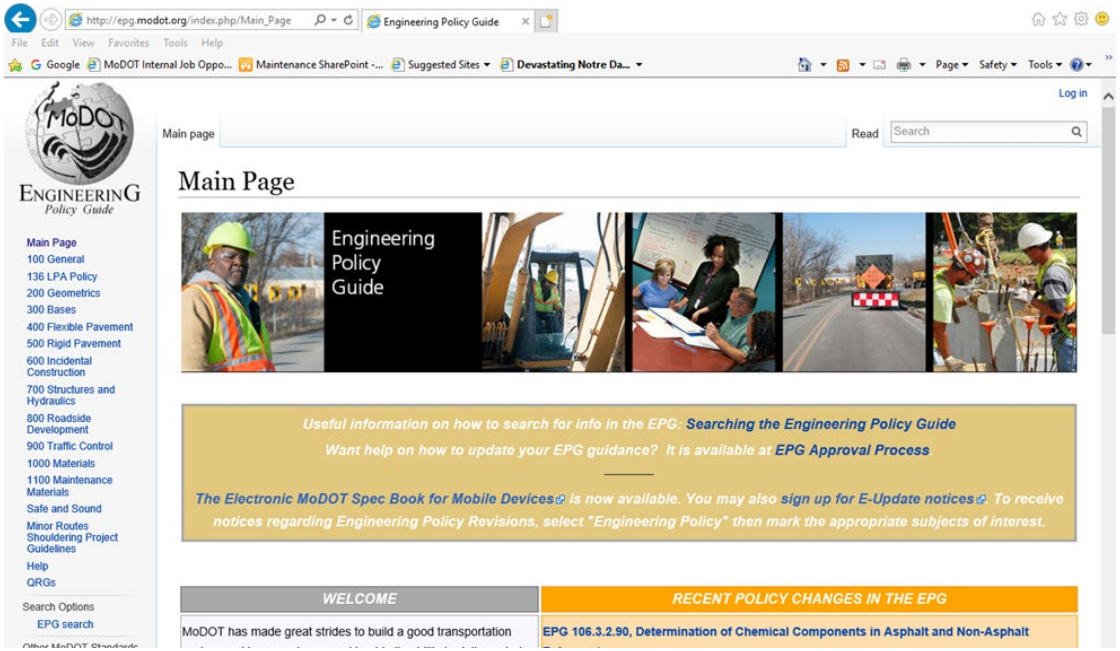
Joe Rickman

For More Information

Contact: Joe Rickman at (417) 895-7635

Additional photos can be seen by accessing the Innovations Challenge homepage at http://wwwi/intranet/cr/SolutionsAtWork/Innovations.htm

Locating Traffic Pacing Worksheet

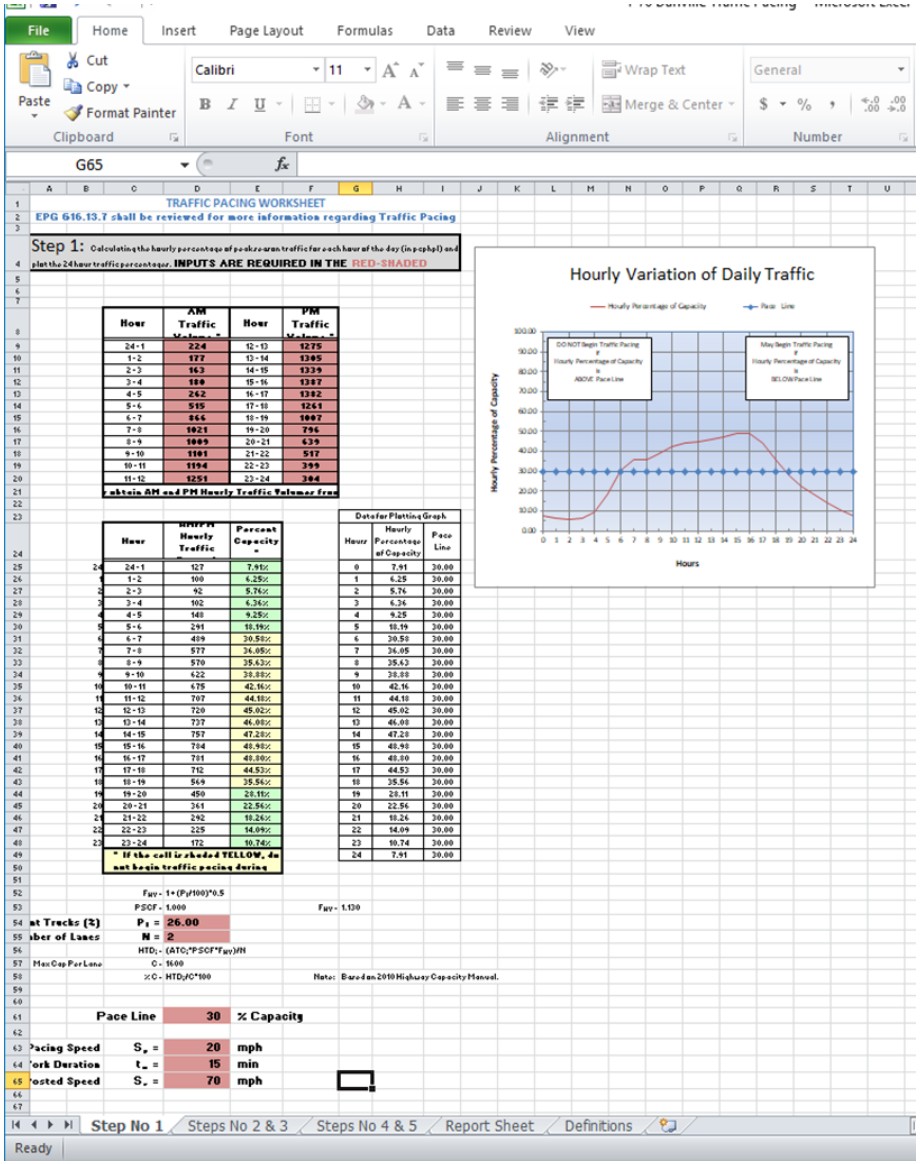


616.13 Work Zone Capacity, Queue and Travel Delay

616.13.7 Traffic Pacing

http://epg.modot.org/index.php/616.13_Work_Zone_Capacity,_Queue_and_Travel_Delay

Step No 1



TRAFFIC PACING WORKSHEET

EPG 616.13.7 shall be reviewed for more information regarding Traffic Pacing

Step 1: Calculating the hourly percentage of peak 2-way traffic for each hour of the day (in pc/hr/l) and plot the 24 hour traffic percentage. **INPUTS ARE REQUIRED IN THE RED-SHADED**

Hour	AM Traffic Volume *	Hour	PM Traffic Volume *
24 - 1	224	12 - 13	1275
1 - 2	177	13 - 14	1305
2 - 3	163	14 - 15	1339
3 - 4	180	15 - 16	1387
4 - 5	262	16 - 17	1382
5 - 6	515	17 - 18	1261
6 - 7	866	18 - 19	1007
7 - 8	1021	19 - 20	796
8 - 9	1009	20 - 21	639
9 - 10	1101	21 - 22	517
10 - 11	1194	22 - 23	399
11 - 12	1251	23 - 24	304

Obtain AM and PM Hourly Traffic Volumes from

Hour	AM/PM Hourly Traffic *	Percent Capacity *
24 - 1	127	7.91%
1 - 2	100	6.25%
2 - 3	92	5.76%
3 - 4	102	6.36%
4 - 5	148	9.25%
5 - 6	291	18.19%
6 - 7	489	30.58%
7 - 8	577	36.05%
8 - 9	570	35.62%
9 - 10	622	38.88%
10 - 11	675	42.16%
11 - 12	707	44.18%
12 - 13	720	45.02%
13 - 14	737	46.08%
14 - 15	757	47.28%
15 - 16	784	48.98%
16 - 17	781	48.80%
17 - 18	712	44.53%
18 - 19	569	35.56%
19 - 20	450	28.11%
20 - 21	361	22.56%
21 - 22	292	18.26%
22 - 23	225	14.09%
23 - 24	172	10.74%

* If the cell is shaded YELLOW, do not begin traffic pacing during

Data for Plotting Graph

Hours	Hourly Percentage of Capacity	Pace Line
0	7.91	30.00
1	6.25	30.00
2	5.76	30.00
3	6.36	30.00
4	9.25	30.00
5	18.19	30.00
6	30.58	30.00
7	36.05	30.00
8	35.62	30.00
9	38.88	30.00
10	42.16	30.00
11	44.18	30.00
12	45.02	30.00
13	46.08	30.00
14	47.28	30.00
15	48.98	30.00
16	48.80	30.00
17	44.53	30.00
18	35.56	30.00
19	28.11	30.00
20	22.56	30.00
21	18.26	30.00
22	14.09	30.00
23	10.74	30.00
24	7.91	30.00

Hourly Variation of Daily Traffic

Hourly Percentage of Capacity — Pace Line

DO NOT Begin Traffic Pacing if Hourly Percentage of Capacity is ABOVE Pace Line

May Begin Traffic Pacing if Hourly Percentage of Capacity is BELOW Pace Line

Hourly Percentage of Capacity

Hours

$F_{HV} = 1 + (P_T/100)*0.5$

PSCF = 1.000

F_{HV} = 1.130

Percent Trucks (%) P_T = 26.00

Number of Lanes N = 2

$HTD_i = (ATC_i * PSCF * F_{HV})/N$

Max Cap Per Lane C = 1600

$\%C = HTD_i/C*100$

Note: Based on 2010 Highway Capacity Manual.

Pace Line		30	% Capacity
Pacing Speed	S_p =	20	mph
Work Duration	t_w =	15	min
Posted Speed	S_s =	70	mph

Step No 1 | Steps No 2 & 3 | Steps No 4 & 5 | Report Sheet | Definitions

Ready

I8

TRAFFIC PACING WORKSHEET

EPG 616.13.7 shall be reviewed for more information regarding Traffic Pacing

Step 1: Calculating the hourly percentage of peak season traffic for each hour of the day (in pcphpl) and plot the 24 hour traffic percentages. **INPUTS ARE REQUIRED IN THE RED-**

Hour	AM Traffic Volume -	Hour	PM Traffic Volume -
24 - 1	224	12 - 13	1275
1 - 2	177	13 - 14	1305
2 - 3	163	14 - 15	1339
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11 - 12	1251	23 - 24	304

obtain AM and PM Hourly Traffic Volumes fro

	Hour	AM/PM Hourly Traffic Demand	Percent Capacity *
24	24 - 1	127	7.91%
1	1 - 2	100	6.25%
2	2 - 3	92	5.76%
3	3 - 4	102	6.36%
4	4 - 5	148	9.25%
5	5 - 6	291	18.19%
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14	47.28	30.00
15	48.98	30.00
16	48.80	30.00
17	44.53	30.00
18	35.56	30.00
19	28.11	30.00
20	22.56	30.00
21	18.26	30.00
22	14.09	30.00
23	10.74	30.00
24	7.91	30.00

F_{HV} = $1+(P_t/100)*0.5$

PSCF = 1.000

F_{HV} = 1.130

Percent Trucks (%)	P_t =	26.00
Number of Lanes	N =	2
	HTD_i =	$(ATC_i*PSCF*F_{HV})/N$
Max Cap Per Lane	C =	1600
	% C =	$HTD_i/C*100$

Note: Based on 2010 Highway Capacity Manual.

	Pace Line	30	% Capacity
Pacing Speed	S_p =	20	mph
Work Duration	t_w =	15	min
Posted Speed	S_r =	70	mph

		F_{HV} =	$1 + (P_t/100)*0.5$		
		PSCF =	1.000	F_{HV} =	1.130
Percent Trucks (%)		**P_t =**	**26.00**		
Number of Lanes		**N =**	**2**		
		HTD_i =	$(ATC_i*PSCF*F_{HV})/N$		
Max Cap Per Lane		C =	1600		
		% C =	$HTD_i/C*100$	Note:	Based on 2010 Highway Capacity Manual.
	Pace Line		**30**	**% Capacity**	
Pacing Speed	**S_p =**		**20**	**mph**	
Work Duration	**t_w =**		**15**	**min**	
Posted Speed	**S_r =**		**70**	**mph**	

	Hour	AM/PM Hourly Traffic Demand	Percent Capacity *
24	24 - 1	127	7.91%
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* If the cell is shaded YELLOW, do not begin traffic pacing during this time

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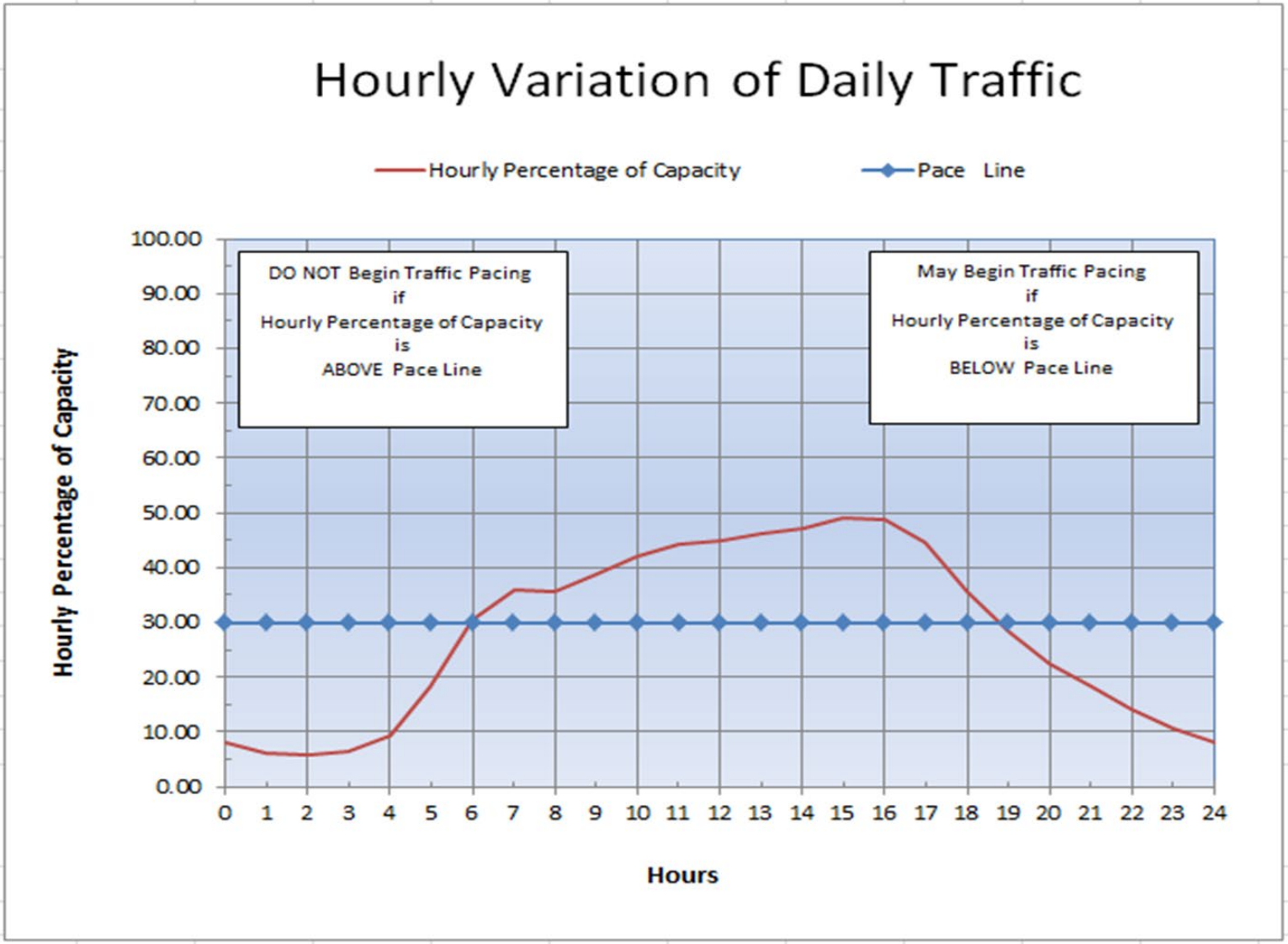
17	44.53	30.00
18	35.56	30.00
19	28.11	30.00
20	22.56	30.00
21	18.26	30.00
22	14.09	30.00
23	10.74	30.00
24	7.91	30.00


Hourly Variation of Daily Traffic
Hourly Percentage of Capacity
Pace Line
DO NOT Begin Traffic Pacing if Hourly Percentage of Capacity is ABOVE Pace Line
May Begin Traffic Pacing if Hourly Percentage of Capacity is BELOW Pace Line
Hourly Percentage of Capacity
100.00
90.00
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
Hours


STOPPED
TRAFFIC
2 MILES

Step 2: Calculating the pacing length, L (Distance measured from the beginning of the work area to where the traffic pacing operation would begin upstream) - **NO INPUTS REQUIRED ON THIS STEP**

$L = S_p(t_w/60)(S_p/(S_r-S_p)+1)$ **L = 7.00 miles**

Step 3: Calculating the Maximum Queue Length, Qmax - **NO INPUTS REQUIRED ON THIS STEP**

$FLOW_A$ =	HTD =	450	*(Highest AM/PM Hourly Travel Demand that is below the Pace Line)*	
$DENSITY_A$ =	$FLOW_A/S_r$ =	6.42	pc/mi/l	
$FLOW_B$ =	1240	pcphpl	(capacity based on MoDOT's Work Zone Guidelines)	
$DENSITY_B$ =	$FLOW_B/S_p$ =	62.00	pc/mi/l	
SW_A =	$(FLOW_B - FLOW_A)/(DENSITY_B - DENSITY_A)$ =		14.22	mph
QGR =	$S_p - SW_A$ =	5.78	mph	
Q_{max} =	**QGR (L/S_p) =**	**2.02**	**miles**	

Step 4: Calculating the Time to Dissipate the Queue, T_D - **NO INPUTS REQUIRED ON THIS STEP**

$FLOW_C$ =	1600	pcphpl (based on 2010 Highway Capacity Manual)						
$DENSITY_C$ =	$(FLOW_C/S_c)$ where:	S_c =	53	mph (for 70 mph regulatory speed limit)		S_c =	53	mph
		S_c =	50	mph (for 50 - 65 mph regulatory speed limi		$DENSITY_C$ =	30	pc/mile
SW_B =	$(FLOW_C - FLOW_B)/(DENSITY_C - DENSITY_B)$ =	-11.32	mph					
QDR =	$SW_A - SW_B$ =	25.54	mph					
T_D =	**$(Q_{max}/QDR)*60$ =**	**4.75**	**min**					

Step 5: Calculating the Total Time to Conduct the Pacing Operation, T_{total} - **NO INPUTS REQUIRED ON THIS STEP**

T_{total} =	**$(L/S_p)*60 + T_D$ =**	**25.75**	**min**

Traffic Pacing Report

PROJECT LOCATION & DESCRIPTION:

Date of Operation: **Notes:**

eport completed by:

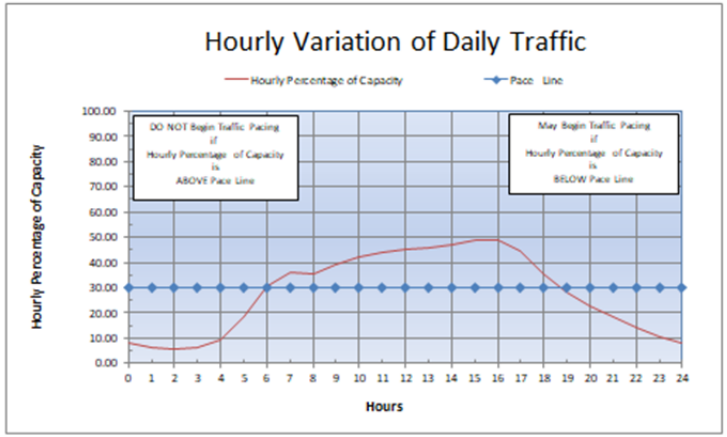
Regulatory Speed	70	mph
Pacing Speed	20	mph
Work Duration	15	min
Pacing Length	7.00	miles
Queue Max	2.02	miles
Dissipation Time	4.75	min
Total Time to conduct Pacing	25.75	min

Number of Lanes	2
Percent Trucks	26.00 %

Traffic Demand

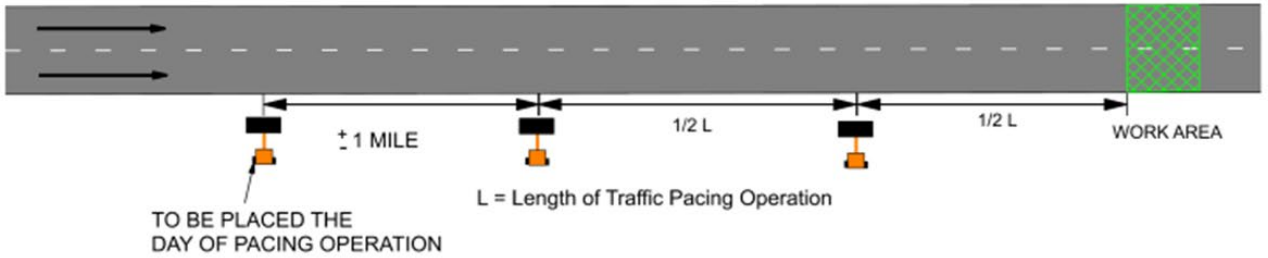
Hour	AM Hourly Traffic	Percent Capacity *	Hour	PM Hourly Traffic	Percent Capacity *
24 - 1	127	7.9%	12 - 13	720	45.0%
1 - 2	100	6.3%	13 - 14	737	46.1%
2 - 3	92	5.8%	14 - 15	757	47.3%
3 - 4	102	6.4%	15 - 16	784	49.0%
4 - 5	148	9.3%	16 - 17	781	48.8%
5 - 6	291	18.2%	17 - 18	712	44.5%
6 - 7	489	30.6%	18 - 19	569	35.6%
7 - 8	577	36.1%	19 - 20	450	28.1%
8 - 9	570	35.6%	20 - 21	361	22.6%
9 - 10	622	38.9%	21 - 22	292	18.3%
10 - 11	675	42.2%	22 - 23	225	14.1%
11 - 12	707	44.2%	23 - 24	172	10.7%

*** If the cell is shaded YELLOW, do not begin pacing operation during this time**



DEFINITIONS	
ATC	Actual Traffic Counts. Hourly traffic volumes for a 24 hour period are needed.
C	Capacity. The capacity of the roadway under free flow conditions in passenger cars per hour per lane.
$DENSITY_A$	Free Flow Density in vehicles per mile. The traffic density under free flow conditions.
$DENSITY_B$	Forced Flow Density in vehicles per mile. The traffic density under forced flow conditions.
$DENSITY_C$	Congested Flow Density in vehicles per mile. The traffic density under congested flow conditions.
F_{HV}	Heavy-vehicle adjustment factor. This factor is used to convert hourly traffic to equivalent passenger cars. Heavy vehicles include trucks, busses and recreational vehicles.
$FLOW_A$	Traffic Demand Flow Rate in passenger cars per hour per lane. This is the traffic flow rate approaching the pacing operation from the upstream direction.
$FLOW_B$	Forced Traffic Flow Rate in passenger cars per hour per lane. This is the traffic flow rate within the queue.
$FLOW_C$	Congested Traffic Flow Rate in passenger cars per hour per lane. This is the traffic flow rate of the vehicles escaping the queue.
HTD	Hourly Traffic Demand in vehicles / hour.
L	Total Pacing Distance in miles. This is the total distance that the pacing vehicles are traveling at the pacing speed. It includes the distance required to clear traffic past the work area, and the distance required to provide the work duration. This distance is measured upstream from the work area.
N	Number of Lanes
PSCF	Peak Season Conversion Factor.
P_t	Percent Trucks (%).
QDR	Queue Dissipation Rate in MPH. The rate that the queue dissipates after the pace cars exit the roadway.
QGR	Queue Growth Rate in MPH. The rate that the queue grows from the time the pacing operation begins until the pace cars exit the roadway.
Q_{max}	The maximum queue length. The maximum queue length occurs when the pacing vehicles reach the work zone.
S_C	The average speed of passenger cars when the roadway reaches capacity.
S_p	Pacing Speed in MPH. This is the speed that the pacing vehicles travel.
S_r	Regulatory Speed in MPH. This is the posted speed on the roadway segment.
SW_A	Speed of Shockwave 'A' in MPH. The speed of the shockwave at the boundary between traffic '$FLOW_A$' and traffic '$FLOW_B$'.
SW_B	Speed of Shockwave 'B' in MPH. The speed of the shockwave at the boundary between traffic '$FLOW_B$' and traffic '$FLOW_C$'.
T_D	Time to dissipate the queue in minutes. T_D is the amount of time beginning at the point when the pacing vehicles leave the roadway until the traffic returns to normal operating conditions.
T_{total}	Total time to conduct the pacing operation. The time from when the pace cars enter the roadway until the queue has dissipated and normal traffic flow is restored.
t_w	Work Duration in minutes. This is the work time allotted for overhead construction.

TRAFFIC PACING
CHANGEABLE MESSAGE SIGNS
(Typical Placement and Messages)



CHANGEABLE MESSAGE SIGN MESSAGE
(MAINLINE AND RAMPS)

ONE WEEK PRIOR TO PACING OPERATION

EXPECT	MMM
DELAYS	DD-DD
ON	X AM - X - AM

DURING DAY OF PACING OPERATION

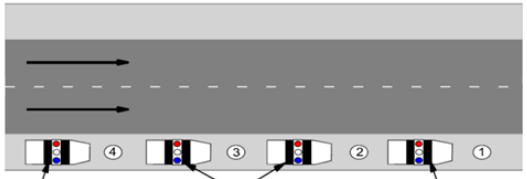
ROAD	EXPECT
WORK	PERIODIC
TONIGHT	DELAYS

DURING PACING OPERATION

SLOW	BE
TRAFFIC	PREPARED
AHEAD	TO STOP

TRAFFIC PACING
MAINLINE PACING DETAILS
(1 DIRECTION OF FOUR LANE ROADWAY EXAMPLE)

STAGE ONE



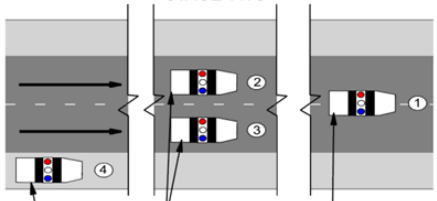
Police Vehicle Located On Shoulder At Beginning Of Pacing Operation

Pace Setting Police Vehicles

Lead Police Vehicle

Four police vehicles located upstream of the work area at the beginning location of the traffic pacing operation with flashing blue lights off.

STAGE TWO



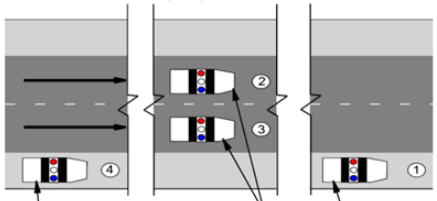
Police Vehicle Located On Shoulder At Beginning Of Pacing Operation

Pace Setting Police Vehicles

Lead Police Vehicle (Flashing Blue Lights Off) At The End Of Regular Traffic

Once the police vehicles are in place and the traffic control officer supervisor at the work area notifies all officers to begin the traffic pacing operation, the last three police vehicles shall turn on their flashing blue lights. The first three police vehicles shall enter the travel lanes with the second and third police vehicles immediately forming a side by side "pacing operation" of all lanes behind the lead police vehicle (flashing blue light off).

STAGE THREE



Police Vehicle Located On Shoulder At Beginning Of Pacing Operation

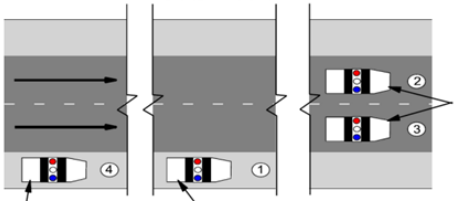
Pace Setting Police Vehicles

Lead Police Vehicle Located Approx. 500' Before Work Area On Shoulder

The two pace setting police vehicles shall begin to slow to the pacing speed , for the duration of the traffic pacing operation.

The lead police vehicle (flashing blue lights off) shall match the speed of the last vehicles ahead of the pacing vehicles and continue following traffic until a point approximately 500' in advance of the work area. The lead police vehicle shall then come to a complete stop on the right shoulder and turn on its flashing blue lights. If required, crash truck(s) with rear mounted impact attenuator(s) and changeable message sign(s) shall move into the travel lanes approximately 200 ft. upstream of the work area with the impact attenuators down and operating once traffic has cleared the work area.

STAGE FOUR



Police Vehicle Located On Shoulder At Beginning Of Pacing Operation

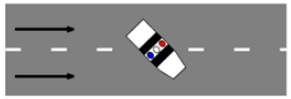
Lead Police Vehicle Located Approx. 500' Before Work Area On Shoulder

Pace Setting Police Vehicles

When the pace setting police vehicles are within approximately two miles of the work area they shall notify the onsite traffic control officer supervisor who will immediately inform the contractor's on site supervisor of the pacing vehicles location.
The contractor shall begin to clear the travel lanes of all equipment and debris in order to reopen all travel lanes.

In case of emergency the pace setting police vehicles shall come to a compete stop once they reach they reach the lead police vehicle. If no emergency is encountered, the crash trucks(s) shall be moved from the travel lanes and the two pace setting police vehicles shall clear the work area and immediately move to the right shoulder or an area designated by the traffic control officer supervisor and turn off the flashing blue lights. Once the two pace setting police vehicles pass the work area, the traffic control officer supervisor shall instruct the lead and last police vehicles to turn off their flashing blue lights.

ONE LANE RAMP



TWO LANE RAMP

Once notified by the on site traffic control officer supervisor to begin the traffic pacing operation each police vehicle at the indicated ramp shall turn their flashing blue lights on and position the vehicle across the ramp lanes(s) to close ramp access.

Once the pacing operation passes the closed on ramp the police vehicle on the ramp shall turn off the flashing blue lights and move from the ramp lane(s) to allow traffic to enter the mainline pacing operation.

Traffic Pacing

- Traffic pacing worksheet provides information (work duration, pacing speed, work hours, etc.) to develop an operation plan.

- MoDOT districts work with many partners (newspapers, radio, contractor, utilities, law enforcement, etc.) to prepare for traffic pacing operation.

- Communication and coordination is critical.

Missouri Contacts

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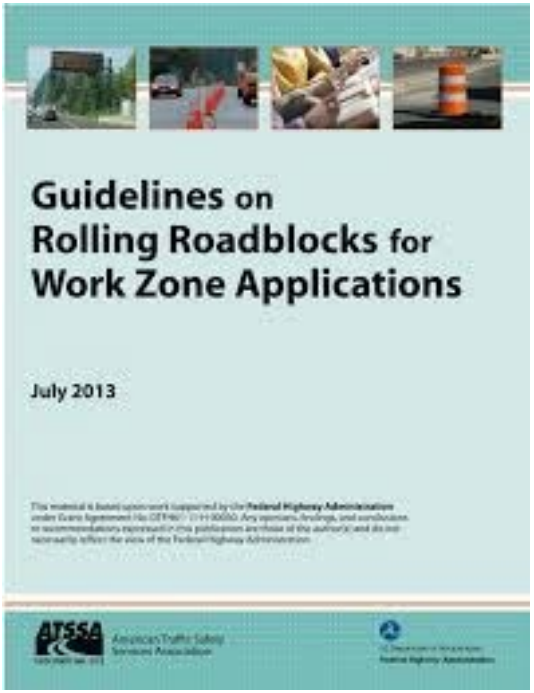
Additional Information and Resources

Guidelines on Rolling Roadblocks for Work Zone Applications

- Establishes best practices in the use of rolling roadblocks:
  - Planning and coordinating a rolling roadblock.
  - Executing a rolling roadblock.
  - Developing a rolling roadblock planning checklist.



https://www.workzonesafety.org

Additional Resources

- Information on available rolling roadblock training course and other resources: https://www.workzonesafety.org
- Information on the FHWA Work Zone Safety and Mobility Rule established under 23 CFR 630 Subpart J: https://ops.fhwa.dot.gov/wz/resources/final_rule.htm
- Additional resources on work zone management and improving work zone safety and mobility through FHWA's Work Zone Management Program: https://ops.fhwa.dot.gov/wz

Additional Resources (Continued)

- Safely Implementing Rolling Roadblocks for Short-term Highway Construction, Maintenance, and Utility Work Zones
  https://ops.fhwa.dot.gov/publications/fhwahop19031/index.htm

- Memo: Guidance on Rolling Roadblock Operations
  https://ops.fhwa.dot.gov/memorandum/rollingblockguide/

Contacts

- State DOTs are encouraged to contact their local FHWA Division Office.

- Also contact:

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Work Zone Management Program
Jawad.Paracha@dot.gov

Questions?