DelDOT
Delaware Department of Transportation

Timesheet Template v3.1.xlsm

Timesheet Notes v3.1.xlsx

Timesheet Training

Version 3.1 Update

March 2022

WRA

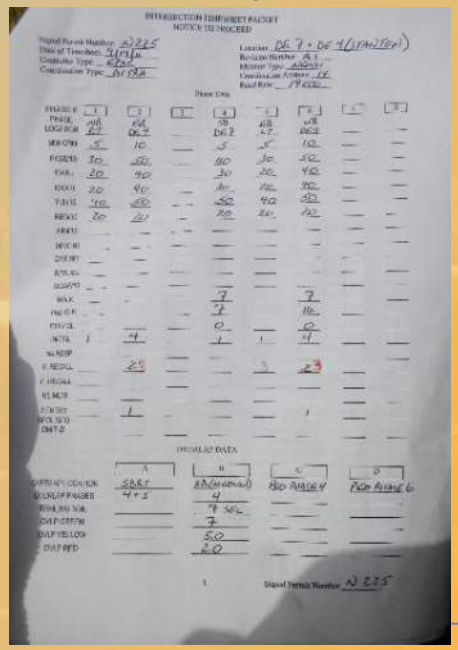
Outline

- Engineering Calcs & Revision Package
  - Current Timesheet / Timings
  - Field Info – Speed Limits, Grades, Crosswalks
  - Turning Paths (W & D) for Red Clearance Calcs
- DelDOT Timesheets for Controller Entry
  - Siemens m60 Series Advanced Traffic Controller
  - Intersection Information and Notes
  - Basic Timing Parameters
  - Preempt & Priority Operation
  - Flashing Red Arrow
- Signal Timing Quick Introduction
  - CMS Analysis
  - MAX Timers

Field Work

- Approach Grades
  - Measure maximum approach downgrade within AASHTO stopping sight distance
  - Only downgrades should be used in yellow interval calculation

- Speed Limit Sign Photos
  - Clear photos showing all approach speed limit sign with location context
  - Photograph the closest sign to the intersection (still on approach)
  - If no sign is posted, typically assume 25 MPH (50 MPH on some unposted rural roads)



- Crosswalk Distances
  - Measure the distance from truncated domes to truncated domes for each crosswalk (or edge of curb if no domes)

- Existing Timings
  - via TMC
    - Existing timesheet (EOPS or scan)
    - Vehicle/Ped basic data from Tactics (if possible)

Timesheet Calculations

SIGNAL TIMESHEET CALCULATIONS

Signal Permit Number:	N999	On System?	☑ Yes ☐ No
Location:	DE 99 @ Main St		
Performed by:	A. Designer	Date:	10/1/2019
Checked by:	A. Manager	Date:	10/5/2019

Major Street Left-Turn Phases	Ø 1 WB L	Ø 5 EB L
Existing Yellow Time (if applicable)	4.0 sec	4.0 sec
YEL/10	60	60
W = intersection width to conflict point (ft), clearing vehicle	83 ft	90 ft
D = conflict distance (ft), entering vehicle	57 ft	51 ft
Red Time (Calculated) R = W/(1.47*20) - 0.283*SQRT(D)	0.7 sec	1.0 sec
Red Time (Implemented)	2.0 sec	2.0 sec
RED/10	20	20

Major Street Through Phases	Ø 2 EB	Ø 6 WB
Existing Yellow Time (if applicable)	6.0 sec	6.0 sec
Approach speed limit (mph)	55 mph	55 mph
Approach Grade (+ for upgrade; - for downgrade)	0.0 %	-1.3 %
Yellow Time (Calculated) Y = 1.2 + V/2(a±Gg) V = Speed Limit + 7	5.3 sec	5.4 sec
Yellow Time (Implemented)	6.0 sec	6.0 sec
YEL/10	60	60
W = intersection width to conflict point (ft), clearing vehicle	78 ft	66 ft
D = conflict distance (ft), entering vehicle	29 ft	38 ft
10th-Percentile Speed (mph) *If W is left-turn path, enter "L"*	47 mph	47 mph
Red Time (Calculated) R = W/(1.47*S_{10}) - 0.283*SQRT(D)	-0.4 sec	-0.8 sec
Red Time (Implemented)	2.0 sec	2.0 sec
RED/10	20	20

Minor Street Left-Turn Phases	Ø	Ø
Existing Yellow Time (if applicable)	sec	sec
YEL/10		
W = intersection width to conflict point (ft), clearing vehicle	ft	ft
D = conflict distance (ft), entering vehicle	ft	ft
Red Time (Calculated) R = W/(1.47*20) - 0.283*SQRT(D)		
Red Time (Implemented)		
RED/10		

Minor Street Through Phases	Ø 3 NB	Ø 4 SB
Existing Yellow Time (if applicable)	4.0 sec	5.0 sec
Approach speed limit (mph)	25 mph	50 mph
Approach Grade (+ for upgrade; - for downgrade)	-3.6 %	0.0 %
Yellow Time (Calculated) Y = 1.2 + V/2(a±Gg) V = Speed Limit + 7	3.5 sec	4.9 sec
Yellow Time (Implemented)	4.0 sec	5.0 sec
YEL/10	40	50
W = intersection width to conflict point (ft), clearing vehicle	117 ft	98 ft
D = conflict distance (ft), entering vehicle	49 ft	51 ft
10th-Percentile Speed (mph) *If W is left-turn path, enter "L"*	25 mph	L 20 mph
Red Time (Calculated) R = W/(1.47*S_{10}) - 0.283*SQRT(D)	1.2 sec	1.3 sec
Red Time (Implemented)	2.0 sec	2.0 sec
RED/10	20	20

- Signal permit number
- On system: yes
- Location: "official" DelDOT signal name, typically from existing timesheet and typically not changed
- Your name and the reviewer's name

- Phase numbers and movements of each active phase
- Existing yellow times: of the existing *movement* (i.e., if phasing is changing)
- Approach speed limits
- Approach grade: Input to nearest 0.1 if negative, 0 if positive (positive grades can be entered but will not impact calculated yellow times
- W and D for each phase (indicate if W is a left-turn)

Timesheet Calculations

DelDOT

SIGNAL TIMESHEET CALCULATIONS

Signal Permit Number: K999 On System? ☑ Yes ☐ No

Location: DE 99 @ Main St

Passage Time and Volume Density Calculations	Ø 2	EB	Ø 6	WB
Distace from loop detector to stop line		ft		ft
Approach speed limit (mph)				
Passage Time (calculated)				
PASS/10				
MIN GRN (Minimum Green Time) *Input value to calculate MAX INI/AINI*		sec		sec
Max. vehicles (L=20') queued between stop line and loop detector				
MAX INI (Maximum Initial Green Time)				
Veh served by MIN GRN				
Remaining number of vehicles to be served				
AINI/10 (Added Initial Green Time)				

Ped Clearance Times Calculations	Ø 2	EB	Ø 6	WB
Ped Crosswalk Length (measured from curb to curb)		60 ft		61 ft
Ped walking speed (Typ. = 3.5 ft/sec)		3.5 ft/sec		3.5 ft/sec
Yellow Change Interval		5.0 sec		5.0 sec
Red Clearance Interval		2.0 sec		2.0 sec
EXT PCL - Fl. Don't Walk ends at: begin Y (0), end AR (1), end Y (2)		0		0
WALK Time		7 sec		7 sec
Pedestrian Clearance Time Required (dist/speed)		18 sec		18 sec

	Ø 3	NB	Ø 4	SB
Ped Crosswalk Length (measured from curb to curb)		ft		75 ft
Ped walking speed (Typ. = 3.5 ft/sec)				3.5 ft/sec
Yellow Change Interval				5.0 sec
Red Clearance Interval				2.0 sec
EXT PCL - Fl. Don't Walk ends at: begin Y (0), end AR (1), end Y (2)				0
WALK Time				7 sec
Pedestrian Clearance Time Required (dist/speed)				22 sec

Notes:

Ped clearance (PED CLR) for major-street movements reduced by duration of yellow and all-red intervals;
Ø2 PED CLR = 18 sec - 7 sec (yellow + red) = 11 sec; Ø6 PED CLR = 18 sec - 7 sec (yellow + red) = 11 sec

Ped clearance (PED CLR) for minor-street movements reduced by duration of yellow and all-red intervals;
Ø4 PED CLR = 22 sec - 7 sec (yellow + red) = 15 sec

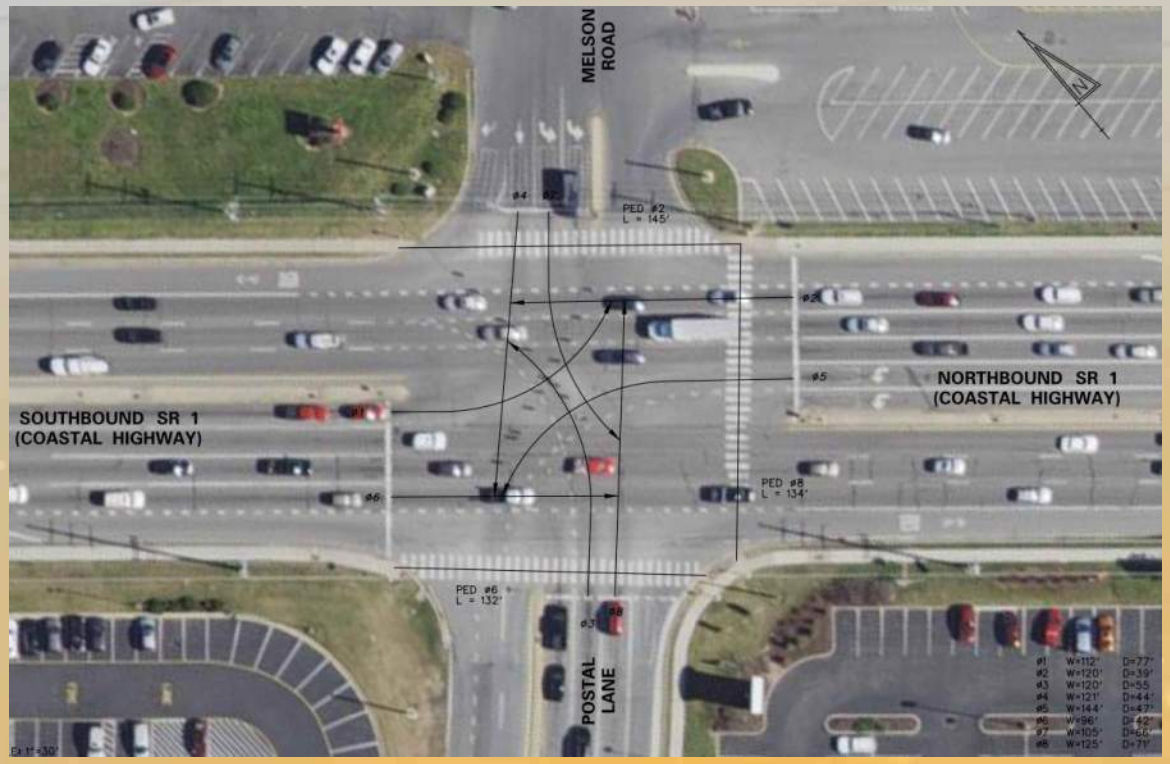
Timesheet Entry

Phase Number	1	2	3	4	5	6	7	8
Movement	WB L	EB	NB	SB	EB L	WB		
YEL/10	50	50	40	50	50	50		
RED/10	20	20	20	20	20	20		
WALK		7		7		7		
PED CLR		11		15		11		

Page 2 of 2

- Passage Time used for new signals only (input distance from passage loop to stop line)
- Volume Density calculations not used
- Field-measured crosswalk distances
- EXT PCL codes (extended ped clear)
  - 0 = countdown ends at end of Green/beginning of Yellow (Most countdown ped signals, except some in City of Newark)
  - 1 = countdown ends at end of All Red/beginning of next Green (Rare)
  - 2 = countdown ends at end of Yellow/beginning of All Red (Non-countdown ped signals)

W and D



Driver's eye visualization > of W & D

- For each phase, find the worst-case (highest R) combination of:
  - W – phase that is ending
  - D – possible conflicting movement
- Suggestion for organization – W (clearing path) shown with arrow; D (conflicting path) not
- Calculate all-red time

$$R = W\frac{W}{1.47 * S_{10}} - 0.283\sqrt{D}$$

- Consider any conflicting phase that could follow (typically, any phase can be skipped except ø2 and ø6)
- Plot the diagram to PDF and paste a screenshot to the "W and D" sheet

DelDOT
Delaware Department of Transportation

Speed Limit Photo Sheet

SPEED LIMIT PHOTOS

Permit Number: N999 **Signal Name:** DE 99 @ Main St

EB DE 99 (phase 2) north of 2nd St
(about 0.1 miles west of Main St)

WB DE 99 (phase 6) north of South Ave
(about 1.3 miles east of Main St)

NB Main St (phase 3)
No Speed Limit sign

SB Main St (phase 4) west of DE 12
(about 0.5 miles north of DE 99)

COMPLETE FOR ALL PHASES

Phase	Speed Limit Sign Present?	Road Name	Location	Distance from Signal (miles, to nearest 0.1)
	Yes	DE 99	north of 2nd St	0.1
	Yes	DE 99	north of South Ave	1.3
	No	Main St		
	Yes	Main St	west of DE 12	0.5

Resize photos to fit in large center cell.
Photos should show the speed limit clearly and provide some context to the sign's location.
To keep file size down, screenshot the speed limit photos rather than inserting the files here.

- Provide documentation of current posted speed limits on all approaches used to calculate yellow and red intervals
- When there is no approach speed limit posted, typically assume 25 MPH (neighborhoods, driveways, parking lots, downtown areas, some ramps)
- Use engineering judgement for higher-speed off-ramps (consider advisory speed) and unposted rural roads (state law – 50 MPH)

MAX Timers

N999 - DE 99 @ Main St

Count Date: Tuesday, February 11, 2020

Main St

						AM	MID	PM	
PM	385	43	158		R	222	124	185	
MID	99	25	104		T	812	375	610	
AM	189	9	122		L	10	34	77	DE 99
	R	T	L						
DE 99	210	130	432	L	L	T	R		
	732	499	822	T	12	8	18	AM	
	19	56	101	R	49	20	36	MID	
	PM	MID	AM		71	41	64	PM	
					Shops				

LANE CONFIGURATION

	L Only	L/T	T Only	T/R	R Only	L/T/R	L/R	"X" if rights are to be excluded
NB						1		
SB	1	1		1				
EB	2		2		1			X
WB	1		2		1			X

PHASING

	L Only	Thru	Split	Bikes	Excl. Ped	Dummy
NB			3			
SB			4			
EB	5	2				
WB	1	6				

"CYCLE LENGTH"

191 seconds

18.84816754 "cycles" per hour

Phase	Min Green	Yellow	All Red	Volume	Lane Factor	Critical Volume	Vehicles per "Cycle"	Green Required	Ex. Max Timer	New Max Timer
1	5	5	2	77	1.00	77	4	12	20	15
2	15	5	2	822	0.55	452	24	54	99	55
3	5	4	2	176	1.00	176	9	23	20	25
4	5	4	2	385	1.00	385	20	47	40	50
5	5	5	2	432	0.55	238	13	30	20	35
6	15	5	2	812	0.55	447	24	53	99	55
7										
8										
								Total:	205	191

NOTES:

- ONE OPTION to check max timers (or provide a CMS file)
- MAX timers used for “free” operation, operation during signal errors, and coordination-type force-offs
- Represent the maximum green time a phase can have
- Steps for engineering:
  - Input peak hour volumes
  - Note lane configuration
    - Exclude rights if they have a dedicated turn lane, and especially if they are channelized ***ENGINEERING JUDGEMENT***
  - Establish signal phasing
  - Input minimum green times and existing max timers (from existing timesheet)
  - Adjust “cycle length” to match total (active feedback provided)
- More information available starting on slide 22

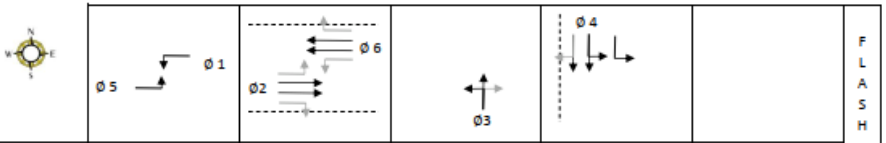
Sequence of Operations

Sequence of Operation Chart

Delaware Department of Transportation
Transportation Management Center

Permit No.: K999
Timesheet Rev: B.1

Intersection: DE 99 @ Main St



Phase	1+5				2+6				3				4								FLASH
Signal # \ Int	1	2	3		4	5	6	7	8	9	10		11	12	13	14					
1,3	R/<G-	R/<Y-	R		G	G	Y	R	R	R	R		R	R	R	R					Y
3,4	R	R	R		G	G	Y	R	R	R	R		R	R	R	R					Y
5	R	R	R		R	R	R	R	G/<G-	Y/<Y-	R		R	R	R	R					R
6	R	R	R		R	R	R	R	G	Y	R		R	R	R	R					R
7	R	R	R		R	R	R	R	R	R	R		<G-	<G-	<Y-	R					R
8	R	R	R		R	R	R	R	R	R	R		G/<G-	G/<G-	Y/<Y-	R					R
9	R	R	R		R	R	R	R	R	R	R		G	G	Y	R					R
10,11,12,13	DW	DW	DW		W	FDW	DW	DW	DW	DW	DW		DW	DW	DW	DW					OFF
14,15	DW	DW	DW		DW	DW	DW	DW	DW	DW	DW		W	FDW	DW	DW					OFF

Legend:	
R	RED
Y	YELLOW
G	GREEN
DW	DON'T WALK
W	WALK
F	FLASHING
◄—	ARROW

Notes:

	SIGNAL HEAD INDICATIONS						
Signal No.:	1,3	2,4,6,9	5,8	7	10,11,12,13, 14,15		
Total:	2	4	2	1	6		
Signal Head Type:							
Notes: Optically limited, tunnel visor, louvers, etc.							
Lens / Symbol:	12" Lenses	12" Lenses	12" Lenses	12" Lenses	9" Symbol		

PREPARED BY: _____ DATE: _____

CHECKED BY: _____ DATE: _____

EMERGENCY PREEMPTION	
PREEMPT 1	PHASE 2+6
PREEMPT 2	PHASE 2+6
PREEMPT 3	PHASE 3
PREEMPT 4	PHASE 4

Version: October 2021

Page 1 of 1

- Details exactly how the signal progresses through a cycle, light by light
- Can leave for reviewer/TMC to complete if unsure

- Create the arrow diagram of signal phasing
  - Black = protected, gray = permissive/flashing
  - Dashed lines are pedestrian phases
  - Show correct number of lanes/lane configuration
- Assign each signal head a number
  - Follow signal plan
  - Include pedestrian heads as well
- Progress through each light sequence
  - Green → Yellow → Red
  - Walk → Flashing Don't Walk → Don't Walk
- Assign colors for flash operation
  - Yellow for main street thru
  - Red for side street and main street lefts
  - Off for peds
- Indicate type of signal head for each number
- List preemption phasing (see later slide)

Cover Page

INTERSECTION TIMESHEET COVER PAGE

INTERSECTION:	DE 99 @ MAIN ST	REVISION:	B.1
PERMIT NUMBER:	K999	PROJECT NUMBER:	T202000401

SUMMARY OF OPERATION

CONTROLLER TYPE:	☑	m60	☐	m50	☐	m40/300-SERIES	☐	OTHER:	
EXISTING SIGNAL TYPE:	FULL COLOR				CONVERSION TO:		NO CHANGE		
MODE OF OPERATION:	COORDINATED				COORDINATION ZONE:		K032		
COORD. MODE:	YIELD	MAX. MODE:	MAX 2	CORR. MODE:	SW	OFFSET MODE:	BEG. GRN	FORCE MODE:	PLAN

☐	5-SECTION LEFT TURN	☑	PED SIGNALS	☑	COUNTDOWNS
☑	PROTECTED-ONLY LEFT TURN	☐	EXCLUSIVE PED	☐	TWO-STAGE PED
☐	FLASHING YELLOW/RED ARROW	☐	LEADING PED INTERVAL		
☐	LAGGING LEFT TURN	☐	DYNAMIC ADVANCE WARNING FLASHER		
☐	YELLOW TRAP MODIFIED	☑	PREEMPT	☐	SPECIAL PREEMPT (R/R TIE-IN)
☑	SPLIT PHASING	☐	SPECIAL RING STRUCTURE		

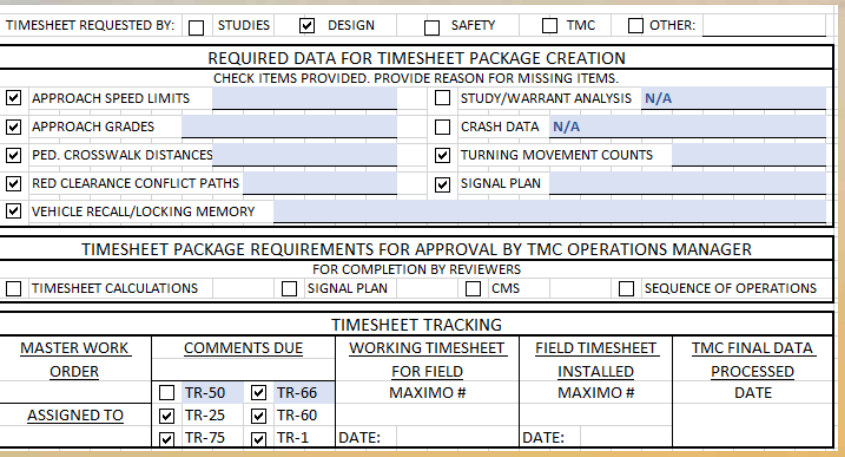
PROJECT NOTES

1	INSTALL EPAC CONTROLLER M60 VERSION 3.58f+
2	ADD PED PHASE 4
3	YELLOW TIME CHANGE PHASES 1, 2, 4, 5 & 6 TO 5.0 SECONDS
4	PLACE PHASES 1, 3, 4 & 5 TO NON-LOCKING
5	ADJUST PREEMPT
6	
7	
8	
9	

*** BLUE = User Input

- Revision: Increase **letter** when making **operational** changes (add/remove phase/ped, convert to m60), increase **number** when making **timing** changes (update yellows/reds/ped times)
  - Letter and number CANNOT both increase
- Project Number: Applies if conversion is done as part of a design contract (i.e. T202012345)
- Controller Type: Specify which controller model will be in the cabinet after completion (field-check or EOPS)
- Existing Signal: Type of signal currently
- Conversion to: Signal type after completion (“No Change” typically)
- Mode of Operation:
  - Coordinated = runs patterns 24/7
  - Coordinated & Free = some combination of the two
  - Free 24/7 = never runs patterns
- Coordination Zone: https://tmc.deldot.gov/datamap/ or ask TMC if unsure
  - Existing signals: “Signal Patterns” level → Click on signal of interest → Group
- Coordination Settings: How the signal operates in various situations
  - Typically copy from existing settings → Ask TMC/reviewer if unsure
  - Preferences: Coordination = Yield, Max. = Max 2 (Max 1 if Free), Correction = SW, Offset = Beg. Grn
- Check all applicable signal characteristics
  - Yellow Trap Modified: for 5-section left turns and FRA (both directions) – check DelDOT guidance for additional situations
- Project Notes: describe the changes in the revision package, used more like a “checklist” of things for the installer to edit or adjust (see notes list)

Cover Page



TIMESHEET REQUESTED BY: ☐ STUDIES ☑ DESIGN ☐ SAFETY ☐ TMC ☐ OTHER:

REQUIRED DATA FOR TIMESHEET PACKAGE CREATION

CHECK ITEMS PROVIDED. PROVIDE REASON FOR MISSING ITEMS.

☑ APPROACH SPEED LIMITS		☐ STUDY/WARRANT ANALYSIS	N/A
☑ APPROACH GRADES		☐ CRASH DATA	N/A
☑ PED. CROSSWALK DISTANCES		☑ TURNING MOVEMENT COUNTS	
☑ RED CLEARANCE CONFLICT PATHS		☑ SIGNAL PLAN	
☑ VEHICLE RECALL/LOCKING MEMORY			

TIMESHEET PACKAGE REQUIREMENTS FOR APPROVAL BY TMC OPERATIONS MANAGER

FOR COMPLETION BY REVIEWERS

☐ TIMESHEET CALCULATIONS ☐ SIGNAL PLAN ☐ CMS ☐ SEQUENCE OF OPERATIONS

TIMESHEET TRACKING

MASTER WORK ORDER	COMMENTS DUE		WORKING TIMESHEET FOR FIELD	FIELD TIMESHEET INSTALLED	TMC FINAL DATA PROCESSED
	☐ TR-50	☑ TR-66	MAXIMO #	MAXIMO #	DATE
ASSIGNED TO	☑ TR-25	☑ TR-60			
	☑ TR-75	☑ TR-1	DATE:	DATE:	

- Timesheet Requested by: Indicate section whose work requires the new timesheet
- Required Data: Check all items that have been done, give a reason why anything hasn't or doesn't need to be done
  - Speed limits, grades, and red clearance paths should always be done
  - Crosswalk distance must be done unless there are no crosswalks
  - Can ignore Vehicle Recall/Locking Memory if unsure(reviewer and TMC will address)
- Timesheet Package Requirements: Do not complete; will be completed by reviewer
- Timesheet Tracking: who will review this timesheet?
  - TR-50 = New Castle signals
  - TR-66 = Kent/Sussex signals
  - The remaining 4 are always included

RSA | WF, HAWKs

FLASHING SIGNAL AHEAD SIGNS - 6/19/2017

The circuit is designed to flash the "Signal Ahead" signs at a programmed time before the beginning of Yellow and continue to flash into the green also at a programmed time. The circuit is activated by the Yellow of Main Street, held by the red of Main Street. The Main Street colors are controlled by the Trailing Green Overlaps. The Yellow and Red of phases 2 & 6 apply a ground to the OFF DELAY timer, starting the circuit. The timer applies a ground to the SCR to activate the flasher. When phases 2 & 6 go Green, the timer turns off after a programmed time, ending the circuit. The circuit is fed from a separate breaker in the cabinet, and the SCR's and flashers are self-contained in the circuit to eliminate any interference with the signal operation.

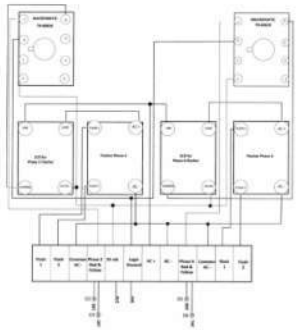
The following adjustments have been made in the signal cabinet:

Phase 2:
- Green (is actually unused in the field)
- Yellow (24V) is wired to the OFF DELAY timer input (activation trigger)
- RED (24) is wired to the OFF DELAY timer input (activation trigger)

Overlap A (phase 2 trailing overlap):
- Green is wired to the green display in the field
- Yellow is wired to SCR phase-2 110V output
  - Field connection to signal display via phase-2 SCR 110V side
- Red is wired to SCR phase-2 110VAC output
  - Field connection to signal display via phase-2 SCR 110V side

Phase 6:
- Green (is actually unused in the field)
- Yellow (24V) is wired to the OFF DELAY timer input (activation trigger)
- RED (24) is wired to the OFF DELAY timer input (activation trigger)

Overlap C (phase 6 trailing overlap):
- Green is wired to the green display in the field
- Yellow is wired to SCR phase-6 110V output
  - Field connection to signal display via phase-2 SCR 110V side
- Red is wired to SCR phase-6 110VAC output
  - Field connection to signal display via phase-2 SCR 110V side



Delaware PED HAWK Signal - Sequence of Operation (rev C.2)

Signal Display	Ped Display	Summary of Sequence
Dark Until Activated	Don't Walk	- Main Street display is dark, and is controlled by phase 1 & 5 Walk Interval - Signal display rests in Phase 1 walk for one direction (no signal display) - Signal display rests in Phase 5 walk for one direction (no signal display) - Pedestrian Signal phase 2 rests in Don't Walk (associated to Phase 1) - Pedestrian Signal phase 6 rests in Don't Walk (associated to Phase 5)
Flashing Yellow	Don't Walk	- Flashing Yellow is activated by ped call placed from a preempt input (phase 2 and 6 calls are placed at the same time). The flashing yellow interval is set by phase 1 & 5 pedestrian clearance interval and must equal the yellow clearance for the through movement (phase 1 & 5 yellow clearance) - Phase 1 & 5 are programmed to minimum vehicle recall and pedestrian recall
Steady Yellow	Don't Walk	- Solid Yellow is controlled by phase 1 & 5 yellow clearance value. This value is calculated using standard engineering practices. Phase 1 & 5 shall not clear through the yellow / red intervals.
Steady Red	Don't Walk	- The Left Head Red is activated by phase 1 red and the Right Head Red is activated by phase 2 red (one combination of displays for one direction) - The Left Head Red is activated by phase 5 red and the Right Head Red is activated by phase 6 red (one combination of displays for one direction)
Steady Red	Walk	- Phase 2 walk activates pedestrian display - Phase 6 walk activates pedestrian display
Alternating Flash Red	Ped Clear	- Phase 2 & 6 pedestrian clearance interval begins - The solid red displays begin to flash in wig/wag operation - The wig/wag is accomplished through the EPAC controller. Load Switches for phases 1, 2, 5, & 6 are programmed to alternatively flash red output. - The wig/wag flash continues through the yellow interval for phase 2 & 6.
Alternating Flash Red	Don't Walk	- The wig/wag flash continues through the red intervals for phase 2 & 6. - The pedestrian display is solid red - don't walk display
Dark Again	Don't Walk	- Return to beginning of sequence.

Notes:
- Main Street dark indication is controlled by phase 1 & 5 Walk interval
- Signal will cycle upon power activation
- Signal Monitor Unit will monitor all indications
- Signal will flash yellow in fault mode (ped displays will be dark)

Delaware FIRE HAWK Signal - Sequence of Operation (rev A.2)

Signal Display	Summary of Sequence
Dark Until Activated	- Main Street display is dark, and is controlled by phase 1 & 5 Walk Interval - Signal display rests in Phase 1 walk for one direction (no signal display) ACT Rest in Walk - Signal display rests in Phase 5 walk for one direction (no signal display) ACT Rest in Walk - Pedestrian Signal phase 2 rests in Don't Walk (associated to Phase 1) is not displayed - Pedestrian Signal phase 6 rests in Don't Walk (associated to Phase 5) is not displayed
Flashing Yellow Upon Activation	- Flashing Yellow is activated by ped call placed from a preempt input (phase 2 and 6 calls are placed at the same time). The flashing yellow interval is set by phase 1 & 5 pedestrian clearance interval and must equal the yellow clearance for the through movement (phase 1 & 5 yellow clearance) - Phase 1 & 5 are programmed to minimum vehicle recall and pedestrian recall - Phase 1 & 5 are programmed for "Actuated rest in Walk"
Steady Yellow	- Solid Yellow is controlled by phase 1 & 5 yellow clearance value. This value is calculated using standard engineering practices. Phase 1 & 5 shall not clear through the yellow / red intervals.
Steady Red	- The Left Head Red is activated by phase 1 red and the Right Head Red is activated by phase 2 red (one combination of displays for one direction) - The Left Head Red is activated by phase 5 red and the Right Head Red is activated by phase 6 red (one combination of displays for one direction) - Minimum 1 second of solid red due to phase 2 & 6 walk time
Alternating Flashing Red	- Phase 2 & 6 pedestrian clearance interval begins - The solid red displays begin to flash in wig/wag operation - The wig/wag is accomplished through the EPAC controller. Load Switches for phases 1, 2, 5, & 6 are programmed to alternatively flash red output. - The wig/wag flash continues through the yellow & red intervals for phase 2 & 6.
Dark Until Activated	- Return to beginning of sequence.

Notes:
- Main Street dark indication is controlled by phase 1 & 5 Walk interval
- Signal will cycle upon power activation
- Signal Monitor Unit will monitor all indications
- Signal will flash yellow in fault mode

Sheets hidden by default. Will print if needed by TMC.

Intersection Info

INTERSECTION TIMESHEET PACKET
NOTICE TO PROCEED

Intersection Info:	
Location:	DE 99 @ MAIN ST
Timesheet Date:	10/1/2019
Signal Permit #:	N999
Timesheet Revision #:	8.1
Controller Type:	EPAC
Controller Model:	m60 3.58f +
Monitor:	NEMA +

System Communication Info:			
ADDRESS:			
BAUD RATE:			
IP Addressing:			
DHCP:	0		
NET:	1		
IP ADDRESS:			
SUBNET MSK:	255.255.255.224		
NETWORK CONFIG:			
TYPE:	1		
DESTINATION:	0.0.0.0		
GATEWAY:			
NETMASK:	255.255.255.224		
SPAT ADDRESSING:			
	DESTINATION IP:	DST PORT:	ENABLED:
01:		1034	0

Signal Permit Number: N999

- Signal information auto-populated from the timesheet calculations sheet
- Reach out to TMC for System Communications info. If unable to, TMC can complete

Phase Data

Phase Data - Bank 1								
DO NOT USE - UNDER CONSTRUCTION								
☐ OK TO USE								
INITIAL, DATE & TIME								
VEHICLE DATA								
VEHICLE TIMES								
PHASE	1	2	3	4	5	6	7	8
DIRECTION	WB	EB	NB	SB	EB	WB		
LOCATION	LT	DE 99	SHOP	MAIN ST	LT	DE 99		
MIN GRN	5	15	5	5	5	15	0	0
PASS/10	40	50	40	40	40	50	0	0
MAX 1	15	60	25	45	35	60	0	0
MAX 2	15	60	20	45	35	60	0	0
YEL/10	60	60	40	50	60	60	0	0
RED/10	20	20	20	20	20	20	0	0
RECALLS +								
VEH RCL	0	2	0	0	0	2	0	0
VEH DLY	0	0	0	0	0	0	0	0
BIKE & AWS TIMES +								
BGRN/10	0	0	0	0	0	0	0	0
BPAS/10	0	0	0	0	0	0	0	0
GDLY/10	0	0	0	0	0	0	0	0
YDLY/10	0	0	0	0	0	0	0	0
DENSITY TIMES +								
AINI/10	0	0	0	0	0	0	0	0
MAX INI	0	0	0	0	0	0	0	0
TIM BEF	0	0	0	0	0	0	0	0
CAR BEF	0	0	0	0	0	0	0	0
TIME TO	0	0	0	0	0	0	0	0
MGAP/10	0	0	0	0	0	0	0	0

- *****ALL UNUSED PHASES MUST HAVE ALL ZEROS HERE**
- DO NOT USE/OK TO USE: For TMC use only
- Phase/Direction/Location:
  - Help clarify which movements are assigned to which phases
  - Use LT or RT for turn phases
  - Use route number for the thru movement, if applicable (**DE, not SR**)
  - Use road name (if it doesn't fit, use a clear abbreviation)
  - Business names for signalized entrances are acceptable
- MIN GRN (Minimum Green): Typically 15 for major street thru phases, 5 otherwise
- PASS/10 (Passage): Copy from existing timesheet (for new signals: left turns = 30, side streets = 40, main thru phases comes from calculation on Timesheet Calcs tab)
- MAX 1 & 2: Copy from existing timesheet unless "Max Timer Calcs" sheet shows updated max green times are warranted
- VEH RCL (Vehicle Recall Mode): Copy from existing timesheet
  - 2 = Min, 3 = Max
  - Major street thrus typically in Min recall

Phase Data

PEDESTRIAN DATA								
PED TIMES +								
WALK 1	0	7	7	0	0	0	0	0
PED CLR 1	0	7	26	0	0	0	0	0
PED RECALL +								
PED RCL	0	0	0	0	0	0	0	0
PED DLY	0	0	0	0	0	0	0	0
PED OFFSET +								
WOFF/10	0	0	0	0	0	0	0	0
MODE *	0	0	0	0	0	0	0	0
MISC PED OPTIONS +								
*FL WK	0	0	0	0	0	0	0	0
**EXT PCL	0	0	0	0	0	0	0	0
*ACT RIW	0	0	0	0	0	0	0	0
INIT & NA RESP +								
INITIAL	1	4	1	1	1	4	0	0
NA RESP	0	1	0	0	0	0	0	0
N. LOCK & MISC +								
NL MEM	1	0	0	0	1	0	0	0
2 ENTRY	0	1	0	0	0	1	0	0
SPEC. SEQUENCE +								
OMIT	2	0	0	0	6	0	0	0
-YEL	0	0	0	0	0	0	0	0
OCAL	4	0	0	0	4	0	0	0
						Signal Permit Number:		N999

- *****ALL UNUSED PHASES MUST HAVE ALL ZEROS HERE**
- PED RCL (Ped Recall Mode): Copy from existing timesheet, usually 0
- WOFF/10 (Walk Offset): Time for a leading ped interval (used only for LPI)
- INITIAL (Initialization):
  - 4 = green, major street thru phases
  - 1 = red, all other phases used
  - 0 = not initialized, unused phases
  - Copy from existing timesheet
- NL MEM (Non-Locking Memory):
  - Usually set all used phases to 1 (TRUE) except coordinated phases (initial = 4)
  - If video detection is used, all used phases must be 0 (FALSE)
- 2 ENTRY (Dual Entry):
  - Copy from existing timesheet – 0 = FALSE, 1 = TRUE
- SPEC. SEQUENCE: Only when both directions have pm+pt or FRA left-turn phasing
  - OMIT: opposing coordinated phase
  - OCAL: side street phase that gets a “soft” call

Unit Data

UNIT DATA

OVERLAP DATA

OVERLAP LOCATION:	A	PHASE 1 FRA	B	PHASE 2 PED	C	PHASE 5 BIKE FYA	D	PHASE 3 PED
	E		F		G		H	

OVERLAP A: 2- FYA/FRA

DELAY/10: 150

PHASE	1	2	3	4	5	6	7	8
PERM PHASES:	0	1	0	0	0	0	0	0
PROT PHASES:	1	0	0	0	0	0	0	0
-PED PHASES:	0	0	0	0	0	0	0	0
OVERLAP	A	B	C	D	E	F	G	H
PERM OVERLAPS:	0	0	0	0	0	0	0	0
PROT OVERLAPS:	0	0	0	0	0	0	0	0

OVERLAP B: 0 - NOT ASSIGNED

OVERLAP C: 2- FYA/FRA

DELAY/10: 0

PHASE	1	2	3	4	5	6	7	8
PERM PHASES:	0	0	0	0	0	1	0	0
PROT PHASES:	0	0	0	0	1	0	0	0
-PED PHASES:	0	0	0	0	0	0	0	0
OVERLAP	A	B	C	D	E	F	G	H
PERM OVERLAPS:	0	0	0	0	0	0	0	0
PROT OVERLAPS:	0	0	0	0	0	0	0	0

OVERLAP D: 0 - NOT ASSIGNED

FLASHING LEFT -TURN NOTES (AS NEEDED)

1	LT IS FLASHING RED ARROW LEFT TURN OPERATION
2	LT HAS A 15-SECOND DELAY PRIOR TO FLASHING
3	LT IS MONITORED ON BOTH SCR 1 AND OVLP A SCR
4	LT (BIKE) IS FLASHING YELLOW BIKE SIGNAL
5	LT (BIKE) HAS A 0-SECOND DELAY PRIOR TO FLASHING
6	LT (BIKE) IS MONITORED ON BOTH SCR 5 AND OVLP C SCR

RING STRUCTURE

CONTROLLER	RING	NXT PHASE	CONCUR PHASE	1	2	3	4	5	6	7	8
PHASE 1			STANDARD	☐	☐	☐	☐	☐	☐	☐	☐
PHASE 2				☐	☐	☐	☐	☐	☐	☐	☐
PHASE 3				☐	☐	☐	☐	☐	☐	☐	☐
PHASE 4				☐	☐	☐	☐	☐	☐	☐	☐
PHASE 5				☐	☐	☐	☐	☐	☐	☐	☐
PHASE 6				☐	☐	☐	☐	☐	☐	☐	☐
PHASE 7				☐	☐	☐	☐	☐	☐	☐	☐
PHASE 8				☐	☐	☐	☐	☐	☐	☐	☐

Signal Permit Number: N999

***** OVERLAP BOXES CHANGE BASED ON INPUTS IN "OVERLAP LOCATION"**

***** IF MORE THAN 4 OVERLAPS NEEDED, DISCUSS WITH TMC / REVIEWERS**

- FRA *must* be placed on Overlap A/C, if applicable
  - DELAY/10: solid red arrow time before flashing begins
    - usually 150 for FRA's, 0 for FYA's
  - Include "BIKE" in label if it is a bike FYA
  - "PERM PHASES": when arrow flashes
  - "PROT PHASES" : when arrow is solid green
- Ped phases *should* be placed as follows:
  - ø2 on Overlap A
  - ø4 on Overlap B
  - ø6 on Overlap C
  - ø8 on Overlap D
  - Ped phases do not get assigned overlap information
- Vehicle phase overlaps (i.e. signalized right turn) *may* be placed on any available overlap
  - Overlap location is the movement where the overlap is placed (i.e. NB RT)
  - TRL GRN is used for trailing overlaps (i.e. 7-second trailing) – 0 otherwise
  - YEL/10 and RED/10 should match the last phase where the overlap is active
- If A-D are filled, use unused phases (via notes). Overlaps E-H are last resort.

Unit Data

UNIT DATA

OVERLAP DATA

OVERLAP LOCATION:	A	PHASE 1 FRA	B	PHASE 2 PED	C	PHASE 5 BIKE FYA	D	PHASE 3 PED
	E		F		G		H	

OVERLAP A: 2- FYA/FRA

DELAY/10: 150

PHASE	1	2	3	4	5	6	7	8
PERM PHASES:	0	1	0	0	0	0	0	0
PROT PHASES:	1	0	0	0	0	0	0	0
-PED PHASES:	0	0	0	0	0	0	0	0
OVERLAP	A	B	C	D	E	F	G	H
PERM OVERLAPS:	0	0	0	0	0	0	0	0
PROT OVERLAPS:	0	0	0	0	0	0	0	0

OVERLAP B: 0 - NOT ASSIGNED

OVERLAP C: 2- FYA/FRA

DELAY/10: 0

PHASE	1	2	3	4	5	6	7	8
PERM PHASES:	0	0	0	0	0	1	0	0
PROT PHASES:	0	0	0	0	1	0	0	0
-PED PHASES:	0	0	0	0	0	0	0	0
OVERLAP	A	B	C	D	E	F	G	H
PERM OVERLAPS:	0	0	0	0	0	0	0	0
PROT OVERLAPS:	0	0	0	0	0	0	0	0

OVERLAP D: 0 - NOT ASSIGNED

FLASHING LEFT -TURN NOTES (AS NEEDED)

1	LT IS FLASHING RED ARROW LEFT TURN OPERATION
2	LT HAS A 15-SECOND DELAY PRIOR TO FLASHING
3	LT IS MONITORED ON BOTH SCR 1 AND OVLP A SCR
4	LT (BIKE) IS FLASHING YELLOW BIKE SIGNAL
5	LT (BIKE) HAS A 0-SECOND DELAY PRIOR TO FLASHING
6	LT (BIKE) IS MONITORED ON BOTH SCR 5 AND OVLP C SCR

RING STRUCTURE

CONTROLLER	RING	NXT PHASE	CONCUR PHASE	1	2	3	4	5	6	7	8
PHASE 1			STANDARD	☐	☐	☐	☐	☐	☐	☐	☐
PHASE 2				☐	☐	☐	☐	☐	☐	☐	☐
PHASE 3				☐	☐	☐	☐	☐	☐	☐	☐
PHASE 4				☐	☐	☐	☐	☐	☐	☐	☐
PHASE 5				☐	☐	☐	☐	☐	☐	☐	☐
PHASE 6				☐	☐	☐	☐	☐	☐	☐	☐
PHASE 7				☐	☐	☐	☐	☐	☐	☐	☐
PHASE 8				☐	☐	☐	☐	☐	☐	☐	☐

Signal Permit Number: N999

- Flashing Left Turn Notes:
  - Input time of day restrictions as needed in blue-shaded entry box
- Ring Structure:
  - "STANDARD" in most cases
  - "PED HAWK" or "FIRE HAWK" when a HAWK signal
  - "NON-STANDARD" when not following standard NEMA phasing
    - Complete "Ring" and "Nxt Phase" columns
    - Check appropriate boxes

m50/m60 Preempt and Priority

m60 PREEMPT DATA PAGE

PREEMPT OVERIDES

	PREEMPT 1	PREEMPT 2	PREEMPT 3	PREEMPT 4	PREEMPT 5	PREEMPT 6
OV FLASH	0	0	0	0		
OV PE+1	0	0	0	0		
OV PRI	0	0	0	0		

PREEMPT MISCELLANEOUS

	PREEMPT 1	PREEMPT 2	PREEMPT 3	PREEMPT 4	PREEMPT 5	PREEMPT 6
TEST	0	0	0	0		
DET	248	249	250	251		
DELAY	0	0	0	0		
MXCAL	0	0	0	0		
DB/10	0	0	0	0		
NON-LOCK	1	1	1	1		
EXTND	0	0	0	0		
LOCK OUT	1	1	1	1		
SRMOD	1	1	0	0		
LINK#	0	0	0	0		
DURAT	0	0	0	0		
GATE	0	0	0	0		
R2C	0	0	0	0		
PREEMPT EXIT PHASE	1 2 3 4 X X 5 6 7 8	1 2 3 4 X X 5 6 7 8	1 2 3 4 X 5 6 7 8	1 2 3 4 X X 5 6 7 8	1 2 3 4 5 6 7 8	1 2 3 4 5 6 7 8

PREEMPT INTERVAL TIMES

	PREEMPT 1	PREEMPT 2	PREEMPT 3	PREEMPT 4	PREEMPT 5	PREEMPT 6
MIN GRN	5	5	5	5		
MIN WALK	0	0	0	0		
DWELL GRN	10	10	5	5		
EXT PED	0	0	0	0		
SELECT PED CLR	26	26	26	26		
SELECT YEL/10	60	60	60	60		
SELECT RED/10	20	20	20	20		
TRACK GRN						
TRACK PED CLR						
TRACK YEL/10	60	60	60	60		
TRACK RED/10	20	20	20	20		
RETURN PED CLR						
RETURN YEL/10	60	60	60	60		
RETURN RED/10	20	20	20	20		

PREEMPT VEHICLE STATUS

	PREEMPT 1	PREEMPT 2	PREEMPT 3	PREEMPT 4	PREEMPT 5	PREEMPT 6
TRACK GRN						
DWELL	1 2 3 4 X X 5 6 7 8	1 2 3 4 X X 5 6 7 8	1 2 3 4 X 5 6 7 8	1 2 3 4 X 5 6 7 8	1 2 3 4 5 6 7 8	1 2 3 4 5 6 7 8
CYCLE						

PREEMPT PEDESTRIAN STATUS **NOT USED**

PREEMPT OVERLAP STATUS

	PREEMPT 1	PREEMPT 2	PREEMPT 3	PREEMPT 4	PREEMPT 5	PREEMPT 6
TRACK STATUS						
DWELL STATUS	A = 0 B = 0 C = 0 D = 0	A = 0 B = 0 C = 0 D = 0	A = 0 B = 0 C = 0 D = 0	A = 0 B = 0 C = 0 D = 0		
CYCLE STATUS						
TRAIL						

Signal Permit Number: N999

- Preempt = High Priority (emergency vehicles)
  Priority = Low Priority (transit vehicles)
- Opticom detector triggered by vehicle and signal transitions to service that phase (“DWELL”)
- Once preempt/priority call is released, controller will “exit” to service next phase (“EXIT PHASE”)
- Assigning Exit Phases:
  - ø2/ø6, ø1/ø6, ø2/ø5 exits to ø2/ø6
  - ø3/ø8, ø4/ø7 exits to ø4/ø8
  - ø4/ø8, ø4 exits to first phases in cycle
  - ø3 exits to ø4

m50/m60 Preempt and Priority

m60 PREEMPT DATA PAGE

PREEMPT OVERIDES

	PREEMPT 1	PREEMPT 2	PREEMPT 3	PREEMPT 4	PREEMPT 5	PREEMPT 6
OV FLASH	0	0	0	0		
OV PE+1	0	0	0	0		
OV PRI	0	0	0	0		

PREEMPT MISCELLANEOUS

	PREEMPT 1	PREEMPT 2	PREEMPT 3	PREEMPT 4	PREEMPT 5	PREEMPT 6
TEST	0	0	0	0		
DET	248	249	250	251		
DELAY	0	0	0	0		
MXCAL	0	0	0	0		
DB/10	0	0	0	0		
NON-LOCK	1	1	1	1		
EXTND	0	0	0	0		
LOCK OUT	1	1	1	1		
SRMOD	1	1	0	0		
LINK#	0	0	0	0		
DURAT	0	0	0	0		
GATE	0	0	0	0		
R2C	0	0	0	0		
PREEMPT EXIT	1 [2] 3 4	1 [2] 3 4	1 2 3 [4]	[1] 2 3 4	1 2 3 4	1 2 3 4
PHASE	X X 5 [6] 7 8	X X 5 [6] 7 8	X 5 6 7 8	X X 5 6 7 8	5 6 7 8	5 6 7 8

PREEMPT INTERVAL TIMES

	PREEMPT 1	PREEMPT 2	PREEMPT 3	PREEMPT 4	PREEMPT 5	PREEMPT 6
MIN GRN	5	5	5	5		
MIN WALK	0	0	0	0		
DWELL GRN	10	10	5	5		
EXT PED	0	0	0	0		
SELECT PED CLR	26	26	26	26		
SELECT YEL/10	60	60	60	60		
SELECT RED/10	20	20	20	20		
TRACK GRN						
TRACK PED CLR						
TRACK YEL/10	60	60	60	60		
TRACK RED/10	20	20	20	20		
RETURN PED CLR						
RETURN YEL/10	60	60	60	60		
RETURN RED/10	20	20	20	20		

PREEMPT VEHICLE STATUS

	PREEMPT 1	PREEMPT 2	PREEMPT 3	PREEMPT 4	PREEMPT 5	PREEMPT 6
TRACK GRN						
DWELL	1 [2] 3 4	1 [2] 3 4	1 2 [3] 4	1 2 3 [4]	1 2 3 4	1 2 3 4
	X X 5 [6] 7 8	X X 5 [6] 7 8	X 5 6 7 8	X 5 6 7 8	5 6 7 8	5 6 7 8
CYCLE						

PREEMPT PEDESTRIAN STATUS **NOT USED**

PREEMPT OVERLAP STATUS

	PREEMPT 1	PREEMPT 2	PREEMPT 3	PREEMPT 4	PREEMPT 5	PREEMPT 6
TRACK STATUS						
DWELL STATUS	A = 0 B = 0 C = 0 D = 0	A = 0 B = 0 C = 0 D = 0	A = 0 B = 0 C = 0 D = 0	A = 0 B = 0 C = 0 D = 0		
CYCLE STATUS						
TRAIL						

Signal Permit Number: N999

- Assigning Preempts ("DWELL") –
  - Preempt 1:
    - ø1 & ø6 (if ø1 is Prot-Only)
    - ø2 & ø6 (if ø1 is Prot/Perm, FRA, Omitted)
  - Preempt 2:
    - ø2 & ø5 (if ø5 is Prot-Only)
    - ø2 & ø6 (if ø5 is Prot/Perm, FRA, Omitted)
  - Preempt 3:
    - ø3 & ø8 (if ø3 is Prot-Only)
    - ø4 & ø8 (if ø3 is Prot/Perm, FRA, Omitted)
    - ø3 (if Split Phased)
  - Preempt 4:
    - ø4 & ø7 (if ø7 is Prot-Only)
    - ø4 & ø8 (if ø7 is Prot/Perm, FRA, Omitted)
    - ø4 (if Split Phased)

m50/m60 Priority Data Page

m60 PRIORITY PREEMPT DATA PAGE

PRIORITY DETECTION **NOT USED**

PRIORITY SERVICE

	PREEMPT 1	PREEMPT 2	PREEMPT 3	PREEMPT 4	PREEMPT 5	PREEMPT 6
CO-PHASE (PHASES FOR PRIORITY)	1 **2** 3 4 X X 5 **6** 7 8	1 **2** 3 4 X X 5 **6** 7 8	1 2 **3** 4 X 5 6 7 8	1 2 3 **4** X 5 6 7 8	1 2 3 4 5 6 7 8	1 2 3 4 5 6 7 8
EXCL	1	1	1	1		
MIN WALK +	0	0	0	0		
MIN GRN	5	5	5	5		
MAX GRN	255	255	255	255		
N-LOUT	1	1	1	1		
LOUT A	1	1	1	1		
LOUT B	1	1	1	1		

PRIORITY TRANSIT SIGNAL **NOT USED**

PRIORITY LEVEL / MISC +

	PRIORITY 1	PRIORITY 2	PRIORITY 3	PRIORITY 4	PRIORITY 5	PRIORITY 6
LEVEL	2	2	2	2		

PRIORITY PARTIAL DATA + **NOT USED**

PRIORITY FULL DATA +

	PRIORITY 1	PRIORITY 2	PRIORITY 3	PRIORITY 4	PRIORITY 5	PRIORITY 6
FP WAIT	0	0	0	0		
FPW LVL	1	1	1	1		
FPW OVR	0	0	0	0		
FRC FUL	1	1	1	1		
PHS OMIT	1 **2** **3** **4** 5 **6** **7** **8**	1 **2** **3** **4** 5 **6** **7** **8**	1 **2** **3** **4** 5 **6** **7** **8**	1 **2** **3** 4 5 **6** **7** **8**	1 2 3 4 5 6 7 8	1 2 3 4 5 6 7 8

PRIORITY RECOVERY +

	PRIORITY 1	PRIORITY 2	PRIORITY 3	PRIORITY 4	PRIORITY 5	PRIORITY 6
METHOD	2	2	2	2		
RETURN	1	1	1	1		
PED WAIT	0	0	0	0		
PED OVR	0	0	0	0		
RECOVERY PHASES	1 **2** 3 4 5 **6** 7 8	1 **2** 3 4 5 **6** 7 8	1 **2** 3 4 5 **6** 7 8	1 **2** 3 4 5 **6** 7 8	1 2 3 4 5 6 7 8	1 2 3 4 5 6 7 8

PRIORITY QUEUE MONITOR + **NOT USED**

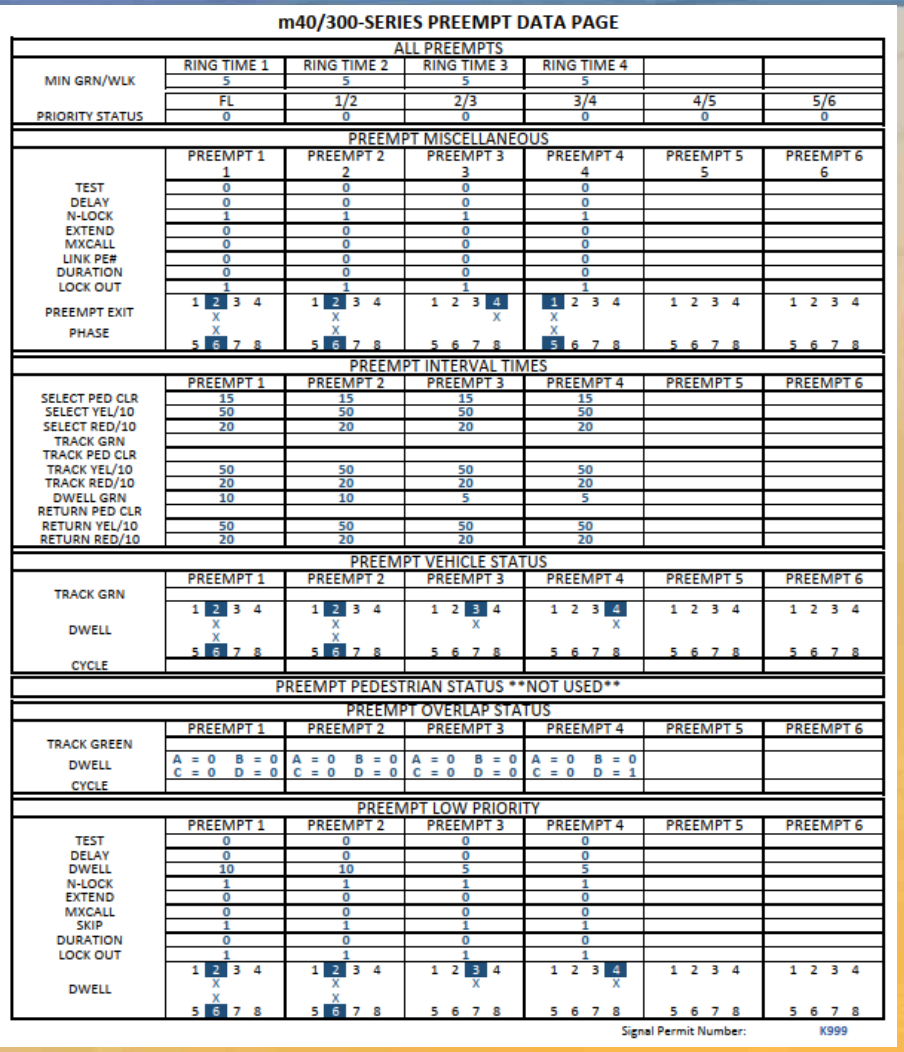
PRIORITY DATA BANK COPY **NOT USED**

PRIORITY SEL DATA BANK (SET TO 1)

Signal Permit Number: N999

- CO-PHASE:
  - The same as Preempt Vehicle "DWELL" except turn phases are not considered
  - i.e. ø2/ø6 on Preempt 1 instead of ø1/ø6
- PHS OMIT: the exact opposite of CO-PHASE (auto-populated)
- RECOVERY PHASES: always the coordinated phases (auto-populated)

m40/300-Series Priority Data Page



m40/300-SERIES PREEMPT DATA PAGE

ALL PREEMPTS

	RING TIME 1	RING TIME 2	RING TIME 3	RING TIME 4		
MIN GRN/WLK	5	5	5	5		
	FL	1/2	2/3	3/4	4/5	5/6
PRIORITY STATUS	0	0	0	0	0	0

PREEMPT MISCELLANEOUS

	PREEMPT 1	PREEMPT 2	PREEMPT 3	PREEMPT 4	PREEMPT 5	PREEMPT 6
	1	2	3	4	5	6
TEST	0	0	0	0		
DELAY	0	0	0	0		
N-LOCK	1	1	1	1		
EXTEND	0	0	0	0		
MXCALL	0	0	0	0		
LINK PE#	0	0	0	0		
DURATION	0	0	0	0		
LOCK OUT	1	1	1	1		
PREEMPT EXIT	1 [2] 3 4	1 [2] 3 4	1 2 3 [4]	[1] 2 3 4	1 2 3 4	1 2 3 4
	X	X	X	X		
PHASE	X	X		X		
	5 [6] 7 8	5 [6] 7 8	5 6 7 8	[5] 6 7 8	5 6 7 8	5 6 7 8

PREEMPT INTERVAL TIMES

	PREEMPT 1	PREEMPT 2	PREEMPT 3	PREEMPT 4	PREEMPT 5	PREEMPT 6
SELECT PED CLR	15	15	15	15		
SELECT YEL/10	50	50	50	50		
SELECT RED/10	20	20	20	20		
TRACK GRN						
TRACK PED CLR						
TRACK YEL/10	50	50	50	50		
TRACK RED/10	20	20	20	20		
DWELL GRN	10	10	5	5		
RETURN PED CLR						
RETURN YEL/10	50	50	50	50		
RETURN RED/10	20	20	20	20		

PREEMPT VEHICLE STATUS

	PREEMPT 1	PREEMPT 2	PREEMPT 3	PREEMPT 4	PREEMPT 5	PREEMPT 6
TRACK GRN						
DWELL	1 [2] 3 4	1 [2] 3 4	1 2 [3] 4	1 2 3 [4]	1 2 3 4	1 2 3 4
	X	X	X	X		
CYCLE	X	X				
	5 [6] 7 8	5 [6] 7 8	5 6 7 8	5 6 7 8	5 6 7 8	5 6 7 8

PREEMPT PEDESTRIAN STATUS **NOT USED**

PREEMPT OVERLAP STATUS

	PREEMPT 1	PREEMPT 2	PREEMPT 3	PREEMPT 4	PREEMPT 5	PREEMPT 6
TRACK GREEN						
DWELL	A = 0 B = 0	A = 0 B = 0	A = 0 B = 0	A = 0 B = 0		
	C = 0 D = 0	C = 0 D = 0	C = 0 D = 0	C = 0 D = 1		
CYCLE						

PREEMPT LOW PRIORITY

	PREEMPT 1	PREEMPT 2	PREEMPT 3	PREEMPT 4	PREEMPT 5	PREEMPT 6
TEST	0	0	0	0		
DELAY	0	0	0	0		
DWELL	10	10	5	5		
N-LOCK	1	1	1	1		
EXTEND	0	0	0	0		
MXCALL	0	0	0	0		
SKIP	1	1	1	1		
DURATION	0	0	0	0		
LOCK OUT	1	1	1	1		
DWELL	1 [2] 3 4	1 [2] 3 4	1 2 [3] 4	1 2 3 [4]	1 2 3 4	1 2 3 4
	X	X	X	X		
	X	X				
	5 [6] 7 8	5 [6] 7 8	5 6 7 8	5 6 7 8	5 6 7 8	5 6 7 8

Signal Permit Number: K999

- Included if m40/300-Series controller is used
- Sheet is hidden by default and is auto-populated using previous m60 sheets, so no need to fill it out
- Will be printed by TMC if needed

Intersection Notes

INTERSECTION NOTES

1	PHASES 1 & 5 ARE PROTECTED-PERMISSIVE (5-SECTION) LEFT TURNS
2	PEDS ARE COUNTDOWN DISPLAYS
3	YELLOW TRAP MODIFY: PHASE 1 OMITTED BY PHASE 2 GREEN; PHASE 5 OMITTED BY PHASE 6 GREEN
4	OCAL = 4 OCAL = 4
5	SYSTEM LOOPS
6	PREEMPT: TRANS (PRIORITY) = EB + WB, NB OR SB
7	EMERG (PREEMPT) = EB + WB, NB OR SB
8	
9	
10	
11	
12	
13	
14	
15	EPAC MUST BE m60 3.58f+

DESIGNED BY: **CHECKED BY:**

PRINT NAME PRINT NAME

RECOMMENDED BY:

PRINT NAME

SIGNATURE DATE

APPROVED BY:

GENE S DONALDSON

PRINT NAME

SIGNATURE DATE

CHIEF OF TRAFFIC ENGINEERING:

PETER HAAG, PE

PRINT NAME

SIGNATURE DATE

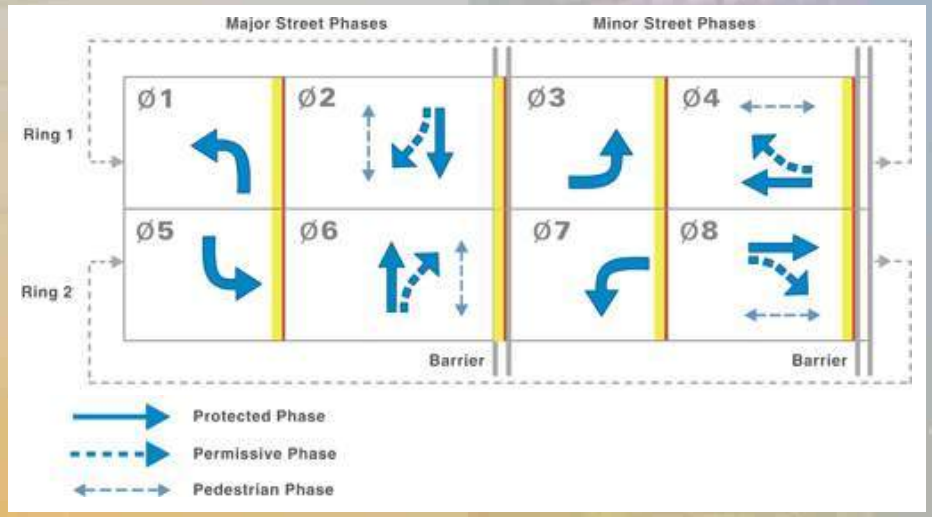
Signal Permit Number: K999

- Generally, this page describes characteristics of the signal operation/equipment or to reinforce/clarify non-standard settings
- Sets of commonly used notes are available in a separate excel file

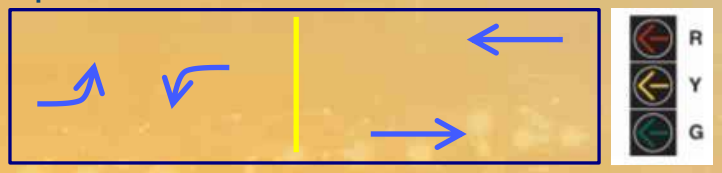
*****Do not complete the "Detector Page" sheet – it is the field sheet for the installer**

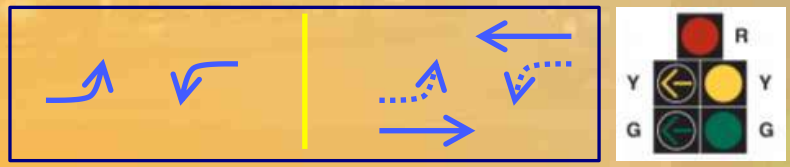
Signal Phasing Basics

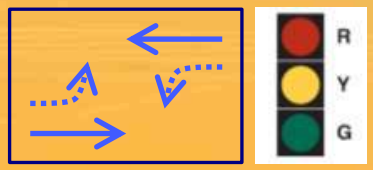
- National Electrical Manufacturers Association (NEMA) standard
  - Major street thrus – Ø2 & Ø6
  - DelDOT – Ø2 is NB or EB
  - Barriers separate major and minor street movements
  - Ped phases share a phase number with the nearest parallel thru phase

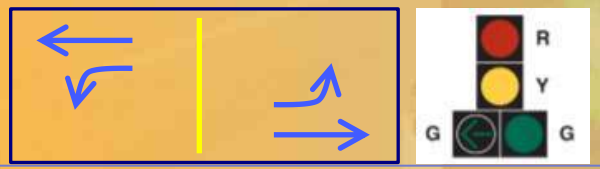


- Terminology:
  - Protected-only
  - Protected-permissive
  - Concurrent
  - Split

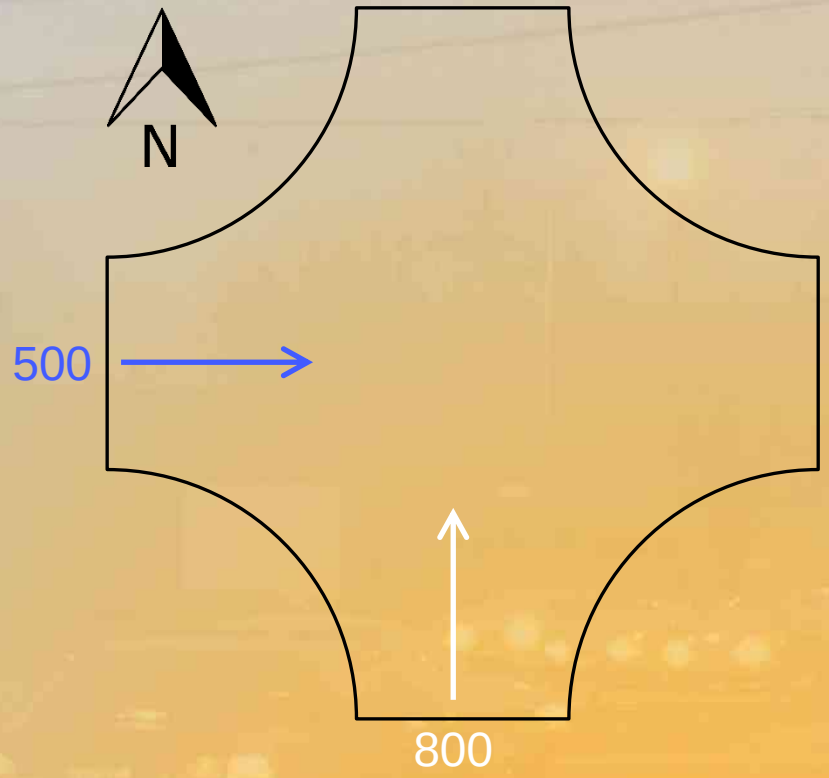








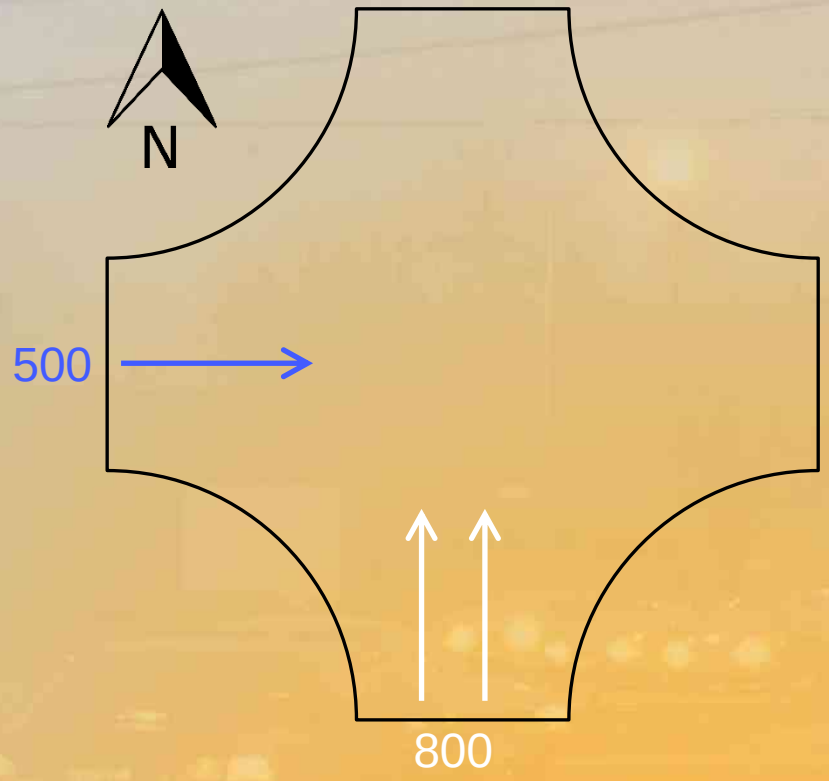
Critical Movement Summation



- Use hour-long turning movement count data
- Also called Critical Lane Volume (CLV) analysis
- Determines how much conflicting volume must be “served” to clear the intersection
- Signal phasing, number of lanes and lane assignment all factor into the calculation

800 + 500 = **1,300**

Critical Movement Summation



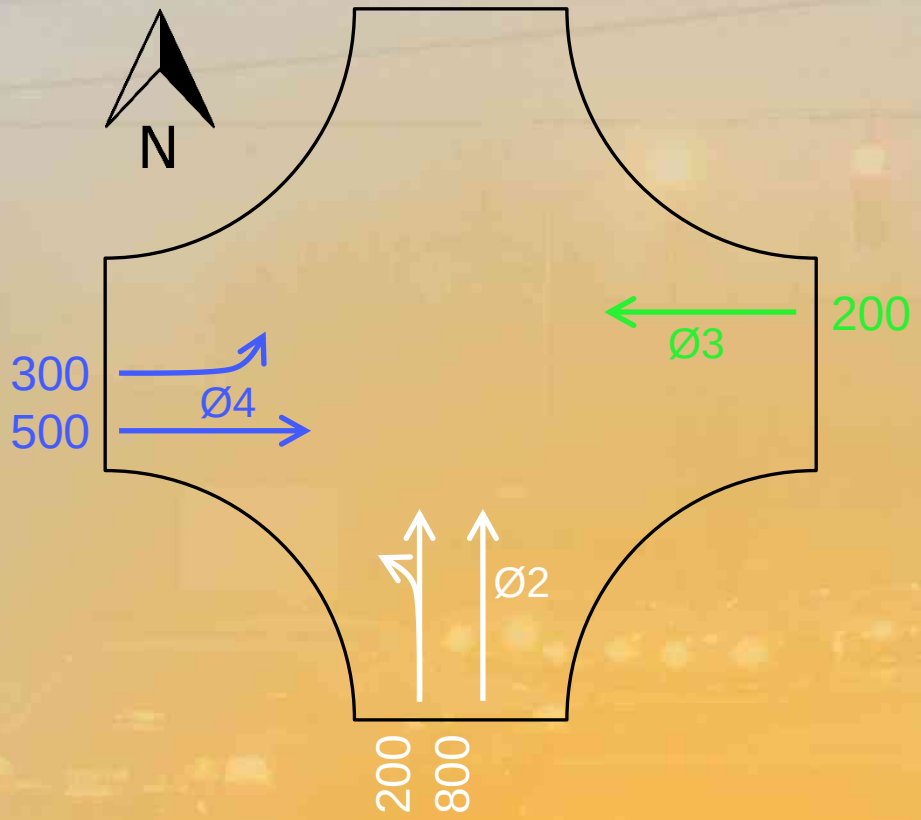
- If a movement has more than one lane provided, a lane factor is applied:

Lanes	Factor
1	1.00
2	0.55
3	0.40
4	0.30

- This accounts for slightly less-than-ideal lane usage (e.g., 55%/45% volume split in two lanes vs. even 50%/50% split)

800(0.55) + 500 = **940**

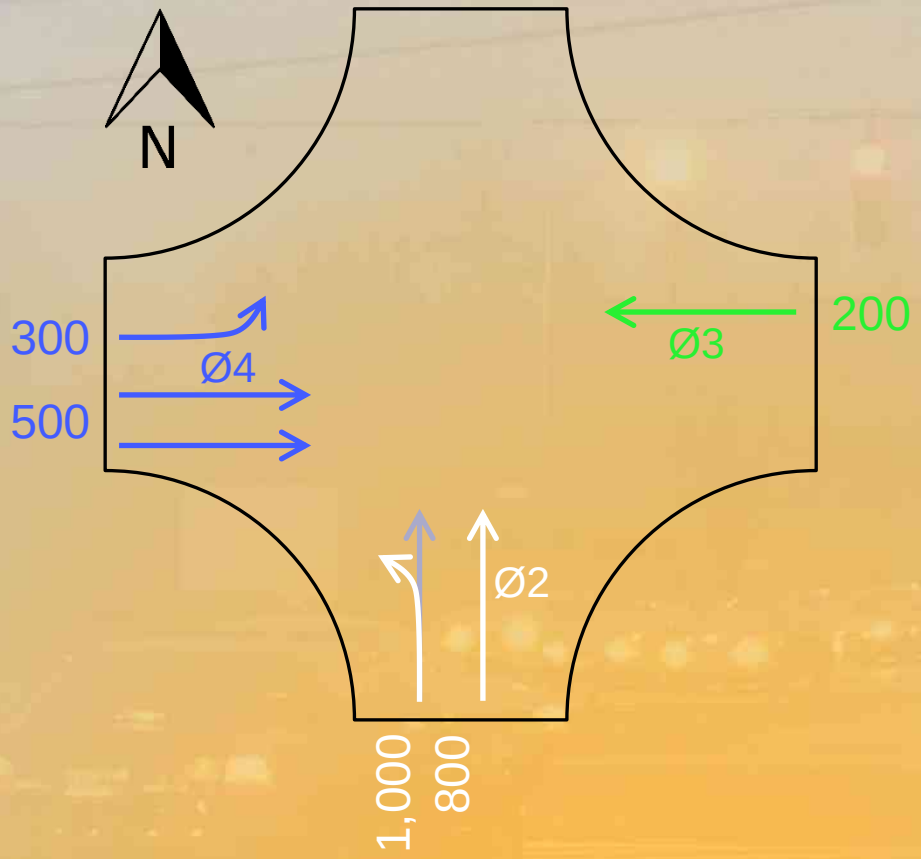
Critical Movement Summation



- Within a single phase:
  - If two movements share a lane, their volumes are added prior to applying a lane factor – motorists will typically occupy available lanes evenly **if possible**
  - If exclusive lanes are provided, only the **maximum lane volume** is included in the summation – these movements clear at the same time, so the critical volume is whichever movement takes the longest to clear

(800+200)(0.55) + 200 + 500 = **1,250**

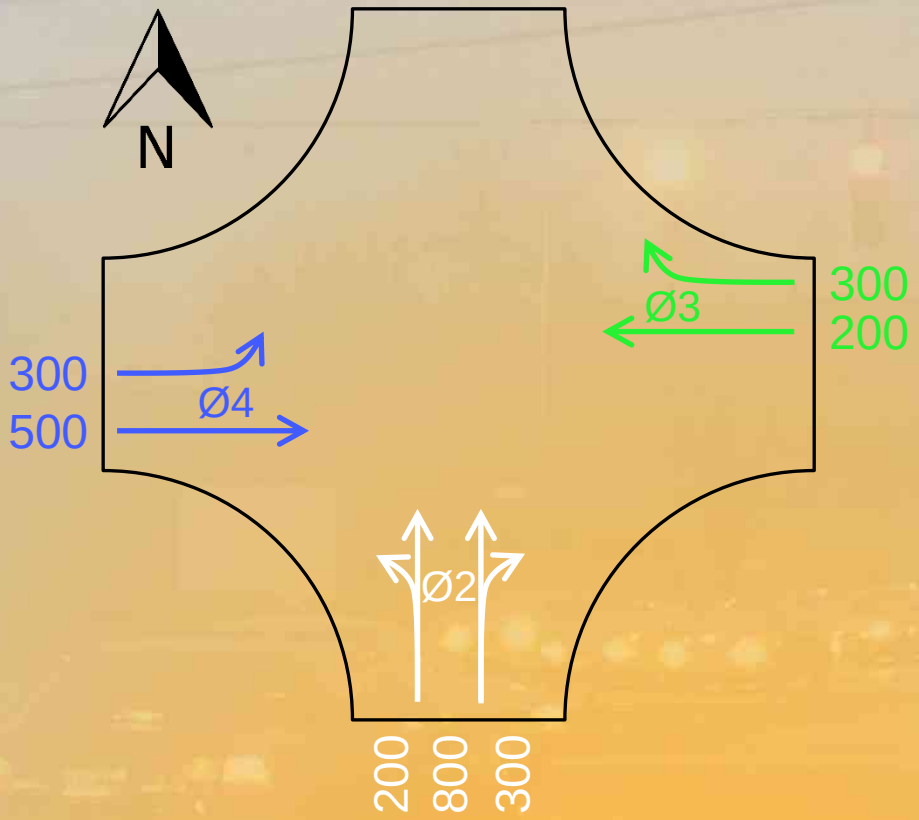
Critical Movement Summation



- But…be aware:
  - A shared lane could be “filled” by one of the shared movements, where it effectively functions as an exclusive lane(s)
  - Make sure to apply lane factors prior to “comparing” different movements using the same phase

1,000 + 200 + 300 = **1,500**

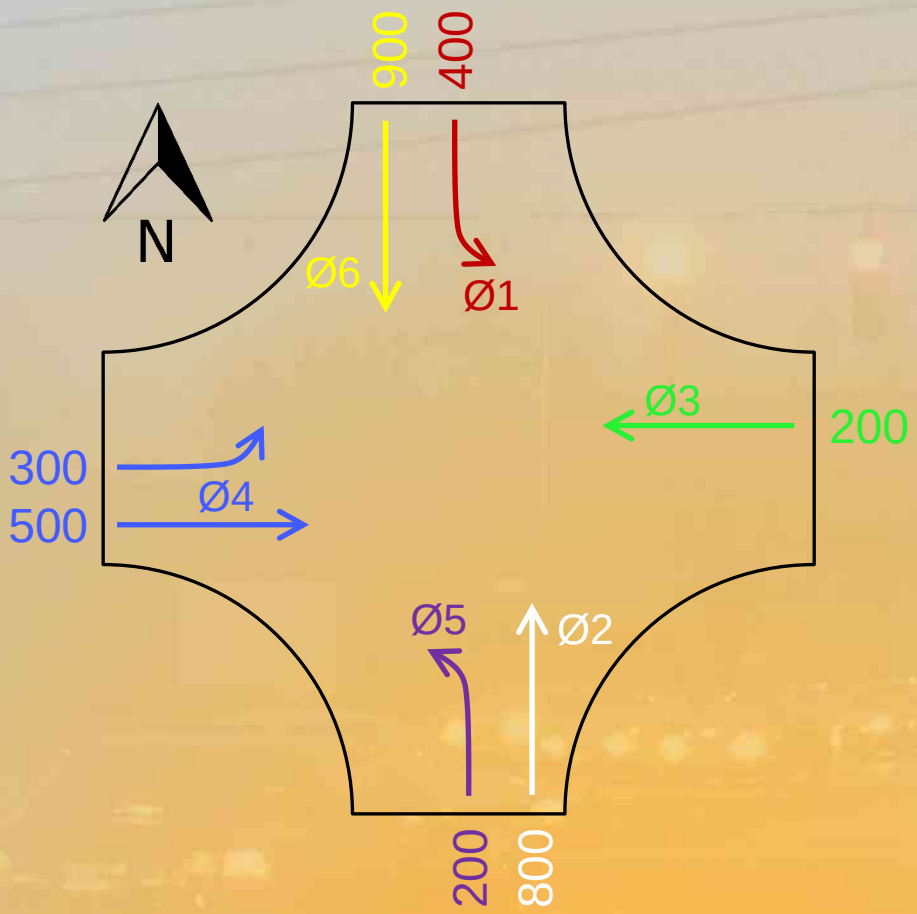
Critical Movement Summation



(800+200+300)(0.55) + 200 + 500 = **1,415**

- Right turns are included in the summation if they are in a shared lane
- Typically, right turns with an exclusive right-turn lane are excluded from the analysis
- Engineering judgement can be used in some scenarios to include all or part of a right-turn volume:
  - No Turn on Red restriction
  - Very short right-turn storage
  - Extremely high volume
  - Exclusive phase provided (or overlap phase)

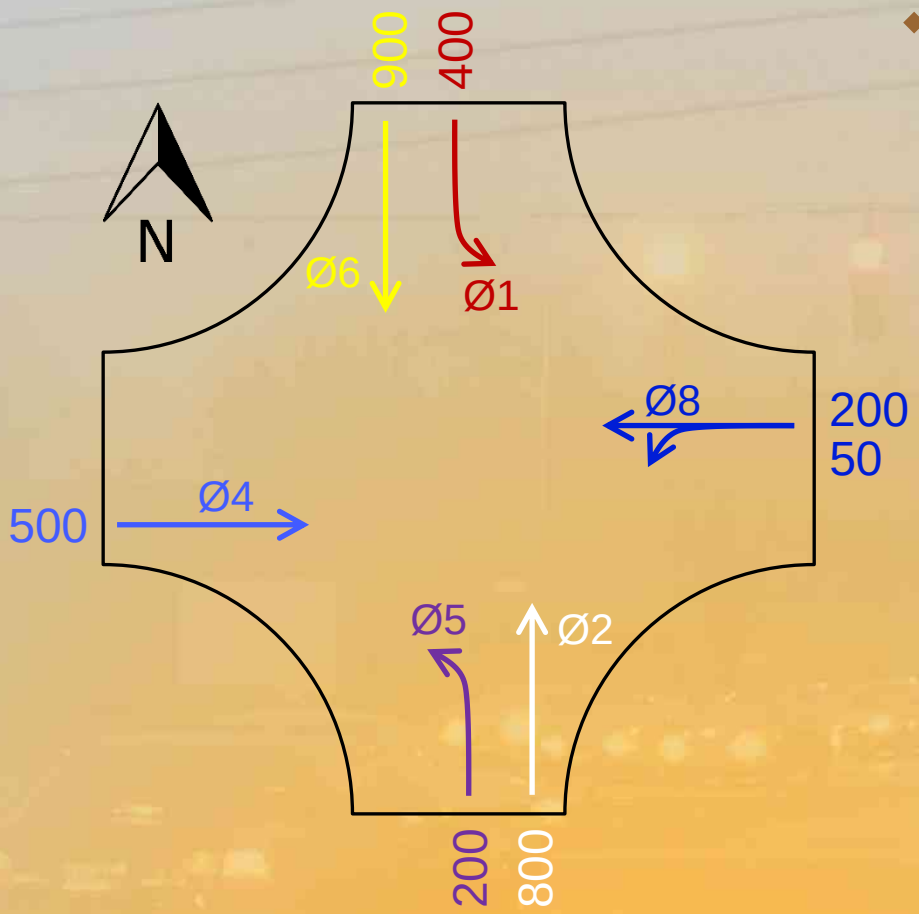
Critical Movement Summation



400 + 800 + 200 + 500 = **1,900**

- Typical major-street operation example:
  - Many movements can overlap/happen concurrently (e.g., NBL can go with SBL or NBT without being in conflict)
  - Two pairs of movements do conflict and typically occur sequentially:
    - NBL followed by SBT
    - SBL followed by NBT
  - Whichever phase "pair" has the largest critical volume are the "critical phases"
    - 200 + 900 = 1,100
    - **400 + 800 = 1,200**

Critical Movement Summation



400 + 800 + (500+50) = **1,750**

- Concurrent example:
  - When no (or only one) left-turn phases are provided, conflicting movements can operate within the same phase or concurrent phases
  - Standard practice is to add "opposing left" volume to the phase being analyzed
    - For example, EBT would clear followed by WBL yielding to the EBT
  - Shared lanes can introduce some uncertainty
    - Worst case would be all lane volume is "blocked" behind yielding lefts
    - Typically, bypassing is possible or left volume is low enough that blocking is uncommon

Using CMS in Practice

- Level of service (LOS) can be approximated based on total critical volume
  - Only recommended as a “ballpark” estimate (i.e., the intersection is likely below/near/over capacity)
  - Does not replicate/replace delay & LOS estimates from modeling software
- Knowing each phase’s critical volume as a percent of the intersection’s critical volume can help to assign phase split times as a percent of the full cycle length
  - Does not account for signal timing parameters (minimums, change/clearance intervals)
  - No way to pinpoint proper cycle length

LOS	Critical Movement Volume
A	Less than 1,000 veh/hr
B	1,000 to 1,150 veh/hr
C	1,151 to 1,300 veh/hr
D	1,301 to 1,450 veh/hr
E	1,451 to 1,600 veh/hr
F	More than 1,600 veh/hr

Using CMS in Practice

Typical cycle lengths to consider:
60, 75, 90, 100, 120, 150

Greenshields' Model

Timesheet Data

Cycle Length = 120 seconds
30 cycles per hour

Phase	Movement	Volume	Lane Factor	Critical Volume	Vehicles Per Cycle	Green Required	Min Green	Clearance (Y + R)	Total Split	Critical Movement
Foulk Rd										
1	SB L	116	1.00	116	4	12	5	5.0	17	
2	NB	456	0.55	251	8	21	10	7.0	28	
5	NB L	93	1.00	93	3	10	5	5.0	15	*
6	SB	666	0.55	366	12	29	10	7.0	36	*
Shipley Rd										
3	EB L	106	1.00	106	4	11	5	5.0	16	*
4	WB	491	1.00	491	16	38	5	6.0	44	*
7	WB L	20	1.00	20	1	5	5	5.0	11	
8	EB	407	1.00	407	14	32	5	6.0	38	
Totals				1056				23	111	

Analysis covered to this point

Relates volumes to signal timings

Required time to clear vehicles per above cycle length; Should be ≤ cycle

Using CMS in Practice

- Recommend split times for implementation based on CMS required splits

Phase	Movement	Total Split	Critical Movement	120" SB Foulk
1	SB L	17		17
2	NB	28		43
5	NB L	15	*	15
6	SB	36	*	45
3	EB L	16	*	16
4	WB	44	*	44
7	WB L	11		11
8	EB	38		49
Totals		111		120

  - Typically, assign time to critical phases first, then fill out rest of phases
  - In this example, “extra time” was all allocated to phase 6; phases 3, 4, and 5 were not given more than needed per CMS
  - Occasionally, protected/permissive phases are a good place to “cheat” time when assigning splits since some vehicles can turn on permissive
  - Also remember that unused minor phase split time is “returned” to coordinated phases (typically)
  - Make sure min times are covered!

Minimum Split Times

- All phases have minimum vehicular programmed split:
  - PH MIN VEH SERV = MIN GRN + YELLOW + ALL-RED + 1 (extra second for coordination purposes)
- Pedestrian phases have minimum service times:
  - Coordinated phase with ped phase
    - PH MIN PED SERV = WALK + PED CLR + YELLOW (if EXT PCL = 0) + ALL-RED + 1 (extra second for coordination purposes)
    - **Split times MUST cover ped phases for coordinated movements**
  - Minor phase with ped phase
    - PH MIN PED SERV = WALK + PED CLR + YELLOW (if EXT PCL = 0) + ALL-RED
    - Split times *do not need* to cover minor movement ped phases, but consideration for frequency of actuation/number of pedestrians served should be taken into account when deciding to cover or not cover a ped phase

Questions

Thank you!

Questions?

Contacts:

Steve Harr
WRA
sharr@wrallp.com

Kevin Konzelman
WRA
kkonzelman@wrallp.com