Technical Memorandum

Date: May 12, 2020
To: Peter Haag
From: Mir Wahed and Joanne Arellano
CC: Chris Sylvester, Max Saintil, Ryan Kusy, Yahya Kenarangi
Project: Pavement and Rehabilitation Design Services
RE: Memorial Drive Before and After Study
Contract No: T201806201
JMT Project No: 17-13205-500

The purpose of this technical memorandum is to review the traffic and safety impacts along Memorial Drive from the US Route 13 intersection to the Delaware Route 9 intersection before and after implementation of the road diet. Memorial Drive was converted from a four-lane section roadway to a two-lane section as part of the *Pavement and Rehabilitation North, 2019 project (DelDOT Contract No. T201806201).* The road diet was implemented on October 18, 2019. This document will summarize before and after results of the road diet installation based on travel time, spot speed, traffic analysis, and crash evaluation.

Background

Memorial Drive is classified as a minor arterial roadway with an AADT of approximately 9,000 vehicles per day and a posted speed limit of 35 miles per hour. Memorial Drive is divided by a concrete median, terminates to the east with its intersection with Delaware Route 9 and terminates to the west with its intersection with US Route 13. Prior to the road diet, within this segment, Memorial Drive was a four-lane roadway. The study area is surrounded primarily by residential uses and four roadways (Lind Avenue, Bizarre Drive, Karlyn Drive, and Parma Avenue) intersect with Memorial Drive to form five unsignalized intersections (Karlyn Drive intersects with Memorial Drive twice). DART Bus Route 14 also traverses along the roadway and has stops at each of those unsignalized intersections. Driveways to single family homes, on-street parking, and sidewalks exist along both sides of the roadway.

As part of the Memorial Drive Pavement and Rehabilitation design service, DelDOT implemented a road diet which converted the roadway from a four-lane section to a two-lane section to improve safety for pedestrians seeking to cross the street as well as a five-foot bike lane and nine-foot curbside parking in each direction. The Before and After study has been conducted to evaluate the operational and safety impacts of the road diet. The before study results contained in this memorandum are taken from the June 18, 2018 Memorial Drive Technical Memorandum prepared by JMT.

Capacity Analysis Methodology

Traffic observations along the corridor were conducted on Tuesday, May 7, 2019 which was prior to the construction of the road diet and during a typical weekday morning, afternoon and evening peak period when all schools were in session. The maximum queue lengths along each approach at the study intersections from the May 7, 2019 observations were compared to the queue results from the June 18, 2018 Memorial

Drive Traffic Study Technical Memorandum and were found to be consistent with each other. As such, the before study results are from the June 18, 2018 Memorial Drive Traffic Study Technical Memorandum.

Traffic counts and observations for the after study were conducted on Thursday, January 16, 2020 which was after the completion of the road diet construction and during a typical weekday morning, afternoon and evening peak period when all schools were in session. Data and traffic observations were collected during the afternoon peak period as this is the time period when schools in the area are dismissed. Figures summarizing the volumes utilized in the before and after study are included in Appendix A. It should be noted that the Delaware Route 9/Halcyon Drive intersection was closed due to construction during the January 2020 traffic counts with traffic detoured to utilize the Memorial Drive/Lind Avenue intersection to access Halcyon Drive. As such, the traffic volumes marked by an asterisk were based on the volumes from the June 18, 2018 Memorial Drive Traffic Study Technical Memorandum.

Synchro software was utilized to conduct the traffic analysis. Appendix B summarizes the AM and PM peak hour delay and queue results for before and after implementation of the road diet. The afternoon peak period was not analyzed as the PM peak period contained higher volumes.

During the AM and PM peak periods the study intersections operate at acceptable Level of Service (LOS) C or better before implementation of the road diet and at acceptable LOS D or better after implementation of the road diet. Queue lengths at the unsignalized intersections are minimal before and after construction. Specifically, the calculated 95th percentile queue lengths along the minor streets are approximately 20 feet before implementation and approximately 30 feet after implementation. Please see Appendix B for additional information. The queue tables within Appendix B also include a comparison between the observed queues from field observations and the calculated queues from the Synchro results. Based on the comparison, most of the observed queues at the unsignalized intersections were found to be longer than the calculated queues but were noted to dissipate quickly without impacting operations along any adjacent intersections.

At the signalized intersection of US Route 13 with Memorial Drive, the calculated 95th percentile queue lengths are comparable between the before and after implementation conditions. However, at the signalized intersection of Delaware Route 9 with Memorial Drive, queue lengths were increased along the eastbound and westbound Memorial Drive left turn/through lanes as well as along the northbound Delaware Route 9 left turn lane. These increases were also consistent with the observed queue lengths. The increased queue length along the northbound Delaware Route 9 left turn lane could be accommodated within the provided storage length and the increased queue length along the eastbound Memorial Drive left turn/through lane would not spillback onto the Lind Avenue intersection. The increased queue length along the westbound Memorial Drive left turn/through lane would spillback past the motel entrance.

Travel Time Study

JMT collected travel times along the Memorial Drive corridor, from US Route 13 to the Delaware Route 9 intersections in each direction during the weekday morning, afternoon, and evening peak periods. Table 1 summarizes the travel times for before and after implementation of the road diet. The before implementation travel times were collected on Tuesday, May 7, 2019 and the after-implementation travel times were collected

on Thursday, January 9, 2020 and Thursday, January 16, 2020. Schools were in session during the data collection.

Table 1: Travel Time Results

Beginning Intersection	Ending Intersection	Peak Period	Before Implementation Time (sec)	After Implementation Time (sec)
Memorial Drive/Delaware Route 9	Memorial Drive/US Route 13	AM	98	104
		Afternoon	95	102
		PM	96	105
		Average	96	104
Memorial Drive/US Route 13	Memorial Drive/Delaware Route 9	AM	98	103
		Afternoon	98	103
		PM	99	102
		Average	98	103

Speed Study

JMT conducted a spot speed study along eastbound and westbound Memorial Drive in accordance with the Institute of Transportation Engineers (ITE) standards for before and after implementation of the road diet. The spot speed study was performed at one location between the Parma Avenue and Karlyn Drive intersections utilizing ATR (Automatic Traffic Recorder) devices. The posted speed limit along this section of roadway is 35 miles per hour.

The before study was based on data collected from Tuesday, May 7, 2019 to Friday, May 17, 2019 during the hours of 10:00 a.m. to 2:00 p.m. when traffic was more free flowing. Based on the data, the 85th percentile speed before implementation of the road diet was 45 miles per hour. Due to a malfunction with the ATR equipment during the January 2020 data collection efforts and the current Covid-19 situation, speed data could not be collected for the after study. However, as the travel time results showed a slight increase in travel time it could be expected that there would be a slight decrease in speed. Updated speed data information may be collected once traffic patterns appear more typical.

NCHRP 562 - Midblock Crossing Evaluation

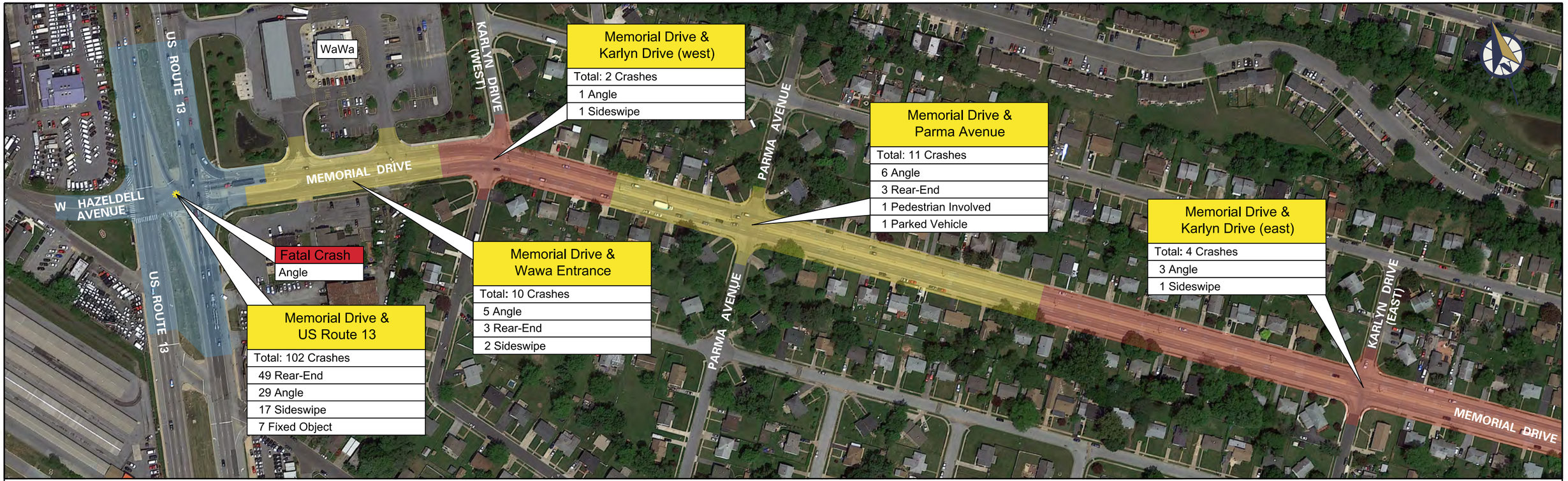
Per the June 18, 2018 Memorial Drive Traffic Study Technical Memorandum, “crosswalk” pedestrian treatments were recommended at the Memorial Drive intersections with Karyln Drive (west), Parma Avenue, Karlyn Drive (east), Lind Avenue, and Bizarre Drive under 2018 conditions with or without the provision of a median for a two-stage crossing and utilizing the 35 miles per hour travel speed consistent with the posted speed limit. A “crosswalk” treatment as defined in NCHRP Report 562 is a marked crosswalk with just pavement markings. For the final design with the implementation of the road diet, crosswalks were installed at the Karlyn Drive (west), Parma Avenue, Karlyn Drive (east), and Bizarre Drive intersections and two-stage crossings were not provided.

Utilizing the after implementation volumes, the crossing distance from the road diet and a 35 miles per hour travel speed consistent with the posted speed limit, “crosswalk” pedestrian treatments are recommended at each unsignalized intersection without the provision of a two-stage crossing. An additional analysis was conducted utilizing a 45 miles per hour travel speed consistent with the speed study results and “active or enhanced” pedestrian treatments are recommended at each unsignalized intersection. An “active or enhanced” treatment is defined in NCHRP Report 562 as a device that enhances the visibility of the crossing location and pedestrians and include warning signs, pavement markings, in-roadway warning lights, or overhead flashing amber beacons. For the final design, pedestrian warning and school crossing signs at and ahead of the crosswalks were recommended and were confirmed to be installed in the field providing “enhanced” treatments. Appendix C contains the NCHRP Report 562 worksheets completed for each intersection as part of the after-implementation evaluation.

Crash Evaluation

In the June 18, 2018 Memorial Drive Traffic Study Technical Memorandum, JMT reviewed crash data along Memorial Drive from the US Route 13 to the Delaware Route 9 intersections from April 2015 to April 2018. As summarized on Figure 1, a total of 205 crashes during the three-year study period were reported. Out of the 205 crashes, 37 crashes occurred in the study area from the Wawa Entrance to Lind Avenue (excludes the incidents reported at the US Route 13 and Delaware Route 9 signalized intersections).

For the crash evaluation after implementation of the road diet JMT reviewed crash data from October 2019 to February 2020. As summarized on Figure 2, a total of 23 crashes during the four-month study period were reported. Out of the 23 crashes, 6 crashes occurred in the study area from the Wawa Entrance to Lind Avenue and one was a fatal crash which involved a southbound vehicle at the Karlyn Drive (east) intersection who failed to yield to right-of-way with a vehicle travelling westbound on Memorial Drive.



PLOTTED BY: YKENARANGI DATE: 5/1/2020
Q:\NDE\150151_000_Traffic_Engineering_\CADD\Task 3-6 MemorialDrive Traffic Analysis\Crash\Crash Diagram 2.dgn

NOT TO SCALE

MEMORIAL DRIVE TRAFFIC STUDY

CRASH DATA
APRIL 2015 – APRIL 2018

FIGURE
1

PLOTTED BY: YKENARANGI DATE: 5/1/2020
C:\Users\ykenarangi\Desktop\Memorial Drive\After Study Crash Diagram 2.dgn

JMT

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MEMORIAL DRIVE TRAFFIC STUDY

CRASH DATA
OCTOBER 2019 – FEBRUARY 2020

FIGURE
2

Table 2 presents the crash summary by manner of impact type before and after implementation of the road diet along Memorial Drive in the study area from the Wawa Entrance to Lind Avenue. As depicted on Table 2, sideswipe crashes as well as incidents with parked vehicles and pedestrians were not reported during the after-implementation crash study period. Appendix D contains the crash data summary tables.

Table 2:
Crash Summary by Manner of Impact Type
Memorial Drive, from Wawa Entrance to Lind Avenue

Manner of Impact	Number of Crashes (percentages within study area)	
	Before Implementation (Based on 3 years of crash data)	After Implementation (Based on 4 months of crash data)
Angle	19 (51%)	1 (17%)
Rear-End	9 (24%)	4 (66%)
Sideswipe	4 (11%)	-
Out of Control*	2 (6%)	1 (17%)
Parked Vehicle	2 (6%)	-
Pedestrian Involved	1 (2%)	-
Total	**37 (100%)**	**6 (100%)**

*The out-of-control incidents were due to drivers losing control of their own vehicles as a result of either speeding, a health condition, or other environmental conditions. These out-of-control incidents resulted in a collision with either the median or a tree.

Gap Study

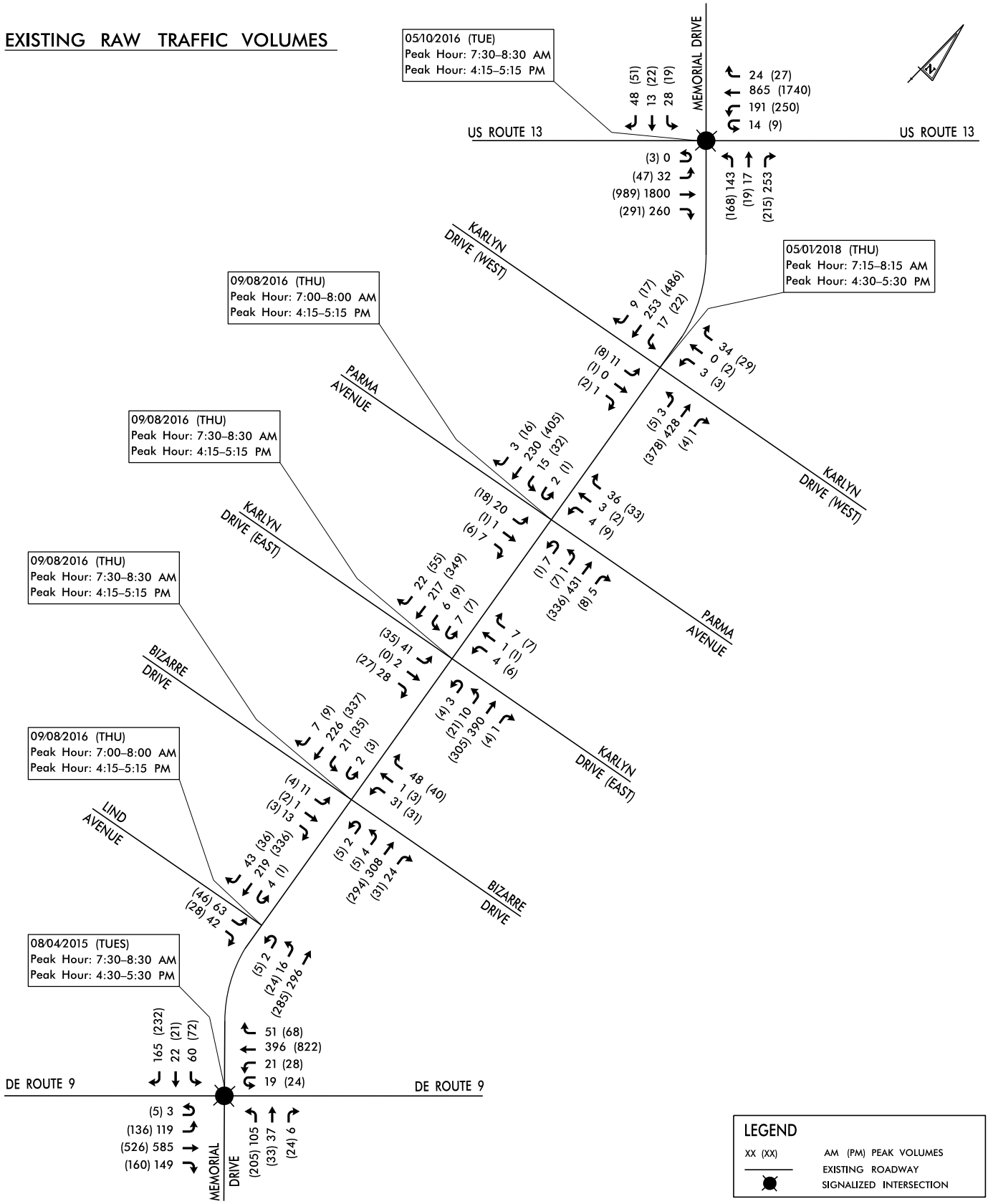
JMT conducted a gap study on Thursday, January 16, 2020 during the morning, afternoon, and evening peak hour at the Memorial Drive intersection with Karlyn Drive (east). The purpose of this study is to determine the availability of appropriate left turn movement gaps from southbound Karlyn Drive (east) during the highest volume peak period. Based on the *Highway Capacity Manual 6th Edition,* Exhibit 20-12 lists the critical gap for a left turn and a through movement from a minor street with two lanes along the major street is 7.1 seconds and 6.5 seconds, respectively. There were 118, 162, and 144 gaps that were 7.1 seconds or longer in duration during the morning, afternoon and evening peak hours, respectively. Appendix E summarizes the gap results.

APPENDIX A
Volume Figures

Before Study

***From the June 18, 2018 Technical Memorandum for the Memorial Drive Traffic Study prepared by JMT**

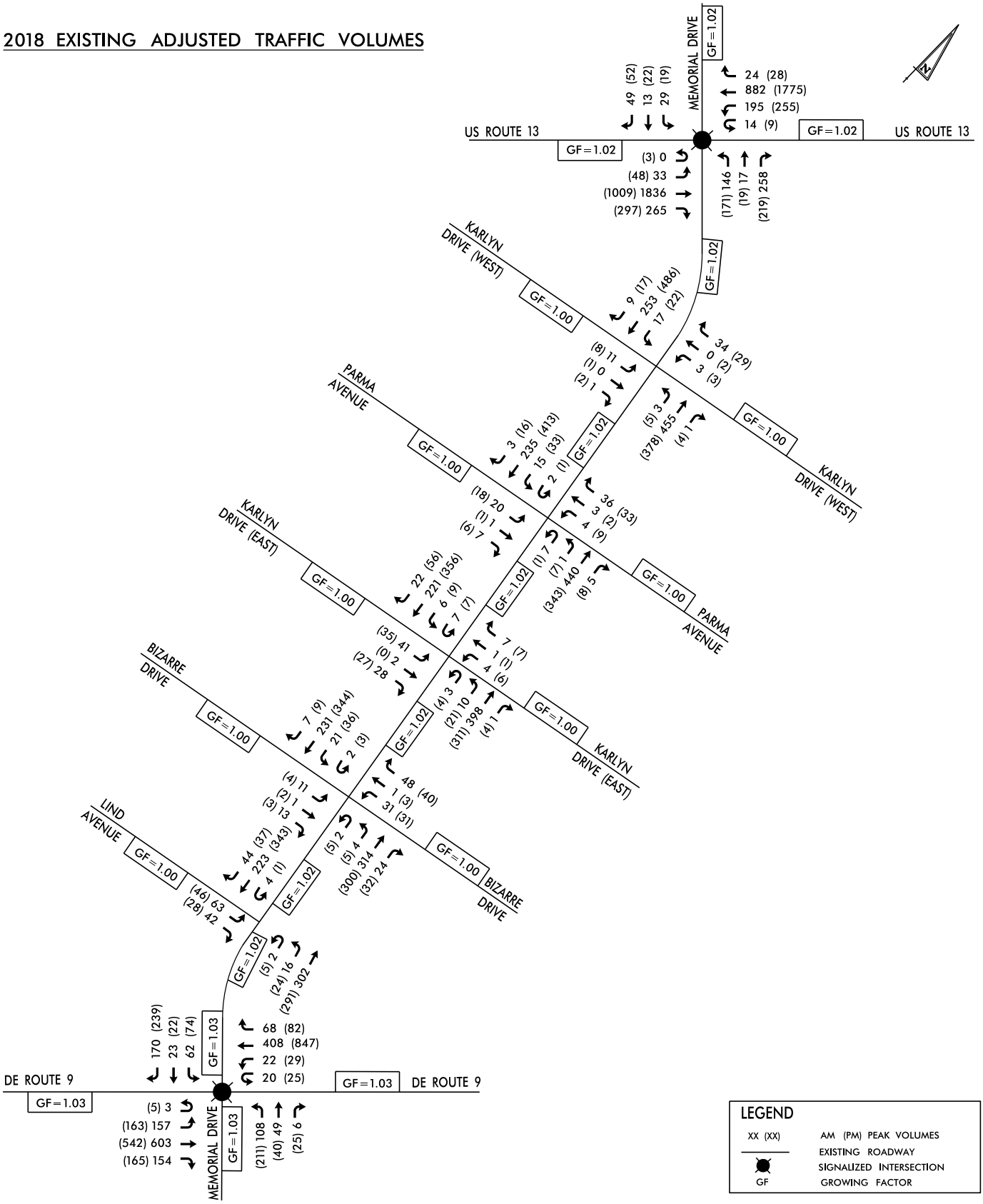
EXISTING RAW TRAFFIC VOLUMES



MEMORIAL DRIVE TRAFFIC STUDY FOR PAVEMENT AND REHABILITATION SERVICES
NEW CASTLE COUNTY, DELAWARE

N.T.S	FIGURE A–1	JUNE 2018

2018 EXISTING ADJUSTED TRAFFIC VOLUMES

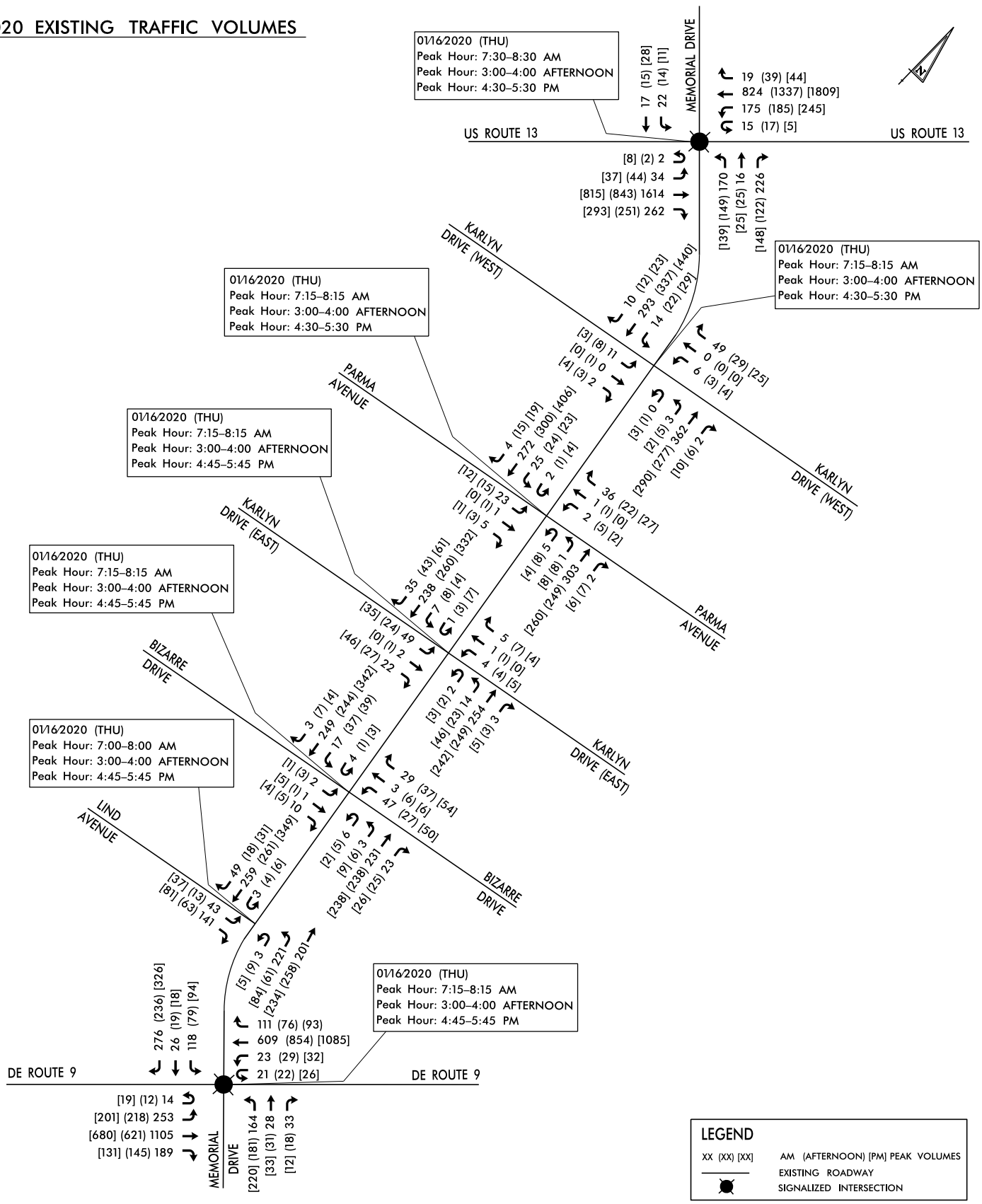


MEMORIAL DRIVE TRAFFIC STUDY FOR PAVEMENT AND REHABILITATION SERVICES
NEW CASTLE COUNTY, DELAWARE

N.T.S	FIGURE A–2	JUNE 2018

After Study

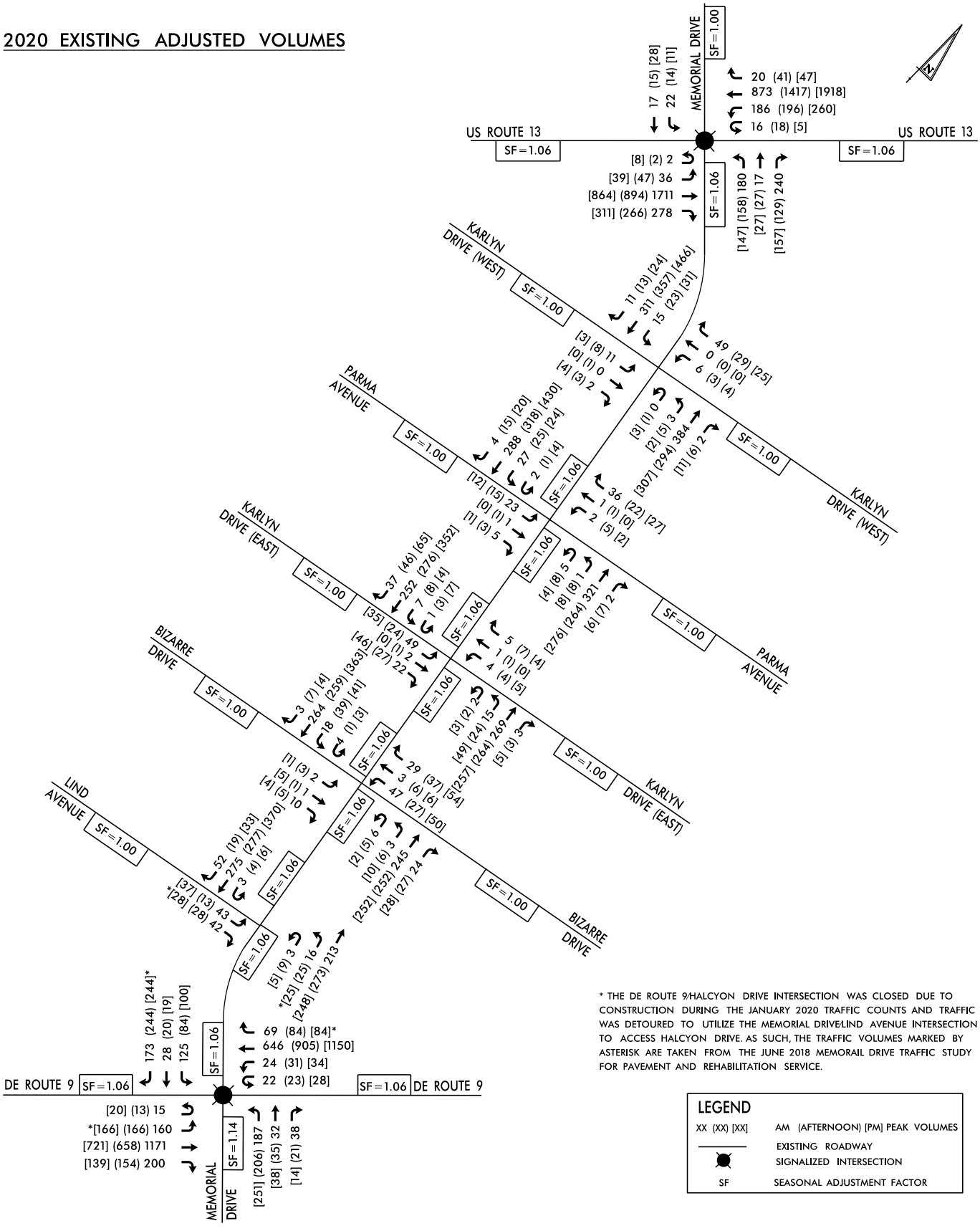
2020 EXISTING TRAFFIC VOLUMES



MEMORIAL DRIVE TRAFFIC STUDY FOR PAVEMENT AND REHABILITATION SERVICES
NEW CASTLE COUNTY, DELAWARE

N.T.S	FIGURE A–1	MAY 2020

2020 EXISTING ADJUSTED VOLUMES



* THE DE ROUTE 9/HALCYON DRIVE INTERSECTION WAS CLOSED DUE TO CONSTRUCTION DURING THE JANUARY 2020 TRAFFIC COUNTS AND TRAFFIC WAS DETOURED TO UTILIZE THE MEMORIAL DRIVE/LIND AVENUE INTERSECTION TO ACCESS HALCYON DRIVE. AS SUCH, THE TRAFFIC VOLUMES MARKED BY ASTERISK ARE TAKEN FROM THE JUNE 2018 MEMORAIL DRIVE TRAFFIC STUDY FOR PAVEMENT AND REHABILITATION SERVICE.

LEGEND

XX (XX) [XX]	AM (AFTERNOON) [PM] PEAK VOLUMES
	EXISTING ROADWAY
	SIGNALIZED INTERSECTION
SF	SEASONAL ADJUSTMENT FACTOR

JMT

MEMORIAL DRIVE TRAFFIC STUDY FOR PAVEMENT AND REHABILITATION SERVICES
NEW CASTLE COUNTY, DELAWARE

N.T.S	FIGURE A–2	MAY 2020

APPENDIX B
Capacity Analysis Results

Signalized Intersection LOS

Intersection	Peak Hour	2018 Before Study		2020 After Study	
		LOS	Delay (sec)	LOS	Delay (sec)
Memorial Drive/US Route 13	AM	C	30.0	D	36.3
	PM	C	26.7	C	27.5
Memorial Drive/Delaware Route 9	AM	C	21.1	C	32.8
	PM	C	28.3	D	36.1

Before LOS (Delay) based on HCM 2010 methodology.

After study LOS (Delay) based on HCM 6th edition methodology.

2018 Before Study results are from the June 18,2018 Technical Memorandum for the Memorial Drive Traffic Study prepared by JMT.

95th Percentile Signalized Queue Results

Intersection	Peak Hour	Movement	Storage (feet)	2018 Before Study Queue (feet)		2020 After Study Queue (feet)	
				Observed Queue	Calculated Queue	Observed Queue	Calculated Queue
Memorial Drive/US Route 13	AM	EBL Memorial Drive	-	75	45	50	37
		WBL Memorial Drive	-	125	121	150	148
		NBL US Route 13	140	0	26	75	38
		SBL US Route 13	190	150	#321	150	#381
	PM	EBL Memorial Drive	-	25	38	50	23
		WBL Memorial Drive	-	50	132	75	#158
		NBL US Route 13	150	50	39	75	40
		SBL US Route 13	150	250	#380	250	#366
Memorial Drive/Delaware Route 9	AM	EBLT Memorial Drive	-	125	74	150	236
		WBLT Memorial Drive	-	100	#182	175	315
		NBL Delaware Route 9	140	25	112	75	134
		SBL Delaware Route 9	190	50	38	50	44
	PM	EBLT Memorial Drive	-	75	96	225	174
		WBL Memorial Drive	-	150	#308	325	#465
		NBL Delaware Route 9	150	75	118	300	#224
		SBL Delaware Route 9	150	75	40	75	57

Notes:

m Volume for 95th percentile queue is metered by upstream signal.

Observed queues are from field observations.

Calculated queues are 95th percentile queue lenghts based on Synchro methodology.

95th percentile volume exceeds capacity, queue may be longer.

2018 Before Study results are from the June 18,2018 Technical Memorandum for the Memorial Drive Traffic Study prepared by JMT.

Unsignalized Intersection LOS

Intersection	Peak Hour	Movement	2018 Before Study		2020 After Study	
			LOS	Delay (sec)	LOS	Delay (sec)
Memorial Drive/Karlyn Drive (west)	AM	EBL Memorial Drive	A	8.5	A	8.3
		WBL Memorial Drive	A	7.8	A	8.0
		NB Karlyn Drive (west) Approach	B	13.9	C	19.0
		SB Karlyn Drive (west) Approach	B	10.7	B	12.5
	PM	EBL Memorial Drive	A	8.2	A	8.0
		WBL Memorial Drive	A	8.5	A	8.4
		NB Karlyn Drive (west) Approach	C	17.8	C	15.7
		SB Karlyn Drive (west) Approach	B	11.2	B	11.9
Memorial Drive/Parma Avenue	AM	EBL Memorial Drive	A	8.5	A	8.1
		WBL Memorial Drive	A	8.7	A	7.9
		NB Parma Avenue Approach	B	13.2	C	18.0
		SB Parma Avenue Approach	B	11.1	B	11.5
	PM	EBL Memorial Drive	A	8.2	A	8.0
		WBL Memorial Drive	A	8.7	A	8.6
		NB Parma Avenue Approach	C	17.2	C	20.6
		SB Parma Avenue Approach	B	12.2	B	10.9
Memorial Drive/Karlyn Drive (east)	AM	EBL Memorial Drive	A	9.1	A	8.0
		WBL Memorial Drive	A	8.6	A	8.1
		NB Karlyn Drive (east) Approach	B	12.9	C	15.5
		SB Karlyn Drive (east) Approach	B	12.0	B	12.9
	PM	EBL Memorial Drive	A	8.6	A	7.9
		WBL Memorial Drive	A	8.7	A	8.5
		NB Karlyn Drive (east) Approach	B	14.5	C	17.1
		SB Karlyn Drive (east) Approach	B	13.3	C	16.1
Memorial Drive/Bizarre Drive	AM	EBL Memorial Drive	A	8.4	A	8.2
		WBL Memorial Drive	A	8.3	A	7.9
		NB Bizarre Drive Approach	B	12.0	B	11.3
		SB Bizarre Drive Approach	B	12.2	C	15.8
	PM	EBL Memorial Drive	A	8.4	A	8.0
		WBL Memorial Drive	A	8.7	A	8.1
		NB Bizarre Drive Approach	C	15.9	C	15.1
		SB Bizarre Drive Approach	B	13.6	C	17.6
Memorial Drive/Lind Avenue	AM	EBL Memorial Drive	A	4.5	A	*
		WBL Memorial Drive	A	8.0	A	8.2
		NB Lind Avenue Approach	B	12.8	B	13.5
	PM	EBL Memorial Drive	A	4.5	A	*
		WBL Memorial Drive	A	8.6	A	8.2
		NB Lind Avenue Approach	B	13.2	B	14.1

Note:

Before study LOS (Delay) based on HCM 2010 methodology.

After study LOS (Delay) based on HCM 6th edition methodology.

*LOS (delay) results not provided by software.

2018 Before Study results are from the June 18,2018 Technical Memorandum for the Memorial Drive Traffic Study prepared by JMT.

Unsignalized Intersection Queue

Intersection	Peak Hour	Movement	2018 Before Study Queue (feet)		2020 After Study	
			Observed Queue	Calculated Queue	Observed Queue	Calculated Queue
Memorial Drive/Karlyn Drive (west)	AM	EBL Memorial Drive	0	3	0	0
		WBL Memorial Drive	0	0	0	0
		NB Karlyn Drive (west) Approach	25	3	25	5
		SB Karlyn Drive (west) Approach	0	5	25	10
	PM	EBL Memorial Drive	0	3	25	3
		WBL Memorial Drive	0	0	0	0
		NB Karlyn Drive (west) Approach	50	3	0	3
		SB Karlyn Drive (west) Approach	0	5	0	5
Memorial Drive/Parma Avenue	AM	EBL Memorial Drive	0	0	25	3
		WBL Memorial Drive	0	0	0	0
		NB Parma Avenue Approach	25	5	75	8
		SB Parma Avenue Approach	25	5	25	5
	PM	EBL Memorial Drive	0	3	25	3
		WBL Memorial Drive	0	0	0	0
		NB Parma Avenue Approach	25	8	25	5
		SB Parma Avenue Approach	25	8	25	5
Memorial Drive/Karlyn Drive (east)	AM	EBL Memorial Drive	0	0	25	0
		WBL Memorial Drive	0	0	25	0
		NB Karlyn Drive (east) Approach	25	13	25	18
		SB Karlyn Drive (east) Approach	25	3	0	3
	PM	EBL Memorial Drive	0	0	0	0
		WBL Memorial Drive	0	3	0	5
		NB Karlyn Drive (east) Approach	50	13	75	23
		SB Karlyn Drive (east) Approach	25	3	25	3
Memorial Drive/Bizarre Drive	AM	EBL Memorial Drive	0	3	25	3
		WBL Memorial Drive	0	0	25	3
		NB Bizarre Drive Approach	0	5	0	0
		SB Bizarre Drive Approach	0	13	50	20
	PM	EBL Memorial Drive	0	3	25	3
		WBL Memorial Drive	0	0	0	0
		NB Bizarre Drive Approach	0	3	0	3
		SB Bizarre Drive Approach	50	15	25	30
Memorial Drive/Lind Avenue	AM	EBL Memorial Drive	0	0	0	*
		WBL Memorial Drive	0	0	25	3
		NB Lind Avenue Approach	25	18	75	18
	PM	EBL Memorial Drive	0	0	0	*
		WBL Memorial Drive	0	3	50	3
		NB Lind Avenue Approach	25	13	25	13

Notes:

Observed queues are from field observations.

Calculated queues are 95th percentile queue lenghts based on Synchro methodology.

*Queue results not provided by software.

2018 Before Study results are from the June 18,2018 Technical Memorandum for the Memorial Drive Traffic Study prepared by JMT.

APPENDIX C
NCHRP 562 Worksheets

Midblock Crossing Evaluation Results

Year Evaluated	Intersection	Assumed Speed	Crossing Type	Crossing Distance (Feet)	Total Pedestrian Delay		Treatment Warranted
					Hours	Seconds	
2020	Memorial Drive/Karlyn Drive (west)	≤35	One Stage	47	0.9	3,240	Crosswalk
		>35	One Stage	47	3.7	13,320	Active or Enhanced
	Memorial Drive/Parma Avenue	≤35	One Stage	47	0.7	2,520	Crosswalk
		>35	One Stage	47	2.8	10,080	Active or Enhanced
	Memorial Drive/Karlyn Drive (east)	≤35	One Stage	47	0.7	2,520	Crosswalk
		>35	One Stage	47	2.1	7,560	Active or Enhanced
	Memorial Drive/Bizarre Drive	≤35	One Stage	47	0.6	2,160	Crosswalk
		>35	One Stage	47	1.9	6,840	Active or Enhanced
	Memorial Drive/Lind Avenue	≤35	One Stage	47	0.5	1,800	Crosswalk
		>35	One Stage	47	1.6	5,760	Active or Enhanced

GUIDELINES FOR PEDESTRIAN CROSSING TREATMENTS

This spreadsheet combines Worksheet 1 and Worksheet 2 (Appendix A, pages 69-70) of TCRP Report 112/NCHRP Report 562 (*Improving Pedestrian Safety at Unsignalized Intersections*) into an electronic format. This spreadsheet should be used in conjunction with, and not independent of, Appendix A documentation.

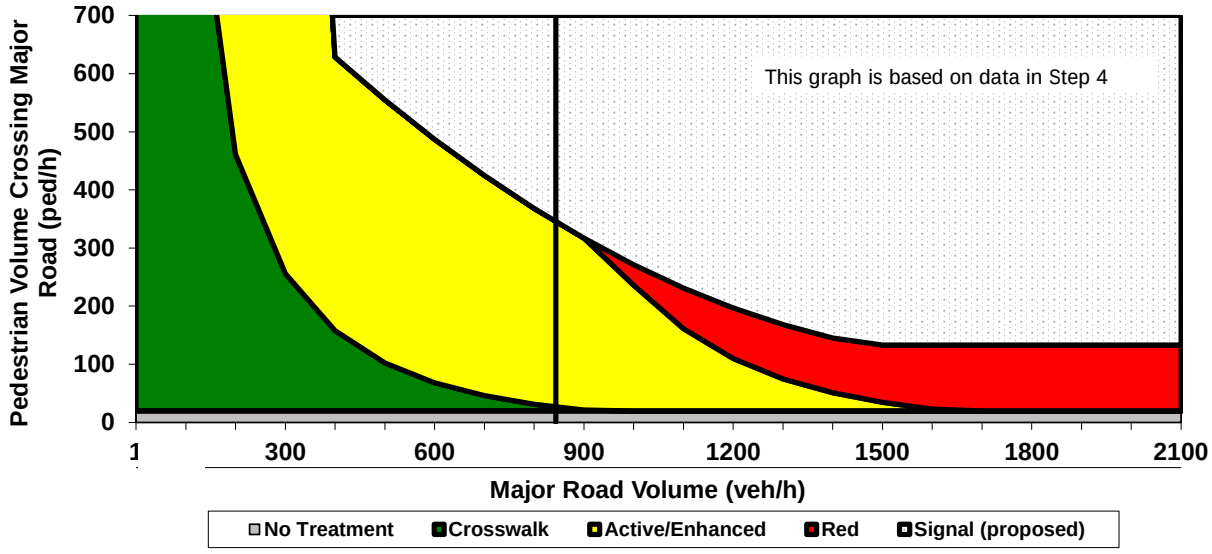
This spreadsheet is still under development, please inform TTI if errors are identified.

Key

Blue fields contain descriptive information.
Green fields are required and must be completed.
Tan fields are adjustments that are filled out only under certain conditions (follow instructions to the left of the cell).
Gray fields are automatically calculated and should not be edited.

Analyst and Site Information			
Analyst	JMT - YK	Major Street	Memorial Drive
Analysis Date	April 27, 2020	Minor Street or Location	Karlyn Drive (west)
Data Collection Date	January 16, 2020	Peak Hour	PM

Step 1: Select worksheet:			
Posted or statutory speed limit (or 85th percentile speed) on the major street (mph)		*1a*	35
Is the population of the surrounding area <10,000? (enter ***YES*** or ***NO***)		*1b*	no
Step 2: Does the crossing meet minimum pedestrian volumes to be considered for a traffic control device?			
Peak-hour pedestrian volume (ped/h), V_p		*2a*	20
Result: Go to step 3.			
Step 3: Does the crossing meet the pedestrian warrant for a traffic signal?			
Major road volume, total of both approaches during peak hour (veh/h), $V_{maj\text{-}s}$		*3a*	844
[Calculated automatically] Preliminary (before min. threshold) peak hour pedestrian volume to meet warrant		*3b*	345
[Calculated automatically] Minimum required peak hour pedestrian volume to meet traffic signal warrant		*3c*	345
Is 15th percentile crossing speed of pedestrians less than 3.5 ft/s (1.1 m/s)? (enter ***YES*** or ***NO***)		*3d*	no
If 15th percentile crossing speed of pedestrians is less than 3.5 ft/s (1.1 m/s), then reduce *3c* by up to 50%.	% rate of reduction for *3c* (up to 50%)	*3e*	
	Reduced value or *3c*	*3f*	345
Result: The signal warrant is not met. Go to step 4.			
Step 4: Estimate pedestrian delay.			
Pedestrian crossing distance, curb to curb (ft), L		*4a*	47
Pedestrian walking speed (ft/s), S_p (suggested speed = 3.5 ft/s)		*4b*	3.5
Pedestrian start-up time and end clearance time (s), t_s (suggested start-up time = 3 sec)		*4c*	3
[Calculated automatically] Critical gap required for crossing pedestrian (s), t_c		*4d*	16
Major road volume, total both approaches OR approach being crossed if raised median island is present, during peak hour (veh/h), $V_{maj\text{-}d}$		*4e*	844
Major road flow rate (veh/s), v		*4f*	0.23
Average pedestrian delay (s/person), d_p		*4g*	169
Total pedestrian delay (h), D_p The value in 4h is the calculated estimated delay for all pedestrians crossing the major roadway without a crossing treatment (assumes 0% compliance). If the actual total pedestrian delay has been measured at the site, that value can be entered in 4i to replace the calculated value in 4h.		*4h*	0.9
		4i	0.005
Step 5: Select treatment based up on total pedestrian delay and expected motorist compliance.			
Expected motorist compliance at pedestrian crossings in region: enter ***HIGH for High Compliance*** or ***LOW for Low Compliance***		*5a*	high
Treatment Category:	**CROSSWALK**		



This worksheet provides general recommendations on pedestrian crossing treatments to consider at unsignalized intersections; in all cases, engineering judgment should be used in selecting a specific treatment for installation. This worksheet does not apply to school crossings. In addition to the results provided by this worksheet, users should consider whether a pedestrian treatment could present an increased safety risk to pedestrians, such as where there is poor sight distance, complex geometrics, or nearby traffic signals.

GUIDELINES FOR PEDESTRIAN CROSSING TREATMENTS

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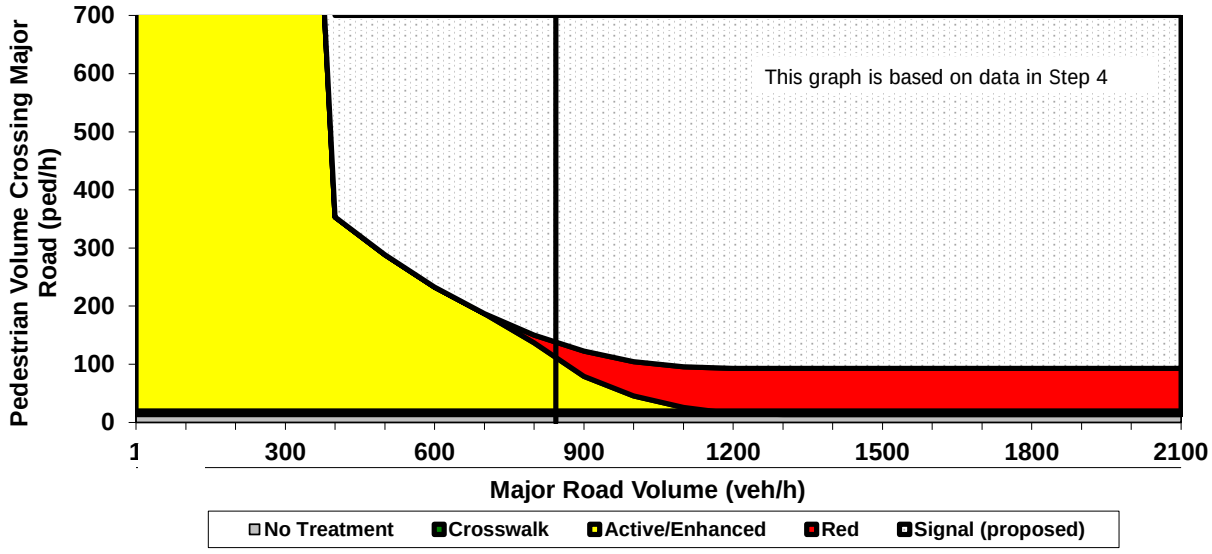
Analyst and Site Information			
Analyst	JMT - YK	Major Street	Memorial Drive
Analysis Date	April 27, 2020	Minor Street or Location	Karlyn Drive (west)
Data Collection Date	January 16, 2020	Peak Hour	PM

Step 1: Select worksheet:			
Posted or statutory speed limit (or 85th percentile speed) on the major street (mph)		*1a*	45
Is the population of the surrounding area <10,000? (enter ***YES*** or ***NO***)		*1b*	no
Step 2: Does the crossing meet minimum pedestrian volumes to be considered for a traffic control device?			
Peak-hour pedestrian volume (ped/h), V_p		*2a*	20
Result: Go to step 3.			
Step 3: Does the crossing meet the pedestrian warrant for a traffic signal?			
Major road volume, total of both approaches during peak hour (veh/h), $V_{maj\text{-}s}$		*3a*	844
[Calculated automatically] Preliminary (before min. threshold) peak hour pedestrian volume to meet warrant		*3b*	137
[Calculated automatically] Minimum required peak hour pedestrian volume to meet traffic signal warrant		*3c*	137
Is 15th percentile crossing speed of pedestrians less than 3.5 ft/s (1.1 m/s)? (enter ***YES*** or ***NO***)		*3d*	no
If 15th percentile crossing speed of pedestrians is less than 3.5 ft/s (1.1 m/s), then reduce *3c* by up to 50%.	% rate of reduction for *3c* (up to 50%)	*3e*	
	Reduced value or *3c*	*3f*	137
Result: The signal warrant is not met. Go to step 4.			
Step 4: Estimate pedestrian delay.			
Pedestrian crossing distance, curb to curb (ft), L		*4a*	47
Pedestrian walking speed (ft/s), S_p (suggested speed = 3.5 ft/s)		*4b*	3.5
Pedestrian start-up time and end clearance time (s), t_s (suggested start-up time = 3 sec)		*4c*	3
[Calculated automatically] Critical gap required for crossing pedestrian (s), t_c		*4d*	16
Major road volume, total both approaches OR approach being crossed if raised median island is present, during peak hour (veh/h), $V_{maj\text{-}d}$		*4e*	844
Major road flow rate (veh/s), v		*4f*	0.33
Average pedestrian delay (s/person), d_p		*4g*	666
Total pedestrian delay (h), D_p The value in 4h is the calculated estimated delay for all pedestrians crossing the major roadway without a crossing treatment (assumes 0% compliance). If the actual total pedestrian delay has been measured at the site, that value can be entered in 4i to replace the calculated value in 4h.		*4h*	3.7
		4i	0.021
Step 5: Select treatment based up on total pedestrian delay and expected motorist compliance.			
Expected motorist compliance at pedestrian crossings in region: enter ***HIGH for High Compliance*** or ***LOW for Low Compliance***		*5a*	high
Treatment Category:	**ACTIVE OR ENHANCED**		



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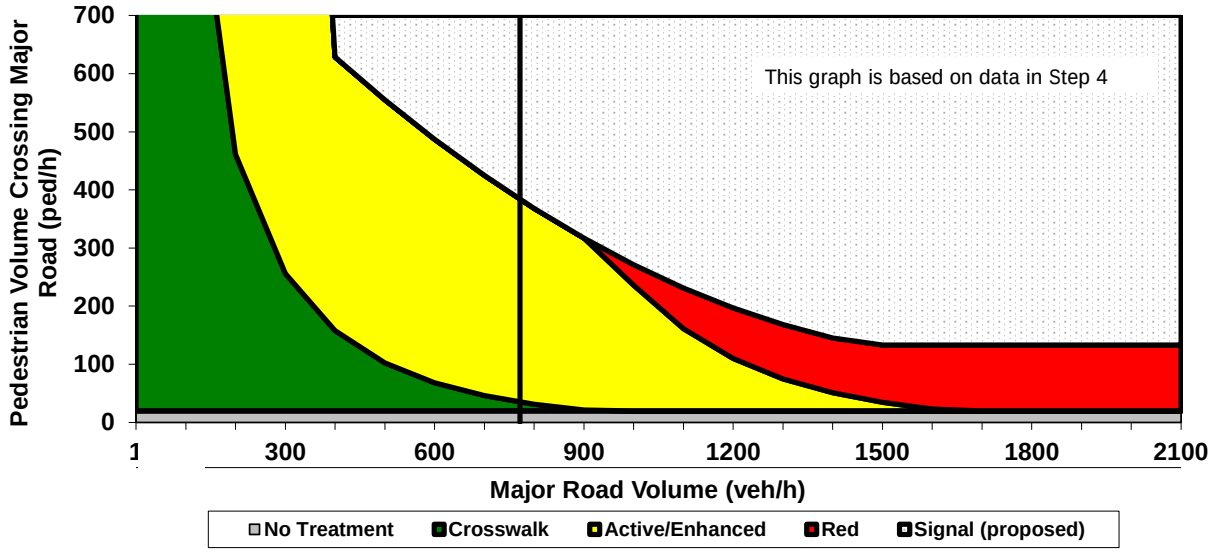
Analyst and Site Information			
Analyst	JMT - YK	Major Street	Memorial Drive
Analysis Date	April 27, 2020	Minor Street or Location	Parma Avenue
Data Collection Date	January 16, 2020	Peak Hour	PM

Step 1: Select worksheet:			
Posted or statutory speed limit (or 85th percentile speed) on the major street (mph)		*1a*	35
Is the population of the surrounding area <10,000? (enter ***YES*** or ***NO***)		*1b*	no
Step 2: Does the crossing meet minimum pedestrian volumes to be considered for a traffic control device?			
Peak-hour pedestrian volume (ped/h), V_p		*2a*	20
Result: Go to step 3.			
Step 3: Does the crossing meet the pedestrian warrant for a traffic signal?			
Major road volume, total of both approaches during peak hour (veh/h), $V_{maj\text{-}s}$		*3a*	772
[Calculated automatically] Preliminary (before min. threshold) peak hour pedestrian volume to meet warrant		*3b*	383
[Calculated automatically] Minimum required peak hour pedestrian volume to meet traffic signal warrant		*3c*	383
Is 15th percentile crossing speed of pedestrians less than 3.5 ft/s (1.1 m/s)? (enter ***YES*** or ***NO***)		*3d*	no
If 15th percentile crossing speed of pedestrians is less than 3.5 ft/s (1.1 m/s), then reduce *3c* by up to 50%.	% rate of reduction for *3c* (up to 50%)	*3e*	
	Reduced value or *3c*	*3f*	383
Result: The signal warrant is not met. Go to step 4.			
Step 4: Estimate pedestrian delay.			
Pedestrian crossing distance, curb to curb (ft), L		*4a*	47
Pedestrian walking speed (ft/s), S_p (suggested speed = 3.5 ft/s)		*4b*	3.5
Pedestrian start-up time and end clearance time (s), t_s (suggested start-up time = 3 sec)		*4c*	3
[Calculated automatically] Critical gap required for crossing pedestrian (s), t_c		*4d*	16
Major road volume, total both approaches OR approach being crossed if raised median island is present, during peak hour (veh/h), $V_{maj\text{-}d}$		*4e*	772
Major road flow rate (veh/s), v		*4f*	0.21
Average pedestrian delay (s/person), d_p		*4g*	129
Total pedestrian delay (h), D_p The value in 4h is the calculated estimated delay for all pedestrians crossing the major roadway without a crossing treatment (assumes 0% compliance). If the actual total pedestrian delay has been measured at the site, that value can be entered in 4i to replace the calculated value in 4h.		*4h*	0.7
		4i	0.004
Step 5: Select treatment based up on total pedestrian delay and expected motorist compliance.			
Expected motorist compliance at pedestrian crossings in region: enter ***HIGH for High Compliance*** or ***LOW for Low Compliance***		*5a*	high

Treatment Category:	**CROSSWALK**



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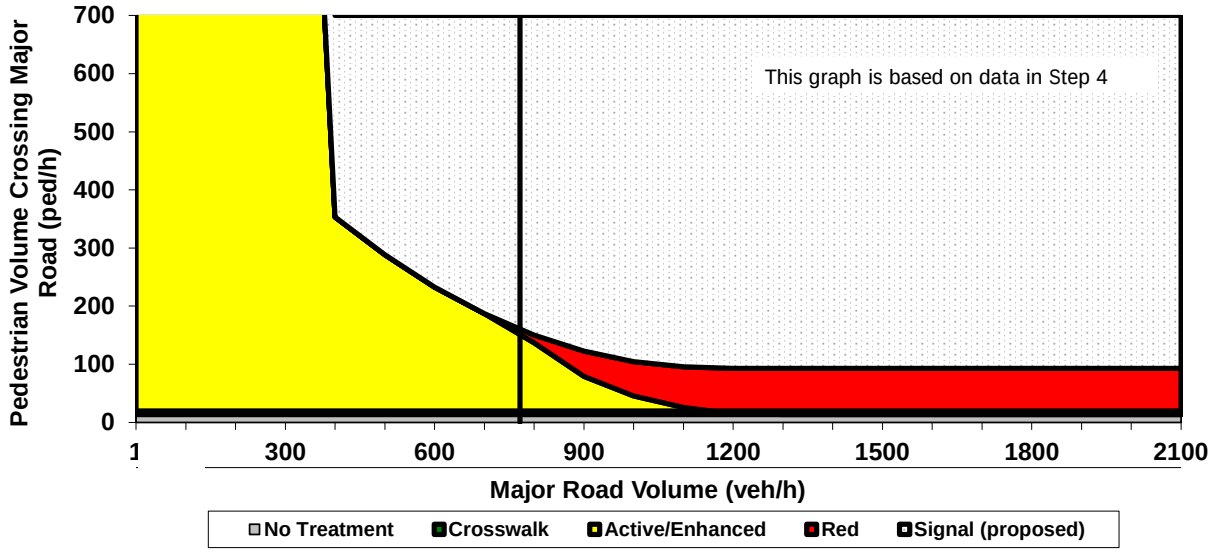
Analyst and Site Information			
Analyst	JMT - YK	Major Street	Memorial Drive
Analysis Date	April 27, 2020	Minor Street or Location	Parma Avenue
Data Collection Date	January 16, 2020	Peak Hour	PM

Step 1: Select worksheet:			
Posted or statutory speed limit (or 85th percentile speed) on the major street (mph)		*1a*	45
Is the population of the surrounding area <10,000? (enter ***YES*** or ***NO***)		*1b*	no
Step 2: Does the crossing meet minimum pedestrian volumes to be considered for a traffic control device?			
Peak-hour pedestrian volume (ped/h), V_p		*2a*	20
Result: Go to step 3.			
Step 3: Does the crossing meet the pedestrian warrant for a traffic signal?			
Major road volume, total of both approaches during peak hour (veh/h), $V_{maj\text{-}s}$		*3a*	772
[Calculated automatically] Preliminary (before min. threshold) peak hour pedestrian volume to meet warrant		*3b*	159
[Calculated automatically] Minimum required peak hour pedestrian volume to meet traffic signal warrant		*3c*	159
Is 15th percentile crossing speed of pedestrians less than 3.5 ft/s (1.1 m/s)? (enter ***YES*** or ***NO***)		*3d*	no
If 15th percentile crossing speed of pedestrians is less than 3.5 ft/s (1.1 m/s), then reduce *3c* by up to 50%.	% rate of reduction for *3c* (up to 50%)	*3e*	
	Reduced value or *3c*	*3f*	159
Result: The signal warrant is not met. Go to step 4.			
Step 4: Estimate pedestrian delay.			
Pedestrian crossing distance, curb to curb (ft), L		*4a*	47
Pedestrian walking speed (ft/s), S_p (suggested speed = 3.5 ft/s)		*4b*	3.5
Pedestrian start-up time and end clearance time (s), t_s (suggested start-up time = 3 sec)		*4c*	3
[Calculated automatically] Critical gap required for crossing pedestrian (s), t_c		*4d*	16
Major road volume, total both approaches OR approach being crossed if raised median island is present, during peak hour (veh/h), $V_{maj\text{-}d}$		*4e*	772
Major road flow rate (veh/s), v		*4f*	0.31
Average pedestrian delay (s/person), d_p		*4g*	506
Total pedestrian delay (h), D_p The value in 4h is the calculated estimated delay for all pedestrians crossing the major roadway without a crossing treatment (assumes 0% compliance). If the actual total pedestrian delay has been measured at the site, that value can be entered in 4i to replace the calculated value in 4h.		*4h*	2.8
		4i	0.016
Step 5: Select treatment based up on total pedestrian delay and expected motorist compliance.			
Expected motorist compliance at pedestrian crossings in region: enter ***HIGH for High Compliance*** or ***LOW for Low Compliance***		*5a*	high
Treatment Category:	**ACTIVE OR ENHANCED**		



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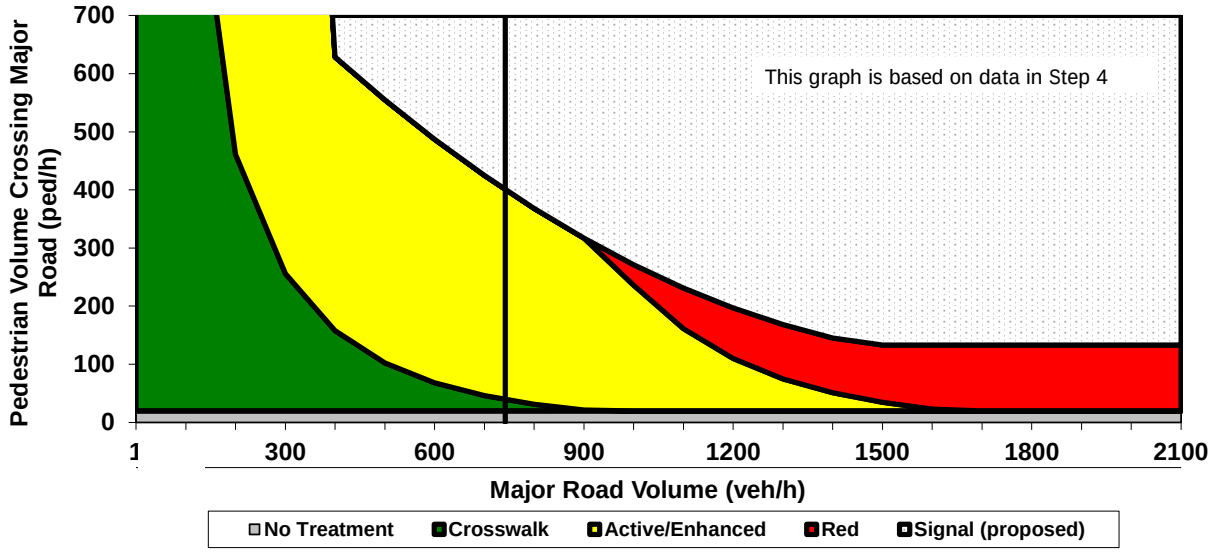
Analyst and Site Information			
Analyst	JMT - YK	Major Street	Memorial Drive
Analysis Date	April 27, 2020	Minor Street or Location	Karlyn Drive (east)
Data Collection Date	January 16, 2020	Peak Hour	PM

Step 1: Select worksheet:			
Posted or statutory speed limit (or 85th percentile speed) on the major street (mph)		*1a*	35
Is the population of the surrounding area <10,000? (enter ***YES*** or ***NO***)		*1b*	no
Step 2: Does the crossing meet minimum pedestrian volumes to be considered for a traffic control device?			
Peak-hour pedestrian volume (ped/h), V_p		*2a*	20
Result: Go to step 3.			
Step 3: Does the crossing meet the pedestrian warrant for a traffic signal?			
Major road volume, total of both approaches during peak hour (veh/h), $V_{maj\text{-}s}$		*3a*	742
[Calculated automatically] Preliminary (before min. threshold) peak hour pedestrian volume to meet warrant		*3b*	400
[Calculated automatically] Minimum required peak hour pedestrian volume to meet traffic signal warrant		*3c*	400
Is 15th percentile crossing speed of pedestrians less than 3.5 ft/s (1.1 m/s)? (enter ***YES*** or ***NO***)		*3d*	no
If 15th percentile crossing speed of pedestrians is less than 3.5 ft/s (1.1 m/s), then reduce *3c* by up to 50%.	% rate of reduction for *3c* (up to 50%)	*3e*	
	Reduced value or *3c*	*3f*	400
Result: The signal warrant is not met. Go to step 4.			
Step 4: Estimate pedestrian delay.			
Pedestrian crossing distance, curb to curb (ft), L		*4a*	47
Pedestrian walking speed (ft/s), S_p (suggested speed = 3.5 ft/s)		*4b*	3.5
Pedestrian start-up time and end clearance time (s), t_s (suggested start-up time = 3 sec)		*4c*	3
[Calculated automatically] Critical gap required for crossing pedestrian (s), t_c		*4d*	16
Major road volume, total both approaches OR approach being crossed if raised median island is present, during peak hour (veh/h), $V_{maj\text{-}d}$		*4e*	742
Major road flow rate (veh/s), v		*4f*	0.21
Average pedestrian delay (s/person), d_p		*4g*	129
Total pedestrian delay (h), D_p The value in 4h is the calculated estimated delay for all pedestrians crossing the major roadway without a crossing treatment (assumes 0% compliance). If the actual total pedestrian delay has been measured at the site, that value can be entered in 4i to replace the calculated value in 4h.		*4h*	0.7
		4i	0.004
Step 5: Select treatment based up on total pedestrian delay and expected motorist compliance.			
Expected motorist compliance at pedestrian crossings in region: enter ***HIGH for High Compliance*** or ***LOW for Low Compliance***		*5a*	high
Treatment Category:	**CROSSWALK**		



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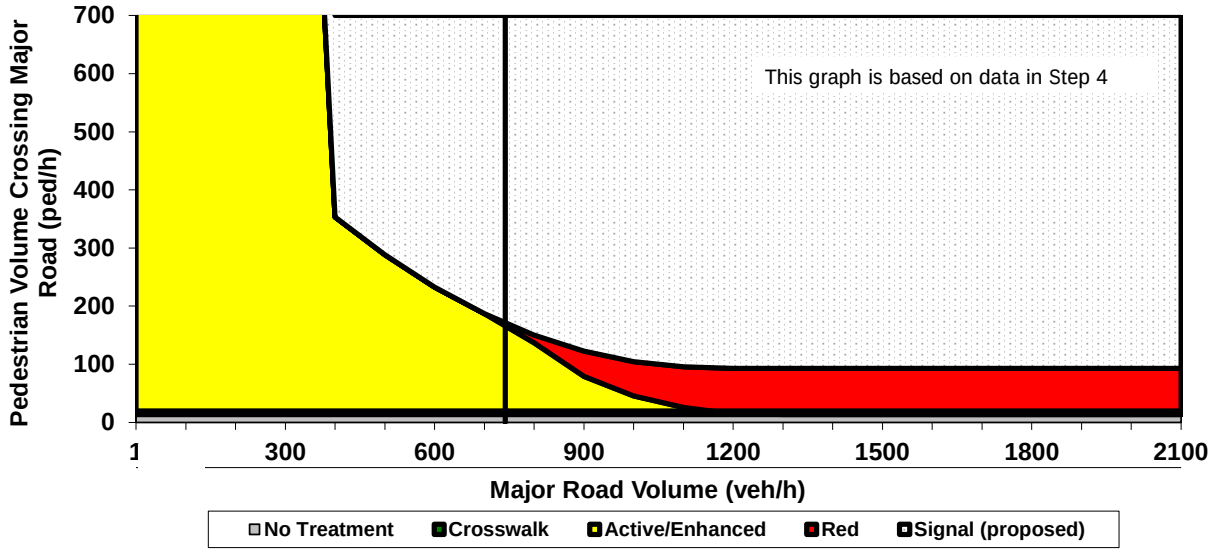
Analyst and Site Information			
Analyst	JMT - YK	Major Street	Memorial Drive
Analysis Date	April 27, 2020	Minor Street or Location	Karlyn Drive (east)
Data Collection Date	January 16, 2020	Peak Hour	PM

Step 1: Select worksheet:			
Posted or statutory speed limit (or 85th percentile speed) on the major street (mph)		*1a*	45
Is the population of the surrounding area <10,000? (enter ***YES*** or ***NO***)		*1b*	no
Step 2: Does the crossing meet minimum pedestrian volumes to be considered for a traffic control device?			
Peak-hour pedestrian volume (ped/h), V_p		*2a*	20
Result: Go to step 3.			
Step 3: Does the crossing meet the pedestrian warrant for a traffic signal?			
Major road volume, total of both approaches during peak hour (veh/h), $V_{maj\text{-}s}$		*3a*	742
[Calculated automatically] Preliminary (before min. threshold) peak hour pedestrian volume to meet warrant		*3b*	170
[Calculated automatically] Minimum required peak hour pedestrian volume to meet traffic signal warrant		*3c*	170
Is 15th percentile crossing speed of pedestrians less than 3.5 ft/s (1.1 m/s)? (enter ***YES*** or ***NO***)		*3d*	no
If 15th percentile crossing speed of pedestrians is less than 3.5 ft/s (1.1 m/s), then reduce *3c* by up to 50%.	% rate of reduction for *3c* (up to 50%)	*3e*	
	Reduced value or *3c*	*3f*	170
Result: The signal warrant is not met. Go to step 4.			
Step 4: Estimate pedestrian delay.			
Pedestrian crossing distance, curb to curb (ft), L		*4a*	47
Pedestrian walking speed (ft/s), S_p (suggested speed = 3.5 ft/s)		*4b*	3.5
Pedestrian start-up time and end clearance time (s), t_s (suggested start-up time = 3 sec)		*4c*	3
[Calculated automatically] Critical gap required for crossing pedestrian (s), t_c		*4d*	16
Major road volume, total both approaches OR approach being crossed if raised median island is present, during peak hour (veh/h), $V_{maj\text{-}d}$		*4e*	742
Major road flow rate (veh/s), v		*4f*	0.29
Average pedestrian delay (s/person), d_p		*4g*	384
Total pedestrian delay (h), D_p The value in 4h is the calculated estimated delay for all pedestrians crossing the major roadway without a crossing treatment (assumes 0% compliance). If the actual total pedestrian delay has been measured at the site, that value can be entered in 4i to replace the calculated value in 4h.		*4h*	2.1
		4i	0.012
Step 5: Select treatment based up on total pedestrian delay and expected motorist compliance.			
Expected motorist compliance at pedestrian crossings in region: enter ***HIGH for High Compliance*** or ***LOW for Low Compliance***		*5a*	high
Treatment Category:	**ACTIVE OR ENHANCED**		



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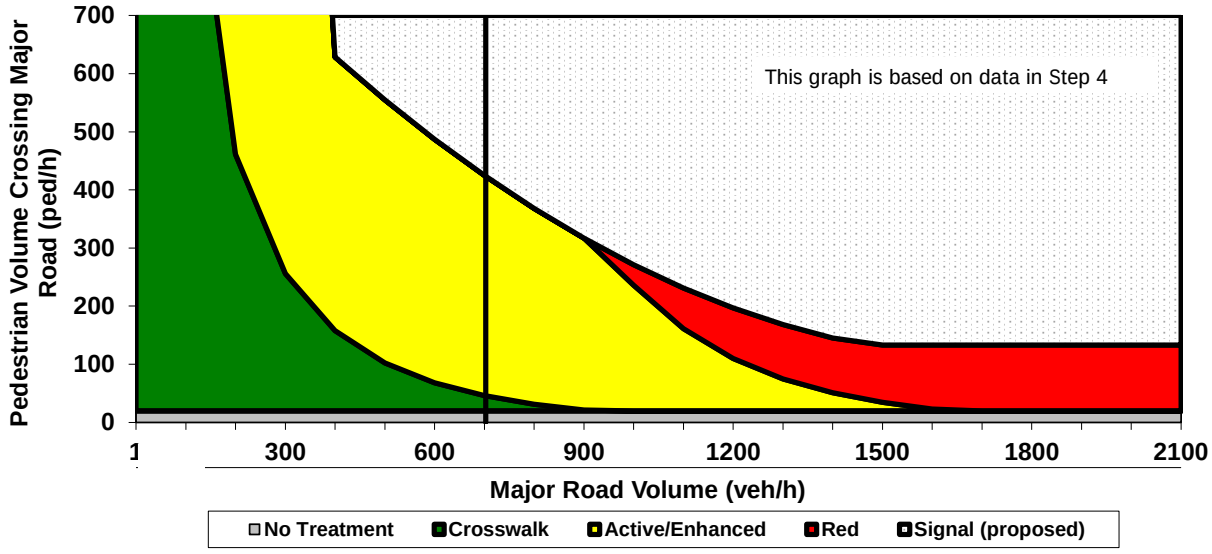
Analyst and Site Information			
Analyst	JMT - YK	Major Street	Memorial Drive
Analysis Date	April 27, 2020	Minor Street or Location	Bizzare Drive
Data Collection Date	January 16, 2020	Peak Hour	PM

Step 1: Select worksheet:			
Posted or statutory speed limit (or 85th percentile speed) on the major street (mph)		*1a*	35
Is the population of the surrounding area <10,000? (enter ***YES*** or ***NO***)		*1b*	no
Step 2: Does the crossing meet minimum pedestrian volumes to be considered for a traffic control device?			
Peak-hour pedestrian volume (ped/h), V_p		*2a*	20
Result: Go to step 3.			
Step 3: Does the crossing meet the pedestrian warrant for a traffic signal?			
Major road volume, total of both approaches during peak hour (veh/h), $V_{maj\text{-}s}$		*3a*	703
[Calculated automatically] Preliminary (before min. threshold) peak hour pedestrian volume to meet warrant		*3b*	423
[Calculated automatically] Minimum required peak hour pedestrian volume to meet traffic signal warrant		*3c*	423
Is 15th percentile crossing speed of pedestrians less than 3.5 ft/s (1.1 m/s)? (enter ***YES*** or ***NO***)		*3d*	no
If 15th percentile crossing speed of pedestrians is less than 3.5 ft/s (1.1 m/s), then reduce *3c* by up to 50%.	% rate of reduction for *3c* (up to 50%)	*3e*	
	Reduced value or *3c*	*3f*	423
Result: The signal warrant is not met. Go to step 4.			
Step 4: Estimate pedestrian delay.			
Pedestrian crossing distance, curb to curb (ft), L		*4a*	47
Pedestrian walking speed (ft/s), S_p (suggested speed = 3.5 ft/s)		*4b*	3.5
Pedestrian start-up time and end clearance time (s), t_s (suggested start-up time = 3 sec)		*4c*	3
[Calculated automatically] Critical gap required for crossing pedestrian (s), t_c		*4d*	16
Major road volume, total both approaches OR approach being crossed if raised median island is present, during peak hour (veh/h), $V_{maj\text{-}d}$		*4e*	703
Major road flow rate (veh/s), v		*4f*	0.20
Average pedestrian delay (s/person), d_p		*4g*	112
Total pedestrian delay (h), D_p The value in 4h is the calculated estimated delay for all pedestrians crossing the major roadway without a crossing treatment (assumes 0% compliance). If the actual total pedestrian delay has been measured at the site, that value can be entered in 4i to replace the calculated value in 4h.		*4h*	0.6
		4i	0.003
Step 5: Select treatment based up on total pedestrian delay and expected motorist compliance.			
Expected motorist compliance at pedestrian crossings in region: enter ***HIGH for High Compliance*** or ***LOW for Low Compliance***		*5a*	high
Treatment Category:	**CROSSWALK**		



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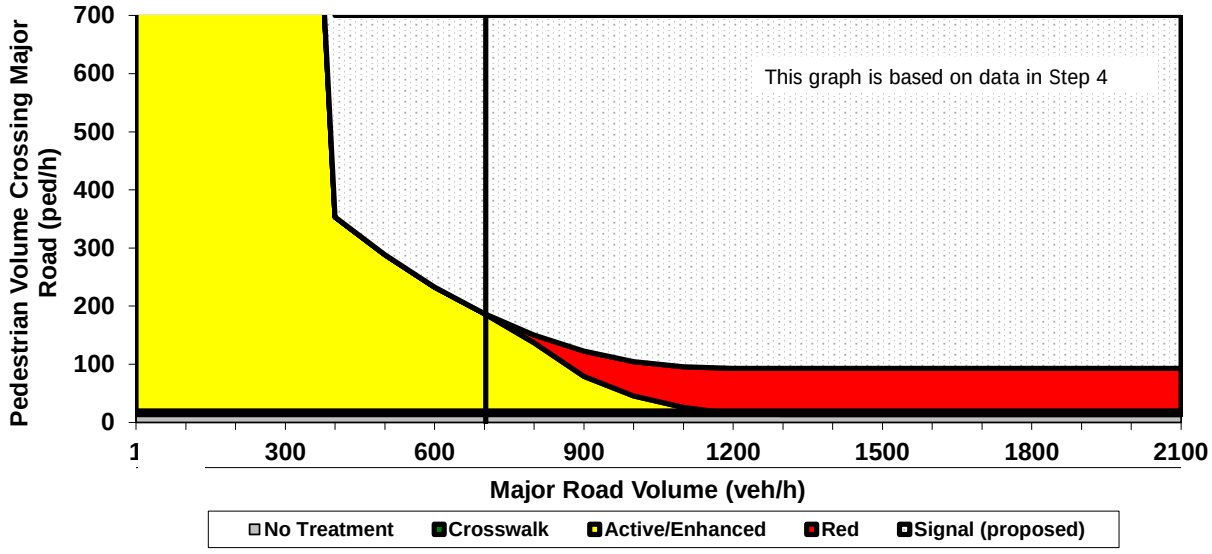
Analyst and Site Information			
Analyst	JMT - YK	Major Street	Memorial Drive
Analysis Date	April 27, 2020	Minor Street or Location	Bizzare Drive
Data Collection Date	January 16, 2020	Peak Hour	PM

Step 1: Select worksheet:			
Posted or statutory speed limit (or 85th percentile speed) on the major street (mph)		*1a*	45
Is the population of the surrounding area <10,000? (enter ***YES*** or ***NO***)		*1b*	no
Step 2: Does the crossing meet minimum pedestrian volumes to be considered for a traffic control device?			
Peak-hour pedestrian volume (ped/h), V_p		*2a*	20
Result: Go to step 3.			
Step 3: Does the crossing meet the pedestrian warrant for a traffic signal?			
Major road volume, total of both approaches during peak hour (veh/h), $V_{maj\text{-}s}$		*3a*	703
[Calculated automatically] Preliminary (before min. threshold) peak hour pedestrian volume to meet warrant		*3b*	186
[Calculated automatically] Minimum required peak hour pedestrian volume to meet traffic signal warrant		*3c*	186
Is 15th percentile crossing speed of pedestrians less than 3.5 ft/s (1.1 m/s)? (enter ***YES*** or ***NO***)		*3d*	no
If 15th percentile crossing speed of pedestrians is less than 3.5 ft/s (1.1 m/s), then reduce *3c* by up to 50%.	% rate of reduction for *3c* (up to 50%)	*3e*	
	Reduced value or *3c*	*3f*	186
Result: The signal warrant is not met. Go to step 4.			
Step 4: Estimate pedestrian delay.			
Pedestrian crossing distance, curb to curb (ft), L		*4a*	47
Pedestrian walking speed (ft/s), S_p (suggested speed = 3.5 ft/s)		*4b*	3.5
Pedestrian start-up time and end clearance time (s), t_s (suggested start-up time = 3 sec)		*4c*	3
[Calculated automatically] Critical gap required for crossing pedestrian (s), t_c		*4d*	16
Major road volume, total both approaches OR approach being crossed if raised median island is present, during peak hour (veh/h), $V_{maj\text{-}d}$		*4e*	703
Major road flow rate (veh/s), v		*4f*	0.28
Average pedestrian delay (s/person), d_p		*4g*	335
Total pedestrian delay (h), D_p The value in 4h is the calculated estimated delay for all pedestrians crossing the major roadway without a crossing treatment (assumes 0% compliance). If the actual total pedestrian delay has been measured at the site, that value can be entered in 4i to replace the calculated value in 4h.		*4h*	1.9
		4i	0.010
Step 5: Select treatment based up on total pedestrian delay and expected motorist compliance.			
Expected motorist compliance at pedestrian crossings in region: enter ***HIGH for High Compliance*** or ***LOW for Low Compliance***		*5a*	high
Treatment Category:	**ACTIVE OR ENHANCED**		



This worksheet provides general recommendations on pedestrian crossing treatments to consider at unsignalized intersections; in all cases, engineering judgment should be used in selecting a specific treatment for installation. This worksheet does not apply to school crossings. In addition to the results provided by this worksheet, users should consider whether a pedestrian treatment could present an increased safety risk to pedestrians, such as where there is poor sight distance, complex geometrics, or nearby traffic signals.

GUIDELINES FOR PEDESTRIAN CROSSING TREATMENTS

This spreadsheet combines Worksheet 1 and Worksheet 2 (Appendix A, pages 69-70) of TCRP Report 112/NCHRP Report 562 (*Improving Pedestrian Safety at Unsignalized Intersections*) into an electronic format. This spreadsheet should be used in conjunction with, and not independent of, Appendix A documentation.

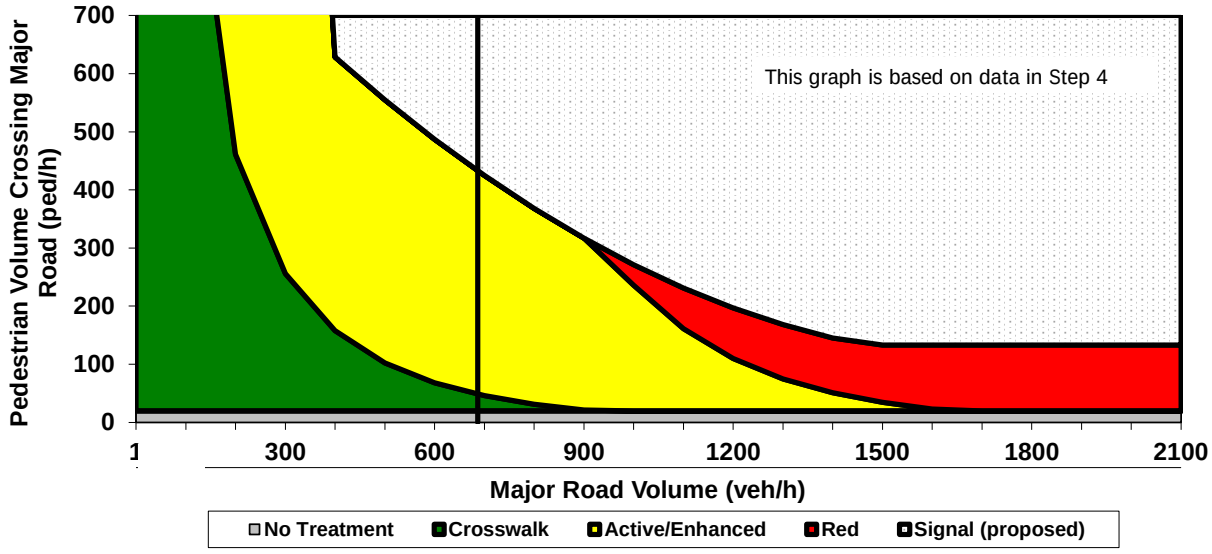
This spreadsheet is still under development, please inform TTI if errors are identified.

Key

Blue fields contain descriptive information.
Green fields are required and must be completed.
Tan fields are adjustments that are filled out only under certain conditions (follow instructions to the left of the cell).
Gray fields are automatically calculated and should not be edited.

Analyst and Site Information			
Analyst	JMT - YK	Major Street	Memorial Drive
Analysis Date	April 27, 2020	Minor Street or Location	Lind Avenue
Data Collection Date	January 16, 2020	Peak Hour	PM

Step 1: Select worksheet:			
Posted or statutory speed limit (or 85th percentile speed) on the major street (mph)		*1a*	35
Is the population of the surrounding area <10,000? (enter ***YES*** or ***NO***)		*1b*	no
Step 2: Does the crossing meet minimum pedestrian volumes to be considered for a traffic control device?			
Peak-hour pedestrian volume (ped/h), V_p		*2a*	20
Result: Go to step 3.			
Step 3: Does the crossing meet the pedestrian warrant for a traffic signal?			
Major road volume, total of both approaches during peak hour (veh/h), $V_{maj\text{-}s}$		*3a*	687
[Calculated automatically] Preliminary (before min. threshold) peak hour pedestrian volume to meet warrant		*3b*	432
[Calculated automatically] Minimum required peak hour pedestrian volume to meet traffic signal warrant		*3c*	432
Is 15th percentile crossing speed of pedestrians less than 3.5 ft/s (1.1 m/s)? (enter ***YES*** or ***NO***)		*3d*	no
If 15th percentile crossing speed of pedestrians is less than 3.5 ft/s (1.1 m/s), then reduce *3c* by up to 50%.	% rate of reduction for *3c* (up to 50%)	*3e*	
	Reduced value or *3c*	*3f*	432
Result: The signal warrant is not met. Go to step 4.			
Step 4: Estimate pedestrian delay.			
Pedestrian crossing distance, curb to curb (ft), L		*4a*	47
Pedestrian walking speed (ft/s), S_p (suggested speed = 3.5 ft/s)		*4b*	3.5
Pedestrian start-up time and end clearance time (s), t_s (suggested start-up time = 3 sec)		*4c*	3
[Calculated automatically] Critical gap required for crossing pedestrian (s), t_c		*4d*	16
Major road volume, total both approaches OR approach being crossed if raised median island is present, during peak hour (veh/h), $V_{maj\text{-}d}$		*4e*	687
Major road flow rate (veh/s), v		*4f*	0.19
Average pedestrian delay (s/person), d_p		*4g*	98
Total pedestrian delay (h), D_p The value in 4h is the calculated estimated delay for all pedestrians crossing the major roadway without a crossing treatment (assumes 0% compliance). If the actual total pedestrian delay has been measured at the site, that value can be entered in 4i to replace the calculated value in 4h.		*4h*	0.5
		4i	0.003
Step 5: Select treatment based up on total pedestrian delay and expected motorist compliance.			
Expected motorist compliance at pedestrian crossings in region: enter ***HIGH for High Compliance*** or ***LOW for Low Compliance***		*5a*	high
Treatment Category:	**CROSSWALK**		



This worksheet provides general recommendations on pedestrian crossing treatments to consider at unsignalized intersections; in all cases, engineering judgment should be used in selecting a specific treatment for installation. This worksheet does not apply to school crossings. In addition to the results provided by this worksheet, users should consider whether a pedestrian treatment could present an increased safety risk to pedestrians, such as where there is poor sight distance, complex geometrics, or nearby traffic signals.

GUIDELINES FOR PEDESTRIAN CROSSING TREATMENTS

This spreadsheet combines Worksheet 1 and Worksheet 2 (Appendix A, pages 69-70) of TCRP Report 112/NCHRP Report 562 (*Improving Pedestrian Safety at Unsignalized Intersections*) into an electronic format. This spreadsheet should be used in conjunction with, and not independent of, Appendix A documentation.

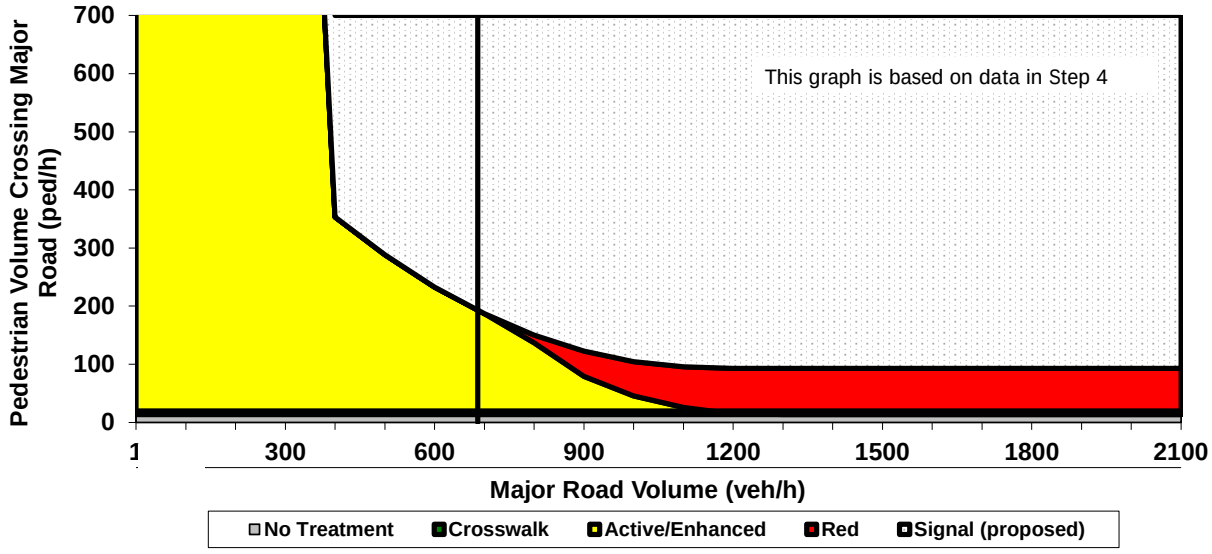
This spreadsheet is still under development, please inform TTI if errors are identified.

Key

Blue fields contain descriptive information.
Green fields are required and must be completed.
Tan fields are adjustments that are filled out only under certain conditions (follow instructions to the left of the cell).
Gray fields are automatically calculated and should not be edited.

Analyst and Site Information			
Analyst	JMT - YK	Major Street	Memorial Drive
Analysis Date	April 27, 2020	Minor Street or Location	Lind Avenue
Data Collection Date	January 16, 2020	Peak Hour	PM

Step 1: Select worksheet:			
Posted or statutory speed limit (or 85th percentile speed) on the major street (mph)		*1a*	45
Is the population of the surrounding area <10,000? (enter ***YES*** or ***NO***)		*1b*	no
Step 2: Does the crossing meet minimum pedestrian volumes to be considered for a traffic control device?			
Peak-hour pedestrian volume (ped/h), V_p		*2a*	20
Result: Go to step 3.			
Step 3: Does the crossing meet the pedestrian warrant for a traffic signal?			
Major road volume, total of both approaches during peak hour (veh/h), $V_{maj\text{-}s}$		*3a*	687
[Calculated automatically] Preliminary (before min. threshold) peak hour pedestrian volume to meet warrant		*3b*	192
[Calculated automatically] Minimum required peak hour pedestrian volume to meet traffic signal warrant		*3c*	192
Is 15th percentile crossing speed of pedestrians less than 3.5 ft/s (1.1 m/s)? (enter ***YES*** or ***NO***)		*3d*	no
If 15th percentile crossing speed of pedestrians is less than 3.5 ft/s (1.1 m/s), then reduce *3c* by up to 50%.	% rate of reduction for *3c* (up to 50%)	*3e*	
	Reduced value or *3c*	*3f*	192
Result: The signal warrant is not met. Go to step 4.			
Step 4: Estimate pedestrian delay.			
Pedestrian crossing distance, curb to curb (ft), L		*4a*	47
Pedestrian walking speed (ft/s), S_p (suggested speed = 3.5 ft/s)		*4b*	3.5
Pedestrian start-up time and end clearance time (s), t_s (suggested start-up time = 3 sec)		*4c*	3
[Calculated automatically] Critical gap required for crossing pedestrian (s), t_c		*4d*	16
Major road volume, total both approaches OR approach being crossed if raised median island is present, during peak hour (veh/h), $V_{maj\text{-}d}$		*4e*	687
Major road flow rate (veh/s), v		*4f*	0.27
Average pedestrian delay (s/person), d_p		*4g*	293
Total pedestrian delay (h), D_p The value in 4h is the calculated estimated delay for all pedestrians crossing the major roadway without a crossing treatment (assumes 0% compliance). If the actual total pedestrian delay has been measured at the site, that value can be entered in 4i to replace the calculated value in 4h.		*4h*	1.6
		4i	0.009
Step 5: Select treatment based up on total pedestrian delay and expected motorist compliance.			
Expected motorist compliance at pedestrian crossings in region: enter ***HIGH for High Compliance*** or ***LOW for Low Compliance***		*5a*	high
Treatment Category:	**ACTIVE OR ENHANCED**		



This worksheet provides general recommendations on pedestrian crossing treatments to consider at unsignalized intersections; in all cases, engineering judgment should be used in selecting a specific treatment for installation. This worksheet does not apply to school crossings. In addition to the results provided by this worksheet, users should consider whether a pedestrian treatment could present an increased safety risk to pedestrians, such as where there is poor sight distance, complex geometrics, or nearby traffic signals.

APPENDIX D
Crash Evaluation

Before Study

***From the June 18, 2018 Technical Memorandum for the Memorial Drive Traffic Study prepared by JMT**

Crash Summary Memorial Drive & Lind Avenue

	Fatality	Injury	Manner of Impact	Lighting Condition	SC	PCC
1	0	1	Front to Rear	Dark-Lighted	Wet	Driver Inattention
2	0	0	Angle	Dark-Not Lighted	Dry	Driving Under The Influence
3	0	0	Angle	Daylight	Wet	Driver Inattention
4	0	1	Angle	Dark-Lighted	Dry	Failed to Yield Right of Way

Crash Summary Memorial Drive & Bizarre Drive

	Fatality	Injury	Manner of Impact	Lighting Condition	SC	PCC
1	0	1	Out of Control	Dark-Lighted	Dry	Speeding
2	0	1	Front to Rear	Daylight	Dry	Failed to Yield Right of Way
3	0	0	Angle	Dark-Lighted	Dry	Failed to Yield Right of Way
4	0	0	Front to Rear	Dark-Lighted	Dry	Made Improper Turn
5	0	2	Out of Control	Dark-Lighted	Dry	Made Improper Turn
6	0	0	Parked Vehicle	Unknown	Dry	Made Improper Turn

Crash Summary Memorial Drive & Karlyn Drive (east)

	Fatality	Injury	Manner of Impact	Lighting Condition	SC	PCC
1	0	2	Angle	Daylight	Dry	Passed Stop Sign
2	0	0	Angle	Daylight	Dry	Passed Stop Sign
3	0	0	Angle	Daylight	Dry	Driver Inattention
4	0	0	Sideswipe, Same Direction	Daylight	Dry	Failed to Yield Right of Way

Crash Summary Memorial Drive & Parma Avenue

	Fatality	Injury	Manner of Impact	Lighting Condition	SC	PCC
1	0	1	Angle	Daylight	Dry	Failed to Yield Right of Way
2	0	0	Angle	Dark-Lighted	Dry	Failed to Yield Right of Way
3	0	0	Angle	Dusk	Wet	Failed to Yield Right of Way
4	0	0	Angle	Daylight	Dry	Failed to Yield Right of Way
5	0	1	Angle	Dark-Lighted	Dry	Failed to Yield Right of Way
6	0	2	Front to Rear	Dark-Lighted	Wet	Driver Inattention
7	0	0	Angle	Daylight	Dry	Failed to Yield Right of Way
8	0	0	Front to Rear	Daylight	Dry	Following too close Following too close
9	0	1	Pedestrian Involved	Dark-Lighted	Dry	Made Improper Turn
10	0	0	Front to Rear	Dark-Lighted	Dry	Driving Under The Influence
11	0	0	Parked Vehicle	Unknown	Unknown	Made Improper Turn

Crash Summary Memorial Drive & Karlyn Drive (west)

	Fatality	Injury	Manner of Impact	Lighting Condition	SC	PCC
1	0	0	Angle	Unknown	Dry	Failed to Yield Right of Way
2	0	1	Sideswipe, Same Direction	Daylight	Dry	Improper Lane Change

Crash Summary Memorial Drive & Wawa Entrance

	Fatality	Injury	Manner of Impact	Lighting Condition	SC	PCC
1	0	0	Sideswipe, Same Direction	Daylight	Wet	Failed to Yield Right of Way
2	0	0	Front to Rear	Daylight	Dry	Following too close
3	0	0	Angle	Daylight	Dry	Failed to Yield Right of Way
4	0	1	Angle	Daylight	Dry	Made Improper Turn
5	0	0	Front to Rear	Daylight	Dry	Failed to Yield Right of Way
6	0	0	Front to Rear	Daylight	Dry	Driver Inattention
7	0	0	Sideswipe, Same Direction	Daylight	Ice/Frost	Made Improper Turn
8	0	0	Angle	Daylight	Dry	Made Improper Turn
9	0	1	Angle	Dark-Lighted	Dry	Failed to Yield Right of Way
10	0	0	Angle	Daylight	Dry	Failed to Yield Right of Way

Crash Summary Memorial Drive Intersection with US Route 13

#	Fatality	Injury	Manner of Impact	Lighting Condition	SC	PCC
1	0	0	Front to Rear	Daylight	Dry	Driver Inattention
2	0	0	Front to Rear	Daylight	Dry	Driver Inattention
3	0	0	Front to Rear	Daylight	Dry	Following Too Close
4	0	2	Front to Rear	Dark-Lighted	Dry	Driver Inattention
5	0	0	Front to Rear	Daylight	Dry	Failed to Yield Right of Way
6	0	0	Front to Rear	Dark-Lighted	Dry	Driver Inattention
7	0	0	Front to Rear	Daylight	Dry	Following Too Close
8	0	0	Front to Rear	Dark-Lighted	Dry	Driver Inattention
9	0	0	Front to Rear	Daylight	Wet	Failed to Yield Right of Way
10	0	0	Front to Rear	Dark-Lighted	Dry	Driving Under The Influence
11	0	1	Front to Rear	Daylight	Dry	Driver Inattention
12	0	0	Front to Rear	Dusk	Wet	Driver Inattention
13	0	0	Front to Rear	Daylight	Dry	Following Too Close
14	0	0	Front to Rear	Daylight	Dry	Driver Inattention
15	0	0	Front to Rear	Daylight	Wet	Following Too Close
16	0	0	Front to Rear	Daylight	Dry	Following Too Close
17	0	0	Front to Rear	Daylight	Wet	Failed to Yield Right of Way
18	0	0	Front to Rear	Daylight	Dry	Driver Inattention
19	0	0	Front to Rear	Daylight	Wet	Following Too Close
20	0	0	Front to Rear	Daylight	Dry	Driver Inattention
21	0	0	Front to Rear	Daylight	Dry	Driver Inattention
22	0	0	Front to Rear	Daylight	Dry	Driver Inattention
23	0	0	Front to Rear	Dark-Lighted	Dry	Made Improper Turn
24	0	0	Front to Rear	Daylight	Dry	Disregard Traffic Signal
25	0	1	Front to Rear	Daylight	Wet	Failed to Yield Right of Way
26	0	0	Front to Rear	Dark-Lighted	Dry	Driver Inattention
27	0	0	Front to Rear	Daylight	Dry	Following Too Close

Crash Summary Memorial Drive Intersection with US Route 13

#	Fatality	Injury	Manner of Impact	Lighting Condition	SC	PCC
28	0	0	Front to Rear	Daylight	Dry	Made Improper Turn
29	0	0	Front to Rear	Daylight	Dry	Driver Inattention
30	0	0	Front to Rear	Daylight	Dry	Following Too Close
31	0	0	Front to Rear	Daylight	Wet	Following Too Close
32	0	0	Front to Rear	Daylight	Dry	Following Too Close
33	0	0	Front to Rear	Daylight	Dry	Failed to Yield Right of Way
34	0	1	Front to Rear	Daylight	Dry	Following Too Close
35	0	1	Front to Rear	Daylight	Dry	Made Improper Turn
36	0	0	Front to Rear	Daylight	Ice/Frost	Driver Inattention
37	0	0	Front to Rear	Dark-Lighted	Dry	Driver Inattention
38	0	1	Front to Rear	Dark-Lighted	Dry	Made Improper Turn
39	0	0	Front to Rear	Daylight	Dry	Improper Lane Change
40	0	0	Front to Rear	Dark-Lighted	Dry	Following Too Close

Crash Summary Memorial Drive Intersection with US Route 13

#	Fatality	Injury	Manner of Impact	Lighting Condition	SC	PCC
41	0	0	Front to Rear	Daylight	Wet	Failed to Yield Right of Way
42	0	0	Front to Rear	Daylight	Dry	Driver Inattention
43	0	0	Front to Rear	Daylight	Dry	Following Too Close
44	0	0	Front to Rear	Daylight	Dry	Made Improper Turn
45	0	0	Front to Rear	Daylight	Dry	Made Improper Turn
46	0	0	Front to Rear	Daylight	Dry	Driver Inattention
47	0	0	Front to Rear	Daylight	Dry	Failed to Yield Right of Way
48	0	0	Front to Rear	Daylight	Dry	Driver Inattention
49	0	1	Not a Collision Between Two Vehicles	Daylight	Dry	Failed to Yield Right of Way
50	0	0	Not a Collision Between Two Vehicles	Daylight	Dry	Mechanical Defects
51	0	1	Not a Collision Between Two Vehicles	Dark-Not Lighted	Dry	Failed to Yield Right of Way
52	0	1	Not a Collision Between Two Vehicles	Dark-Not Lighted	Dry	Failed to Yield Right of Way
53	0	0	Not a Collision Between Two Vehicles	Dark-Lighted	Wet	Following Too Close
54	0	0	Not a Collision Between Two Vehicles	Daylight	Dry	Improper Lane Change
55	0	1	Sideswipe, Opposite Direction	Dark-Lighted	Dry	Disregard Traffic Signal
56	0	0	Sideswipe, Same Direction	Daylight	Dry	Driver Inattention
57	0	0	Sideswipe, Same Direction	Daylight	Dry	Improper Lane Change
58	0	0	Sideswipe, Same Direction	Dark-Lighted	Dry	Failed to Yield Right of Way
59	0	0	Sideswipe, Same Direction	Daylight	Dry	Mechanical Defects
60	0	0	Sideswipe, Same Direction	Daylight	Dry	Failed to Yield Right of Way
61	0	0	Sideswipe, Same Direction	Dark-Lighted	Dry	Improper Lane Change
62	0	0	Sideswipe, Same Direction	Daylight	Dry	Made Improper Turn
63	0	0	Sideswipe, Same Direction	Dark-Lighted	Dry	Improper Lane Change
64	0	0	Sideswipe, Same Direction	Dark-Not Lighted	Dry	Improper Lane Change
65	0	0	Sideswipe, Same Direction	Dark-Lighted	Dry	Driver Inattention
66	0	0	Sideswipe, Same Direction	Daylight	Dry	Failed to Yield Right of Way
67	0	0	Sideswipe, Same Direction	Daylight	Dry	Improper Lane Change

Crash Summary Memorial Drive Intersection with US Route 13

#	Fatality	Injury	Manner of Impact	Lighting Condition	SC	PCC
68	0	1	Sideswipe, Same Direction	Dark-Not Lighted	Dry	Made Improper Turn
69	0	0	Sideswipe, Same Direction	Daylight	Dry	Made Improper Turn
70	0	0	Sideswipe, Same Direction	Dark-Lighted	Dry	Failed to Yield Right of Way
71	0	0	Sideswipe, Same Direction	Daylight	Dry	Failed to Yield Right of Way
72	0	0	Unknown	Daylight	Dry	Made Improper Turn
73	0	0	Unknown	Dark-Lighted	Dry	Driver Inattention
74	0	2	Angle	Dark-Lighted	Wet	Disregard Traffic Signal
75	0	0	Angle	Daylight	Dry	Speeding
76	0	1	Angle	Daylight	Dry	Disregard Traffic Signal
77	0	0	Angle	Daylight	Dry	Disregard Traffic Signal
78	0	2	Angle	Daylight	Dry	Failed to Yield Right of Way
79	0	1	Angle	Dark-Lighted	Dry	Disregard Traffic Signal
80	0	0	Angle	Daylight	Dry	Disregard Traffic Signal

Crash Summary Memorial Drive Intersection with US Route 13

#	Fatality	Injury	Manner of Impact	Lighting Condition	SC	PCC
81	0	2	Angle	Daylight	Dry	Disregard Traffic Signal
82	0	1	Angle	Dark-Lighted	Dry	Disregard Traffic Signal
83	0	0	Angle	Dark-Lighted	Dry	Disregard Traffic Signal
84	0	0	Angle	Dark-Not Lighted	Dry	Failed to Yield Right of Way
85	1	1	Angle	Daylight	Dry	Disregard Traffic Signal
86	0	0	Angle	Daylight	Dry	Disregard Traffic Signal
87	0	5	Angle	Dark-Lighted	Dry	Disregard Traffic Signal
88	0	0	Angle	Daylight	Wet	Disregard Traffic Signal
89	0	0	Angle	Daylight	Dry	Driver Inattention
90	0	0	Angle	Daylight	Dry	Mechanical Defects
91	0	0	Angle	Dark-Lighted	Dry	Made Improper Turn
92	0	0	Angle	Daylight	Wet	Disregard Traffic Signal
93	0	0	Angle	Daylight	Dry	Disregard Traffic Signal
94	0	0	Angle	Daylight	Dry	Disregard Traffic Signal
95	0	1	Angle	Daylight	Dry	Made Improper Turn
96	0	0	Angle	Daylight	Dry	Disregard Traffic Signal
97	0	4	Angle	Daylight	Dry	Disregard Traffic Signal
98	0	2	Angle	Daylight	Dry	Mechanical Defects
99	0	2	Angle	Dark-Lighted	Dry	Disregard Traffic Signal
100	0	0	Angle	Dark-Lighted	Dry	Speeding
101	0	0	Front to Front	Daylight	Dry	Made Improper Turn
102	0	0	Not a Collision Between Two Vehicles	Dark-Lighted	Dry	Speeding

Crash Summary Memorial Drive Intersection with Delaware Route 9

#	Fatality	Injury	Manner of Impact	Lighting Condition	SC	PCC
1	0	1	Not a Collision Between Two Vehicles	Daylight	Dry	Made Improper Turn
2	0	0	Front to Rear	Daylight	Dry	Following Too Close
3	0	1	Front to Rear	Daylight	Dry	Following Too Close
4	0	0	Angle	Daylight	Dry	Disregard Traffic Signal
5	0	0	Front to Rear	Daylight	Dry	Made Improper Turn
6	0	0	Angle	Daylight	Dry	Mechanical Defects
7	0	0	Front to Rear	Daylight	Dry	Following Too Close
8	0	0	Sideswipe, Same Direction	Daylight	Dry	Improper Passing
9	0	0	Front to Rear	Daylight	Dry	Driver Inattention
10	0	1	Not a Collision Between Two Vehicles	Dark-Lighted	Wet	Failed to Yield Right of Way1
11	0	0	Angle	Daylight	Wet	Disregard Traffic Signal
12	0	0	Front to Rear	Daylight	Dry	Following Too Close
13	0	2	Angle	Dark-Lighted	Wet	Failed to Yield Right of Way
14	0	0	Angle	Daylight	Dry	Disregard Traffic Signal
15	0	0	Sideswipe, Same Direction	Daylight	Dry	Made Improper Turn
16	0	0	Front to Rear	Daylight	Dry	Driver Inattention
17	0	2	Angle	Daylight	Dry	Failed to Yield Right of Way
18	0	0	Not a Collision Between Two Vehicles	Dark-Lighted	Dry	Driver Inattention
19	0	0	Angle	Daylight	Dry	Failed to Yield Right of Way
20	0	0	Angle	Dark-Lighted	Dry	Following Too Close Following Too Close
21	0	0	Angle	Daylight	Dry	Failed to Yield Right of Way
22	0	0	Angle	Daylight	Dry	Failed to Yield Right of Way
23	0	0	Front to Rear	Daylight	Dry	Following Too Close
24	0	1	Angle	Daylight	Dry	Failed to Yield Right of Way
25	0	0	Sideswipe, Same Direction	Daylight	Wet	Failed to Yield Right of Way
26	0	0	Front to Rear	Dark-Lighted	Dry	Following Too Close
27	0	1	Front to Front	Daylight	Wet	Failed to Yield Right of Way
28	0	0	Angle	Dark-Lighted	Wet	Failed to Yield Right of Way
29	0	0	Angle	Daylight	Wet	Failed to Yield Right of Way
30	0	0	Front to Rear	Daylight	Wet	Made Improper Turn
31	0	0	Front to Rear	Daylight	Dry	Following Too Close
32	0	0	Sideswipe, Same Direction	Daylight	Dry	Driver Inattention
33	0	0	Angle	Daylight	Wet	Made Improper Turn
34	0	0	Sideswipe, Same Direction	Dark-Lighted	Dry	Made Improper Turn
35	0	1	Angle	Daylight	Dry	1Failed to Yield Right of Way

Crash Summary Memorial Drive Intersection with Delaware Route 9

#	Fatality	Injury	Manner of Impact	Lighting Condition	SC	PCC
36	0	1	Angle	Daylight	Wet	Mechanical Defects
37	0	0	Front to Rear	Dark-Not Lighted	Dry	Driver Inattention
38	0	0	Front to Rear	Daylight	Dry	Improper Passing
39	0	0	Sideswipe, Same Direction	Daylight	Dry	Failed to Yield Right of Way
40	0	2	Front to Front	Daylight	Dry	Made Improper Turn
41	0	0	Front to Rear	Daylight	Dry	Driver Inattention
42	0	3	Angle	Daylight	Wet	Failed to Yield Right of Way
43	0	2	Front to Front	Dark-Lighted	Dry	Failed to Yield Right of Way
44	0	0	Sideswipe, Same Direction	Daylight	Dry	Failed to Yield Right of Way
45	0	1	Angle	Dark-Lighted	Wet	Failed to Yield Right of Way
46	0	1	Front to Rear	Daylight	Dry	Driver Inattention
47	0	1	Angle	Daylight	Wet	Failed to Yield Right of Way
48	0	0	Angle	Daylight	Dry	Driving Under the Influence
49	0	0	Front to Rear	Daylight	Dry	Driver Inattention
50	0	0	Front to Rear	Dark-Lighted	Dry	Made Improper Turn
51	0	0	Sideswipe, Same Direction	Daylight	Dry	Driver Inattention
52	0	0	Sideswipe, Same Direction	Dark-Lighted	Dry	Made Improper Turn
53	0	0	Angle	Daylight	Ice/Frost	1Failed to Yield Right of Way
54	0	0	Front to Rear	Daylight	Dry	Driver Inattention
55	0	0	Front to Rear	Daylight	Dry	Made Improper Turn
56	0	0	Angle	Daylight	Dry	Made Improper Turn
57	0	0	Angle	Dark-Lighted	Dry	Made Improper Turn
58	0	0	Sideswipe, Same Direction	Dark-Lighted	Wet	Improper Lane Change
59	0	0	Angle	Daylight	Dry	Failed to Yield Right of Way
60	0	2	Front to Front	Dark-Lighted	Dry	Failed to Yield Right of Way
61	0	0	Angle	Daylight	Dry	Failed to Yield Right of Way
62	0	0	Sideswipe, Same Direction	Dark-Lighted	Dry	Driver Inattention
63	0	1	Not a Collision Between Two Vehicles	Daylight	Dry	Failed to Yield Right of Way1
64	0	0	Angle	Dark-Lighted	Dry	Failed to Yield Right of Way
65	0	2	Angle	Daylight	Dry	Failed to Yield Right of Way
66	0	0	Sideswipe, Opposite Direction	Daylight	Dry	Failed to Yield Right of Way

After Study

Lind Avenue & Memorial Drive Reported Crashes, October 2019 - February 2020							
#	Manner of Impact	Primary Contributing Circumstance	Lighting Condition	Weather	Surface	Fat	Inj
1	Front to rear	Driver inattention, distraction, or fatigue	Dark-Lighted	Clear	Dry	0	0

Bizzare Drive & Memorial Drive Reported Crashes, October 2019 - February 2020							
#	Manner of Impact	Primary Contributing Circumstance	Lighting Condition	Weather	Surface	Fat	Inj
1	Front to rear	Unknown (hit and run)	Dark-Lighted	Rain	Wet	0	0
2	Front to rear	Driver inattention, distraction, or fatigue	Daylight	Clear	Dry	0	0

Karlyn Drine (east) & Memorial Drive Reported Crashes, October 2019 - February 2020							
#	Manner of Impact	Primary Contributing Circumstance	Lighting Condition	Weather	Surface	Fat	Inj
1	Angle	Failed to yield right of way	Daylight	Clear	Dry	1	8
2	Not a collision between two vehicles (Fixed Object - Tree)	Other environmental circumstances - weather, glare	Dark-Lighted	Rain	Wet	0	0

Karlyn Drive (west) & Memorial Drive Reported Crashes, October 2019 - February 2020							
#	Manner of Impact	Primary Contributing Circumstance	Lighting Condition	Weather	Surface	Fat	Inj
1	Front to rear	Driver inattention, distraction, or fatigue	Dark-Lighted	Unknown	Wet	0	0

US 13 & Memorial Drive Reported Crashes, October 2019 - February 2020							
#	Manner of Impact	Primary Contributing Circumstance	Lighting Condition	Weather	Surface	Fat	Inj
1	Angle	Disregard Traffic Signal	Dark-Lighted	Clear	Dry	0	1
2	Front to rear	Driver inattention, distraction, or fatigue	Daylight	Cloudy	Wet	0	0
3	Front to rear	Driver inattention, distraction, or fatigue	Daylight	Clear	Dry	0	0
4	Front to rear	Following too close	Daylight	Cloudy	Dry	0	0
5	Front to rear	Driver inattention, distraction, or fatigue	Daylight	Clear	Dry	0	0
6	Front to rear	Driver inattention, distraction, or fatigue	Daylight	Clear	Dry	0	0
7	Front to rear	Driver inattention, distraction, or fatigue	Dark-Lighted	Clear	Dry	0	0
8	Front to rear	Following too close	Daylight	Clear	Dry	0	0
9	Front to rear	Driver inattention, distraction, or fatigue	Daylight	Clear	Dry	0	0
10	Front to rear	Mechanical defects	Daylight	Rain	Wet	0	0
11	Angle	Driving in a careless or reckless manner	Daylight	Rain	Wet	0	3

Route 9 & Memorial Drive Reported Crashes, October 2019 - February 2020							
#	Manner of Impact	Primary Contributing Circumstance	Lighting Condition	Weather	Surface	Fat	Inj
1	Front to rear	Driving in a careless or reckless manner	Daylight	Rain	Wet	0	1
2	Angle	Disregard Traffic Signal	Dark-Lighted	Clear	Dry	0	0
3	Angle	Driver inattention, distraction, or fatigue	Dark-Lighted	Clear	Dry	0	1
4	Front to rear	Driver inattention, distraction, or fatigue	Daylight	Clear	Dry	0	0
5	Not a collision between two vehicles (pedestrian)	Driving in a careless or reckless manner	Dark-Not Lighted	Unknown	Unknown	0	1
6	Angle	Failed to yield right of way	Daylight	Rain	Wet	0	0

APPENDIX E
Gap Study Results

JOHNSON, MIRMIRAN & THOMPSON
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Gap Study

Project: Memorial Drive Gap Study
Major Road: Memorial Dr
Intersection: Memorial Dr / Kaelyn Drive (east)
Peak Hour/Date of Field Visit: 1/16/2020
Weather:

Gap Size (Sec)	Number of Gaps							
	Period 1		Period 2		Period 3		Period 4	
	From: 7:15 ~~7:00~~ AM To: 7:30 ~~7:15~~ AM		From: 7:30 ~~7:15~~ AM To: 7:45 ~~7:30~~ AM		From: 7:45 ~~7:30~~ AM To: 8:00 ~~7:45~~ AM		From: 8:00 ~~7:45~~ AM To: 8:15 ~~8:00~~ AM	
	Tally	Total	Tally	Total	Tally	Total	Tally	Total
1			11	2				
2	111111	6	1111 1111 11	12	1111 1111 111	12	1111 1111 11	11
3	1111 1111 11	12	1111 1111 11	10	1111 1111 1111	14	1111 1111	8
4	111	3	111111	7	1111 1111 1111	14	11111	5
5	11111	5	111	3	1111 1111	10	1111 1111	9
6	11111	5	1111	4	1111	4	1111 1111	9
7	1111 1111	9	11111	5	1111 1111	8	11111	5
8	11	2	1	1	1	1	1111 11	6
9	1111	4	11	2	11	2	11111	5
10	1111	4	111	3	1111 111	7	111	3
11			11	2	1111	4	1	1
12	1	1	1	1	111	3	111 1	4
13	11	2	111	3	111	3	11	2
14	11	2	11	2	11	2	11111	6
15	111	3	1	1	111	3	11	2
16			1	1			11	2
17	1	1	1	1	11	2	11	2
18			111	3	1	1		
19	1							
20			11	2				
21							1	1
22			1	1	1	1	11	2
23					1	1		
24					1	1	1	1
25	1	1			1	1	1	1
26					1	1		
27								
28								
29								
30								
31								
32			1	1				

36
35

33 1
42 1

45
32

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Gap Study

Project: Memorial Drive Gap Study
Major Road: ~~Memorial Dr~~
Intersection: ~~Memorial Dr / Kerlyn Drive (east)~~
Peak Hour/Date of Field Visit: ~~1/16/2020~~
Weather:

Gap Size (Sec)	Number of Gaps							
	Period 1		Period 2		Period 3		Period 4	
	From: 3:00pm ~~7:00 AM~~ To: 3:15 ~~7:15~~ AM		From: 3:15 ~~7:15~~ AM To: 3:30 ~~7:30~~ AM		From: 3:30 ~~7:30 AM~~ To: 3:45 ~~7:45 AM~~		From: 3:45 ~~7:45 AM~~ To: 4:00pm 8:~~00 AM~~	
	Tally	Total	Tally	Total	Tally	Total	Tally	Total
1					1			
2	11				1111		1111	
3	1111 1111		1111		1111 1111 111		1111 1111	
4	1111 1111		1111 11		1111 1111 1111		1111 1111 1111	
5	1111 111		1111 1111		1111 1111 111		1111 1111 1111	
6	1111		1111 1111		1111		1111 111	
7	1111 1		1111		1111 1111		1111 1111	
8	1111 1111	8	1111	4	1111 1111	9	1111	4
9	11	2	1111	6	1111 1111 111	12	11	2
10	111	3	111	3	111	3	1	1
11	111	3	11	2	111	3		
12	1111 1111	10	111	3	1111	5	111	3
13	1	2	11	2	1111	5	11	2
14			1	1	1	1	1	1
15	111	3			11	2	11	2
16	11	2			11	2	1	1
17	1	1	111	3				
18	11	2	1111	4	1	1	1	1
19	11	2	1	1	1	1	1	1
20	1	1	11	2	1	1	1	1
21	111	3			1	1	11	2
22	1	1	11	2	1	1	111	3
23					11	2	1	1
24			1	1				
25	1	1			1	1		
26	1	1	1	1				
27			1	1				
28								
29			1	1			1	1
30								
31								
32							1	1

61 , 58 , 37 45 34 56 1

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Gap Study

Project: Memorial Drive Gap Study
Major Road: Memorial Drive
Intersection: Memorial Dr / Karlyn Drive (east)
Peak Hour/Date of Field Visit: 2/6/2020
Weather:

Gap Size (Sec)	Number of Gaps							
	Period 1		Period 2		Period 3		Period 4	
	From: 4:45 7:~~00 AM~~ PM To: 5:00 7:~~15 AM~~ PM		From: 5:00 7:~~15 AM~~ To: 5:15 7:~~30 AM~~		From: 5:15 7:~~30 AM~~ PM To: 5:30 7:~~45 AM~~ PM		From: ~~5:30~~ 7:~~45 AM~~ PM To: 5:45 8:~~00 AM~~ PM	
	Tally	Total	Tally	Total	Tally	Total	Tally	Total
1								
2								
3								
4								
5								
6								
7								
8		9		3		5		7
9		2		5		3		4
10		2		5		5		
11		3		3		4		5
12		3		4		3		3
13		3		1				3
14		4				2		7
15				1				
16		1		1				2
17		1		1		2		
18								
19				2				
20		1		2		4		
21		1		1		1		3
22		1		2		1		1
23		1				1		
24								
25		1		1				2
26		1				2		
27				1				
28		1						1
29		1						1
30								
31		2						
32								
	40	1	35				36	