d. The intersection with N Wixom Road is controlled by stop signs, and west of this intersection, Theodore provides access to the north parking lot and drop-off area of Wixom Elementary School. The roadway terminates in a dead end to the west and is unmarked, with parking permitted on both sides. The road has a width of 26 feet and a posted speed limit of 25 mph.

2. Jurisdiction

a. N Wixom Road is the only road in the study area that is under the jurisdiction of Oakland County. The rest of the roads in the study area are owned and maintained by the City of Wixom.

E. Operational Assessment

1. Existing Levels of Service

A Level of Service (LOS) is a qualitative measure that describes the operational conditions within a traffic stream and at intersections and the perception of these conditions by the drivers. There are six Levels of Service set forth in the Highway Capacity Manual[2], ranging from A (highest LOS) through F (lowest LOS). For signalized and unsignalized intersections, Levels of Service are based on control delay per vehicle in seconds and assigned an associated letter value. For a signalized intersection, LOS and control delay are calculated for all movements; while an unsignalized intersection will only calculate LOS and delay for the movements that are non-free-flow conditions (stop or yield control). The following distribution is used to assign Levels of Service, with descriptions. Synchro reports detailing the LOS for each intersection are included in *Appendix B*. Delays at an intersection are considered acceptable for a LOS A through LOS D. LOS E and LOS F are both considered to be failing.

Level of Service	***Expected Delay at Intersection***	***Delay per Vehicle (sec)***	
		Signalized Intersection	**Unsignalized Intersection**
A	Very Low Delay	≤ 10	≤ 10
B	Short Traffic Delays	> 10 ≤ 20	> 10 ≤ 15
C	No. of Vehicles Stopping is Significant	> 20 ≤ 35	> 15 ≤ 25
D	Influence of Congestion Noticeable	> 35 ≤ 55	> 25 ≤ 35
E	Limit of Acceptable Delay	> 55 ≤ 80	> 35 ≤ 50
F	Over-Saturated	> 80	> 50

Table 3: Levels of Service and Control Delay

Level of Service was calculated for the current conditions as well as the 2027 Build, 2047 No Build, and 2047 Build scenarios. The vehicle delays calculated from current traffic conditions are used as baseline to compare the proposed build scenario. The results show that there are failing LOS for the eastbound and westbound approaches to the intersection of Wixom Road and Theodore during the morning and afternoon peak times. The southbound left turn at Wixom Road and Maple Road also degrades to a failing LOS during the afternoon peak hour. The failing movements continue to degrade through the 2047 horizon year with the

[2] Highway Capacity Manual 6th Edition, Transportation Research Board, 2016

northbound thru and right turn movements also degrading to a failing LOS during the afternoon peak hour. The failing movements on Theodore are the result of the large amount of traffic on Wixom Road that does not provide sufficient gaps for vehicles to pull out.

2025 AM Levels of Service - Existing													
Intersection	Eastbound			Westbound			Northbound			Southbound			All
	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Total
Maple Rd and Millstream Dr	A 0.0	A 0.0			A 0.0	A 0.0				A 9.5		A 9.5	A 1.0
Maple Rd and Hedigham Blvd	A 0.0	A 0.0			A 0.0	A 0.0				A 9.7		A 9.7	A 2.4
Maple Rd and Castlewood Ct	A 0.0	A 0.0			A 0.0	A 0.0				A 8.7		A 8.7	A 0.7
Wixom Rd and Maple Rd	C 32.7	D 36.1	D 36.1	D 43.3	C 31.7	C 31.7	C 32.6	B 12.6	B 12.6	B 15.7	C 20.7	C 20.7	C 22.1
Wixom Rd and Theodore	F 74.0	F 74.0	F 74.0	F 67.3	F 67.3	F 67.3	B 10.8	A 0.0	A 0.0	A 8.1	A 0.0	A 0.0	A 7.4
Wixom Rd and North School Dwy	A 0.0		A 0.0				B 10.6	A 0.0			A 0.0	A 0.0	A 0.0
Wixom Rd and South School Dwy	D 25.5		D 25.5				B 10.6	A 0.0			A 0.0	A 0.0	A 2.2

Table 4: Existing AM Levels of Service

2025 PM Levels of Service - Existing													
Intersection	Eastbound			Westbound			Northbound			Southbound			All
	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Total
Maple Rd and Millstream Dr	A 0.0	A 0.0			A 0.0	A 0.0				A 9.3		A 9.3	A 0.8
Maple Rd and Hedigham Blvd	A 0.0	A 0.0			A 0.0	A 0.0				A 9.6		A 9.6	A 1.2
Maple Rd and Castlewood Ct	A 0.0	A 0.0			A 0.0	A 0.0				A 9.9		A 9.9	A 0.4
Wixom Rd and Maple Rd	D 35.4	C 33.5	C 33.5	D 36.8	C 33.3	C 33.3	C 20.2	D 37.5	D 37.5	E 60.0	B 14.1	B 14.1	C 30.5
Wixom Rd and Theodore	F 165.8	F 165.8	F 165.8	F 73.6	F 73.6	F 73.6	A 8.7	A 0.2	A 0.2	B 10.9	A 0.1	A 0.1	A 8.9
Wixom Rd and North School Dwy	C 21.7		C 21.7				A 8.8	A 0.1			A 0.0	A 0.0	A 0.1
Wixom Rd and South School Dwy	D 28.2		D 28.2				A 8.8	A 0.3			A 0.0	A 0.0	A 2.5

Table 5: Existing PM Levels of Service

2027 AM Levels of Service - No-Build													
Intersection	Eastbound			Westbound			Northbound			Southbound			All
	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Total
Maple Rd and Millstream Dr	A 0.0	A 0.0			A 0.0	A 0.0				A 9.5		A 9.5	A 1.1
Maple Rd and Hedigham Blvd	A 0.0	A 0.0			A 0.0	A 0.0				A 9.8		A 9.8	A 2.4
Maple Rd and Castlewood Ct	A 0.0	A 0.0			A 0.0	A 0.0				A 8.7		A 8.7	A 0.7
Wixom Rd and Maple Rd	C 32.8	D 36.3	D 36.3	D 43.8	C 31.7	C 31.7	C 33.7	B 13.1	B 13.1	B 16.7	C 21.2	C 21.2	C 22.5
Wixom Rd and Theodore	F 90.3	F 90.3	F 90.3	F 80.3	F 80.3	F 80.3	B 10.9	A 0.0	A 0.0	A 8.2	A 0.0	A 0.0	A 9.2
Wixom Rd and North School Dwy	A 0.0		A 0.0				B 10.7	A 0.0			A 0.0	A 0.0	A 0.0
Wixom Rd and South School Dwy	D 26.0		D 26.0				B 10.6	A 0.0			A 0.0	A 0.0	A 2.3

Table 6: 2027 No-Build AM Levels of Service

2027 PM Levels of Service - No-Build													
Intersection	Eastbound			Westbound			Northbound			Southbound			All
	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Total
Maple Rd and Millstream Dr	A 0.0	A 0.0			A 0.0	A 0.0				A 9.3		A 9.3	A 0.9
Maple Rd and Hedigham Blvd	A 0.0	A 0.0			A 0.0	A 0.0				A 9.6		A 9.6	A 1.3
Maple Rd and Castlewood Ct	A 0.0	A 0.0			A 0.0	A 0.0				A 10.0		A 10.0	A 0.5
Wixom Rd and Maple Rd	D 35.6	C 33.5	C 33.5	D 37.0	C 33.4	C 33.4	C 20.6	D 40.4	D 40.2	E 65.4	B 14.3	B 14.3	C 32.2
Wixom Rd and Theodore	F 213.9	F 213.9	F 213.9	F 85.6	F 85.6	F 85.6	A 8.8	A 0.2	A 0.2	B 11.0	A 0.1	A 0.1	B 11.9
Wixom Rd and North School Dwy	C 22.0		C 22.0				A 8.7	A 0.1			A 0.0	A 0.0	A 0.1
Wixom Rd and South School Dwy	D 29.5		D 29.5				A 8.8	A 0.3			A 0.0	A 0.0	A 2.6

Table 7: 2027 No-Build PM Levels of Service

2047 AM Levels of Service - No-Build													
Intersection	Eastbound			Westbound			Northbound			Southbound			All
	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Total
Maple Rd and Millstream Dr	A 0.0	A 0.0			A 0.0	A 0.0				A 9.5		A 9.5	A 1.1
Maple Rd and Hedigham Blvd	A 0.0	A 0.0			A 0.0	A 0.0				A 9.9		A 9.9	A 2.4
Maple Rd and Castlewood Ct	A 0.0	A 0.0			A 0.0	A 0.0				A 8.7		A 8.7	A 0.7
Wixom Rd and Maple Rd	C 33.1	D 36.9	D 36.9	D 45.8	C 31.8	C 31.8	D 41.9	B 13.8	B 13.8	B 18.0	C 25.1	C 25.1	C 25.0
Wixom Rd and Theodore	F 188.1	F 188.1	F 188.1	F 170.6	F 170.6	F 170.6	B 11.5	A 0.0	A 0.0	A 8.3	A 0.0	A 0.0	C 19.0
Wixom Rd and North School Dwy	A 0.0		A 0.0				B 11.3	A 0.0			A 0.0	A 0.0	A 0.0
Wixom Rd and South School Dwy	D 33.5		D 33.5				B 11.2	A 0.0			A 0.0	A 0.0	A 2.9

Table 8: 2047 No-Build AM Levels of Service

2047 PM Levels of Service - No-Build													
Intersection	Eastbound			Westbound			Northbound			Southbound			All
	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Total
Maple Rd and Millstream Dr	A 7.4	A 0.3			A 0.0	A 0.0				A 9.4		A 9.4	A 0.9
Maple Rd and Hedigham Blvd	A 0.0	A 0.0			A 0.0	A 0.0				A 9.7		A 9.7	A 1.4
Maple Rd and Castlewood Ct	A 0.0	A 0.0			A 0.0	A 0.0				B 10.1		B 10.1	A 0.5
Wixom Rd and Maple Rd	D 36.1	C 33.9	C 33.9	D 37.9	C 33.7	C 33.7	C 23.0	E 67.1	E 67.1	F 91.7	B 15.2	B 15.2	D 47.6
Wixom Rd and Theodore	F 460.1	F 460.1	F 460.1	F 149.0	F 149.0	F 149.0	A 9.0	A 0.0	A 0.0	B 11.7	A 0.0	A 0.0	C 24.8
Wixom Rd and North School Dwy	C 24.5		C 24.5				A 8.9	A 0.1			A 0.0	A 0.0	A 0.1
Wixom Rd and South School Dwy	E 41.3		E 41.3				A 9.0	A 0.3			A 0.0	A 0.0	A 3.6

Table 9: 2047 No-Build PM Levels of Service

Level of service and control delay are not the only parameters by which traffic operations can be evaluated. SimTraffic traffic simulation software was utilized to review traffic queuing and operational characteristics as well. SimTraffic is a modeling simulation software that is part of the Synchro suite of software. The software provides a variety of evaluation variables; for the purposes of this study, the 95th percentile queue length and delay per vehicle were analyzed. Queue length is a useful parameter to evaluate in this study because of the proximity of the intersections to each other. Queues that form at intersections can impact operations upstream. The northbound approach to the intersection was found to have queue lengths exceeding 1,000 feet during the afternoon peak hour, likely causing driveways and Theodore to become blocked by vehicles on Wixom Road.

2025 AM 95th Percentile Queue Length (ft)												
Intersection	Eastbound			Westbound			Northbound			Southbound		
	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Maple Rd and Millstream Dr	0				0					37		37
Maple Rd and Hedigham Blvd	0				0					46		46
Maple Rd and Castlewood Ct	0				0					27		27
Wixom Rd and Maple Rd	37	132		96	43		57	177		107	482	
Wixom Rd and Theodore	74			59			47	0	9	18	8	
Wixom Rd and North School Dwy	13		13				0	0			0	
Wixom Rd and South School Dwy	82		82				51				14	

Table 10: Existing AM 95th Percentile Queue Lengths

2025 PM 95th Percentile Queue Length (ft)												
Intersection	Eastbound			Westbound			Northbound			Southbound		
	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Maple Rd and Millstream Dr	0				0					30		30
Maple Rd and Hedigham Blvd	0				0					45		45
Maple Rd and Castlewood Ct	0				0					31		31
Wixom Rd and Maple Rd	50	94		85	104		88	1098		86	259	
Wixom Rd and Theodore	130			39			47	122	18	20	0	
Wixom Rd and North School Dwy	9		9				17	70			0	
Wixom Rd and South School Dwy	166		166				53				3	

Table 11: Existing PM 95th Percentile Queue Lengths

2027 AM 95th Percentile Queue Length (ft) - No-Build												
Intersection	Eastbound			Westbound			Northbound			Southbound		
	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Maple Rd and Millstream Dr	0				0					47		47
Maple Rd and Hedigham Blvd	0				0					45		45
Maple Rd and Castlewood Ct	0				0					34		34
Wixom Rd and Maple Rd	49	131		103	57		67	189		102	444	
Wixom Rd and Theodore	85			61			44	0	0	8	4	
Wixom Rd and North School Dwy	21		21				0	0			0	
Wixom Rd and South School Dwy	68		68				46	0			3	

Table 12: 2027 No-Build AM 95th Percentile Queue Lengths

2027 PM 95th Percentile Queue Length (ft) No-Build												
Intersection	Eastbound			Westbound			Northbound			Southbound		
	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Maple Rd and Millstream Dr	0				0					35		35
Maple Rd and Hedigham Blvd	0				0					42		42
Maple Rd and Castlewood Ct	0				0					25		25
Wixom Rd and Maple Rd	52	72		92	115		89	945		105	276	
Wixom Rd and Theodore	85			40			34	58	12	20	0	
Wixom Rd and North School Dwy	18		18				20	22			0	
Wixom Rd and South School Dwy	132		132				36	4			13	

Table 13: 2027 No-Build PM 95th Percentile Queue Lengths

2047 AM 95th Percentile Queue Length (ft) - No-Build												
Intersection	Eastbound			Westbound			Northbound			Southbound		
	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Maple Rd and Millstream Dr	0				0					53		53
Maple Rd and Hedigham Blvd	0				0					47		47
Maple Rd and Castlewood Ct	0				0					33		33
Wixom Rd and Maple Rd	50	156		111	49		73	257		116	573	
Wixom Rd and Theodore	115			113			44	0	9	12	8	
Wixom Rd and North School Dwy	12		12				0	0			0	
Wixom Rd and South School Dwy	134		134				64				6	

Table 14: 2047 No-Build AM 95th Percentile Queue Lengths

2047 PM 95th Percentile Queue Length (ft) No-Build												
Intersection	Eastbound			Westbound			Northbound			Southbound		
	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Maple Rd and Millstream Dr	0				0					33		33
Maple Rd and Hedigham Blvd	0				0					48		48
Maple Rd and Castlewood Ct	0				0					35		35
Wixom Rd and Maple Rd	64	113		95	135		105	1446		98	315	
Wixom Rd and Theodore	383			133			91	353	59	18	3	
Wixom Rd and North School Dwy	19		19				29	227			0	
Wixom Rd and South School Dwy	269		269				273				5	

Table 15: 2047 No-Build PM 95th Percentile Queue Lengths

2. Proposed Levels of Service

The Levels of Service and Queue Lengths for the adjacent intersections as well as at the proposed driveway locations were determined. This build-out scenario models the two driveways along Maple Road with the three existing school access points being unused. Redistributing traffic from the new school location has a positive impact on vehicles existing and entering the school. The proposed school driveways will operate at significantly improved LOS compared to the existing conditions. The same movements that are currently operating at failing LOS continue to do so under the 2027 build-out conditions with the exception of the southbound left turn at Wixom Road and Maple Road which improves from a LOS E in the PM No-build conditions to a LOS D in the Build-out scenario. The northbound left turn through

the intersection of Wixom Road and Maple Road degrades to a failing LOS during the afternoon peak hour during the 2047 horizon year morning peak hour as a result of the redistributed traffic from the new school location. The southbound left turn through this intersection improves from a LOS F (91.7 seconds) to a LOS E (76.2 seconds) during the afternoon peak hour.

2027 AM Levels of Service - Build-out													
Intersection	Eastbound			Westbound			Northbound			Southbound			All
	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Total
Maple Rd and Millstream Dr	A 0.0	A 0.0			A 0.0	A 0.0				A 9.5		A 9.5	A 1.1
Maple Rd and Hedigham/ W Dwy	A 0.0	A 0.0	A 0.0	A 7.6	A 0.0	A 0.0	B 10.1	B 10.1	B 10.1	B 10.4	B 10.4	B 10.4	A 3.3
Maple Rd and Castlewood/ E Dwy	A 0.0	A 0.0	A 0.0	A 8.3	A 0.0	A 0.0	B 10.7	B 10.7	B 10.7	A 8.9	A 8.9	A 8.9	A 5.5
Wixom Rd and Maple Rd	D 35.3	D 40.4	D 40.4	D 49.8	C 32.0	C 23.0	D 45.3	B 12.3	B 12.3	B 15.0	C 21.9	C 21.9	C 25.9
Wixom Rd and Theodore	D 34.6	D 34.6	D 34.6	F 55.6	F 55.6	F 55.6	B 10.3	A 0.0	A 0.0	A 8.3	A 0.0	A 0.0	A 3.3
Wixom Rd and North School Dwy	A 0.0		A 0.0				A 0.0	A 0.0			A 0.0	A 0.0	A 0.0
Wixom Rd and South School Dwy	A 0.0		A 0.0				A 0.0	A 0.0			A 0.0	A 0.0	A 0.0

Table 16: 2027 AM Build-out Levels of Service

2027 PM Levels of Service - Build-out													
Intersection	Eastbound			Westbound			Northbound			Southbound			All
	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Total
Maple Rd and Millstream Dr	A 0.0	A 0.0			A 0.0	A 0.0				A 9.3		A 0.0	A 0.9
Maple Rd and Hedigham/ W Dwy	A 7.5	A 0.5	A 0.5	A 7.4	A 0.7	A 0.7	A 9.7	A 9.7	A 9.7	B 10.2	B 10.2	B 10.2	A 2.5
Maple Rd and Castlewood/ E Dwy	A 0.0	A 0.0	A 0.0	A 7.7	A 3.3	A 3.3	B 10.3	B 10.3	B 10.3	C 18.9	B 10.9	B 10.9	A 5.4
Wixom Rd and Maple Rd	D 40.9	D 37.2	D 37.2	D 42.1	C 33.6	C 33.6	C 23.3	C 29.5	C 29.5	D 47.8	B 14.4	B 14.4	C 27.3
Wixom Rd and Theodore	F 55.6	F 55.6	F 55.6	F 76.9	F 76.9	F 76.9	A 8.7	A 0.0	A 0.0	B 11.1	A 0.1	A 0.1	A 1.9
Wixom Rd and North School Dwy	A 0.0		A 0.0				A 0.0	A 0.0			A 0.0	A 0.0	A 0.0
Wixom Rd and South School Dwy	A 0.0		A 0.0				A 0.0	A 0.0			A 0.0	A 0.0	A 0.0

Table 17: 2027 PM Build-out Levels of Service

2047 AM Levels of Service - Build-out													
Intersection	Eastbound			Westbound			Northbound			Southbound			All
	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Total
Maple Rd and Millstream Dr	A 0.0	A 0.0			A 0.0	A 0.0				A 9.5		A 9.5	A 1.1
Maple Rd and Hedigham/ W Dwy	A 0.0	A 0.0	A 0.0	A 7.6	A 1.2	A 1.2	B 10.2	B 10.2	B 10.2	B 10.6	B 10.6	B 10.6	A 3.3
Maple Rd and Castlewood/ E Dwy	A 0.0	A 0.0	A 0.0	A 8.4	A 5.3	A 5.3	B 10.8	B 10.8	B 10.8	A 9.0	A 9.0	A 9.0	A 5.3
Wixom Rd and Maple Rd	D 35.5	D 41.5	D 41.5	D 53.0	C 32.1	C 32.1	E 64.0	B 12.8	B 12.8	B 16.1	C 26.3	C 26.3	C 29.2
Wixom Rd and Theodore	E 48.6	E 48.6	E 48.6	F 101.1	F 101.1	F 101.1	B 10.9	A 0.1	A 0.1	A 8.4	A 0.1	A 0.1	A 5.7
Wixom Rd and North School Dwy	A 0.0		A 0.0				A 0.0	A 0.0			A 0.0	A 0.0	A 0.0
Wixom Rd and South School Dwy	A 0.0		A 0.0				A 0.0	A 0.0			A 0.0	A 0.0	A 0.0

Table 18: 2047 AM Build-out Levels of Service

2047 PM Levels of Service - Build-out													
Intersection	Eastbound			Westbound			Northbound			Southbound			All
	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Total
Maple Rd and Millstream Dr	A 0.0	A 0.0			A 0.0	A 0.0				A 9.3		A 9.3	A 0.8
Maple Rd and Hedigham/ W Dwy	A 0.0	A 0.0	A 0.0	A 7.4	A 0.7	A 0.7	A 9.7	A 9.7	A 9.7	B 10.3	B 10.3	B 10.3	A 2.3
Maple Rd and Castlewood/ E Dwy	A 0.0	A 0.0	A 0.0	A 7.7	A 3.2	A 3.2	B 10.4	B 10.4	B 10.4	C 19.7	C 19.7	C 19.7	A 5.2
Wixom Rd and Maple Rd	D 41.7	D 37.7	D 37.7	D 43.2	C 33.9	C 33.9	C 26.4	D 44.9	D 44.9	E 76.2	B 15.3	B 15.3	D 35.5
Wixom Rd and Theodore	F 94.4	F 94.4	F 94.4	F 136.7	F 136.7	F 136.7	A 8.9	A 0.1	A 0.1	B 11.7	A 0.1	A 0.1	A 3.3
Wixom Rd and North School Dwy	A 0.0		A 0.0				A 0.0	A 0.0			A 0.0	A 0.0	A 0.0
Wixom Rd and South School Dwy	A 0.0		A 0.0				A 0.0	A 0.0			A 0.0	A 0.0	A 0.0

Table 19: 2047 PM Build-out Levels of Service

Queue Lengths were generally shown to increase at the intersection of Wixom Road and Maple Road as a result of the redistributed school traffic. However, queue lengths for the proposed school driveways off Maple Road were found to decrease compared to the existing school. Analysis shows that the proposed school driveway locations results in reduced on site queueing and improved delays for vehicles exiting the site.

2027 AM 95th Percentile Queue Length (ft)												
Intersection	Eastbound			Westbound			Northbound			Southbound		
	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Maple Rd and Millstream Dr	0				0					49		49
Maple Rd and Hedigham/ W Dwy	0			10			60			46		
Maple Rd and Castlewood/ E Dwy	3			62			58			32		
Wixom Rd and Maple Rd	109	206		98	70		112	326		142	505	
Wixom Rd and Theodore	36			46			16	0	3	15	0	
Wixom Rd and North School Dwy	0		0				0	0			0	
Wixom Rd and South School Dwy	0		0				0				0	

Table 20: Proposed 2027 AM Build-Out 95th Percentile Queue Lengths

2027 PM 95th Percentile Queue Length (ft)												
Intersection	Eastbound			Westbound			Northbound			Southbound		
	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Maple Rd and Millstream Dr	0				0					44		44
Maple Rd and Hedigham/ W Dwy	8			12			61			44		
Maple Rd and Castlewood/ E Dwy	0			37			62			28		
Wixom Rd and Maple Rd	133	165		81	105		111	954		84	273	
Wixom Rd and Theodore	38			54			25	64	17	22	0	
Wixom Rd and North School Dwy	0		0				0	0			0	
Wixom Rd and South School Dwy	0		0				0				0	

Table 21: Proposed 2027 PM Build-Out 95th Percentile Queue Lengths

2047 AM 95th Percentile Queue Length (ft)												
Intersection	Eastbound			Westbound			Northbound			Southbound		
	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Maple Rd and Millstream Dr	0				0					53		53
Maple Rd and Hedigham/ W Dwy	0			12			64			49		
Maple Rd and Castlewood/ E Dwy	3			75			59			35		
Wixom Rd and Maple Rd	129	225		113	78		120	1192		141	626	
Wixom Rd and Theodore	59			78			40	178	26	19	4	
Wixom Rd and North School Dwy	0		0				0	0			0	
Wixom Rd and South School Dwy	0		0				0				0	

Table 22: Proposed 2047 AM Build-Out 95th Percentile Queue Lengths

2047 PM 95th Percentile Queue Length (ft)												
Intersection	Eastbound			Westbound			Northbound			Southbound		
	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right
Maple Rd and Millstream Dr	0				0					36		36
Maple Rd and Hedigham/ W Dwy	0			4			69			40		
Maple Rd and Castlewood/ E Dwy	0			41			56			31		
Wixom Rd and Maple Rd	137	145		86	123		114	1489		99	304	
Wixom Rd and Theodore	158			136			30	375	55	55	18	
Wixom Rd and North School Dwy	0		0				0	0			0	
Wixom Rd and South School Dwy	0		0				0				0	

Table 23: Proposed 2047 PM Build-Out 95th Percentile Queue Lengths

3. Alternative Analysis

Traffic mitigation improvements were investigated to improve traffic operations in the worst-case scenario. The two alternative analysis scenarios that were analyzed were the 2047 horizon year assuming no changes to the school location and the 2047 horizon year with the new school trip distribution incorporated. The purpose of the two scenarios is to address congestion problems that are related and unrelated to the new school location separately.

For the no-build scenario a second northbound lane on Wixom Road was modeled from the Foundations for Learning Preschool & Daycare driveway through the intersection of Wixom Road and Maple Road to address the failing movements that are currently present. This

improvement matches the cross section of Wixom Road at the intersection with W Pontiac Trail, which tapers to a single lane approximately 250 feet north of the intersection. This represents a long-term mitigation that would improve vehicle delays to acceptable levels for both the morning and afternoon peak hours. Current traffic counts show that more than 1,000 vehicles travel northbound through the corridor during the afternoon peak hour. This volume is likely to increase with the typical background growth of traffic.

Intersection upgrades at Wixom Road and Maple Road were analyzed for the 2047 horizon year with the proposed development. The intersection improvements analyzed include permitted-permissive left turn phasing for the northbound and southbound left turns, as well as a proposed 100-foot right turn lane for northbound traffic. The two improvements were analyzed separately from the 2047 no-build scenario improvements. The northbound left turn movement was able to be improved to acceptable levels for the morning peak hour while preserving acceptable delays for all other turning movements. For the afternoon peak hour, all movements were able to be improved to acceptable levels with the exception of the northbound through movement. It was observed that five to ten northbound vehicles require two signal cycles to clear the intersection, leading to the high delays. Providing more green time for northbound traffic would reduce green time for westbound and eastbound traffic and lead to a falling LOS for those movements. The failing northbound movements are present during the build and no-build 2047 scenarios.

2047 AM Levels of Service Wixom Rd and Maple Rd													
Intersection	Eastbound			Westbound			Northbound			Southbound			All
	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Total
No-build, No improvements	C 33.1	D 36.9	D 36.9	D 45.8	C 31.8	C 31.8	D 41.9	B 13.8	B 13.8	B 18.0	C 25.1	C 25.1	C 25.0
No-build, with Addt'l Lane	C 33.1	D 36.9	D 36.9	D 45.8	C 31.8	C 31.8	D 41.9	B 11.1	B 11.1	B 13.0	C 25.1	C 25.1	C 24.2
Build, No improvements	D 35.5	D 41.5	D 41.5	D 53.0	C 32.1	C 32.1	E 64.0	B 12.8	B 12.8	B 16.1	C 26.3	C 26.3	C 29.2
Build, with Signal Timing	D 38.7	D 43.2	D 43.2	E 55.5	D 35.4	D 35.4	C 26.4	B 13.0	B 10.8	A 9.9	C 32.9	C 32.9	C 30.7

Table 24: 2047 AM Levels of Service at Wixom Rd and Maple Rd

2047 PM Levels of Service Wixom Rd and Maple Rd													
Intersection	Eastbound			Westbound			Northbound			Southbound			All
	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Total
No-build, No improvements	D 36.1	C 33.9	C 33.9	D 37.9	C 33.7	C 33.7	C 23.0	E 67.1	E 67.1	F 91.7	B 15.2	B 15.2	D 47.6
No-build, with Addt'l Lane	C 32.7	D 36.4	D 36.4	D 45.2	C 31.5	C 31.5	D 39.4	B 10.5	B 10.5	B 12.3	C 23.5	C 23.5	C 23.0
Build, No improvements	D 41.7	D 37.7	D 37.7	D 43.2	C 33.9	C 33.9	C 26.4	D 44.9	D 44.9	E 76.2	B 15.3	B 15.3	D 35.5
Build, with Signal Timing	D 53.3	D 48.0	D 48.0	E 56.1	D 43.6	D 43.6	A 9.1	C 22.4	A 7.7	B 17.2	B 13.2	B 13.2	C 24.0

Table 25: 2047 PM Levels of Service at Wixom Rd and Maple Rd

4. Turn Lane Treatment Analysis

SD analyzed the proposed Wixom Elementary School driveways to determine whether traffic volumes meet criteria to recommend turning lane treatments. These analyses were based on the MDOT Geometric Design Guidance and its criteria set in Sections 1.1.4 and 1.1.5, Traffic Guidelines for Right-Turn Lanes and Tapers and Traffic Volume Guidelines for Left-Turn Lanes and Passing Flares, respectively. A summary of recommendations regarding turn treatments for the East and West School Driveways is provided in a table at the end of this section.

Right Turn Treatment Analysis

SD utilized the MDOT graphs for 2-lane highways since Maple Rd currently has a 2-lane cross-section. For the West School Driveway, right turn volumes are generally low – with most coming from WB Maple Rd traffic turning right to NB Hedingham Dr. In both the AM and PM 2047 Build Scenarios, only a right turn radius is recommended for both EB and WB Maple Rd. SD did not analyze 2027 scenarios since volumes would only be lower and thus, the radius recommendation would remain. It should be noted that at the West Driveway an existing EB passing flare and WB right turn lane existing for Hedingham Dr. The construction of the new school should accommodate these existing geometric features. Should construction disturb Maple Rd, the passing flare and right turn lane should be restored to their existing conditions.

A similar result was determined for the East School Driveway with low turn volumes in the 2047 Build scenario for EB and WB Maple Rd. Therefore, only right turn radii are recommended for EB and WB Maple Rd. It should be noted that at the East Driveway there is an existing WB right turn lane for Castlewood Ct. The construction of the new school should accommodate this existing geometric feature. Should construction disturb Maple Rd, the right turn lane should be restored to its existing conditions.

SD did not analyze 2027 scenarios since volumes would only be lower than 2047 and thus, the recommendations would remain. See Appendix E for graphs used in this analysis.

Left Turn Treatment Analysis

SD utilized the MDOT graphs for 2-lane highways with 35 mph speed limits since Maple Rd currently has a 2-lane cross-section. MDOT has not published a graph for speed limits lower than 35 mph, so SD determined that this graph would be most appropriate. The analysis discussed below is based on 2047 Build scenario volumes.

At the West School Driveway, the volumes of advancing and opposing traffic are generally low. Coupled with a maximum left turn percentage of 16%, left-turn treatments are not recommended for either EB or WB Maple Rd. SD also reviewed MDOT's passing flare chart and has determined that since there are so few EB left turns, a passing flare is not recommended.

For the East School Driveway, similar patterns are held as above for EB Maple Rd. Although advancing and opposing volumes are slightly higher, there are very few left turns from EB Maple Rd to NB Castlewood Ct. As such, a left turn treatment is not recommended. For WB Maple Rd left turn percentages are higher, since this is the predominant movement for drop-

off and pick-up with 60% of traffic turning left during the AM Peak period. Based on the graph, volumes were found to be at the threshold to recommend a left turn treatment.

Since WB Maple Rd is very close to the left turn treatment threshold, SD determined it valid to conduct further investigation into the need for a passing flare. SEMCOG's traffic count database indicates that WB Maple Rd experienced approximately 2,500 vehicles per day in 2021. Grown with a rate consistent with the rest of the report, this is approximately 2,850 vehicles per day in 2047. The peak hour for left turns in 2047 is in the AM, which experiences 125 left turns. Corresponding with the graph, these volumes do result in the recommendation of a passing flare. Though the graphical analysis shows that a left turn treatment is warranted, the operational analysis resulted in LOS A for the left turns at this driveway. A left turn treatment would likely result in very little operational improvement at this location. **SD recommends to maintain the cross-section of Maple Rd.**

SD did not analyze 2027 scenarios since volumes would only be lower than 2047 and thus, the recommendations would remain. See Appendix E for graphs used in this analysis.

Driveway	Direction	Turn	Recommendation
West Driveway	EB Maple Rd	Left	**No Treatment**
		Right	**Radius Only**
	WB Maple Rd	Left	**No Treatment**
		Right	**Retain Ex turn lane**
East Driveway	EB Maple Rd	Left	**No Treatment**
		Right	**Radius Only**
	WB Maple Rd	Left	**No Treatment**
		Right	**Radius Only**

Table 26: Turn Treatment Summary

5. Left Turn Phasing Analysis

SD noted that the most substantial delays in the study network were observed at the signalized intersection of Maple Rd at Wixom Rd. As part of modeling the proposed improvements, SD considered whether left turn phasing would assist with improving operations at Maple Rd / Wixom Rd. SD utilized the MDOT Left Turn Phasing spreadsheet to complete this analysis.

The results of utilizing the MDOT Left Turn Phasing spreadsheet can be seen summarized in the table below. See Appendix E for graphs used in this analysis.

Scenario	Direction	Recommendation
2027 Build	NB / SB	**Install Permissive-Protected Left Turn Phasing**
	EB / WB	No Left Turn Phasing
2047 No Build	NB / SB	No Left Turn Phasing
	EB / WB	No Left Turn Phasing
2047 Build	NB / SB	**Install Permissive-Protected Left Turn Phasing**
	EB / WB	No Left Turn Phasing

Table 27: Left Turn Phasing Analysis Summary

SD began the analysis by evaluating the 2047 Build Scenario, since if it was not warranted when traffic volumes were the highest it would thus not be warranted in lower volume scenarios. It was determined that based on left turning volumes and opposing traffic, permissive-protected phasing could be justified for NB / SB Wixom Rd. To determine if this conclusion is due to the reassigned school traffic, SD analyzed the 2047 No Build scenario volumes. Ultimately, the analysis of the 2047 No Build scenario indicated that left turn phasing would not be recommended. Additionally, SD desired to determine if permissive-protected phasing would only be justified 20 years into the future, or closer to the present day, so the 2027 Build scenario was also analyzed. The results of the 2027 Build analysis similarly indicate that permissive-protected left turn phasing could be justified.

It is worth noting that the results of the analysis above are based solely on AM and PM Peak hour counts, as SD did not collect 24-hr counts at the Maple Rd / Wixom Rd intersection. A more robust left turn analysis could be conducted if 24-hr counts are collected. SD yields to the City to determine whether this further analysis is required.

SD also notes that any installation of new left turn phasing would be pending the approval of the Road Commission for Oakland County, the agency with jurisdiction over Wixom Rd and the traffic signal itself. SD understands that the City's reviewing consultant, Hubbell, Roth & Clark, Inc. (HRC), is currently engaged in designing several modernized traffic signals on the Wixom Rd corridor. This presents a unique opportunity for the school to provide the City and RCOC with justification to improve operations at the intersection.

Direction	Movement	2027 Build		2047 Build		2047 Build w/ Improvements	
		AM	PM	AM	PM	AM	PM
EB	LT	35.3	40.9	35.5	41.7	38.7	53.3
	TH	0	0	0	0	0	0
	RT	40.4	37.2	41.5	37.7	43.2	48.0
	Total	**39.2**	**38.7**	**40.1**	**39.3**	**42.2**	**50.1**
WB	LT	49.8	42.1	53.0	43.2	55.5	56.1
	TH	0	0	0	0	0	0
	RT	32.0	33.6	32.1	33.9	35.4	43.6
	Total	**43.7**	**36.6**	**46.1**	**37.3**	**48.9**	**48.1**
NB	LT	45.3	23.3	64.0	26.4	26.4	9.1
	TH	0	0	0	0	13.0	22.4
	RT	12.3	29.5	12.8	44.9	10.8	7.7
	Total	**20.1**	**28.7**	**24.0**	**42.8**	**15.6**	**19.9**
SB	LT	15.0	47.8	16.1	76.2	9.9	17.2
	TH	0	0	0	0	0	0
	RT	21.9	14.4	26.3	15.3	32.9	13.2
	Total	**21.7**	**16.2**	**25.9**	**18.5**	**32.1**	**13.4**
Total	**Total**	**25.8**	**27.3**	**29.2**	**35.5**	**30.7**	**24.0**

Table 28: LOS Delay Comparison

The results of adding left turn phasing to NB / SB Wixom Rd can be seen in the summary delay table above which compares delay between scenarios. Most critically, as time progresses in the Build scenario, the delay associated with NB / SB Wixom Rd increases. Various movements in the 2047 Build scenario reach delays which correspond to Level of Service E and F – which indicate breakdown of traffic flow.

SD added leading protected-permissive left turn phasing to NB / SB Wixom Rd in the 2047 Build with Improvements scenario. This improvement coincided with other signal timing upgrades and optimizations such as flashing yellow arrow signals, vehicular detection to allow None recall, and adjustments to splits. In this scenario, both in the AM and PM Peaks, movements with LOS E and F are generally eliminated, which benefits the intersection and Wixom Rd corridor at-large.

The split adjustments were conducted by holding the 120 second cycle length stead and using Synchro's "Optimize Splits" function. SD feels this is an accurate representation of how the intersection will operate after modernization by HRC, the City, and RCOC. The modernized signal will likely run on RCOC's Sydney Coordinated Adaptive Traffic System (SCATS) program. SCATS works by using real-time traffic volumes to continuously adjust signal timings to best serve the network. This creates a highly coordinated system which can minimize delays throughout the network in real-time.

SD recommends that HRC discuss with RCOC the opportunity to install permissive-protected phasing at the modernized signal for NB / SB Wixom Rd at Maple Rd. This installation should be installed per the latest MDOT and RCOC standards, with flashing yellow arrow signal heads and leading protected-permissive phasing. Ideally, this phasing would be installed in conjunction with modernized vehicular and pedestrian detection at the intersection. This would

allow for protected phases to run on None recall and be skipped absent the presence of turning vehicles.

6. Signal Warrant Analysis

SD performed a signal warrant analysis for the intersection of Maple Rd at Castlewood Ct / East School Driveway. The study reviewers asked for a warrant analysis at Hedingham Dr / West School Driveway, however, volumes are projected to be much lower in that location than the East Driveway. SD believes that because of lower volumes, should a signal not be warranted at the East Driveway it would similarly not be warranted at the West Driveway.

The Michigan Manual on Uniform Traffic Control Devices (MMUTCD) describes nine (9) warrants which may be utilized as part of an engineering study to warrant the installation of a traffic signal. The MMUTCD also specifically mentions that in the event a warrant is met, the installation is neither required nor recommended, only that thresholds have been met where a signal may be beneficial. The warrants are listed in the table below along with descriptions of their analysis. The MDOT Signal Warrant Spreadsheet was utilized for the analysis.

Warrant	Is Warrant Met?
Warrant 1: 8-Hr Vehicular Volume Condition A	Insufficient Data, but **unlikely to be met***
Warrant 1: 8-Hr Vehicular Volume Condition B	Insufficient Data, but **unlikely to be met***
Warrant 1: 8-Hr Vehicular Volume Condition A&B	Insufficient Data, but **unlikely to be met***
Warrant 2: 4-Hr Vehicular Volumes	Insufficient Data, but **unlikely to be met***
Warrant 3: Peak Hour Vehicular Volume	**Not Warranted**
Warrant 4: Pedestrian Volume	N/A; No Crossing at East Driveway
Warrant 5: School Crossing	N/A; No School Crossing at East Driveway
Warrant 6: Coordinated Signal System	N/A
Warrant 7: Crash Experience	N/A; 0 crashes last 5 years at Castlewood Ct
Warrant 8: Roadway Network	N/A
Warrant 9: Intersection near a Grade Crossing	N/A

***Note: See justification in subsequent discussion**

Table 29: Signal Warrant Summary

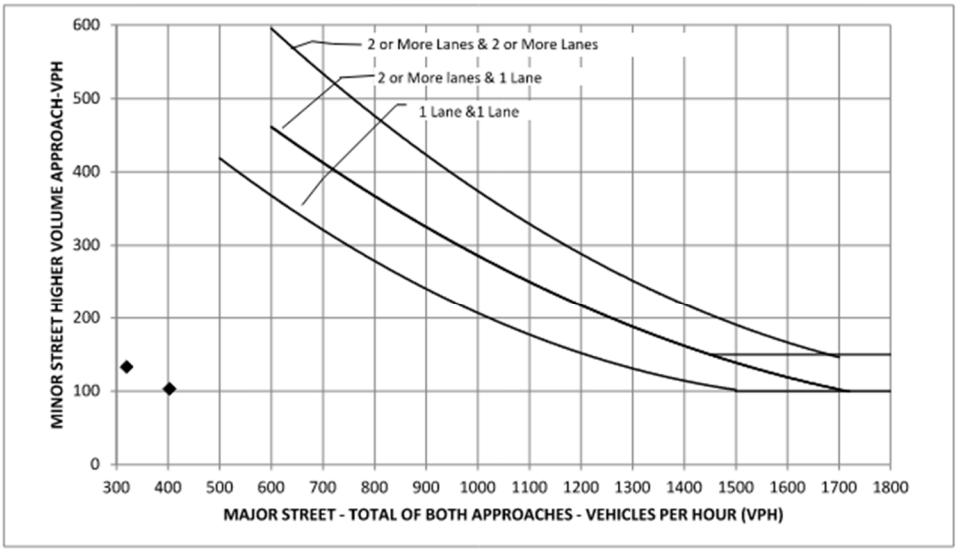
SD utilized Warrant 3 (Peak Hour) to justify whether a signal is warranted for the East School Driveway. Warrant 3 is intended for unusual cases per the MMUTCD, like office complexes, industrial plants, or schools where significant traffic is experienced in a concentrated period of the day. It is feasible to use Warrant 3 as a preliminary justification since 4- or 8-hour volumes are not available since the intersection does not yet exist.

Based on the chart for Warrant 3, volumes on Maple Rd and the minor approaches in the 2047 AM Peak are not large enough to meet thresholds. As such, a signal is not warranted based on Warrant 3. SD feels that this preliminary justification is sufficient to say that Warrants 1 and 2 are similarly unlikely to be met. Since volumes are not large enough during the peak hour (highest daily volume hour), the other 23 hours of the day will experience even less volume. SD also notes that since 2047 Build volumes to not meet signal warrant thresholds, the smaller volumes in 2027 Build will similarly fail to meet the thresholds.

Michigan Manual of Uniform Traffic Control Devices
Worksheet for Signal Warrants (Section 4C)
WARRANT 3 B(100%): Peak-Hour Vehicular Volume

Spot Number:	0		
Intersection:	Maple Rd @ Castlewood Ct / E School Dwy		
Date	12/16/2025	by	SDA-JDH

1	: No. of Lanes on Major St.
2	: No. of Lanes on Minor St.
30	: Speed limit or 85th Percentile? (MPH)
NO	: Is the intersection within an Isolated community?
0	: What is the of the population isolated community?



How Many Hours Are Met	0
Is Warrant 3 B (100%) Met?	NO

Figure 3: MUTCD Warrant 3 B Worksheet

Traffic would need to grow significantly on Maple Rd and the minor approaches to satisfy conditions of Warrants 1, 2, or 3. SD notes that road agencies like Michigan Department of Transportation (MDOT) and Road Commission for Oakland County (RCOC) typically do not permit signals to be installed unless the location meets thresholds in Warrant 1. While neither MDOT or RCOC own Maple Rd, RCOC would maintain the signal for the City of Wixom. This notion, coupled with the lack of meeting warrants, leads SD to recommend the East School Driveway be installed and Castlewood Ct remain as STOP-controlled approaches, respectively. This recommendation holds true for the Hedingham Dr / West School Driveway approaches to Maple Rd as well.

F. Conclusions and Recommendations

1. Report Overview

Most traffic conditions around the Wixom Elementary School area operate at acceptable Levels of Service during the morning and afternoon peak hours. Some of turning movements do operate at unacceptable levels. A proposed lane addition for northbound traffic was modeled to show a potential improvement to address the current failing LOS that would work for the long-term. Wixom Road serves as a primary connection point from I-96 to the south to

many residential neighborhoods to the north as well as several parks. Traffic volumes on Wixom Road are likely to increase with time. Adding the additional northbound lane would improve the intersection capacity at Wixom Road and Maple Road. The large amount of traffic volumes on Wixom Road are indicative of systemic concerns that are beyond the scope of this traffic study. The closest adjacent north and south roads are Beck Road a mile to the east and Old Plank Road two miles to the west.

The construction and relocation of the Wixom Elementary School will change traffic patterns in the area but is not expected to increase the amount of school-related traffic. One impact of relocating the elementary school to Maple Road is the increased traffic for northbound left turns from Wixom Road to Maple Road that will degrade to a failing LOS for the morning peak hour for the 20-year horizon year analysis. To mitigate long term congestion from the relocation of the school, permitted-protected left turn phasing was analyzed for northbound and southbound left turns. Delays for left turns were able to be reduced to acceptable levels with only the additional signal timing. A northbound right turn lane was also modeled for the 2047 build scenario to better improve the existing northbound congestion for thru and right turns. The turn lane would be less costly and less impactful than the full northbound lane that was modeled for the no-build 2047 scenario. The additional lane analysis shows improvements for the No-build and Build scenarios showing that the school relocation is not the cause of the school relocation. The school relocation analysis also shows that delays for the southbound left turn decrease due to the redistributed school volumes. **Walled Lake Consolidated Schools will not include this improvement as part of the school relocation project.**

The proposed school access points on Maple Road were shown to operate acceptably for all scenarios. Vehicle movements to and from the school are able to do so with minimal delays. The neighborhood roads that connect to Maple Road continue to operate at acceptable levels for the build-out scenarios.

The excessive delays currently present at Wixom Road and Theodore are the result of the large traffic volumes on Wixom Road. Limited gaps in traffic on Wixom Road cause a large amount of waiting for vehicles on Theodore, while traffic volumes turning off Theodore onto Wixom Road are relatively small. Eastbound traffic on Theodore will decrease with the school relocation. No other improvements are recommended.

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