TOWN OF TECUMSEH

Tecumseh Road / Lacasse Boulevard Intersection Analysis

Traffic Analysis and Recommendations

July 2019 –18-7539

July 2, 2019

SENT ELECTRONICALLY VIA EMAIL

Town of Tecumseh
917 Lesperance Road
Tecumseh, ON N8N 1W9

Attention: Mr. Phil Bartnik, P.Eng.,
Director, Public Works & Environmental Services

Tecumseh Road / Lacasse Boulevard Intersection Analysis
Final Report and Recommendations

Dear Mr. Bartnik:

The enclosed report outlines the results of our analysis related to the existing traffic operations at the intersection of Tecumseh Road and Lacasse Boulevard, including an evaluation of alternative solutions and recommendations.

Please contact us should you have any further questions or require further clarification.

Sincerely,

DILLON CONSULTING LIMITED

Flavio R. Forest, P.Eng.,
Project Manager

ACW:ges:sll

Enclosure(s)

cc: Mr. John Henderson, Town of Tecumseh

Our file: 18-7539

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1.0 Background

1.1 Purpose

The Town of Tecumseh (Town) has been considering the addition of a westbound right turn lane at the intersection of Tecumseh Road and Lacasse Boulevard, depending on the degree of improvements to traffic operations that may be achieved during peak periods. This traffic analysis was completed to determine whether improvements to the geometric design of the roadway, including traffic signal improvements, would be warranted at this time.

1.2 Previous Studies

1.2.1 Environmental Study Report

An Environmental Study Report (ESR) for the improvements to the Tecumseh Road East and Manning Road corridors was completed by the Town of Tecumseh in May 2004. These roadway improvements have now been implemented, though the recommended westbound right turn lane at the intersection of Tecumseh Road and Lacasse Boulevard was not completed, as it was identified as future works which were dependent on the warrants.

The justification for the turning lane was partially based on the understanding that trucks entering and exiting the site of the food processing facility at the northeast corner of Tecumseh Road and Lacasse Boulevard (previously Family Tradition Foods, currently Bonduelle Canada Inc.) have historically experienced difficulty with maneuvering and experienced delays in entering/exiting the facility.

The current shipping and receiving entrance for Bonduelle Canada Inc. is located directly off of Tecumseh Road, east of the intersection. This entrance allows for large vehicles to enter and exit the facility without the need to utilize the Lacasse and Tecumseh Intersection. Recent concerns have not been identified by the Town of Tecumseh from this property owner.

1.2.2 Town of Tecumseh Transportation Master Plan (TMP)

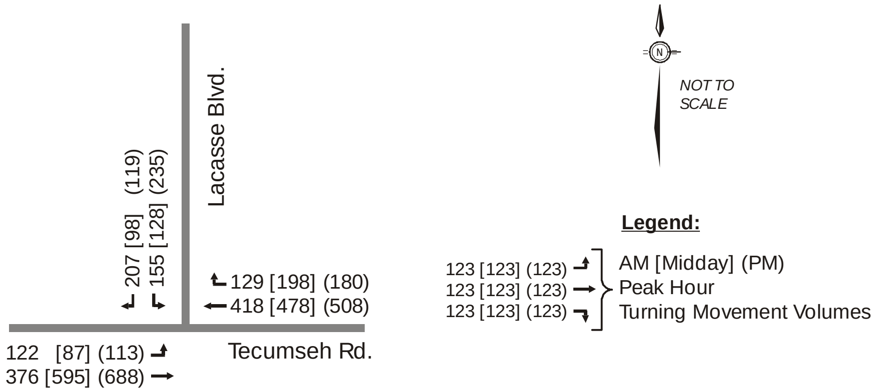
Based on the Town of Tecumseh Transportation Master Plan (TMP) completed in 2017, Tecumseh Road has been classified as a two lane "main street" west of the railway tracks, and as a minor arterial to the east, including the Lacasse Boulevard intersection. In comparison, Tecumseh Road was classified as a collector road at the time of the 2004 ESR.

2.0 Existing Conditions

2.1 Existing Traffic Volumes

Traffic volumes were surveyed by Dillon on Thursday, April 26, 2018 from 6:00–9:00 AM, 11:00 AM–1:00 PM, and 3:00–6:00 PM. The intersection survey results are provided in ***Appendix A***. The peak hour volumes are illustrated in ***Figure 1***.

Figure 1: Existing Peak Hour Traffic Volumes, Tecumseh Road at Lacasse Boulevard



Truck and pedestrian activity were observed to be relatively low. Trucks comprised 1% to 2% of overall intersection traffic. Pedestrian activity was negligible during the AM and midday periods, and low during the PM peak period (approximately 7 pedestrian crossings per hour).

2.2 Existing Intersection Operations

Traffic analyses were undertaken based on the April 2018 counts. Following the completion of those traffic counts, the traffic signal timings at this intersection were adjusted in August 2018. The existing intersection volumes were analyzed under the previous timings that were in place at the time of the counts (Scenario 1), as presented in **Appendix B**, and the new updated timings that are currently in effect (Scenario 2), as presented in **Appendix C**.

Table 1 outlines the intersection operations during the AM, midday and PM peak hours under both traffic signal timing scenarios.

Table 1: Existing Intersection Operations, Tecumseh Road at Lacasse Boulevard

Movement	AM peak hour v/c	AM Delay (s/veh)	AM LOS	AM 95th %ile queue (m)	Midday peak hour v/c	Midday Delay (s/veh)	Midday LOS	Midday 95th %ile queue (m)	PM peak hour v/c	PM Delay (s/veh)	PM LOS	PM 95th %ile queue (m)
Scenario 1: Original traffic signal timing plans (in effect during traffic survey)												
EB left	0.37	7.7	A	15	0.24	5.4	A	9	0.32	8.2	A	15
EB through	0.39	7.9	A	49	0.52	8.3	A	73	0.61	12.0	B	115
WB through	0.78	26.0	C	129	0.77	21.7	C	166	0.80	27.2	C	193
SB left	0.60	37.0	D	43	0.46	33.1	C	36	0.65	36.7	D	61
SB right	0.51	7.5	A	12	0.30	8.7	A	13	0.28	7.1	A	13
Overall	—	**18.1**	**B**	—	—	**15.9**	**B**	—	—	**20.3**	**C**	—
Scenario 2: Current traffic signal timing plans												
EB left	0.38	7.1	A	11	0.24	5.4	A	9	0.30	6.4	A	10
EB through	0.39	7.2	A	38	0.52	8.3	A	71	0.59	10.1	B	83
WB through	0.80	25.0	C	108	0.77	21.6	C	160	0.78	23.3	C	158
SB left	0.62	37.6	D	43	0.46	32.2	C	36	0.72	42.1	D	68
SB right	0.52	8.2	A	13	0.30	8.7	A	13	0.31	8.0	A	14
Overall	—	**17.6**	**B**	—	—	**15.8**	**B**	—	—	**18.7**	**B**	—

Typically, an individual movement at an intersection would be considered to be "critical" once it exceeds a volume to capacity (v/c) ratio of 0.85 (or 1.00 for dedicated turn lanes), or once the level of service reaches LOS E or F, or once queues exceed the available storage length.

The v/c ratio on the westbound approach is between 0.77 and 0.80 during all peak hours. This is approaching the critical threshold but generally would still be considered to be acceptable. All other v/c ratios are 0.72 or less.

The intersection is operating at a good overall level of service (LOS B). The westbound approach is at LOS C; the southbound left turn is at LOS C to D; all other movements are at LOS A to B. Therefore, while the westbound approach experiences somewhat higher delays and a lower level of service than other movements, the levels of service are all below critical thresholds.

The westbound queue is calculated to extend approximately 160 metres during the midday and PM peak hour, corresponding to a point just west of the bend in the road and the change in cross-section from two westbound lanes to one westbound lane. Although this queue would not conflict with other driveways or intersections, it is an indication that at some times during the midday and PM peak hour, there may be more vehicles queued than can be accommodated in one green signal.

There is a storage length of approximately 45 metres in the eastbound lane before reaching the upstream level rail crossing. The calculated 95th percentile queue can be accommodated in this distance during the AM peak hour, but extends beyond the rail crossing during the midday and PM peak hours.

The 2018 traffic signal timing adjustments resulted in an 18% reduction in the westbound queue length during the midday and PM peak hours, improved the overall level of service from LOS C to LOS B during the PM peak hour, and resulted in a minor reduction in delay during the AM and PM peak hours (both overall and on the westbound approach specifically). The timing adjustments did not substantially impact the v/c ratios for the westbound approach.

3.0 Potential Alternatives

3.1 Do Nothing

Based on our analysis of traffic operations under the previous signal timings, the worst case scenario for the westbound approach would be considered acceptable (i.e., traffic volumes are far enough below capacity that the intersection turning movements would not normally be considered to be critical; and levels of service are reasonable).

With the updated signal timings, the queues and delays have become a little shorter on the westbound approach during the PM peak hour, as have those on the eastbound approach. It was noted that the eastbound queues still extend across the level rail crossing, though the duration of this extended queue length has been reduced.

Further, the signal (as it is presently configured) governs how much traffic can enter the CIP area. Maintaining the intersection "as is" could be considered to be a strategic measure that displaces queuing and/or congestion from a more sensitive location (Lesperance Road intersection in the CIP area) to a less sensitive location (Lacasse intersection with less sensitive adjacent uses). This option also allows for less queuing over the VIA Rail tracks.

3.2 Traffic Signal Operational Improvements

The following opportunities to further refine the traffic signal operations were considered to increase capacity and reduce delays on the westbound approach:

- Reduction in the gap parameters so that the signal is more responsive to gaps on the minor movements (southbound; eastbound left turn).
- Adjustments to the signal timings, either to provide proportionally more time to the east/west movements, and/or shortening the cycle to increase turnover. The effectiveness of these types of adjustments may depend on the Town of Tecumseh's policy on timing pedestrian clearance intervals.
- Replacement of the detector in the eastbound left turn lane. The existing detector is at the stop bar, so it calls the left turn phase if there is a single vehicle waiting (at any time of day). This could be replaced with a setback detector that only calls the left turn phase if 3 or more vehicles are waiting. Normally this type of modification would be recommended as a design that only calls the left turn arrow when it is needed to mitigate left turn capacity constraints. However, in this case it might be preferable to prioritize the left turn, at the expense of a minor reduction in overall efficiency, because of the proximity to the level rail crossing. This change would also require a realignment of the lanes (pavement marking modifications) to gain additional storage length in the left turn lane. This adjustment would also need to be compatible with any Tecumseh Road Streetscape street layouts.

Although these alternatives have not been analyzed in detail, it is anticipated that their effect on traffic operations would be relatively minor (similar to the magnitude of the changes experienced following the August 2018 timing adjustments) and that they would not substantially change the overall results.

3.3 Roadway Geometric Modifications

3.3.1 Anticipated Operational Impacts

In order to achieve a more substantial increase in capacity and a more substantial reduction in queues and delays on the westbound approach, a right turn lane would be required. The intersection operations were re-assessed with a westbound right turn lane and compared against the existing operations. The results are presented in ***Table 2***.

Table 2: Anticipated Traffic Operations with Westbound Right Turn Lane

Movement	AM peak hour				Midday peak hour				PM peak hour			
	v/c	Delay (s/veh)	LOS	95th %ile queue (m)	v/c	Delay (s/veh)	LOS	95th %ile queue (m)	v/c	Delay (s/veh)	LOS	95th %ile queue (m)
With westbound right turn lane												
EB left	0.30	6.0	A	11	0.17	4.8	A	9	0.23	5.7	A	11
EB through	0.40	7.5	A	39	0.53	8.7	A	72	0.61	10.7	B	84
WB through	0.62	19.0	B	77	0.55	15.6	B	86	0.58	17.6	B	91
WB right	0.21	3.4	A	7	0.25	3.0	A	12	0.23	3.2	A	11
SB left	0.60	34.5	C	42	0.45	29.7	C	33	0.69	37.7	D	64
SB right	0.51	7.7	A	12	0.29	8.1	A	12	0.30	7.5	A	13
Overall	—	**13.4**	**B**	—	—	**11.5**	**B**	—	—	**14.8**	**B**	—
Existing geometry (reference case)												
EB left	0.38	7.1	A	11	0.24	5.4	A	9	0.30	6.4	A	10
EB through	0.39	7.2	A	38	0.52	8.3	A	71	0.59	10.1	B	83
WB through	0.80	25.0	C	108	0.77	21.6	C	160	0.78	23.3	C	158
SB left	0.62	37.6	D	43	0.46	32.2	C	36	0.72	42.1	D	68
SB right	0.52	8.2	A	13	0.30	8.7	A	13	0.31	8.0	A	14
Overall	—	**17.6**	**B**	—	—	**15.8**	**B**	—	—	**18.7**	**B**	—

A westbound right turn lane would be expected to result in the following effects:

- Reduce the overall intersection delay by approximately 4 seconds per vehicle;
- Reduce the westbound (through lane) v/c ratio from 0.77–0.80 to 0.55–0.62;
- Improve the westbound (through lane) level of service from LOS C to LOS B; and
- Reduce westbound (through lane) queues during the midday and PM peak hours from approximately 160 metres to approximately 90 metres.

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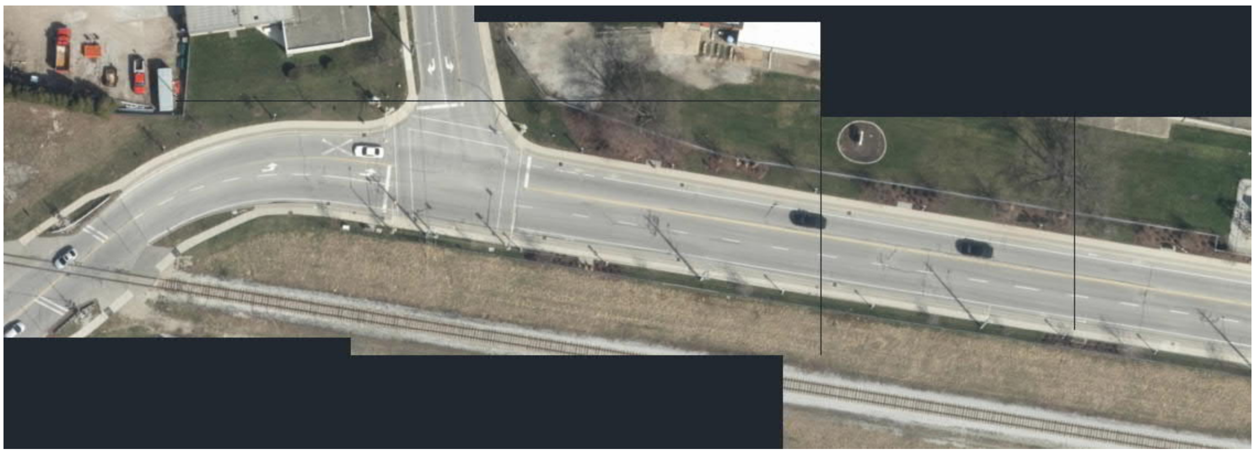
3.3.2 Potential Opportunities

Figure 2 illustrates the existing intersection configuration for context. The existing pavement width east of the intersection is approximately 13.8 m, comprised of the following elements:

- 1.5 m: westbound bicycle lane
- 3.75 m: westbound through / right turn lane
- 3.3 m: inside eastbound lane
- 4.0 m: outside eastbound lane
- 1.25 m: eastbound bicycle lane

Figure 2: Existing Intersection Configuration



Several alternative means of accommodating a westbound right turn lane were identified and screened at a high level. All alternatives include the following two measures:

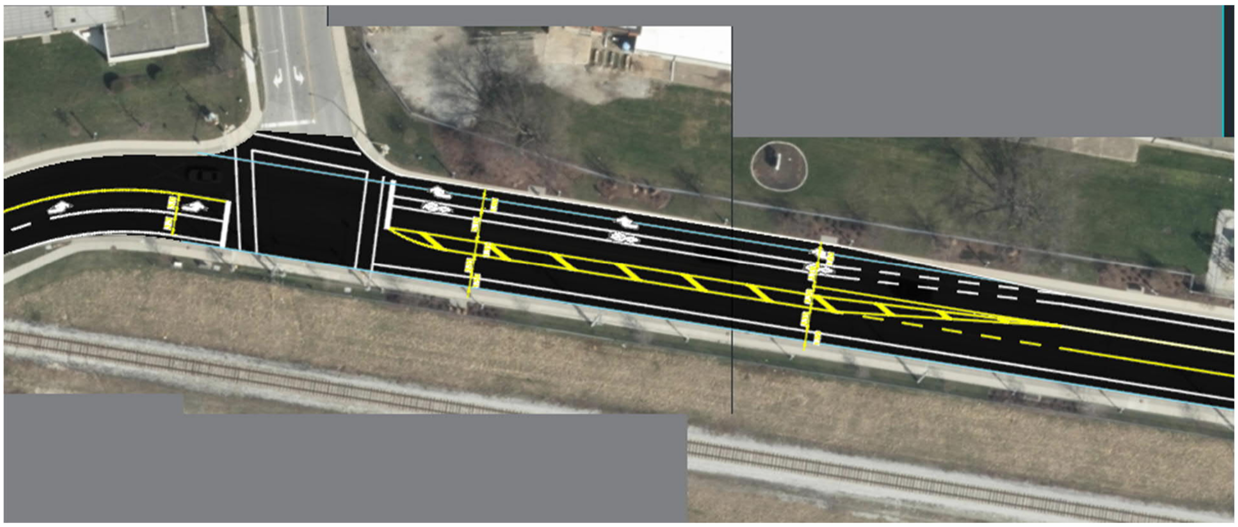
1) ***Eastbound lane reduction east of the intersection.*** There are two eastbound lanes immediately east of the intersection, but the capacity of the second lane is not effectively used because there is only one eastbound lane west of the intersection, and there are no driveways for approximately 300 metres east of Lacasse Boulevard (i.e., there is no need to provide a second lane for left-turning traffic). Therefore, one of the two eastbound lanes can be removed (for a distance of up to 200 metres) without a substantial impact on operations.

2) ***Southerly lane shift of eastbound left turn lane.*** On the west side of Lacasse Boulevard, the eastbound lanes consist of a 3.4 m left turn lane, a 4.3 m through lane and a 0.9 m painted shoulder (leading to the eastbound bicycle lane). It is proposed to narrow the eastbound lanes to 3.0 m in the left turn lane, 3.3 m in the through lane and 0.8 m in the painted shoulder, with the centre line being shifted southerly by 1.5 metres.

3.3.2.1 Alternative 1: Road Widening on North Side

The conventional means of providing a right turn lane would be to widen the road on the north side. After accounting for the assumed eastbound lane modifications, a widening of 1.5 metres would be required. The design includes 67.5 metres of storage and a 35-metre taper. When accounting for the additional width of the bicycle lane, this storage length would allow right-turning vehicles to bypass a 90-metre queue in the westbound through lane. A functional design is shown in ***Figure 3***.

Figure 3: Alternative 1: Road Widening on North Side



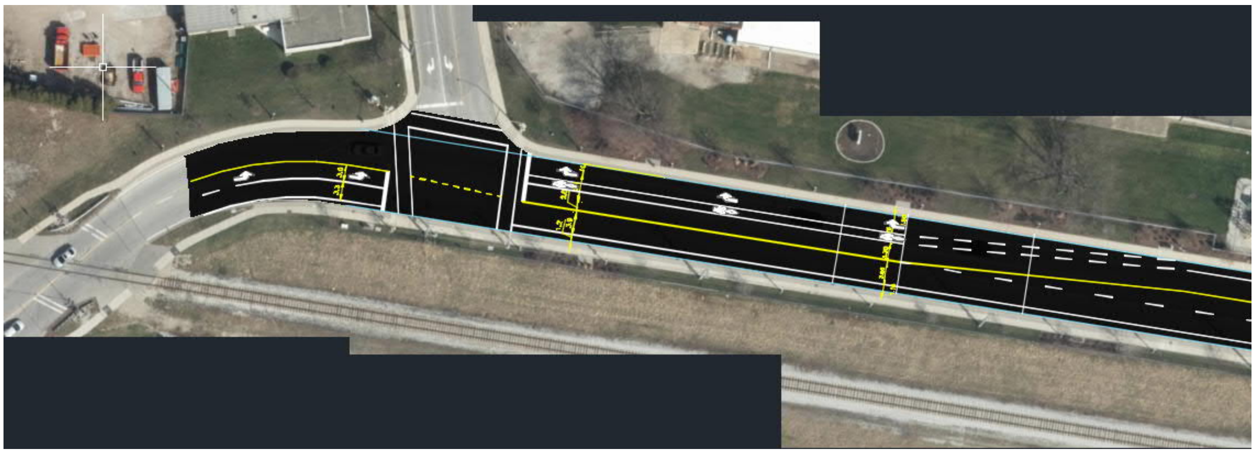
Advantages: This would allow a right turn lane to be provided without affecting any existing vehicular or bicycle lanes.

Disadvantages: Widening the road would result in a higher construction cost, would require consideration for signal reconfiguration, would impact existing trees and landscaping, and could potentially have property impacts. The cost of Alternative 1 is estimated to be approximately $390,000 which is significantly higher than Alternatives 2 through 4.

3.3.2.2 Alternative 2: Lane Shift through Intersection

Alternative 1 proposed a 1.5-metre road widening and a 1.95-metre flush (painted) median. In Alternative 2, the 1.5-metre road widening would be eliminated, and the right turn lane would instead be achieved by eliminating the 1.95-metre flush median and widening the eastbound lane by 0.45 metres (for a net combined decrease of 1.5 metres). The right turn lane would have the same storage length (67.5 metres) as in Alternative 1. The right turn taper (or, more accurately, the deflection of the through lane and the bicycle lane) would extend over 50 metres, equivalent to a 17.5:1 taper ratio, which falls within TAC guidelines. A functional design of this alternative is shown in ***Figure 4***.

Figure 4: Alternative 2: Lane Shift Through Intersection



Advantages: This would allow a right turn lane to be provided while maintaining the westbound bicycle lane to the intersection (aligning with the Transportation Master Plan (TMP)), without requiring substantial construction and without impacting existing landscaping. The reconfiguration would not require road reconstruction and would primarily be based around pavement marking adjustments. The construction cost for Alternatives 2 through 4 are similar and estimated to be approximately $50,000.

Disadvantages: The westbound lane would no longer be aligned when crossing Lacasse Boulevard. There would be a lane shift of 1.5 metres to the right when travelling westbound through the intersection, delineated by dashed pavement markings through the intersection. While the resulting taper angle (ratio of approximately 16:1) would be reasonable, **achieving the lane shift through this intersection would be considered undesirable as it would introduce conflicts with eastbound left turning vehicles at the centre of the intersection.**

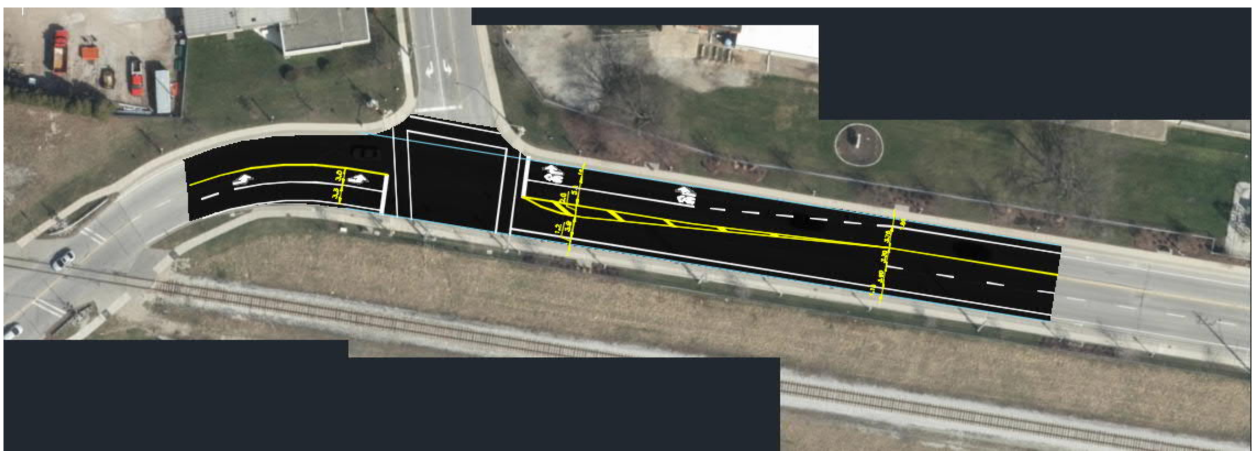
3.3.2.3 Alternative 3: Shared Westbound Right Turn / Bicycle Lane

If the westbound through lane is to be directly aligned through the Lacasse Boulevard intersection, all westbound functions would need to be accommodated within a width of 6.6 metres. This width is not sufficient to accommodate two vehicular lanes plus a dedicated bicycle lane.

In Alternative 3, the westbound bicycle lane would be terminated approximately 65 metres east of Lacasse Boulevard. The north half of the road would be divided into two general traffic lanes: a 3.0-metre through lane and a 3.6-metre right turn lane with 30 metres of storage plus a 35-metre taper. Cyclists would ride in the right turn lane, and sharrows would be painted on the left side of the lane to guide cyclists and right-turning motorists into the appropriate position on the road (i.e., so that right-turning motorists do not turn across the path of a cyclist). A functional design is provided in ***Figure 5***.

The functional design assumes a reduced storage length of 30 metres because of the increased exposure of cyclists to vehicular traffic. When accounting for the wider curb lane, right-turning vehicles would be able to bypass a queue of approximately 40 metres (compared to a 95th percentile queue of approximately 90 metres during the midday and PM peak hours).

Figure 5: Alternative 3: Shared Westbound Right Turn / Bicycle Lane



Advantages: Allows a right turn lane to be provided without requiring substantial construction and without requiring a westbound lane shift through the intersection. While cyclists would need to ride in mixed traffic, they would be in a lower-volume lane and could be directed/positioned on the correct side of right-turning traffic. The cyclists will be aligned to transition into on-road shared lanes as per the TMP onto either Lacasse Boulevard or Tecumseh Road, west of the intersection. The construction cost for Alternatives 2 through 4 are similar and estimated to be approximately $50,000.

Disadvantages: Cyclists would no longer have a dedicated lane for the last 65 metres before the intersection and would need to ride in mixed traffic over that distance. (This disadvantage may be offset by the fact that the bicycle lane does not exist west of the intersection and there are no plans to extend it in accordance with the TMP, so network connectivity is less of a consideration.) If a shorter right turn lane is provided to reduce cyclist exposure, the traffic benefits would be somewhat lower than in Alternatives 1 and 2.

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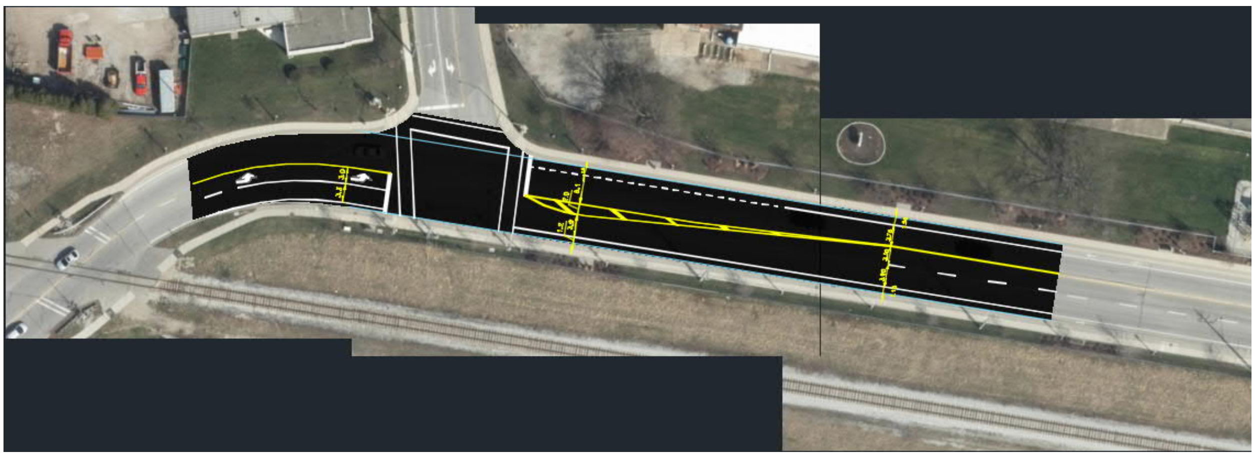
3.3.2.4 Alternative 4: Wide Westbound Lane

In this alternative, the bicycle lane would continue to terminate at the intersection (rather than in advance of the intersection) along with a wider westbound lane (a 5.1 m travel lane and 1.5 m bicycle lane, instead of two general purpose lanes). The bicycle lane markings would be dashed for a certain distance ahead of the intersection to permit encroachment by right-turning traffic (again, to mitigate the potential for right turns to be made across the path of cyclists). The combined width of 6.6 m would be wide enough for right turns to slip around queued vehicles (assuming that through traffic queues in the southerly half of the lane), resulting in a *de facto* right turn lane while the westbound traffic signals are red. A functional design is illustrated in ***Figure 6***.

Figure 6: Alternative 4: Wide Westbound Lane with Separate Bicycle Lane



Advantages: The westbound bicycle lane would continue to extend to the intersection. There would be sufficient lane width to allow right-turning vehicles to bypass through traffic (with encroachment on the bicycle lane, and assuming through traffic is positioned far enough to the left). The construction cost for Alternatives 2 through 4 are similar and estimated to be approximately $50,000.

Disadvantages: Cyclists would not be positioned on the correct side of right-turning traffic, leading to the potential for right turns to be made across the path of cyclists. If the wider westbound lane extends over a shorter distance to reduce cyclist exposure, the traffic benefits would be somewhat reduced. The traffic benefits may also be slightly lower than Alternative 3 because, during the green signal, right-turning vehicles would be more likely to affect through traffic using the same lane. The delineation of lanes for this alternative is not as clear as Alternative 3.

3.4 Truck Turning Path Assessments

Vehicle turning path assessments were undertaken to confirm the space that would be required for a truck to make a westbound right turn from Tecumseh Road to Lacasse Boulevard. The turning path assessments were based on Alternative 3, which maintains the curbs in their existing locations but realigns the lanes on the westbound approach. Turning path assessments were undertaken using AutoTURN software (version 10.2).

For the purpose of this assessment, a distinction was made between the design vehicle and the control vehicle, as follows:

- A design vehicle is a vehicle that would be expected to be common enough at the intersection that it should be able to complete the turn with relative ease.
- A control vehicle is a vehicle that may be anticipated on occasion, but not commonly enough that it should govern the design. The vehicle should be able to complete the turn, but given the limited frequency, it may be acceptable that the turn may be more constrained (e.g., encroachment on adjacent lanes).

During the 8-hour count undertaken at the intersection in April 2018, only 17 trucks of varying sizes were observed making the westbound right turn movement. Although the size of truck was not specifically recorded, it was generally observed that most trucks are smaller, single-unit trucks (e.g., delivery trucks, school buses) and that few, if any tractor-trailer trucks would have been making the right turn movement. (There are no major truck generators north of Tecumseh Road other than the Bonduelle facility, which is now accessed directly from Tecumseh Road.) As such, the design vehicle was taken to be a large, single-unit truck. However, three different sizes of tractor-trailer combinations were also tested as control vehicles.

The turning path assessments are shown in Figures 7 through 9. The findings from this assessment are as follows:

- A single-unit truck would be able to start a westbound right turn from the right turn lane and complete the turn without crossing the curb or encroaching on the opposing southbound lane.
- A small tractor-trailer (WB-12M) would be able to start a westbound right turn from the right turn lane and complete the turn without crossing the curb, but would encroach on the southbound left turn lane.
- Larger tractor-trailers (WB-19M / WB-20M) would need to start their turn from the westbound through lane and would also need to encroach on the southbound left turn lane.

Given that no changes are proposed to the curb locations (other than in Alternative 1) or the lane widths on Lacasse Boulevard, tractor-trailers already require a similar level of encroachment under current conditions. As such, the design alternatives would not be more restrictive than the existing configuration with respect to available pavement for turning movements, and accommodates the vehicles most commonly observed at the intersection.

Figure 7: WB-12M Vehicle Turning Movement Simulation

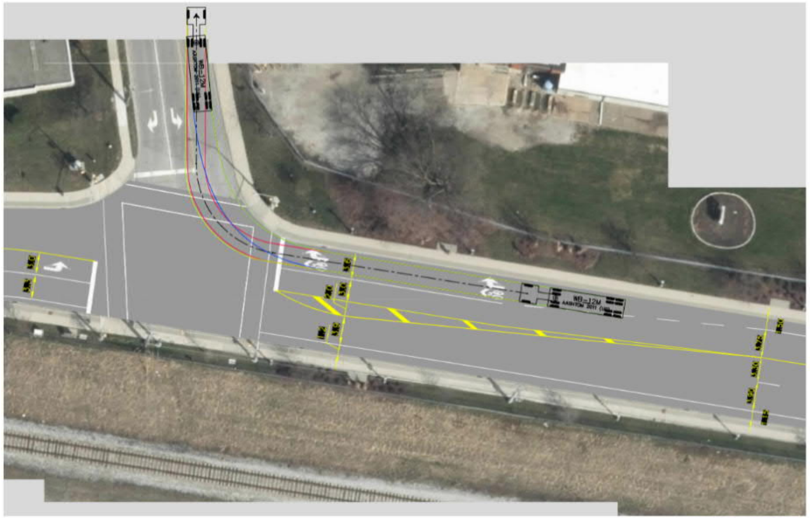


Figure 8: WB-19M Vehicle Turning Movement Simulation

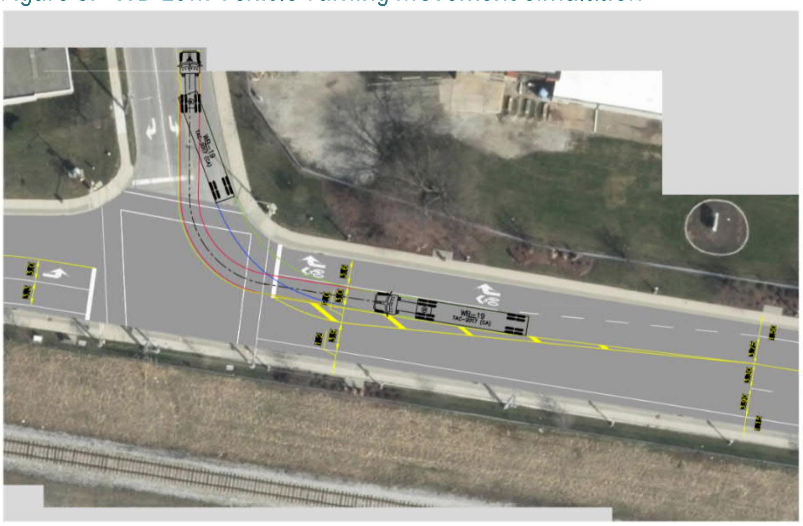
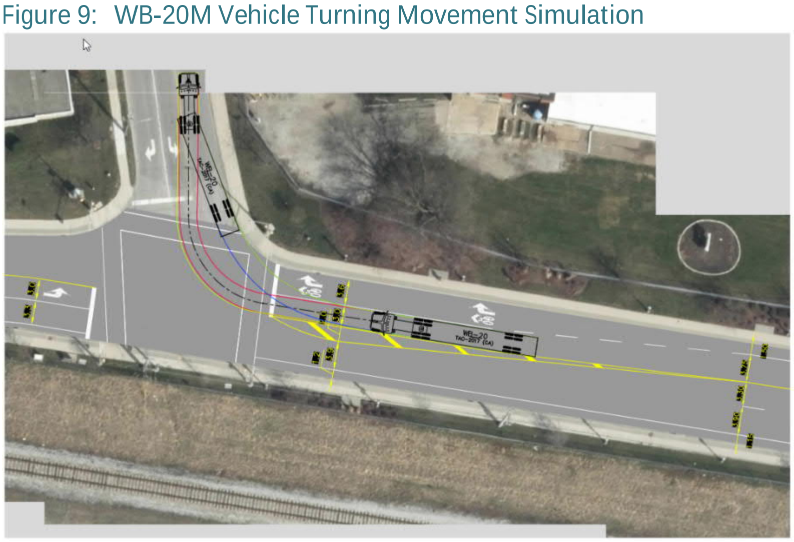


Figure 9: WB-20M Vehicle Turning Movement Simulation



4.0 Recommendations

A traffic analysis of the intersection was completed in order to confirm the existing level of service. Based on our analysis, the intersection is considered to be acceptable (i.e., traffic volumes are far enough below capacity that the intersection turning movements would not normally be considered to be critical; and levels of service are reasonable). The recently updated signal timings have resulted in a degree of improvement in queue lengths and vehicular delays on the eastbound and westbound approaches during the PM peak hour. And while the eastbound queues still extend across the level rail crossing, the duration of this extended queue length has been reduced.

In an effort to determine whether there are opportunities to enhance traffic operations at this intersection, particularly for the westbound approach, the following alternative solutions were evaluated:

1. Traffic Signal Operational Improvements
2. Roadway Geometric Modifications

   The following alternative roadway geometric modifications were evaluated to confirm the degree of improvement to the capacity of the westbound approach that could be achieved:

   - Alternative 1 – Road Widening on North Side

     Road widening by 1.5m to the north, allowing for a right turn lane and a separate bicycle lane.
   - Alternative 2 – Lane Shift Through Intersection

     No pavement widening. Right turn lane and separate bicycle lane.
   - Alternative 3 – Shared Westbound Right Turn / Bicycle Lane

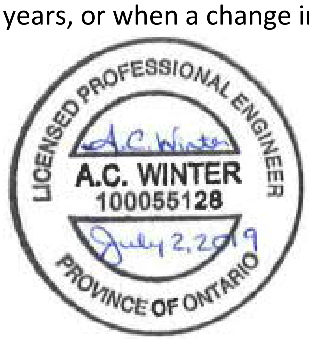
     No pavement widening. Shared right turn and bicycle lane.
   - Alternative 4 – Wide Westbound Lane

     No pavement widening. Wide westbound lane with a separate bicycle lane.

Further improvements as a result of traffic signal operational improvements are anticipated to be relatively minor and would not substantially alter the existing conditions at this intersection.

Roadway geometric improvements could result in varying levels of improvements to traffic operations at this intersection, though there are disadvantages related to each alternative, as outlined above. Alternative 1 would be considered the preferred geometric modification alternative, though the significant cost of implementation is not considered warranted given that the intersection is considered to be operating at an acceptable level of service at this time.

Accordingly, it is recommended that the Town consider doing nothing at this time. It is also recommended that the Town monitor traffic operations and consider re-evaluating this intersection in 5 years, or when a change in traffic conditions becomes apparent.



Appendix A

Traffic Volume Data

Intersection Turning Movement Count Data

Tecumseh Road East at Lacasse Boulevard

Thursday, April 26, 2018

Time period:		WEST APPROACH										EAST APPROACH									
		Cars			Trucks			Total			Peds	Cars			Trucks			Total			Peds
From	To	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right		Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	
6:00	6:15	2	21	0	0	0	0	2	21	0	0	0	28	8	0	0	0	0	28	8	0
6:15	6:30	5	29	0	0	0	0	5	29	0	0	0	45	6	0	1	0	0	46	6	0
6:30	6:45	1	28	0	1	0	0	2	28	0	0	0	61	11	0	2	0	0	63	11	0
6:45	7:00	9	41	0	0	5	0	9	46	0	0	0	53	22	0	0	0	0	53	22	0
7:00	7:15	9	38	0	0	2	0	9	40	0	0	0	84	19	0	1	0	0	85	19	0
7:15	7:30	9	47	0	0	1	0	9	48	0	0	0	58	24	0	0	0	0	58	24	0
7:30	7:45	12	60	0	0	1	0	12	61	0	0	0	96	26	0	3	1	0	99	27	0
7:45	8:00	23	109	0	0	4	0	23	113	0	0	0	80	27	0	1	1	0	81	28	0
8:00	8:15	20	73	0	0	0	0	20	73	0	0	0	120	23	0	1	0	0	121	23	0
8:15	8:30	36	80	0	2	2	0	38	82	0	0	0	93	34	0	4	2	0	97	36	0
8:30	8:45	40	103	0	1	5	0	41	108	0	0	0	118	41	0	1	1	0	119	42	0
8:45	9:00	16	108	0	1		0	17	108	0	0	0	79	19	0	6	0	0	85	19	0
6:00	**9:00**	**182**	**737**	**0**	**5**	**20**	**0**	**187**	**757**	**0**	**0**	**0**	**915**	**260**	**0**	**20**	**5**	**0**	**935**	**265**	**0**
Total HV%:					3%	3%	0%								0%	2%	2%				
7:45	**8:45**	**119**	**365**	**0**	**3**	**11**	**0**	**122**	**376**	**0**	**0**	**0**	**411**	**125**	**0**	**7**	**4**	**0**	**418**	**129**	**0**
Peak hour HV%:					2%	3%	0%								0%	2%	3%				
11:00	11:15	19	135	0	0	2	0	19	137	0	0	0	69	19	0	0	2	0	69	21	1
11:15	11:30	12	158	0	0	0	0	12	158	0	0	0	94	40	0	1	0	0	95	40	0
11:30	11:45	20	155	0	0	2	0	20	157	0	0	0	85	37	0	3	1	0	88	38	0
11:45	12:00	16	139	0	2	1	0	18	140	0	0	0	90	43	0	0	1	0	90	44	0
12:00	12:15	15	168	0	0	2	0	15	170	0	0	0	123	51	0	2	2	0	125	53	0
12:15	12:30	26	141	0	0	3	0	26	144	0	0	0	127	39	0	2	1	0	129	40	0
12:30	12:45	23	152	0	0	0	0	23	152	0	0	0	93	44	0	1	1	0	94	45	0
12:45	13:00	23	127	0	0	2	0	23	129	0	0	0	129	58	0	1	2	0	130	60	0
13:00	13:15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13:15	13:30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13:30	13:45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13:45	14:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11:00	**14:00**	**154**	**1175**	**0**	**2**	**12**	**0**	**156**	**1187**	**0**	**0**	**0**	**810**	**331**	**0**	**10**	**10**	**0**	**820**	**341**	**1**
Total HV%:					1%	1%	0%								0%	1%	3%				
12:00	**13:00**	**87**	**588**	**0**	**0**	**7**	**0**	**87**	**595**	**0**	**0**	**0**	**472**	**192**	**0**	**6**	**6**	**0**	**478**	**198**	**0**
Peak hour HV%:					0%	1%	0%								0%	1%	3%				
15:00	15:15	33	133	0	0	0	0	33	133	0	3	0	118	55	0	0	0	0	118	55	1
15:15	15:30	17	153	0	0	0	0	17	153	0	0	0	110	45	0	3	0	0	113	45	2
15:30	15:45	29	171	0	0	1	0	29	172	0	0	0	118	70	0	1	0	0	119	70	0
15:45	16:00	23	191	0	1	2	0	24	193	0	0	0	123	31	0	2	0	0	125	31	1
16:00	16:15	25	162	0	0	0	0	25	162	0	0	0	127	40	0	2	0	0	129	40	0
16:15	16:30	35	160	0	0	1	0	35	161	0	0	0	132	39	0	3	0	0	135	39	0
16:30	16:45	24	164	0	0	0	0	24	164	0	0	0	100	48	0	1	1	0	101	49	0
16:45	17:00	31	157	0	0	0	0	31	157	0	0	0	130	35	0	0	0	0	130	35	0
17:00	17:15	27	157	0	0	0	0	27	157	0	0	0	113	61	0	0	0	0	113	61	0
17:15	17:30	29	129	0	0	2	0	29	131	0	0	0	133	45	0	0	0	0	133	45	3
17:30	17:45	27	158	0	0	0	0	27	158	0	0	0	107	43	0	1	0	0	108	43	0
17:45	18:00	23	132	0	0	0	0	23	132	0	0	0	120	52	0	2	1	0	122	53	1
15:00	**18:00**	**323**	**1867**	**0**	**1**	**6**	**0**	**324**	**1873**	**0**	**3**	**0**	**1431**	**564**	**0**	**15**	**2**	**0**	**1446**	**566**	**8**
Total HV%:					0%	0%	0%								0%	1%	0%				
15:30	**16:30**	**112**	**684**	**0**	**1**	**4**	**0**	**113**	**688**	**0**	**0**	**0**	**500**	**180**	**0**	**8**	**0**	**0**	**508**	**180**	**1**
Peak hour HV%:					1%	1%	0%								0%	2%	0%				
Total survey:		**659**	**3779**	**0**	**8**	**38**	**0**	**667**	**3817**	**0**	**3**	**0**	**3156**	**1155**	**0**	**45**	**17**	**0**	**3201**	**1172**	**9**
Total HV%:																					

Time period:		SOUTH APPROACH										NORTH APPROACH									
		Cars			Trucks			Total			Peds	Cars			Trucks			Total			Peds
From	To	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right		Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	
6:00	6:15	0	0	0	0	0	0	0	0	0	0	25	0	44	1	0	0	26	0	44	1
6:15	6:30	0	0	0	0	0	0	0	0	0	0	17	0	20	0	0	0	17	0	20	0
6:30	6:45	0	0	0	0	0	0	0	0	0	0	17	0	29	0	0	0	17	0	29	0
6:45	7:00	0	0	0	0	0	0	0	0	0	0	32	0	19	0	0	0	32	0	19	1
7:00	7:15	0	0	0	0	0	0	0	0	0	0	12	0	33	1	0	0	13	0	33	0
7:15	7:30	0	0	0	0	0	0	0	0	0	0	21	0	34	1	0	1	22	0	35	0
7:30	7:45	0	0	0	0	0	0	0	0	0	0	27	0	11	1	0	2	28	0	13	0
7:45	8:00	0	0	0	0	0	0	0	0	0	0	37	0	44	0	0	0	37	0	44	0
8:00	8:15	0	0	0	0	0	0	0	0	0	0	26	0	41	0	0	2	26	0	43	0
8:15	8:30	0	0	0	0	0	0	0	0	0	0	33	0	51	0	0	0	33	0	51	0
8:30	8:45	0	0	0	0	0	0	0	0	0	0	52	0	68	7	0	1	59	0	69	0
8:45	9:00	0	0	0	0	0	0	0	0	0	0	54	0	34	1	0	1	55	0	35	0
6:00	**9:00**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**353**	**0**	**428**	**12**	**0**	**7**	**365**	**0**	**435**	**2**
Total HV%:					0%	0%	0%								3%	0%	2%				
7:45	**8:45**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**148**	**0**	**204**	**7**	**0**	**3**	**155**	**0**	**207**	**0**
Peak hour HV%:					0%	0%	0%								5%	0%	1%				
11:00	11:15	0	0	0	0	0	0	0	0	0	0	23	0	21	1	0	0	24	0	21	0
11:15	11:30	0	0	0	0	0	0	0	0	0	0	53	0	20	0	0	0	53	0	20	0
11:30	11:45	0	0	0	0	0	0	0	0	0	0	43	0	11	0	0	1	43	0	12	0
11:45	12:00	0	0	0	0	0	0	0	0	0	0	27	0	24	0	0	0	27	0	24	0
12:00	12:15	0	0	0	0	0	0	0	0	0	0	47	0	17	1	0	0	48	0	17	0
12:15	12:30	0	0	0	0	0	0	0	0	0	0	14	0	21	0	0	0	14	0	21	0
12:30	12:45	0	0	0	0	0	0	0	0	0	0	38	0	25	0	0	2	38	0	27	0
12:45	13:00	0	0	0	0	0	0	0	0	0	0	28	0	33	0	0	0	28	0	33	0
13:00	13:15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13:15	13:30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13:30	13:45	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13:45	14:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11:00	**14:00**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**273**	**0**	**172**	**2**	**0**	**3**	**275**	**0**	**175**	**0**
Total HV%:					0%	0%	0%								1%	0%	2%				
12:00	**13:00**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**127**	**0**	**96**	**1**	**0**	**2**	**128**	**0**	**98**	**0**
Peak hour HV%:					0%	0%	0%								1%	0%	2%				
15:00	15:15	0	0	0	0	0	0	0	0	0	0	47	0	45	1	0	1	48	0	46	3
15:15	15:30	0	0	0	0	0	0	0	0	0	0	33	0	42	1	0	2	34	0	44	1
15:30	15:45	0	0	0	0	0	0	0	0	0	0	45	0	34	0	0	0	45	0	34	1
15:45	16:00	0	0	0	0	0	0	0	0	0	0	36	0	27	0	0	0	36	0	27	2
16:00	16:15	0	0	0	0	0	0	0	0	0	0	88	0	31	2	0	0	90	0	31	2
16:15	16:30	0	0	0	0	0	0	0	0	0	0	63	0	27	1	0	0	64	0	27	1
16:30	16:45	0	0	0	0	0	0	0	0	0	0	74	0	27	0	0	0	74	0	27	
16:45	17:00	0	0	0	0	0	0	0	0	0	0	77	0	18	0	0	0	77	0	18	1
17:00	17:15	0	0	0	0	0	0	0	0	0	0	47	0	15	0	0	0	47	0	15	
17:15	17:30	0	0	0	0	0	0	0	0	0	0	77	0	16	0	0	1	77	0	17	1
17:30	17:45	0	0	0	0	0	0	0	0	0	0	46	0	27	1	0	0	47	0	27	
17:45	18:00	0	0	0	0	0	0	0	0	0	0	39	0	16	1	0	0	40	0	16	1
15:00	**18:00**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**672**	**0**	**325**	**7**	**0**	**4**	**679**	**0**	**329**	**13**
Total HV%:					0%	0%	0%								1%	0%	1%				
15:30	**16:30**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**232**	**0**	**119**	**3**	**0**	**0**	**235**	**0**	**119**	**6**
Peak hour HV%:					0%	0%	0%								1%	0%	0%				
Total survey:		**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1298**	**0**	**925**	**21**	**0**	**14**	**1319**	**0**	**939**	**15**
Total HV%:																					

Time period:		Total vehicles:				Hourly total vehicles:
From	To	Cars	Trucks	Total	Peds	
6:00	6:15	128	1	129	1	583
6:15	6:30	122	1	123	0	653
6:30	6:45	147	3	150	0	726
6:45	7:00	176	5	181	1	816
7:00	7:15	195	4	199	0	961
7:15	7:30	193	3	196	0	1068
7:30	7:45	232	8	240	0	1209
7:45	8:00	320	6	326	0	**1407**
8:00	8:15	303	3	306	0	1400
8:15	8:30	327	10	337	0	
8:30	8:45	422	16	438	0	
8:45	9:00	310	9	319	0	
6:00	**9:00**	**2875**	**69**	**2944**	**2**	
Total HV%:			2%			
7:45	**8:45**	**1372**	**35**	**1407**	**0**	**1407**
Peak hour HV%:			2%			PHF = 0.8
11:00	11:15	286	5	291	1	1370
11:15	11:30	377	1	378	0	1507
11:30	11:45	351	7	358	0	1503
11:45	12:00	339	4	343	0	1524
12:00	12:15	421	7	428	0	**1584**
12:15	12:30	368	6	374	0	1156
12:30	12:45	375	4	379	0	782
12:45	13:00	398	5	403	0	403
13:00	13:15	0	0	0	0	0
13:15	13:30	0	0	0	0	
13:30	13:45	0	0	0	0	
13:45	14:00	0	0	0	0	
11:00	**14:00**	**2915**	**39**	**2954**	**1**	
Total HV%:			1%			
12:00	**13:00**	**1562**	**22**	**1584**	**0**	**1584**
Peak hour HV%:			1%			PHF = 0.92
15:00	15:15	431	2	433	7	1744
15:15	15:30	400	6	406	3	1788
15:30	15:45	467	2	469	1	**1843**
15:45	16:00	431	5	436	3	1813
16:00	16:15	473	4	477	2	1825
16:15	16:30	456	5	461	1	1768
16:30	16:45	437	2	439	0	1739
16:45	17:00	448	0	448	1	1710
17:00	17:15	420	0	420	0	1648
17:15	17:30	429	3	432	4	
17:30	17:45	408	2	410	0	
17:45	18:00	382	4	386	2	
15:00	**18:00**	**5182**	**35**	**5217**	**24**	
Total HV%:			1%			
15:30	**16:30**	**1827**	**16**	**1843**	**7**	**1843**
Peak hour HV%:			1%			PHF = 0.96
Total survey:		**10972**	**143**	**11115**	**27**	
Total HV%:			1%			

Appendix B

Intersection Analysis Worksheets – Scenario 1 Previous Configuration

DILLON CONSULTING

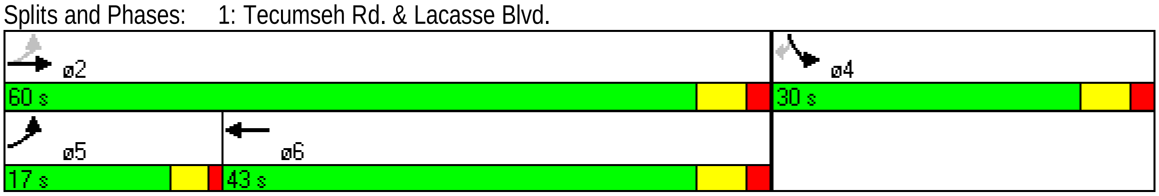
Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (vph)	122	376	418	129	155	207
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (m)	15.0			0.0	35.0	0.0
Storage Lanes	1			0	1	1
Taper Length (m)	30.0			7.5	25.0	7.5
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.968			0.850
Flt Protected	0.950				0.950	
Satd. Flow (prot)	1770	1845	1799	0	1719	1599
Flt Permitted	0.182				0.950	
Satd. Flow (perm)	339	1845	1799	0	1719	1599
Right Turn on Red				Yes		Yes
Satd. Flow (RTOR)			21			259
Link Speed (k/h)		50	50		50	
Link Distance (m)		275.0	276.3		232.7	
Travel Time (s)		19.8	19.9		16.8	
Peak Hour Factor	0.80	0.80	0.80	0.80	0.80	0.80
Heavy Vehicles (%)	2%	3%	2%	3%	5%	1%
Adj. Flow (vph)	152	470	522	161	194	259
Shared Lane Traffic (%)						
Lane Group Flow (vph)	152	470	683	0	194	259
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Left	Left	Right	Left	Right
Median Width(m)		3.6	3.6		3.6	
Link Offset(m)		0.0	0.0		0.0	
Crosswalk Width(m)		4.8	4.8		4.8	
Two way Left Turn Lane						
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (k/h)	25			15	25	15
Turn Type	pm+pt					Perm
Protected Phases	5	2	6		4	
Permitted Phases	2					4
Detector Phase	5	2	6		4	4
Switch Phase						
Minimum Initial (s)	7.0	37.0	19.0		10.0	10.0
Minimum Split (s)	11.0	43.0	25.0		27.0	27.0
Total Split (s)	17.0	60.0	43.0	0.0	30.0	30.0
Total Split (%)	18.9%	66.7%	47.8%	0.0%	33.3%	33.3%
Maximum Green (s)	13.0	54.0	37.0		24.0	24.0
Yellow Time (s)	3.0	4.0	4.0		4.0	4.0
All-Red Time (s)	1.0	2.0	2.0		2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	2.0	0.0	0.0
Total Lost Time (s)	4.0	6.0	6.0	6.0	6.0	6.0
Lead/Lag	Lead		Lag			
Lead-Lag Optimize?	Yes		Yes			
Vehicle Extension (s)	3.5	3.0	3.0		3.5	3.5
Recall Mode	None	Min	Max		None	None
Walk Time (s)			7.0		7.0	7.0

Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Flash Dont Walk (s)			12.0		14.0	14.0
Pedestrian Calls (#/hr)			0		0	0
Act Effct Green (s)	52.9	50.9	37.2		14.7	14.7
Actuated g/C Ratio	0.68	0.66	0.48		0.19	0.19
v/c Ratio	0.37	0.39	0.78		0.60	0.51
Control Delay	7.7	7.9	26.0		37.0	7.5
Queue Delay	0.0	0.0	0.0		0.0	0.0
Total Delay	7.7	7.9	26.0		37.0	7.5
LOS	A	A	C		D	A
Approach Delay		7.9	26.0		20.2	
Approach LOS		A	C		C	
Queue Length 50th (m)	6.7	28.4	79.6		27.5	0.0
Queue Length 95th (m)	14.9	49.4	128.8		43.3	11.8
Internal Link Dist (m)		251.0	252.3		208.7	
Turn Bay Length (m)	15.0				35.0	
Base Capacity (vph)	452	1234	873		476	630
Starvation Cap Reductn	0	0	0		0	0
Spillback Cap Reductn	0	0	0		0	0
Storage Cap Reductn	0	0	0		0	0
Reduced v/c Ratio	0.34	0.38	0.78		0.41	0.41

Intersection Summary

Area Type: Other
Cycle Length: 90
Actuated Cycle Length: 77.7
Natural Cycle: 75
Control Type: Semi Act-Uncoord
Maximum v/c Ratio: 0.78
Intersection Signal Delay: 18.1 — Intersection LOS: B
Intersection Capacity Utilization 58.5% — ICU Level of Service B
Analysis Period (min) 15

Splits and Phases: 1: Tecumseh Rd. & Lacasse Blvd.



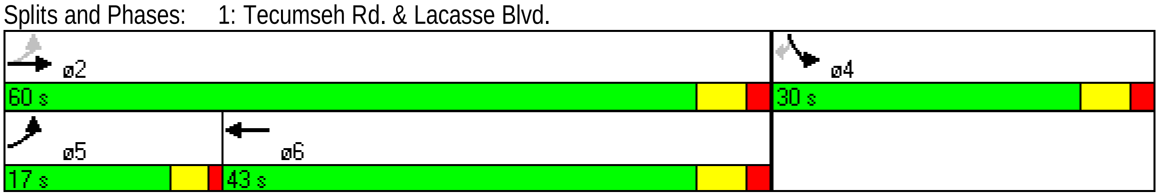
Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (vph)	87	595	478	198	128	98
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (m)	15.0			0.0	35.0	0.0
Storage Lanes	1			0	1	1
Taper Length (m)	25.0			7.5	25.0	7.5
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.961			0.850
Flt Protected	0.950				0.950	
Satd. Flow (prot)	1805	1881	1797	0	1787	1583
Flt Permitted	0.183				0.950	
Satd. Flow (perm)	348	1881	1797	0	1787	1583
Right Turn on Red				Yes		Yes
Satd. Flow (RTOR)			28			107
Link Speed (k/h)		50	50		50	
Link Distance (m)		275.0	276.3		232.7	
Travel Time (s)		19.8	19.9		16.8	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	0%	1%	1%	3%	1%	2%
Adj. Flow (vph)	95	647	520	215	139	107
Shared Lane Traffic (%)						
Lane Group Flow (vph)	95	647	735	0	139	107
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Left	Left	Right	Left	Right
Median Width(m)		3.6	3.6		3.6	
Link Offset(m)		0.0	0.0		0.0	
Crosswalk Width(m)		4.8	4.8		4.8	
Two way Left Turn Lane						
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (k/h)	25			15	25	15
Turn Type	pm+pt					Perm
Protected Phases	5	2	6		4	
Permitted Phases	2					4
Detector Phase	5	2	6		4	4
Switch Phase						
Minimum Initial (s)	7.0	37.0	19.0		10.0	10.0
Minimum Split (s)	11.0	43.0	25.0		27.0	27.0
Total Split (s)	17.0	60.0	43.0	0.0	30.0	30.0
Total Split (%)	18.9%	66.7%	47.8%	0.0%	33.3%	33.3%
Maximum Green (s)	13.0	54.0	37.0		24.0	24.0
Yellow Time (s)	3.0	4.0	4.0		4.0	4.0
All-Red Time (s)	1.0	2.0	2.0		2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	2.0	0.0	0.0
Total Lost Time (s)	4.0	6.0	6.0	6.0	6.0	6.0
Lead/Lag	Lead		Lag			
Lead-Lag Optimize?	Yes		Yes			
Vehicle Extension (s)	3.5	3.0	3.0		3.5	3.5
Recall Mode	None	Min	Max		None	None
Walk Time (s)			7.0		7.0	7.0

Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Flash Dont Walk (s)			12.0		14.0	14.0
Pedestrian Calls (#/hr)			0		0	0
Act Effct Green (s)	48.9	46.9	37.4		12.0	12.0
Actuated g/C Ratio	0.67	0.66	0.53		0.17	0.17
v/c Ratio	0.24	0.52	0.77		0.46	0.30
Control Delay	5.4	8.3	21.7		33.1	8.7
Queue Delay	0.0	0.0	0.0		0.0	0.0
Total Delay	5.4	8.3	21.7		33.1	8.7
LOS	A	A	C		C	A
Approach Delay		7.9	21.7		22.5	
Approach LOS		A	C		C	
Queue Length 50th (m)	3.4	38.0	76.8		18.4	0.0
Queue Length 95th (m)	9.0	72.9	#166.1		35.8	12.6
Internal Link Dist (m)		251.0	252.3		208.7	
Turn Bay Length (m)	15.0				35.0	
Base Capacity (vph)	461	1303	959		519	536
Starvation Cap Reductn	0	0	0		0	0
Spillback Cap Reductn	0	0	0		0	0
Storage Cap Reductn	0	0	0		0	0
Reduced v/c Ratio	0.21	0.50	0.77		0.27	0.20

Intersection Summary

Area Type: Other
Cycle Length: 90
Actuated Cycle Length: 71
Natural Cycle: 75
Control Type: Semi Act-Uncoord
Maximum v/c Ratio: 0.77
Intersection Signal Delay: 15.9 — Intersection LOS: B
Intersection Capacity Utilization 64.7% — ICU Level of Service C
Analysis Period (min) 15
\# 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 1: Tecumseh Rd. & Lacasse Blvd.



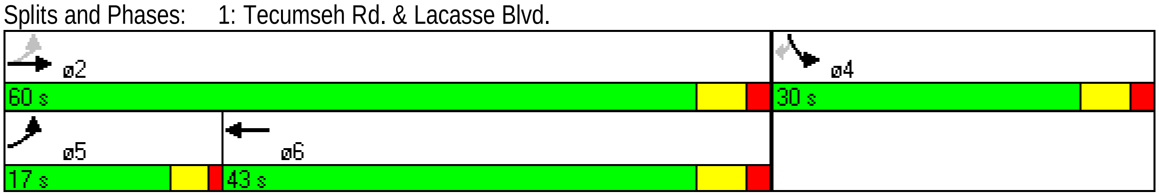
Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (vph)	113	688	508	180	235	119
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (m)	15.0			0.0	35.0	0.0
Storage Lanes	1			0	1	1
Taper Length (m)	30.0			7.5	25.0	7.5
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor			0.99		1.00	
Frt			0.965			0.850
Flt Protected	0.950				0.950	
Satd. Flow (prot)	1787	1881	1791	0	1787	1615
Flt Permitted	0.166				0.950	
Satd. Flow (perm)	312	1881	1791	0	1783	1615
Right Turn on Red				Yes		Yes
Satd. Flow (RTOR)			24			124
Link Speed (k/h)		50	50		50	
Link Distance (m)		275.0	276.3		232.7	
Travel Time (s)		19.8	19.9		16.8	
Confl. Peds. (#/hr)	6			6	1	
Peak Hour Factor	0.96	0.96	0.96	0.96	0.96	0.96
Heavy Vehicles (%)	1%	1%	2%	0%	1%	0%
Adj. Flow (vph)	118	717	529	188	245	124
Shared Lane Traffic (%)						
Lane Group Flow (vph)	118	717	717	0	245	124
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Left	Left	Right	Left	Right
Median Width(m)		3.6	3.6		3.6	
Link Offset(m)		0.0	0.0		0.0	
Crosswalk Width(m)		4.8	4.8		4.8	
Two way Left Turn Lane						
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (k/h)	25			15	25	15
Turn Type	pm+pt					Perm
Protected Phases	5	2	6		4	
Permitted Phases	2					4
Detector Phase	5	2	6		4	4
Switch Phase						
Minimum Initial (s)	7.0	37.0	19.0		10.0	10.0
Minimum Split (s)	11.0	43.0	25.0		27.0	27.0
Total Split (s)	17.0	60.0	43.0	0.0	30.0	30.0
Total Split (%)	18.9%	66.7%	47.8%	0.0%	33.3%	33.3%
Maximum Green (s)	13.0	54.0	37.0		24.0	24.0
Yellow Time (s)	3.0	4.0	4.0		4.0	4.0
All-Red Time (s)	1.0	2.0	2.0		2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0	2.0	0.0	0.0
Total Lost Time (s)	4.0	6.0	6.0	6.0	6.0	6.0
Lead/Lag	Lead		Lag			
Lead-Lag Optimize?	Yes		Yes			
Vehicle Extension (s)	3.5	3.0	3.0		3.5	3.5

Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Recall Mode	None	Min	Max		None	None
Walk Time (s)			7.0		7.0	7.0
Flash Dont Walk (s)			12.0		14.0	14.0
Pedestrian Calls (#/hr)			0		0	0
Act Effct Green (s)	49.8	47.9	37.7		16.2	16.2
Actuated g/C Ratio	0.63	0.63	0.49		0.21	0.21
v/c Ratio	0.32	0.61	0.80		0.65	0.28
Control Delay	8.2	12.0	27.2		36.7	7.1
Queue Delay	0.0	0.0	0.0		0.0	0.0
Total Delay	8.2	12.0	27.2		36.7	7.1
LOS	A	B	C		D	A
Approach Delay		11.5	27.2		26.7	
Approach LOS		B	C		C	
Queue Length 50th (m)	5.7	57.1	88.9		35.1	0.0
Queue Length 95th (m)	14.7	114.5	#193.4		60.6	12.9
Internal Link Dist (m)		251.0	252.3		208.7	
Turn Bay Length (m)	15.0				35.0	
Base Capacity (vph)	421	1235	897		514	553
Starvation Cap Reductn	0	0	0		0	0
Spillback Cap Reductn	0	0	0		0	0
Storage Cap Reductn	0	0	0		0	0
Reduced v/c Ratio	0.28	0.58	0.80		0.48	0.22

Intersection Summary

Area Type: Other
Cycle Length: 90
Actuated Cycle Length: 76.3
Natural Cycle: 75
Control Type: Semi Act-Uncoord
Maximum v/c Ratio: 0.80
Intersection Signal Delay: 20.3 Intersection LOS: C
Intersection Capacity Utilization 70.5% ICU Level of Service C
Analysis Period (min) 15
\# 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 1: Tecumseh Rd. & Lacasse Blvd.



Appendix C

Intersection Analysis Worksheets – Scenario 2 Current Configuration

Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	122	376	418	129	155	207
Future Volume (vph)	122	376	418	129	155	207
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (m)	15.0			0.0	35.0	0.0
Storage Lanes	1			0	1	1
Taper Length (m)	30.0				25.0	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.968			0.850
Flt Protected	0.950				0.950	
Satd. Flow (prot)	1770	1845	1799	0	1719	1599
Flt Permitted	0.176				0.950	
Satd. Flow (perm)	328	1845	1799	0	1719	1599
Right Turn on Red				Yes		Yes
Satd. Flow (RTOR)			25			259
Link Speed (k/h)		50	50		50	
Link Distance (m)		275.0	276.3		232.7	
Travel Time (s)		19.8	19.9		16.8	
Peak Hour Factor	0.80	0.80	0.80	0.80	0.80	0.80
Heavy Vehicles (%)	2%	3%	2%	3%	5%	1%
Adj. Flow (vph)	153	470	523	161	194	259
Shared Lane Traffic (%)						
Lane Group Flow (vph)	153	470	684	0	194	259
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Left	Left	Right	Left	Right
Median Width(m)		3.6	3.6		3.6	
Link Offset(m)		0.0	0.0		0.0	
Crosswalk Width(m)		4.8	4.8		4.8	
Two way Left Turn Lane						
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (k/h)	25			15	25	15
Turn Type	pm+pt	NA	NA		Prot	Perm
Protected Phases	5	2	6		4	
Permitted Phases	2					4
Detector Phase	5	2	6		4	4
Switch Phase						
Minimum Initial (s)	7.0	42.0	24.0		10.0	10.0
Minimum Split (s)	11.0	48.0	30.0		21.0	21.0
Total Split (s)	17.0	60.0	43.0		21.0	21.0
Total Split (%)	21.0%	74.1%	53.1%		25.9%	25.9%
Maximum Green (s)	13.0	54.0	37.0		15.0	15.0
Yellow Time (s)	3.0	4.0	4.0		4.0	4.0
All-Red Time (s)	1.0	2.0	2.0		2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0		0.0	0.0
Total Lost Time (s)	4.0	6.0	6.0		6.0	6.0
Lead/Lag	Lead		Lag			
Lead-Lag Optimize?	Yes		Yes			
Vehicle Extension (s)	3.5	3.0	3.0		3.5	3.5
Recall Mode	None	Min	Min		None	None

Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Walk Time (s)			7.0		7.0	7.0
Flash Dont Walk (s)			12.0		14.0	14.0
Pedestrian Calls (#/hr)			0		0	0
Act Effct Green (s)	48.4	46.4	33.4		12.9	12.9
Actuated g/C Ratio	0.68	0.65	0.47		0.18	0.18
v/c Ratio	0.38	0.39	0.80		0.62	0.52
Control Delay	7.1	7.2	25.0		37.6	8.2
Queue Delay	0.0	0.0	0.0		0.0	0.0
Total Delay	7.1	7.2	25.0		37.6	8.2
LOS	A	A	C		D	A
Approach Delay		7.1	25.0		20.8	
Approach LOS		A	C		C	
Queue Length 50th (m)	6.6	27.6	75.9		24.3	0.0
Queue Length 95th (m)	11.3	38.3	107.9		43.4	12.6
Internal Link Dist (m)		251.0	252.3		208.7	
Turn Bay Length (m)	15.0				35.0	
Base Capacity (vph)	487	1407	952		364	543
Starvation Cap Reductn	0	0	0		0	0
Spillback Cap Reductn	0	0	0		0	0
Storage Cap Reductn	0	0	0		0	0
Reduced v/c Ratio	0.31	0.33	0.72		0.53	0.48

Intersection Summary

Area Type: Other
Cycle Length: 81
Actuated Cycle Length: 71.4
Natural Cycle: 70
Control Type: Semi Act-Uncoord
Maximum v/c Ratio: 0.80
Intersection Signal Delay: 17.6 Intersection LOS: B
Intersection Capacity Utilization 58.5% ICU Level of Service B
Analysis Period (min) 15

Splits and Phases: 1: Tecumseh Rd. & Lacasse Blvd.

Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	87	595	478	198	128	98
Future Volume (vph)	87	595	478	198	128	98
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (m)	15.0			0.0	35.0	0.0
Storage Lanes	1			0	1	1
Taper Length (m)	25.0				25.0	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt			0.961			0.850
Flt Protected	0.950				0.950	
Satd. Flow (prot)	1805	1881	1797	0	1787	1583
Flt Permitted	0.179				0.950	
Satd. Flow (perm)	340	1881	1797	0	1787	1583
Right Turn on Red				Yes		Yes
Satd. Flow (RTOR)			34			107
Link Speed (k/h)		50	50		50	
Link Distance (m)		275.0	276.3		232.7	
Travel Time (s)		19.8	19.9		16.8	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Heavy Vehicles (%)	0%	1%	1%	3%	1%	2%
Adj. Flow (vph)	95	647	520	215	139	107
Shared Lane Traffic (%)						
Lane Group Flow (vph)	95	647	735	0	139	107
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Left	Left	Right	Left	Right
Median Width(m)		3.6	3.6		3.6	
Link Offset(m)		0.0	0.0		0.0	
Crosswalk Width(m)		4.8	4.8		4.8	
Two way Left Turn Lane						
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (k/h)	25			15	25	15
Turn Type	pm+pt	NA	NA		Prot	Perm
Protected Phases	5	2	6		4	
Permitted Phases	2					4
Detector Phase	5	2	6		4	4
Switch Phase						
Minimum Initial (s)	7.0	42.0	24.0		10.0	10.0
Minimum Split (s)	11.0	48.0	30.0		21.0	21.0
Total Split (s)	17.0	60.0	43.0		21.0	21.0
Total Split (%)	21.0%	74.1%	53.1%		25.9%	25.9%
Maximum Green (s)	13.0	54.0	37.0		15.0	15.0
Yellow Time (s)	3.0	4.0	4.0		4.0	4.0
All-Red Time (s)	1.0	2.0	2.0		2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0		0.0	0.0
Total Lost Time (s)	4.0	6.0	6.0		6.0	6.0
Lead/Lag	Lead		Lag			
Lead-Lag Optimize?	Yes		Yes			
Vehicle Extension (s)	3.5	3.0	3.0		3.5	3.5
Recall Mode	None	Min	Min		None	None

Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Walk Time (s)			7.0		7.0	7.0
Flash Dont Walk (s)			12.0		14.0	14.0
Pedestrian Calls (#/hr)			0		0	0
Act Effct Green (s)	47.7	45.7	36.3		11.8	11.8
Actuated g/C Ratio	0.69	0.66	0.52		0.17	0.17
v/c Ratio	0.24	0.52	0.77		0.46	0.30
Control Delay	5.4	8.3	21.6		32.2	8.7
Queue Delay	0.0	0.0	0.0		0.0	0.0
Total Delay	5.4	8.3	21.6		32.2	8.7
LOS	A	A	C		C	A
Approach Delay		7.9	21.6		21.9	
Approach LOS		A	C		C	
Queue Length 50th (m)	3.4	37.8	75.1		17.0	0.0
Queue Length 95th (m)	8.7	70.8	#160.0		35.5	12.6
Internal Link Dist (m)		251.0	252.3		208.7	
Turn Bay Length (m)	15.0				35.0	
Base Capacity (vph)	508	1469	1004		387	427
Starvation Cap Reductn	0	0	0		0	0
Spillback Cap Reductn	0	0	0		0	0
Storage Cap Reductn	0	0	0		0	0
Reduced v/c Ratio	0.19	0.44	0.73		0.36	0.25

Intersection Summary

Area Type: Other
Cycle Length: 81
Actuated Cycle Length: 69.6
Natural Cycle: 70
Control Type: Semi Act-Uncoord
Maximum v/c Ratio: 0.77
Intersection Signal Delay: 15.8 Intersection LOS: B
Intersection Capacity Utilization 64.7% ICU Level of Service C
Analysis Period (min) 15
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 1: Tecumseh Rd. & Lacasse Blvd.

Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations	↰	↑	↑↱		↰	↱
Traffic Volume (vph)	113	688	508	180	235	119
Future Volume (vph)	113	688	508	180	235	119
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Storage Length (m)	15.0			0.0	30.0	0.0
Storage Lanes	1			0	1	1
Taper Length (m)	7.5				7.5	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Ped Bike Factor			0.99		1.00	
Frt			0.965			0.850
Flt Protected	0.950				0.950	
Satd. Flow (prot)	1787	1881	1791	0	1787	1615
Flt Permitted	0.178				0.950	
Satd. Flow (perm)	335	1881	1791	0	1784	1615
Right Turn on Red				Yes		Yes
Satd. Flow (RTOR)			29			124
Link Speed (k/h)		50	50		50	
Link Distance (m)		275.0	276.3		232.7	
Travel Time (s)		19.8	19.9		16.8	
Confl. Peds. (#/hr)	6			6	1	
Peak Hour Factor	0.96	0.96	0.96	0.96	0.96	0.96
Heavy Vehicles (%)	1%	1%	2%	0%	1%	0%
Adj. Flow (vph)	118	717	529	188	245	124
Shared Lane Traffic (%)						
Lane Group Flow (vph)	118	717	717	0	245	124
Enter Blocked Intersection	No	No	No	No	No	No
Lane Alignment	Left	Left	Left	Right	Left	Right
Median Width(m)		3.6	3.6		3.6	
Link Offset(m)		0.0	0.0		0.0	
Crosswalk Width(m)		4.8	4.8		4.8	
Two way Left Turn Lane						
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (k/h)	25			15	25	15
Turn Type	pm+pt	NA	NA		Prot	Perm
Protected Phases	5	2	6		4	
Permitted Phases	2					4
Detector Phase	5	2	6		4	4
Switch Phase						
Minimum Initial (s)	7.0	42.0	24.0		10.0	10.0
Minimum Split (s)	11.0	48.0	30.0		21.0	21.0
Total Split (s)	17.0	60.0	43.0		21.0	21.0
Total Split (%)	21.0%	74.1%	53.1%		25.9%	25.9%
Maximum Green (s)	13.0	54.0	37.0		15.0	15.0
Yellow Time (s)	3.0	4.0	4.0		4.0	4.0
All-Red Time (s)	1.0	2.0	2.0		2.0	2.0
Lost Time Adjust (s)	0.0	0.0	0.0		0.0	0.0
Total Lost Time (s)	4.0	6.0	6.0		6.0	6.0
Lead/Lag	Lead		Lag			
Lead-Lag Optimize?	Yes		Yes			

Lane Group	EBL	EBT	WBT	WBR	SBL	SBR
Vehicle Extension (s)	3.5	3.0	3.0		3.5	3.5
Recall Mode	None	Min	Min		None	None
Walk Time (s)			7.0		7.0	7.0
Flash Dont Walk (s)			12.0		14.0	14.0
Pedestrian Calls (#/hr)			0		0	0
Act Effct Green (s)	48.4	46.3	36.5		13.7	13.7
Actuated g/C Ratio	0.67	0.64	0.51		0.19	0.19
v/c Ratio	0.30	0.59	0.78		0.72	0.31
Control Delay	6.4	10.1	23.3		42.1	8.0
Queue Delay	0.0	0.0	0.0		0.0	0.0
Total Delay	6.4	10.1	23.3		42.1	8.0
LOS	A	B	C		D	A
Approach Delay		9.5	23.3		30.6	
Approach LOS		A	C		C	
Queue Length 50th (m)	5.4	54.3	84.1		33.0	0.0
Queue Length 95th (m)	10.3	83.2	#157.9		#68.2	13.5
Internal Link Dist (m)		251.0	252.3		208.7	
Turn Bay Length (m)	15.0				30.0	
Base Capacity (vph)	488	1417	966		374	436
Starvation Cap Reductn	0	0	0		0	0
Spillback Cap Reductn	0	0	0		0	0
Storage Cap Reductn	0	0	0		0	0
Reduced v/c Ratio	0.24	0.51	0.74		0.66	0.28

Intersection Summary

Area Type: Other
Cycle Length: 81
Actuated Cycle Length: 72.1
Natural Cycle: 70
Control Type: Semi Act-Uncoord
Maximum v/c Ratio: 0.78
Intersection Signal Delay: 18.7 Intersection LOS: B
Intersection Capacity Utilization 70.5% ICU Level of Service C
Analysis Period (min) 15
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Splits and Phases: 1: Tecumseh Rd. & Lacasse Blvd.