PW-C2-1

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REPORT
Meeting Date: July 7, 2011
Regional Council

DATE: June 3, 2011

REPORT TITLE: **TRANSPORTATION DIVISION**
TRAFFIC SIGNAL WARRANT ANALYSIS AND EVALUATION - ALL WARDS

FROM: Dan Labrecque, Commissioner of Public Works

RECOMMENDATION

That the Ontario Traffic Manual Book 12 Traffic Signals warrant methodology to evaluate the installation of traffic signals continue to be used.

REPORT HIGHLIGHTS

- The Region of Peel Traffic staff currently use the Ontario Traffic Manual Book 12 Traffic Signals warrant methodology to evaluate the installation of traffic signals.
- A comparison of the Ontario Traffic Manual Book 12 and the Transportation Association of Canada signal warrant methodologies was undertaken.
- A survey indicated that the majority of Ontario municipalities contacted are using the Ontario Traffic Manual Book 12 Traffic Signals Warrant including the Cities of Mississauga and Brampton and the Town of Caledon.
- Intersections in the Region of Peel have been compared using both methodologies and Traffic staff endorse the Ontario Traffic Manual Book 12 Traffic Signals warrant methodology as being the most effective and applicable for use in the Region of Peel.

DISCUSSION

1. *Background*

Regional staff undertook a review of the method in which traffic control signals (hereafter referred to as traffic signals) are justified, by comparing the current signal warranting method to other utilized methodologies.

Currently, Traffic staff use the justifications contained in the *Ontario Traffic Manual (OTM) Book 12 Traffic Signals* (hereafter referred to as OTM Book 12) to make recommendations on the installation of traffic signals, and rarely, the removal of traffic signals in the Region of Peel.

The OTM series is an evolving series of books being developed by the Ontario Ministry of Transportation (MTO) through partnerships with Ontario municipalities. These manuals provide information and guidance on topics such as signage, pavement markings and traffic signals to transportation practitioners in the effort of promoting uniformity across Ontario.

Prior to using the OTM signal warrant, the Manual of Uniform Traffic Control Devices (MUTCD) served as a determinant for establishing funding from the MTO for installation of traffic signals.

2. Reasons for Using a Signal Warrant Justification

Signal warrants are used as a benchmark to determine the need for the installation or removal of traffic control signals based on volumes and delay for traffic (including pedestrians) as well as the intersection collision history. The warrant thresholds used in warrant methodologies (i.e. traffic volumes, collisions) ensure justifications remain consistent and reliable. Signal warrant justifications, while being the primary method used, are not in and of itself the sole determining factor for the installation of traffic signals. Warrants must be used in conjunction with engineering judgment and personal experience as each intersection has unique characteristics.

The use of a signal warrant methodology is consistent with the Region's Strategic Plan Goal 4: "Support and influence sustainable transportation systems" and Goal 6.2 "Manage Regional infrastructure to ensure a safe, living and working environment" and further ensures:

- The installation of traffic signals is determined by uniform and proven benchmarks.
- Consistency is maintained with other jurisdictions and agencies within Ontario.
- A consistent methodology is applied in determining the locations where traffic signals are required.
- The Region's transportation network maintains efficiency for its users.
- Public confidence is maintained in the rationale in which traffic signals are installed.

3. Impacts of Installing Unwarranted Traffic Signals

Many negative impacts can occur as a result of installing unwarranted (i.e. unjustified) traffic signals. The installation process in general will change the pattern and frequency of collisions at an intersection.

As per the 2009 MUTCD published by the US Federal Highway Association:

> "Traffic control signals, even when justified by traffic and roadway conditions, can be ill-designed, ineffectively placed, improperly operated, or poorly maintained. Improper or unjustified traffic control signals can result in one or more of the following disadvantages:
>
> A. Excessive delay;
> B. Excessive disobedience of the signal indications;
> C. Increased use of less adequate routes as road users attempt to avoid the traffic control signals; and
> D. Significant increases in the frequency of collisions (especially rear-end collisions)."

Generally, there are certain types of collisions that are reduced and others that are increased by the installation of traffic signals. Collisions such as right angle collisions and turning collisions tend to decrease when traffic signals are installed, while rear collisions tend to increase. Overall, signalized intersections have higher collision rates due to

exposure than non-signalized intersections, but typically the collisions are of a lower severity.

The Highway Safety Manual (HSM) has reviewed the Crash Modification Factors (CMF) for changing an intersection from a stop control to signalization and the rates are consistent with the above assumptions.

Excessive delay which occurs as a result of installing unwarranted signals impacts our environment negatively due to the pollution caused by the delayed vehicles.

The capital cost of installing new traffic signals ranges anywhere from $85,000 to $150,000. On average, the cost to operate and maintain each set of signals is $6,500 annually.

It is clear that installing unwarranted traffic signals has many negative road safety, capacity, environmental and financial impacts.

FINDINGS

1. Description and Comparison of the Common Traffic Signal Warrants

The Region of Peel has been following the OTM Book 12 warrant methodology for many years. The Transportation Association of Canada (TAC) has developed a traffic signal warrant which follows a different methodology than the OTM method.

a) Ontario Traffic Manual (OTM) Book 12 Traffic Signal Warrant

The OTM method consists of seven signal warrant justifications. These justifications can be utilized under a number of circumstances such as:

- At typical intersections with heavy morning (AM), mid-day, and afternoon (PM) traffic volumes.
- Where volumes are heavy for only a few hours of the day.
- Where a high collision frequency is observed.
- At proposed intersections using projected volumes.

The OTM warrant requires either eight hours of traffic data, four hours of traffic data, or collision data depending on the justification being used. As opposed to the TAC warrant which is discussed below and requires some subjective judgment, the OTM warrant uses strictly objective data (i.e. traffic counts). A description of the justifications and when they are typically used is outlined in Appendix I – Ontario Traffic Manual Book 12 Signal Warrant Justification Descriptions.

b) Transportation Association of Canada (TAC) Traffic Signal Warrant:

The alternative methodology used by some jurisdictions in Canada is the Canadian Traffic Signal Warrant Matrix Procedure produced by the TAC. The TAC method, unlike the OTM method's seven justifications, consists only of a single warrant to be used for all circumstances.

The TAC signal matrix evaluates vehicle/vehicle and vehicle/pedestrian interactions. It is further refined and adjusted based on demographic information (i.e. population, on a transit route, near a school, in the central business district, near a seniors' complex, etc.)

producing a final warrant value. Some of the data required for the TAC signal matrix are subjective in nature, such as the inputs for "near a seniors' complex" and "near a school". As opposed to using emperical collision history data this method incorporates collision prediction theory which calculates the anticipated amount of collisions using traffic volume data and intersection geometry. In order for traffic signals to be considered with this method the threshold is 100 points or more. The signals are deemed unwarranted if the threshold is less than 100 points.

Comparisons of the two methods can be found in Appendix II – Comparison of OTM vs. TAC warrant methods.

2. Data Analysis and Survey

Regional staff have completed a review using 2010 traffic count data comparing the results of the OTM Book 12 warrant and the TAC warrant matrix to determine if revisions to the Region's current warrant method should be implemented.

In addition to this comparison, several Ontario municipalities were surveyed as to their use and preference of warrants.

a) Intersection Data Analysis

Traffic staff have reviewed a 2007 Council report from the Region of Waterloo indicating their adoption of the OTM signal warrant methodology. Prior to this report the Region of Waterloo used the TAC methodology. Contained in the Waterloo report is a comparison of intersections using both the TAC and OTM methodologies. Waterloo's comparison found that the OTM methodology is usually more generous in applying points when compared to the TAC warrant. Further, they found that in certain circumstances the TAC warrant deemed traffic signals warranted when the actual field data would indicate otherwise. The Region of Waterloo contacted TAC about these circumstances and were advised that TAC is aware of such scenarios.

In order to validate the Region of Waterloo findings, Region of Peel Traffic staff conducted a comparison of the warrant methodologies at various intersections. Based on this review the Region of Peel concur with the results in the Region of Waterloo report.

b) Remarks from Agencies

Several Ontario municipalities were contacted and they provided a variety of comments in regard to their policies and practices with signal warrants. With the exception of the Town of Milton, and the Region of Durham the majority of the municipalities surveyed use OTM exclusively. Some respondents previously used the TAC warrant but switched to the OTM warrant to keep consistency with other municipalities or because of the flexibility in justifications it offers.

A summary of the responses can be found in Appendix III – Responses to Signal Warrant Methodology Survey.

June 3, 2011
TRANSPORTATION DIVISION
TRAFFIC SIGNAL WARRANT ANALYSIS AND EVALUATION - ALL WARDS

CONCLUSION

Based on the comparison of traffic signal warrants, our review of the practices of area municipalities, and Peel's past experiences and applications it is recommended that the Region of Peel continue to use the OTM warrant in deciding whether or not the installation of signals is appropriate; and although rare, also for determining the removal of traffic signals. The OTM warrant provides flexibility in its application allowing it to be utilized in a wide variety of situations. The use of the OTM warrant has been successful in justifying and controlling the installation of traffic control signals on Regional Roads. Furthermore, the continued use of this method ensures consistency of signal installations within the Region of Peel.

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Commissioner of Public Works

Approved for Submission:

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June 3, 2011
TRANSPORTATION DIVISION
TRAFFIC SIGNAL WARRANT ANALYSIS AND EVALUATION - ALL WARDS

APPENDIX I

Ontario Traffic Manual Book 12 Traffic Signal Warrant Justification Descriptions

Justification:	Description:	When to use:
1. Minimum Eight Hour Vehicle Volume	The Minimum Vehicular Volume Justification is intended for applications where the principal reason to consider the installation of a traffic signal is the cumulative delay produced by a large volume of intersecting traffic at an un-signalized intersection.	At a typical 3 or 4 leg intersection
2. Delay to Cross Traffic (Eight-hour)	The Delay to Cross Traffic Justification is intended for application where the traffic volume on the main road is so heavy that traffic on the minor road suffers excessive delay or hazard in entering or crossing the main road.	At a typical 3 or 4 leg intersection
3. Volume and Delay Combination	Signals may occasionally be justified where neither of Justifications 1 or 2 are 100 percent satisfied, but both are satisfied to the extent of 80 percent or more of the stated values.	When neither justification 1 or 2 are met 100 percent
4. Minimum Four-Hour Vehicle Volume	The Minimum Four-Hour Vehicular Volume Justification is intended for applications where the intersection experiences excessive delays for four or more peak hours of the day, but do not have the prolonged demands throughout the day to meet an eight hour warrant.	Commercial areas, commuter areas, industrial areas where volumes are very high for short periods of time
5. Collision Experience	Traffic signals may be considered as one means of improving intersection safety where an un-signalized intersection has an unusually high collision history.	Where collision history shows a pattern of collisions that can be remedied by the installation of signals
6. Pedestrian Volume and Delay	The minimum pedestrian volume conditions are intended for application where the traffic volume on a main road is so heavy that pedestrians experience excessive delay or hazard in crossing the main road, or where high pedestrian crossing volumes produce the likelihood of such delays.	Locations with high pedestrian volume and delay
7. Projected Volumes	Uses Justifications 1 and 2 and increases the threshold values by 120 percent or 150 percent (depending on new or existing intersection) in order to offset the uncertainty of using projected traffic volumes.	At proposed or existing intersections where future signals may be warranted due to increase in volume (typically from development)

When any one (1) justification is met 100 percent, signals should be considered

PW-C2-7

TRANSPORTATION DIVISION
TRAFFIC SIGNAL WARRANT ANALYSIS AND EVALUATION - ALL WARDS

APPENDIX II

Comparison of Ontario Traffic Manual (OTM) vs. Transportation Association of Canada (TAC) warrant methods

Categories	OTM Warrant Method	TAC Warrant Method
Requirement to meet Warrant	100 percent satisfaction or a combination of two warrants 80 percent satisfied.	100 points
Method of Analysis	Data is tabulated based on minimum vehicle volumes, delay to cross traffic, collision experience and pedestrian volume.	Based on the relationship between various vehicular and pedestrian conflicts.
Demographic Factors	Considers excessive delay or hazard in pedestrians crossing the main road.	Considers proximity to elementary schools, seniors' facilities, pathways and central business districts.
Intersection Features	Incorporates lane configuration and number of legs.	Incorporates detailed lane configuration, distance to upstream adjacent signals and median width.
Roadway Features	Incorporates posted speed and geographic area type.	Incorporates adjustments for intersection spacing, vehicle classification, posted speed and geographic area.
Traffic Volume Analysis	Incorporates turning movement and pedestrian volumes for eight or four peak hours.	Incorporates turning movement and pedestrian volumes for six peak hours.
Collision Analysis	Takes into account collision history.	Not included in the warrant. Uses collision prediction theory built into the calculations.

PW-C2-8

TRANSPORTATION DIVISION
TRAFFIC SIGNAL WARRANT ANALYSIS AND EVALUATION - ALL WARDS

APPENDIX III

Responses to Traffic Signal Warrant Methodology Survey

Municipality	Primary method used	Secondary method used	Comments
Brampton	OTM Book 12	None	
Mississauga	OTM Book 12	None	Base their criteria on provincial standards
Caledon	OTM Book 12	None	
Hamilton	OTM Book 12	None	
Durham Region	OTM Book 12	TAC sometimes as a check	TAC more generous in applying points
Sudbury	OTM Book 12	None	
Milton	TAC	OTM	Uses OTM as a comparison
Burlington	OTM Book 12	None	
Waterloo Region	OTM Book 12	None	OTM usually more generous in applying points - switched to OTM in 2007
Kingston	OTM Book 12	None	
Chatham-Kent	OTM Book 12	None	
Halton Region	OTM Book 12	None	