The Corporation of the City of Kawartha Lakes

Council Report

Report Number ENG2016-004

Date: **January 26, 2016**
Time: 2:00 p.m.
Place: Council Chambers

Ward Community Identifier: Ward 12

Subject: **CKL 36 and Weldon Road intersection improvements**

Author/Title: **Michael Farquhar, Supervisor, Technical Services** **Signature:**

Recommendation(s):

RESOLVED THAT Report ENG2016-004, "**CKL Road 36 and Weldon Road Intersection Improvements**" be received;

THAT Council approves the establishment of an All-Way Stop Control at the intersection of Weldon Road and CKL Road 36;

THAT a necessary By-Law for the above recommendations be forwarded to Council for the approval; and

THAT the Mayor and Clerk be authorized to execute any documents and agreements required by the approval of this decision.

Department Head:

Corporate Services Director / Other:

Chief Administrative Officer:

Background:

The intersection of Weldon Road and CKL 36 has for a long time served as an East to West crossing point for pedestrians (majority being I. E. Weldon Secondary School students). Prior to this, students utilized the route labeled "pathway" on Appendix A , as the route to the intersection of CKL 36 and Queen Street where the students used the traffic lights to cross CKL 36. However, over the years there has been a shift by pedestrians to utilize more the intersection of CKL 36 and Weldon Road when crossing CKL 36, more so now that the south east corner of the intersection has been redeveloped with a gas bar/convenience store.

Through initial public requests and concerns about the pedestrian movement at this unprotected crossing, Staff proposed in its 2015 Capital Budget under the program RD1514 Traffic Improvements, a project line for the intersection of Weldon Road and CKL 36. The scope of this project was to study, design, and implement a solution with regards to the movement of pedestrians across the intersection of CKL 36 and Weldon Road. Staff is bringing this report back to Council with a recommendation because the preferred recommendation requires that Council enact a By-Law in order to implement it .

A study was conducted over the spring and falls months of 2015 by Tranplan Consultants which is a traffic consulting firm contracted by the City. This was to examine traffic operational and safety issues at the intersection and supply recommendations for correcting those issues. The identified problems and recommendations can be viewed in Appendix A in section 3 and 5.

From the observations and site analysis done by Tranplan the following issues were identified (shown in Appendix A section 2).

2.2 Observed Traffic Flow and Operational Concerns

Based on the field observations taken during the traffic count programs and site visits the following operational issues and safety concerns were noted:

- Long vehicle queues and delay times occur on the minor stop-controlled approaches of the CKL 36 / Weldon-Riverview Road intersection. These delays occur during School PM peak hour (2:15 – 3:15 PM) when *I. E. Weldon High School* is finished for the day.
- The northbound traffic on the south approach of the study intersection is off-set to accommodate a southbound left turn lane on the north approach. Northbound left turns share a single lane with northbound "through" traffic.

- The asymmetrical north/south geometrics could create some operational difficulties during school PM peak hour periods for left turning drivers as well as for pedestrians crossing CKL 36.
- Commercial entrances and the King Street intersection are located immediately north of the Weldon-Riverview Rd intersection. With no centre two-way left turn lane (TWLTL), left turning vehicles on CKL 36 create additional delay and potential hazards to "through" traffic.
- The pedestrian crossing across CKL 36 does not appear to be particularly obvious to drivers traveling along CKL 36. Traffic turning to/from the entrance to the Gas Station/Convenience Store immediately south of the Weldon intersection can create an additional distraction. All this can be a concern for drivers traveling in the northbound direction as they transition from a rural high-speed environment to a lower speed suburban environment.
- The CKL 36 approach speeds to the study intersection do not seem to be a major issue.

  The turning volumes, pedestrian traffic and limited Weldon intersection geometrics discourage higher speeds.

2.3 Pedestrian Facility and Crosswalk Concerns

Specific pedestrian safety issues observed during the field visits include:

- Missing or inadequate sidewalks on the approaches to the intersection, particularly in the east-west pedestrian travel direction across CKL 36 as well as to/from the I.E. Weldon High School.
- No provision of a pedestrian refuge area on any of the CKL 36 / Weldon-Riverview Road intersection corners. This is a particular concern during the peak pedestrian flow times when large groups of students are waiting to cross CKL 36.
- Extended pedestrian crossing distances across CKL 36 are created by the large corner radii.
- No accessibility provisions for mobility challenged pedestrians.
- Poor driver guidance to warn of/identify high pedestrian volumes that will be crossing CKL 36 during the High School peak traffic periods when vehicles and pedestrians are accessing/departing the school.
- AM peak hour vehicle travel demand along the study area roadways coincides with the school peak period.
- Lack of crosswalk signs or markings particularly on the south CKL 36 approach at the Weldon Road intersection. Advance school area signs (fluorescent yellow-green pentagon) are posted about 150m upstream of the intersection along CKL 36.
- Lack of barrier curb and gutter on the intersection corners to protect waiting pedestrians from an off-tracking or errant vehicle.

2.4 Collision Data Review

A review of the most recently recorded collision information was carried in an attempt to identify any trends or patterns relating to the most common types of collisions and/or locations. Reported collision data was provided by the City of Kawartha Lakes and spanned from September, 2008 to April, 2014. A summary of the key findings is provided in the following:

- Frequency: A total of 12 collisions occurred over this time period for annual average frequency of about 2 collisions per year.
- Severity: The majority of these collisions were Property Damage Only (PDO) (10 or 83%) and the remaining were reported as Personal Injury (PI) (2 or 17%). No Fatal collisions occurred. Although there is a small amount of data to review it appears that there is a relatively low level of collision severity and this is likely due in part to the relatively low operating speeds observed in the vicinity of the intersection.
- Seasonal: The seasonality of the data did not show any significant trends when we compared the winter months to spring and fall. Although not significant, there was one less collision occurring in the summer months (July and August) relative to the other seasons and this may be attributable to reduction in vehicle and pedestrian traffic associated with the High School. CKL 36 / Weldon-Riverview Intersection P a g e | 4 Traffic Operations Review
- Configuration: All of the reported collisions involved multiple vehicles. Again, the small data set made it difficult to identify patterns, but the most common configurations were rear ends (25%), turning/right angle (25%), and fail to yield (33%).
- Pedestrian Injuries – Key to this study is the potential for pedestrian collisions. The collision data did not include any collisions involving pedestrians. This data fact was confirmed by CKL staff.
- While there were no pedestrian collisions observed during the time included in the collision data set, it should not be concluded that the pedestrian collision risk is low.

Rationale:

Based on the above mentioned operational concerns that were observed by Tranplan, an initial list of recommendations was developed in order determine the best approach for a solution, this list can be seen below.

Table 1: List of Candidate Solutions at the CKL 36 / Weldon-Riverview Intersection

Candidate Solution	Carry Forward?	Comment
1. Do Nothing – Two-way Stop Control	NO	Concerns discussed in *Section 2.0*
2. Install Traffic Signals	NO	TAC Warrant not met / Close to other Signals
3. Install Pedestrian Half-Signal	NO	TAC Warrant not met
4. Install All-Way Stop Control	YES	Delay and Volume warrants met
5. Implement One-way flow - eastbound only to the high school, all other traffic use east access via Pidgeon Lake Road	YES	Reduces road safety risk, improves Weldon/CKL 36 operations, provides more intersection capacity
6. Install a signed/marked crosswalk across the intersection south approach	YES	Follows TAC Pedestrian Control Guide, reduces road safety risk
7. Install sidewalk connections and refuge areas at the intersection corners.	YES	Reduces pedestrian safety risk

This List was then further refined.

Using the results of the traffic operational analysis discussed in *Section 3*, a more detailed assessment of each potential candidate solution was carried out, to provide a more thorough assessment of each solution. The focus of this second assessment was to determine how appropriate/applicable the candidate solutions were and how they might be combined to the specific needs and issues of the CKL 36/ Weldon-Riverview intersection.

Based on this assessment the preferred solutions can be broken down into the follow recommendations.

Immediate Implementation:

- Install AWSC control at the Weldon/CKL 36 intersection.
- The new AWSC intersection control should be supported with an over-head red flashing beacon as well as over-sized stop signs. This will be particularly important during the early days of the installation while local drivers become accustomed to the new control.
- Install a continuous sidewalk from the High School to the southeast corner of the intersection. The sidewalk should be of sufficient width to accommodate large pedestrian groups that are characteristic of the student pedestrians.
- Install a large concrete sidewalk waiting area for pedestrians on all four corners of the intersection.
- Install concrete barrier curb and gutter on all four corner radii of the intersection and relocate the existing sidewalk on Riverview Road behind the barrier curb.

- Install painted pedestrian crosswalks across all four approaches to the intersection using an enhanced marking technique (i.e. zebra markings). The pavement markings and signs should follow TAC guidelines.
- Replace existing yellow hatching on CKL 36 with a painted northbound left turn lane to eliminate the off-set left.

Plan for Intermediate Term Improvements:

The second stage for improving the CKL 36 corridor between Queen Street and Weldon Road will focus on geometric improvements to CKL 36. A portion of CKL 36 between Queen Street and Weldon Road has already been constructed with a centre left turn lane. This includes much of the section between King Street north to Queen Street. South from King Street to the left turn bay at Weldon Road will require additional pavement to complete the left turn lane from King Street South. Between Queen Street and Weldon Road CKL 36 has an open ditch rural cross-section. The existing road platform includes wide gravel shoulders. It appears that space is available to provide a continuous left turn lane with a minimum of impact in the CKL 36 road corridor itself. The completion of the centre left turn lane between Weldon and Queen will provide a left turn lane for the King Street intersection. Beyond the immediate areas of the intersections themselves, the left turn lane can function as a two-way-left turn lane (TWLTL). This TWLTL will serve existing and future entrances along this section of CKL 36. In terms of traffic operations it will provide a continuous straight alignment for the "through" northbound and southbound lanes on CKL 36. It will improve the southbound left turn lane at Weldon with better approach geometrics and additional left turn capacity. It is assumed that the following recommendations have been implemented in *the Immediate.*

Action Plan. If any of the following recommendations are incomplete, they should be completed at this time. These could include:

- Install concrete barrier curb and gutter on all four corner radii of the intersection and relocate the existing sidewalk on Riverview Road behind the barrier curb.
- Further improve the sidewalk waiting area for pedestrians on all four corners of the intersection.

Longer Term Improvements – One-way Traffic Flow on Weldon Road

As background traffic volumes grow over time, particularly in the CKL 36 corridor, the third stage of the improvement program is recommended to deal with these growing volumes.

- The principal strategy is to convert Weldon to One-way travel (eastbound only) from CKL 36 to the High School west entrance. This would eliminate the westbound traffic movements at the Weldon/CKL 36 intersection.

- Traffic exiting the High School would travel east to CKL 17 (*Pigeon Lake Rd*), and return to the CKL 36 corridor via the traffic signal at Queen Street. Since much of the westbound high school traffic now turns right at the Weldon intersection, the additional travel via the CKL 17 intersection to reach CKL 36 would not be significant.
- Further improvements could be made to the sidewalk from the High School to the southeast corner of the intersection now that additional right-of-way space would be available with the conversion to a one-way street. These improvements could not only include additional width to accommodate larger pedestrian groups but also accommodate a potential bicycle lane.

In the longer term, traffic volumes and new development will occur in the CKL 36 corridor. The implementation of the eastbound one-way strategy for Weldon combined with the implementation of AWSC will provide additional capacity at this intersection. This additional capacity should delay, or possibly negate the need for signals at this intersection. This will also have the benefit of eliminating the immediate need of having to operate/co-ordinate the existing signal at Queen Street. It would also eliminate potential operational issues with the King Street intersection that might be created by a future signal at Weldon Road.

It is Staff's recommendation that the option of installing an All Way Stop at the Weldon Road / CKL 36 and Riverview road be selected and implemented through the existing capital budget of RD1514.

Other Alternatives Considered:

Refer to section 5 of Appendix A.

Financial Considerations:

To review if future recommendations in Appendix A are DC eligible.

Relationship of Recommendation(s) To Strategy Map:

The City's Strategy Map outlines Council's Vision of a Community Pursuing Prosperity, Quality of Life and a Healthy Environment.

This report relates to the strategy map as it pertains to infrastructure expansion and maintenance under Prosperity and Quality of Life.

Review of Accessibility Implications of Any Development or Policy:

There are no Accessibility implications with this report.

Servicing Comments:

N/A

Consultations:

Attachments:

Appendix A- Traffic Operations Review

CKL 33 & Weldon Road Intersection Tra

Appendix B- Intersection map

Weldon_Verulam_Key_Map.pdf

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APPENDIX "A"
to
REPORT ENG2016-004
FILE NO. _____

CKL 36 / Weldon Intersection

City of Kawartha Lakes

Traffic Operations Review

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Prepared for:
City of Kawartha Lakes

December 2015

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1. INTRODUCTION

1.1 Project Overview

At the request of the City of Kawartha Lakes (CKL), Tranplan Associates was engaged to carry out a traffic operational review of the CKL 36 / Weldon-Riverview intersection. This review was to identify any intersection operational and safety performance issues and prepare a set of recommendations to address/mitigate such issues.

1.2 Study Context

This study was carried out to examine traffic operational and safety issues that may be contributing to areas of increased risk for both drivers and pedestrians. This review was not intended to be a detailed standards or geometric design compliance check. These operational reviews do not attempt to question past geometric design decisions, the cost-effectiveness of these decisions, nor the design standards the road agency currently applies. Although traffic operations and safety are important factor in the design process, they are not the only factor that should influence these decisions.

The outcomes of this study focus on providing CKL with a set of suggested improvements for consideration and possible implementation. Information provided by this study will assist CKL staff in rationalizing any decisions to implement the set of recommended improvements given their cost-effectiveness in the context of current policy, standards, best practice and capital budget opportunities.

2. TRAFFIC DATA AND FIELD OBSERVATIONS

2.1 Overview

A series of site visits were carried out to observe the existing traffic operations at the CKL 36/Weldon/Riverview intersection during representative week day periods. Initial observations were taken in November, 2014. Full traffic count programs were carried out on May 27, 2015. The field observations included the signalized Queen/CKL 36 intersection immediately north of the study intersection and the Gas Station/C-Store/Subway Restaurant located in the southeast quadrant of the Weldon study intersection. Data assembled included a full day of turning movement volumes at the Weldon intersection as well as AM and PM peak period traffic counts at the Queen intersection and the Gas Station entrances. An additional PM "short count" was taken on June 17, 2015 during the School PM peak hour with a focus on the pedestrian volumes and flows. Additional video and photo data were collected to provide a visual record of the intersection operations. This data was further supplemented with Weldon intersection turning volumes collected by CKL staff on September 4, 2014. The exhibit following the report text illustrates the peak hour volumes used in the intersection capacity analyses. More detailed traffic volume data used in the warrant analyses are included in the *Technical Appendix – Traffic Data*.

2.2 Observed Traffic Flow and Operational Concerns

Based on the field observations taken during the traffic count programs and site visits the following operational issues and safety concerns were noted:

- Long vehicle queues and delay times occur on the minor stop-controlled approaches of the CKL 36 / Weldon-Riverview Road intersection. These delays occur during School PM peak hour (2:15 – 3:15 PM) when *I. E. Weldon High School* is finished for the day.
- The northbound traffic on the south approach of the study intersection is off-set to accommodate a southbound left turn lane on the north approach. Northbound left turns share a single lane with northbound "through" traffic. The asymmetrical north/south geometrics could create some operational difficulties during school PM peak hour periods for left turning drivers as well as for pedestrians crossing CKL 36.
- Commercial entrances and the King Street intersection are located immediately north of the Weldon-Riverview Rd intersection. With no centre two-way left turn lane (TWLTL), left turning vehicles on CKL 36 create additional delay and potential hazards to "through" traffic.
- The pedestrian crossing across CKL 36 does not appear to be particularly obvious to drivers traveling along CKL 36. Traffic turning to/from the entrance to the Gas Station/C-Store immediately south of the Weldon intersection can create an additional distraction. All this can be a concern for drivers traveling in the northbound direction as they transition from a rural high-speed environment to a lower speed suburban environment.
- The CKL 36 approach speeds to the study intersection do not seem to be a major issue. The turning volumes, pedestrian traffic and limited Weldon intersection geometrics discourage higher speeds.

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Specific pedestrian safety issues observed during the field visits include:

- Missing or inadequate sidewalks on the approaches to the intersection, particularly in the east-west pedestrian travel direction across CKL 36 as well as to/from the I.E. Weldon High School.
- No provision of a pedestrian refuge area on any of the CKL 36 / Weldon-Riverview Rd intersection corners. This is a particular concern during the peak pedestrian flow times when large groups of students are waiting to cross CKL 36.
- Extended pedestrian crossing distances across CKL 36 are created by the large corner radii.
- No accessibility provisions for mobility challenged pedestrians.
- Poor driver guidance to warn of/identify high pedestrian volumes that will be crossing CKL 36 during the High School peak traffic periods when vehicles and pedestrians are accessing/departing the school.
- AM peak hour vehicle travel demand along the study area roadways coincides with the school peak period.
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- *Seasonal*: The seasonality of the data did not show any significant trends when we compared the winter months to spring and fall. Although not significant, there was one less collision occurring in the summer months (July and August) relative to the other seasons and this may be attributable to reduction in vehicle and pedestrian traffic associated with the High School.

- *Configuration*: All of the reported collisions involved multiple vehicles. Again, the small data set made it difficult to identify patterns, but the most common configurations were rear ends (25%), turning/right angle (25%), and fail to yield (33%).
- *Pedestrian Injuries* – Key to this study is the potential for pedestrian collisions. The collision data did not include any collisions involving pedestrians. This data fact was confirmed by CKL staff.
- While there were no pedestrian collisions observed during the time included in the collision data set, it should not be concluded that the pedestrian collision risk is low.

3. THE TRAFFIC ANALYSIS PROCESS

3.1 Overview of the Process

The first step in the study analyses of the Weldon intersection was to assess intersection capacity during peak hour periods. The analyses identified the current Levels of Service[1] (LoS) based on existing geometrics and intersection control. The peak hour LoS were computed based on the current 2010 Highway Capacity Manual (HCM) criteria and standards. The analyses were done using *Trafficware's Synchro 8* intersection capacity analyses software and traffic simulation options. Copies of the Synchro printouts summarizing the capacity analysis for each scenario are included in the *Technical Appendix – Intersection Capacity Analyses*.

The study analyses included a signal warrant analysis to identify the need for signalization of the Weldon intersection. This warrant analysis applied the current Transportation Association of Canada (TAC) signal warrant procedures. A pedestrian crossing warrant analysis was also carried out to identify the need for specific pedestrian crossing facilities on the south CKL 36 approach to the Weldon intersection. The pedestrian crossing analysis applied the current TAC pedestrian warrant procedures. Summary copies of the warrant analyses are contained in the *Technical Appendix – Warrant Analyses*.

Summaries of the analyses and their findings are described in these sections following.

3.2 Existing Intersection Capacity Analyses: Two way Stop-Control (TWSC)

- 2015 AM and PM (school peak hour) volumes were established using the intersection traffic data collected during the May-June, 2015 traffic count/data collection program when the high school was open.
- The *Synchro* software was used to evaluate the current peak hour operations of the unsignalized CKL 36 / Weldon-Riverview and signalized CKL 36 / Queen St intersections based on the existing two-way stop control (TWSC) and current Weldon intersection and Queen Street geometrics.
- The peak hour capacity analysis results were found to be representative of observed field conditions at the two intersections. The critical AM peak hour movement at the Weldon intersection is operating at LoS "C" with an average delay of about 22 – 23 seconds.
- The School AM peak hour coincided with the background AM peak hour in the CKL 36 corridor. School traffic was observed to arrive during the 45 minutes or so before classes started at 8 AM. Pedestrian traffic crossing CKL 36 was more focussed in the 20 minutes preceding the school start time.
- The School PM peak hour did not coincide with the normal background PM peak hour. It occurred from about 2:15 to 3:15 PM. The traffic was particularly focussed for a 20 minute period from 2:30 to 2:50 PM. This was evidenced by an observed intersection

[1] See the *Technical Appendix-Intersection Capacity Analyses* for definitions of Levels of Service.

peak hour factor (phf) of 0.70 observed during the school PM peak hour. The critical movement during the school PM peak hour was at the CKL 36 / Weldon-Riverview intersection. The westbound single lane approach experienced long delays (LOS F), near capacity conditions and long queues. The majority of westbound vehicles were observed turning right to the north along CKL 36. However, these right-turning vehicles were delayed by the left turning vehicles (to go south on CKL 36) which have to wait for a gap in the CKL 36 traffic stream as well as a gap in crossing pedestrians.

3.3 Traffic Signals – Warrant Analysis

Given the poor operating conditions for traffic on the minor Weldon intersection approaches, a traffic signal warrant analyses was the next step in the study process.

- A TAC traffic signal warrant analysis procedure was then carried out to assess the need for signals at the Weldon intersection. The TAC warrant procedure uses traffic and pedestrian volumes from the six highest hours of a typical weekday as observed during the 2015 traffic count program.
- The number of calculated priority points in the TAC signal warrant analyses at the CKL 36 / Weldon-Riverview intersection for current 2015 conditions was found to be 82 (33 vehicles, 49 pedestrians). The minimum number of points to meet the TAC signal warrant is 100 points. Based on the observed volumes at the Weldon intersection there is no warrant for a traffic signal. This finding was consistent with the initial evaluation carried out by CKL staff in the Fall of 2014. A summary of this warrant analysis is contained in the *Technical Appendix – Warrant Analyses*
- The 6-hour average pedestrian volume crossing CKL 36, along the south side of the intersection was found to be 71 pedestrians.
- CKL staff also carried out a signal warrant analysis based on Ontario Traffic Manual (OTM) procedures. Based on this analysis there is a potential signal warrant based only on pedestrian demand. However, there could be issues with signalizing the intersection that are not considered in applying only the pedestrian criteria. There is just under 200 m of separation along CKL 36 between Queen Street and Weldon intersection. TAC guidelines for signalized intersection spacing depends on posted speeds and signal cycle lengths. However, the minimum preferred spacing is usually at least 400 m or more. In addition, the STOP-controlled King Street intersection is located between Queen Street and Weldon Road.

3.4 All-Way Stop Control Assessment

Based on TAC criteria there is currently no warrant for a traffic signal at the Weldon intersection. Given the poor peak hour performance of the intersection with TWSC, the next step was to assess the need for the installation of All-Way Stop Control (AWSC).

- The current (January, 2014) TAC Manual of Uniform Traffic Control Devices (MUTCD) contains a warrant procedure for assessing the need for AWSC at an intersection. A copy of the warrants is included in the *Technical Appendix*.

- The peak hour volume data assembled for the traffic signal warrant analyses were applied to the AWSC assessment.
- Two of the TAC warrants for AWSC are met at this intersection. The first is the volume warrant. The minor street vehicle volumes plus pedestrian volumes average more than 200 combined units per hour over an 8 hour period. The delay warrant is also met. Minor street traffic delay exceeds 30 seconds during the peak hour.
- It is noted that based on OTM warrants the directional split on the approach volumes is not met. However, considering the relatively weak case for signals and the poor observed performance of TWSC at the study intersection, the installation of AWSC at the Weldon intersection should be considered for application to the study intersection.

3.5 Pedestrian Crossing Control Assessment

- The current TAC pedestrian crossing control guide methodology[2] was applied to the CKL 36 / Weldon-Riverview intersection to determine if current conditions require additional pedestrian crossing signs, markings, etc.
- The data inputs were assembled. They included an average daily traffic volume (ADT) of 7,000-9,000 vehicles per day (vpd) in the vicinity of the study intersection, a speed limit of 50 km/h, and an average hourly pedestrian crossing volume greater than 15 pedestrians (during typical school operations).

Using these data, the TAC guidelines suggest that a crosswalk with side-mounted signs and pavement markings are required for a crosswalk on the south approach on CKL 36 at the Weldon intersection. The pedestrian crossing signs (both in advance and at the crossing) should be specific to a school zone. The Municipality will need to select for installation from either the OTM (provincial) or TAC (national) school crosswalk signs.

[2] Pedestrian Crossing Control Guide – Transportation Association of Canada (TAC) pub.

4. DEVELOPING CANDIDATE SOLUTIONS

4.1 Overview

The consultant team reviewed the collective set of results derived from the field observations, the collision data, and the traffic/pedestrian analyses. This review determined the contributing factors to the operational issues that presently exist at the CKL 36/Weldon-Riverview intersection. Once this diagnostic step was complete a comprehensive list of potential candidate solutions were developed using experience gained from past studies as well as the road safety research literature. These potential candidate solutions have been identified as having some merit in improving the operations conditions at the subject intersection and are summarized in *Table 1*.

Table 1: List of Candidate Solutions at the CKL 36 / Weldon-Riverview Intersection

Candidate Solution	Carry Forward?	Comment
1. Do Nothing – Two-way Stop Control	NO	Concerns discussed in *Section 2.0*
2. Install Traffic Signals	NO	TAC Warrant not met / Close to other Signals
3. Install Pedestrian Half-Signal	NO	TAC Warrant not met
4. Install All-Way Stop Control	YES	Delay and Volume warrants met
5. Implement One-way flow - eastbound only to the high school, all other traffic use east access via Pidgeon Lake Road	YES	Reduces road safety risk, improves Weldon/CKL 36 operations, provides more intersection capacity
6. Install a signed/marked crosswalk across the intersection south approach	YES	Follows TAC Pedestrian Control Guide, reduces road safety risk
7. Install sidewalk connections and refuge areas at the intersection corners.	YES	Reduces pedestrian safety risk

Using the results of the traffic operational analysis discussed in *Section 3*, a more detailed assessment of each potential candidate solution was carried out, to provide a more thorough assessment of each solution. The focus of this second assessment was to determine how appropriate/applicable the candidate solutions were and how they might be combined to the specific needs and issues of the CKL 36/ Weldon-Riverview intersection. Additional analyses in support of this process included running Synchro simulations for the AM and PM peak hour periods to assess queue extensions during these high demand periods. This was particularly important in assessing the CKL 36 southbound queues created by the new AWSC at the Weldon intersection. During the simulations no significant spillback towards Queen Street were observed on the north approach to the Weldon intersection.

Based on these assessments and the summaries presented in *Table 1*, candidate solution numbers 4, 5, 6 and 7 were deemed appropriate and applicable to the site. Implementation of these solutions are forecast to improve operations and reduce road safety risks for both drivers and pedestrians.

5. THE INTERSECTION IMPROVEMENT PROGRAM

A three stage improvement program is recommended for the Weldon intersection. The first stage is presented as an *Immediate Action Plan* that will deal directly with traffic operational and pedestrian safety concerns. The second stage would be an *Intermediate Improvement Program* that could be implemented in the next 3 to 5 years as monies for capital improvements become available. The *Third Stage Improvement Program* is seen as a set of longer term solutions that could be implemented at some point in the future as traffic demands grow and more capital funding becomes available. This three stage program is described in detail following:

5.1 Plan for Immediate Implementation - Convert the Weldon Intersection to AWSC

- Install AWSC control at the Weldon/CKL 36 intersection.
- The new AWSC intersection control should be supported with an over-head red flashing beacon as well as over-sized stop signs. This will be particularly important during the early days of the installation while local drivers become accustomed to the new control.
- Install a continuous sidewalk from the High School to the southeast corner of the intersection. The sidewalk should be of sufficient width to accommodate large pedestrian groups that are characteristic of the student pedestrians.
- Install a large concrete sidewalk waiting area for pedestrians on all four corners of the intersection.
- Install concrete barrier curb and gutter on all four corner radii of the intersection and relocate the existing sidewalk on Riverview Road behind the barrier curb.
- Install painted pedestrian crosswalks across all four approaches to the intersection using an enhanced marking technique (i.e. zebra markings). The pavement markings and signs should follow TAC guidelines.
- Replace existing yellow hatching on CKL 36 with a painted northbound left turn lane to eliminate the off-set left.

5.2 Plan for Intermediate Term Improvements

The second stage for improving the CKL 36 corridor between Queen Street and Weldon Road will focus on geometric improvements to CKL 36. A portion of CKL 36 between Queen Street and Weldon Road has already been constructed with a centre left turn lane. This includes much of the section between King Street north to Queen Street. South from King Street to the left turn bay at Weldon Road will require additional pavement to complete the left turn lane from King Street south.

Between Queen Street and Weldon Road CKL 36 has an open ditch rural cross-section. The existing road platform includes wide gravel shoulders. It appears that space is available to provide a continuous left turn lane with a minimum of impact in the CKL 36 road corridor itself.

The completion of the centre left turn lane between Weldon and Queen will provide a left turn lane for the King Street intersection. Beyond the immediate areas of the intersections themselves, the left turn lane can function as a two-way-left turn lane (TWLTL). This TWLTL will serve existing

and future entrances along this section of CKL 36. In terms of traffic operations it will provide a continuous straight alignment for the "through" northbound and southbound lanes on CKL 36. It will improve the southbound left turn lane at Weldon with better approach geometrics and additional left turn capacity.

It is assumed that the following recommendations have been implemented in *the Immediate Action Plan*. If any of the following recommendations are incomplete, they should be completed at this time. These could include:

- Install concrete barrier curb and gutter on all four corner radii of the intersection and relocate the existing sidewalk on Riverview Road behind the barrier curb.
- Further improve the sidewalk waiting area for pedestrians on all four corners of the intersection.

5.3 Longer Term Improvements – One-way Traffic Flow on Weldon Road

As background traffic volumes grow over time, particularly in the CKL 36 corridor, the third stage of the improvement program is recommended to deal with these growing volumes.

- The principal strategy is to convert Weldon to One-way travel (eastbound only) from CKL 36 to the High School west entrance. This would eliminate the westbound traffic movements at the Weldon/CKL 36 intersection.
- Traffic exiting the High School would travel east to CKL 17 (*Pigeon Loke Rd*), and return to the CKL 36 corridor via the traffic signal at Queen Street. Since much of the westbound high school traffic now turns right at the Weldon intersection, the additional travel via the CKL 17 intersection to reach CKL 36 would not be significant.
- Further improvements could be made to the sidewalk from the High School to the southeast corner of the intersection now that additional right-of-way space would be available with the conversion to a one-way street. These improvements could not only include additional width to accommodate larger pedestrian groups but also accommodate a potential bicycle lane.

In the longer term, traffic volumes and new development will occur in the CKL 36 corridor. The implementation of the eastbound one-way strategy for Weldon combined with the implementation of AWSC will provide additional capacity at this intersection. This additional capacity should delay, or possibly negate the need for signals at this intersection. This will also have the benefit of eliminating the immediate need of having to operate/co-ordinate the existing signal at Queen Street. It would also eliminate potential operational issues with the King Street intersection that might be created by a future signal at Weldon Road.

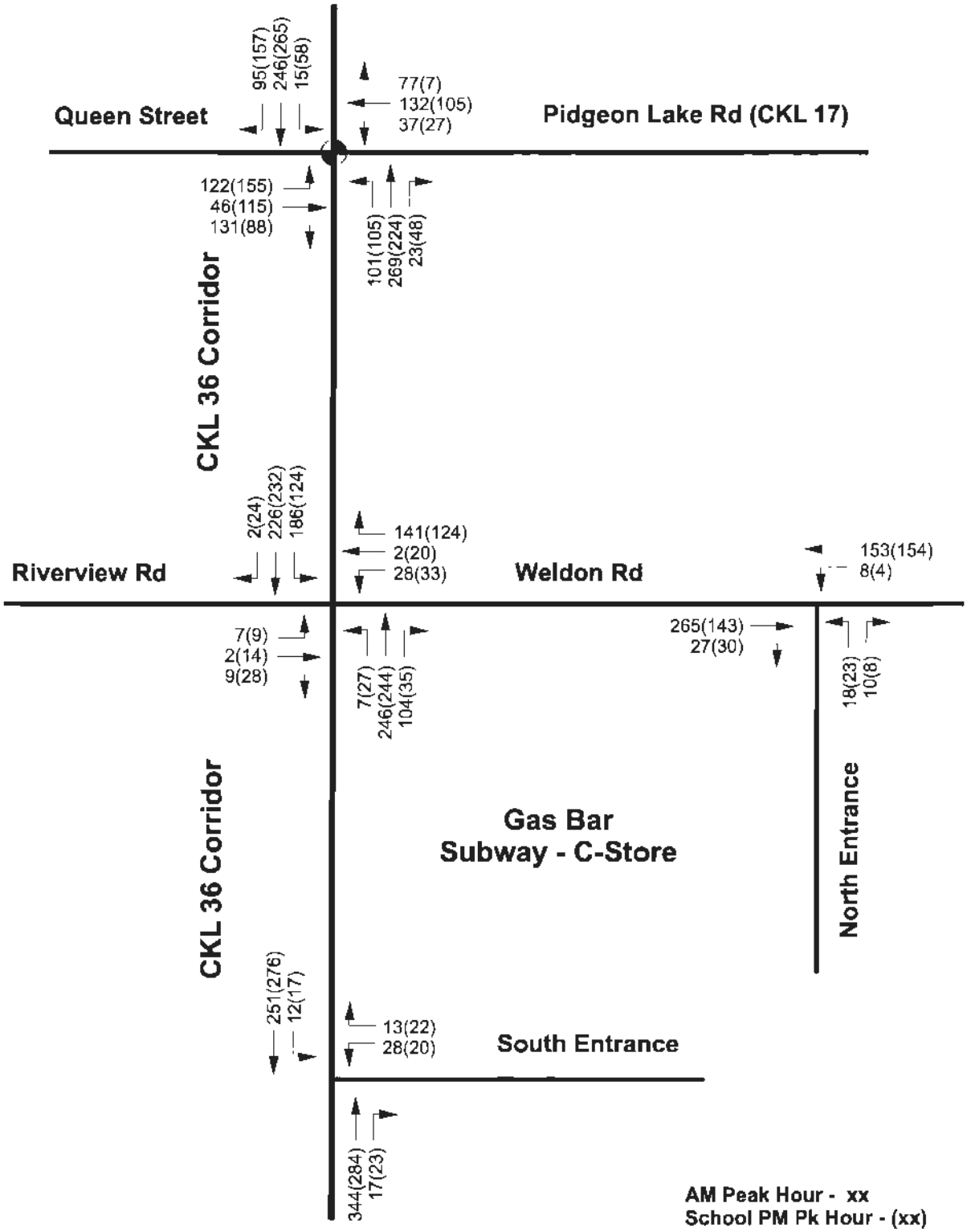
Additional background information on the traffic data, field observations and analyses are available in the study working papers. If any such additional information is required, please contact our office at your convenience. Tranplan Associates would like to extend their appreciation to City staff for their support in completing this operational review.

Yours truly,

William Copeland, P.Eng.

EXHIBIT

Exhibit
2015 Peak Hour Volumes



TECHNICAL APPENDIX

Traffic Data

CKL 36/Weldon-River Road Intersection
Observed Counts - May 27, 2015

Selected Highest Hours

Hour Ending	Main Northbound Approach			Minor Eastbound Approach			Main Southbound Approach			Minor Westbound Approach			Peds Crossing	Total
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT	Main Road	
8:00 AM	6	213	66	8	3	8	135	198	2	15	1	73	27	728
9:00 AM	6	213	60	1	2	8	127	227	4	28	4	113	29	793
10:00 AM	11	176	20	4	6	5	69	165	8	17	3	64	10	548
11:00 AM	8	172	12	9	2	10	54	166	8	10	2	42	28	495
12:00 PM	12	138	18	11	10	10	92	151	14	27	19	86	213	588
1:00 PM	18	175	10	10	9	18	62	195	9	13	5	53	19	577
2:00 PM	10	192	11	11	10	15	59	180	10	16	6	62	46	582
3:00 PM	21	196	44	7	4	14	113	212	10	41	13	131	115	806
4:00 PM	15	218	12	9	5	20	56	243	18	10	8	75	21	689
5:00 PM	15	254	12	14	13	18	69	252	10	18	10	67	18	752
6:00 PM	21	216	24	11	13	11	68	206	13	32	7	67	8	689

Highest 8 hours In order of time

Hour Ending	Main Northbound Approach			Minor Eastbound Approach			Main Southbound Approach			Minor Westbound Approach			Peds Crossing	AWSC Warrant Vols	
	LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT	Main Road	Total	Tot Minor
8:00 AM	6	213	66	8	3	8	135	198	2	15	1	73	27	728	135
9:00 AM	6	213	60	1	2	8	127	227	4	28	4	113	29	793	185
12:00 PM	12	138	18	11	10	10	92	151	14	27	19	86	213	588	376
2:00 PM	10	192	11	11	10	15	59	180	10	16	6	62	46	582	166
3:00 PM	21	196	44	7	4	14	113	212	10	41	13	131	115	806	325
4:00 PM	15	218	12	9	5	20	56	243	18	10	8	75	21	689	148
5:00 PM	15	254	12	14	13	18	69	252	10	18	10	67	18	752	158
6:00 PM	21	216	24	11	13	11	68	206	13	32	7	67	8	689	149
														Avg 8 hrs	205.25

Intersection Capacity Analyses

DEFINITION OF LEVELS OF SERVICE
Automobile Mode

SIGNALIZED INTERSECTIONS

Analysis of the Level of Service for signalized intersections is based on the ***Highway Capacity Manual*** *(HCM 2010)* procedures using current software for signalized intersections. The Level of Service for intersections is based on *Control Delay* and *Volume to Capacity Ration (v/c)*. At signalized intersections, *Control Delay* is the total delay attributed to traffic signal operation at a signalized intersection. *Control Delay* includes initial deceleration delay, queue move-up time, stopped delay and final acceleration delay. The analysis of individual movements at signalized intersections also includes the ratio of volume or demand to available capacity for the movements. This is commonly know as the (v/c) ratio. The v/c ratio provides some indication of how well these individual intersection movements will function during peak hour periods.

Level of Service definitions for signalized intersections as defined by the ***Highway Capacity Manual*** are summarized in the table below.

Definition of Level of Service for Signalized Intersections

Level of Service	Average Delay (seconds)	Volume/Capacity Ratio > 1.0*
A	Less than 10	F
B	>10 - 20	F
C	>20 - 35	F
D	>35 - 55	F
E	>55 - 80	F
F	More than 80	F

* *Note: For approach-based and intersectionwide assessments, LoS is determined solelyby Control Delay HCM 2010 Manual, Exhibit 18-4.*

Level of Service (LoS) for a signalized intersection is determined by the computed or measured *Control Delay* and is defined for each lane/movement at the intersection. LoS is also defined for the intersection as a whole. LoS "F" is considered to be undesirable for design or planning purposes with LoS "E" the upper limit of acceptable service. However, many individual turning movements at signalized intersections along urban arterial corridors in larger urban areas operate at LoS "E" and "F" during peak hour periods.

DEFINITION OF LEVELS OF SERVICE
Automobile Mode

UNSIGNALIZED INTERSECTIONS

Analysis of the Level of Service for unsignalized intersections is based on the ***Highway Capacity Manual*** *(HCM 2010)* procedures using current software for unsignalized intersections. The Level of Service for intersections is based on *Control Delay*. At two way stop controlled intersections (TWSC), *Control Delay* is the total elapsed time from a vehicle joining the queue until its departure from the stopped position at the head of the queue. The *Control Delay* also includes the time required to decelerate from a stop and to accelerate to the free-flow speed.

The analysis of individual movements at TWSC intersections can also include the estimate of the ratio of volume or demand to available capacity for the movements. This is commonly know as the (v/c) ratio. The v/c ratio provides some indication of how well these individual intersection movements will function during peak hour periods.

Level of Service definitions for unsignalized intersections as defined by the ***Highway Capacity Manual*** are summarized in the table below.

Definition of Level of Service for Unsignalized Intersections
(see Exhibit 19-1, Highway Capacity Manual 2010)

Level of Service	Average Delay (seconds)
A	0 - 10
B	>10-15
C	>15-25
D	>25-35
E	>35-50
F	More than 50s and/or v/c > 1

Level of Service (LoS) for a TWSC intersection is determined by the computed or measured *Control Delay* and is defined for each minor movement at the intersection. LoS is not defined for the major street approaches or the intersection as a whole. LoS "F" is considered to be undesirable for design or planning purposes. However, many individual turning movements at TWSC intersections and commercial entrances along urban arterial corridors operate at LoS "F" during peak hour periods.

DEFINITION OF LEVELS OF SERVICE
Automobile Mode

UNSIGNALIZED INTERSECTIONS
(All-Way Stop Control)

Analysis of the Level of Service for unsignalized intersections is based on the ***Highway Capacity Manual*** *(HCM 2010)* procedures using current software for unsignalized intersections. The Level of Service for intersections is based on *Control Delay*. At an All-Way Stop Controlled intersections (AWSC), *Control Delay* is the total elapsed time from a vehicle joining the queue until its departure from the stopped position at the head of the queue. The *Control Delay* also includes the time required to decelerate from a stop and to accelerate to the free-flow speed.

The analysis of individual movements at AWSC intersections can also include the estimate of the ratio of volume or demand to available capacity for the movements. This is commonly know as the (v/c) ratio. The v/c ratio provides some indication of how well these individual intersection movements will function during peak hour periods.

Level of Service definitions for unsignalized intersections as defined by the ***Highway Capacity Manual*** are summarized in the table below.

Definition of Level of Service for Unsignalized Intersections
(see Exhibit 20-2, Highway Capacity Manual 2010)

Level of Service	Average Delay (seconds)
A	0 - 10
B	>10-15
C	>15-25
D	>25-35
E	>35-50
F	More than 50s and/or v/c > 1

Level of Service (LoS) for a AWSC intersection is determined by the computed or measured *Control Delay* and is defined for each minor movement at the intersection. LoS "F" is considered to be undesirable for design or planning purposes. However, many individual turning movements at AWSC intersections and commercial entrances along urban arterial corridors operate at LoS "F" during peak hour periods.

Intersection	
Int Delay, s/veh	6.6

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Vol, veh/h	7	2	9	28	2	141	7	246	104	186	226	2
Conflicting Peds, #/hr	5	0	48	48	0	5	5	0	5	5	0	5
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	400	-	-
Veh in Median Storage, #	-	1	-	-	1	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	75	75	75	75	75	75	80	80	80	80	80	80
Heavy Vehicles, %	5	5	5	15	5	15	5	15	15	15	15	5
Mvmt Flow	9	3	12	37	3	188	9	308	130	232	282	2

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	1330	1300	337	1242	1236	426	333	0	0	486	0	0
Stage 1	797	797	-	438	438	-	-	-	-	-	-	-
Stage 2	533	503	-	804	798	-	-	-	-	-	-	-
Critical Hdwy	7.15	6.55	6.25	7.25	6.55	6.35	4.15	-	-	4.25	-	-
Critical Hdwy Stg 1	6.15	5.55	-	6.25	5.55	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.15	5.55	-	6.25	5.55	-	-	-	-	-	-	-
Follow-up Hdwy	3.545	4.045	3.345	3.635	4.045	3.435	2.245	-	-	2.335	-	-
Pot Cap-1 Maneuver	130	159	698	142	174	602	1210	-	-	1013	-	-
Stage 1	376	394	-	573	574	-	-	-	-	-	-	-
Stage 2	525	536	-	358	394	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	68	111	667	108	122	575	1205	-	-	1009	-	-
Mov Cap-2 Maneuver	98	180	-	200	217	-	-	-	-	-	-	-
Stage 1	357	291	-	544	545	-	-	-	-	-	-	-
Stage 2	347	509	-	267	291	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	27.1	22.1	0.2	4.3
HCM LOS	D	C		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	1205	-	-	187	434	1009	-	-
HCM Lane V/C Ratio	0.007	-	-	0.128	0.525	0.23	-	-
HCM Control Delay (s)	8	0	-	27.1	22.1	9.6	-	-
HCM Lane LOS	A	A	-	D	C	A	-	-
HCM 95th %tile Q(veh)	0	-	-	0.4	3	0.9	-	-

Intersection	
Intersection Delay, s/veh	15.7
Intersection LOS	C

Movement	EBU	EBL	EBT	EBR	WBU	WBL	WBT	WBR	NBU	NBL	NBT	NBR
Vol, veh/h	0	7	2	9	0	28	2	141	0	7	246	104
Peak Hour Factor	0.92	0.75	0.75	0.75	0.92	0.75	0.75	0.75	0.92	0.80	0.80	0.80
Heavy Vehicles, %	2	5	5	5	2	15	5	15	2	5	15	15
Mvmt Flow	0	9	3	12	0	37	3	188	0	9	307	130
Number of Lanes	0	0	1	0	0	0	1	0	0	0	1	0

Approach	EB	WB	NB
Opposing Approach	WB	EB	SB
Opposing Lanes	1	1	2
Conflicting Approach Left	SB	NB	EB
Conflicting Lanes Left	2	1	1
Conflicting Approach Right	NB	SB	WB
Conflicting Lanes Right	1	2	1
HCM Control Delay	10.2	12.9	19
HCM LOS	B	B	C

Lane	NBLn1	EBLn1	WBLn1	SBLn1	SBLn2
Vol Left, %	2%	39%	16%	100%	0%
Vol Thru, %	69%	11%	1%	0%	99%
Vol Right, %	29%	50%	82%	0%	1%
Sign Control	Stop	Stop	Stop	Stop	Stop
Traffic Vol by Lane	357	18	171	186	228
LT Vol	7	7	28	186	0
Through Vol	246	2	2	0	226
RT Vol	104	9	141	0	2
Lane Flow Rate	446	24	228	232	285
Geometry Grp	5	2	2	7	7
Degree of Util (X)	0.673	0.045	0.385	0.428	0.484
Departure Headway (Hd)	5.433	6.77	6.081	6.632	6.118
Convergence, Y/N	Yes	Yes	Yes	Yes	Yes
Cap	665	526	591	542	587
Service Time	3.477	4.853	4.135	4.38	3.866
HCM Lane V/C Ratio	0.671	0.046	0.386	0.428	0.486
HCM Control Delay	19	10.2	12.9	14.3	14.5
HCM Lane LOS	C	B	B	B	B
HCM 95th-tile Q	5.2	0.1	1.8	2.1	2.6

Intersection	
Intersection Delay, s/veh	
Intersection LOS	

Movement	SBU	SBL	SBT	SBR
Vol, veh/h	0	186	226	2
Peak Hour Factor	0.92	0.80	0.80	0.80
Heavy Vehicles, %	2	15	15	5
Mvmt Flow	0	232	282	2
Number of Lanes	0	1	1	0

Approach	SB
Opposing Approach	NB
Opposing Lanes	1
Conflicting Approach Left	WB
Conflicting Lanes Left	1
Conflicting Approach Right	EB
Conflicting Lanes Right	1
HCM Control Delay	14.4
HCM LOS	B

Lane

Intersection	
Int Delay, s/veh	59.9

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Vol, veh/h	9	14	28	33	20	124	27	244	35	124	232	24
Conflicting Peds, #/hr	5	0	152	152	0	5	37	0	5	5	0	37
Sign Control	Stop	Stop	Stop	Stop	Stop	Stop	Free	Free	Free	Free	Free	Free
RT Channelized	-	-	None	-	-	None	-	-	None	-	-	None
Storage Length	-	-	-	-	-	-	-	-	-	400	-	-
Veh in Median Storage, #	-	1	-	-	1	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-	-	0	-
Peak Hour Factor	67	67	67	50	50	50	79	79	79	86	86	86
Heavy Vehicles, %	5	5	5	10	5	20	5	15	5	15	15	5
Mvmt Flow	13	21	42	66	40	248	34	309	44	144	270	28

Major/Minor	Minor2			Minor1			Major1			Major2		
Conflicting Flow All	1419	1298	473	1306	1289	520	450	0	0	505	0	0
Stage 1	724	724	-	551	551	-	-	-	-	-	-	-
Stage 2	695	574	-	755	738	-	-	-	-	-	-	-
Critical Hdwy	7.15	6.55	6.25	7.2	6.55	6.4	4.15	-	-	4.25	-	-
Critical Hdwy Stg 1	6.15	5.55	-	6.2	5.55	-	-	-	-	-	-	-
Critical Hdwy Stg 2	6.15	5.55	-	6.2	5.55	-	-	-	-	-	-	-
Follow-up Hdwy	3.545	4.045	3.345	3.59	4.045	3.48	2.245	-	-	2.335	-	-
Pot Cap-1 Maneuver	113	159	585	132	161	522	1095	-	-	996	-	-
Stage 1	412	426	-	505	510	-	-	-	-	-	-	-
Stage 2	428	498	-	389	420	-	-	-	-	-	-	-
Platoon blocked, %								-	-		-	-
Mov Cap-1 Maneuver	30	99	494	80	100	441	1061	-	-	965	-	-
Mov Cap-2 Maneuver	~ 12	179	-	173	196	-	-	-	-	-	-	-
Stage 1	345	316	-	422	427	-	-	-	-	-	-	-
Stage 2	158	417	-	274	311	-	-	-	-	-	-	-

Approach	EB	WB	NB	SB
HCM Control Delay, s	$ 341.3	135	0.8	3.1
HCM LOS	F	F		

Minor Lane/Major Mvmt	NBL	NBT	NBR	EBLn1	WBLn1	SBL	SBT	SBR
Capacity (veh/h)	1061	-	-	58	308	965	-	-
HCM Lane V/C Ratio	0.032	-	-	1.312	1.149	0.149	-	-
HCM Control Delay (s)	8.5	0	-	$ 341.3	135	9.4	-	-
HCM Lane LOS	A	A	-	F	F	A	-	-
HCM 95th %tile Q(veh)	0.1	-	-	6.6	14.8	0.5	-	-

Notes			
~: Volume exceeds capacity	$: Delay exceeds 300s	+: Computation Not Defined	*: All major volume in platoon

Intersection	
Intersection Delay, s/veh	18.5
Intersection LOS	C

Movement	EBU	EBL	EBT	EBR	WBU	WBL	WBT	WBR	NBU	NBL	NBT	NBR
Vol, veh/h	0	9	14	28	0	33	20	124	0	27	244	35
Peak Hour Factor	0.92	0.67	0.67	0.67	0.92	0.50	0.50	0.50	0.92	0.79	0.79	0.79
Heavy Vehicles, %	2	5	5	5	2	10	5	20	2	5	15	5
Mvmt Flow	0	13	21	42	0	66	40	248	0	34	309	44
Number of Lanes	0	0	1	0	0	0	1	0	0	0	1	0

Approach	EB	WB	NB
Opposing Approach	WB	EB	SB
Opposing Lanes	1	1	2
Conflicting Approach Left	SB	NB	EB
Conflicting Lanes Left	2	1	1
Conflicting Approach Right	NB	SB	WB
Conflicting Lanes Right	1	2	1
HCM Control Delay	11.5	19	21.7
HCM LOS	B	C	C

Lane	NBLn1	EBLn1	WBLn1	SBLn1	SBLn2
Vol Left, %	9%	18%	19%	100%	0%
Vol Thru, %	80%	27%	11%	0%	91%
Vol Right, %	11%	55%	70%	0%	9%
Sign Control	Stop	Stop	Stop	Stop	Stop
Traffic Vol by Lane	306	51	177	124	256
LT Vol	27	9	33	124	0
Through Vol	244	14	20	0	232
RT Vol	35	28	124	0	24
Lane Flow Rate	387	76	354	144	298
Geometry Grp	5	2	2	7	7
Degree of Util (X)	0.679	0.151	0.617	0.291	0.567
Departure Headway (Hd)	6.312	7.141	6.278	7.259	6.855
Convergence, Y/N	Yes	Yes	Yes	Yes	Yes
Cap	573	501	573	495	527
Service Time	4.358	5.208	4.321	5.008	4.603
HCM Lane V/C Ratio	0.675	0.152	0.618	0.291	0.565
HCM Control Delay	21.7	11.5	19	13	18.3
HCM Lane LOS	C	B	C	B	C
HCM 95th-tile Q	5.2	0.5	4.2	1.2	3.5

Intersection	
Intersection Delay, s/veh	
Intersection LOS	

Movement	SBU	SBL	SBT	SBR
Vol, veh/h	0	124	232	24
Peak Hour Factor	0.92	0.86	0.86	0.86
Heavy Vehicles, %	2	5	15	15
Mvmt Flow	0	144	270	28
Number of Lanes	0	1	1	0

Approach	SB
Opposing Approach	NB
Opposing Lanes	1
Conflicting Approach Left	WB
Conflicting Lanes Left	1
Conflicting Approach Right	EB
Conflicting Lanes Right	1
HCM Control Delay	16.6
HCM LOS	C

Lane

Warrant Analyses

City of Kawartha Lakes - Traffic Signal Warrant Analysis

Main Street (name)	CKL 36
Side Street (name)	Weldon - Riverview
Quadrant / Int #	1
for Warrant Calculation Results, please hit 'Page Down'	CHECK SHEET

Direction (EW or NS)	NS
Direction (EW or NS)	EW
Comments	Existing 2015 Conditions

Road Authority:	City of Kawartha Lakes
City:	City of Kawartha Lakes
Analysis Date:	2015 Aug 01, Sat
Count Date:	-
Date Entry Format:	(yyyy-mm-dd)

Lane Configuration		Excl LT	Th & LT	Through	Th-RT+LT	Th & RT	Excl RT	UpStream Signal (m)	# of Thru Lanes
CKL 36	NB				1			2,000	1
CKL 36	SB	1				1		180	1
Weldon - Riverview	WB				1				
Weldon - Riverview	EB				1				
Are the Weldon - Riverview WB right turns significantly impeded by through movements? (y/n)							y		
Are the Weldon - Riverview EB right turns significantly impeded by through movements? (y/n)							n		

Demographics		
Elem. School/Mobility Challenged	(y/n)	y
Senior's Complex	(y/n)	n
Pathway to School	(y/n)	y
Metro Area Population	(#)	20,000
Central Business District	(y/n)	n

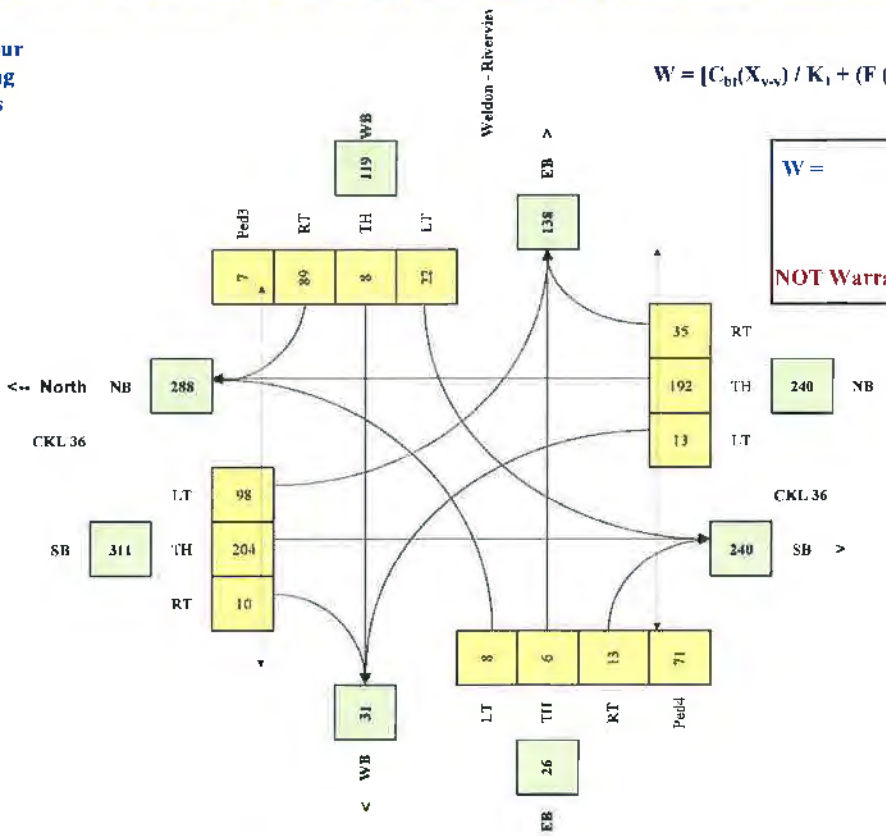
Other Input		Speed (km/h)	Truck %	Bus Rt (y/n)	Median (m)
CKL 36	NS	50	15.0%	n	0.0
Weldon - Riverview	EW		15.0%	n	

Set Peak Hours

Traffic Input	NB			SB			WB			EB			Ped1 NS	Ped2 NS	Ped3 EW	Ped4 EW
	LT	Th	RT	LT	Th	RT	LT	Th	RT	LT	Th	RT	W Side	E Side	N Side	S Side
press 'Set Peak Hours' Button to set the peak hour periods	6	213	66	135	198	2	15	1	73	8	3	8	5	5	5	27
	6	213	60	127	227	4	28	4	113	1	2	8	5	5	5	20
	12	138	18	92	151	14	27	19	86	11	10	10	10	10	10	213
	18	175	10	62	195	9	13	5	53	10	9	18	5	5	5	19
	21	196	13	113	212	10	41	13	131	7	4	14	10	10	10	115
	15	218	12	56	243	18	10	8	75	9	3	20	5	5	5	21
Total (6-hour peak)	78	1,153	210	585	1,226	57	134	50	531	46	33	78	40	40	40	424
Average (6-hour peak)	13	192	35	98	204	10	22	8	89	8	6	13	7	7	7	71

Average 6-hour Peak Turning Movements

$$W = [C_{bl}(X_{v-v}) / K_1 + (F (X_{v-p}) L) / K_2] \times C_i$$



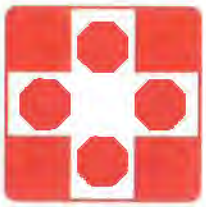
W =	82	33	49
		Veh	*Ped*

NOT Warranted

RESET SHEET

Pictographic tabs RA-1S1 to RA-1S3 are preferred since they illustrate the lay-out of the intersection, but text tabs RA-1S4 or RA-1S5 may be used as an alternative.

RA-1S1
300 x 300 mm



RA-1S2
300 x 300 mm

RA-1S3
300 x 300 mm

RA-1S4
300 x 150 mm

RA-1S5
400 x 150 mm

RA-1S5F
400 x 250 mm

All Way Stop signs may be warranted under one or more of the following conditions:

(a) where the traffic volumes on the intersecting roads are approximately equal, and the combined pedestrian and vehicular volumes on the minor road average 200 per hour for an eight hour period;

(b) where the average delay to the minor road vehicular traffic entering the intersection exceeds 30 seconds per vehicle during the peak hour;

(c) where traffic signals are not warranted, and a collision problem exists, as indicated by five or more reported collisions per year of a type which may be prevented by an All Way Stop sign installation. Such collisions include right and left turn collisions as well as right angle collisions;

(d) as an interim measure prior to the installation of traffic signals; or

(e) as an interim measure, for a period of approximately one month prior to switching the stop control from one road to an intersecting road, and the subsequent removal of existing Stop signs on the first road.

APPENDIX "B"
to
REPORT ENG2016-004
FILE NO.

CKL Rd 36/Weldon Rd

0 25 50 Meters

N

Projection: Transverse Mercator
Coordinate System: NAD83 Zone 17