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November 7, 2011 Tel: (604) 869-4945

File: 10270-5 006

Troika Developments Inc.
Unit 114 - 1856 Ambrosi Road
Kelowna, BC V1Y 4R9

Attention: Mr. Bob Guy

Reference: Green Square Project, Kelowna BC
Traffic Impact Study

We are pleased to present our Traffic Impact Study for the above-mentioned project. This report is based on discussions with City of Kelowna Staff, and our work on previous traffic studies for similar projects in the Okanagan.

The Traffic Impact Study has been prepared to determine the effect the proposed residential development, and the anticipated community growth will have on adjacent roadways and City of Kelowna Infrastructure. This report addresses the off-site planning, traffic generation and distribution, traffic analysis, and recommendations for major street improvement requirements.

A) SITE CONTEXT

The existing 4.1 ha site is zoned A-1, and is currently undeveloped. Current plans are based on the development of the northern half of the site for multifamily housing, with the southern portion of the site retained as a future municipal park.

As identified in **Figure 1**, a single family neighborhood is fully developed on the northern side of Barnes Avenue; a seniors assisted living complex is located to the east of the site, with a multifamily development to the south east of the site. The Casorso elementary school is on the west side of the site. On the south side of Casorso Road, there is a combination of single family housing, a senior's residential complex and a Church.

Reference: **Green Square Project, Kelowna BC**
Traffic Review

On the northwest corner of the existing multifamily development there is a road dedication that has been established in anticipation of the proposed extension of Mission Springs Drive, from Casorso Road to Barnes Avenue. The new portion of Mission Springs Drive would run along the eastern side of the proposed Municipal Park and multifamily development site. Due to the establishment of the existing road dedication, the southern portion of the Mission Springs Drive right of way would be fully contained within the park lands, and the northern portion of the right of way would be split between the development site, and the road reserve located on the seniors assisted living site.

Aerial View of Site (City of Kelowna Map Guide)

Figure 1

Reference: **Green Square Project, Kelowna BC**
Traffic Review

B) BACKGROUND INFORMATION

The City of Kelowna provided a traffic count for Gordon Drive and Casorso Road, completed August 11, 2011.

CTQ has also completed additional one day traffic counts for the following intersections in July 2011

- Casorso Road And Mission Springs Road – July 22, 2011;
- Gordon Drive and Barnes Road, July 21, 2011.

The existing and future (2011, and 2021) traffic volumes were prepared based on the assessment of the traffic information listed above. The 2021 background traffic was increased an additional 28% to account for the anticipated 2.5% growth per year in the municipal traffic. The 2011 AM and PM Peak Hour background traffic actual volumes are presented in **Figure 2**, and the adjusted 2021 background PM Peak Hour traffic volumes are presented in **Figure 3**, below.

The above noted one day traffic count information is also presented in the **Appendix**.

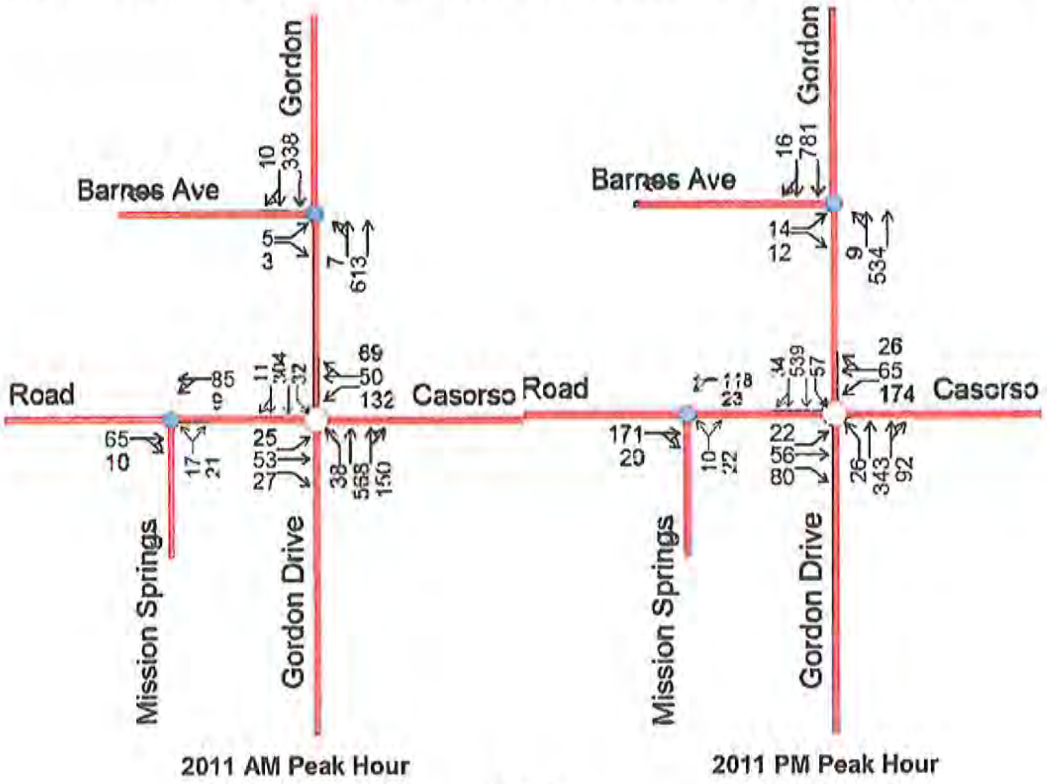


Figure 2

Reference: **Green Square Project, Kelowna BC**
Traffic Review

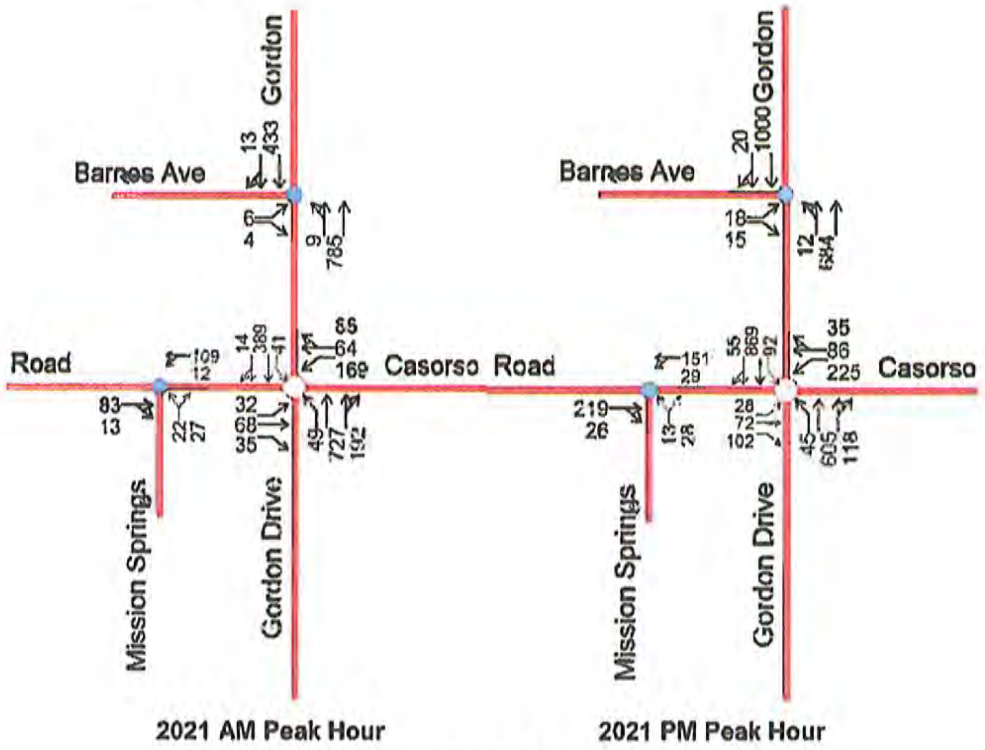


Figure 3

The Peak hour traffic volumes were reviewed based on all movements and determining best fit with standard peak hour assumptions and adjacent street networks.

Reference: **Green Square Project, Kelowna BC**
Traffic Review

C) TRAFFIC GENERATION and DISTRIBUTION

Development Traffic

Traffic impact reviews are based on trip generation rates. The rates are based on information collated from actual traffic studies, and presented for the average weekday Peak Hour volumes the specific land use will generate, during normal operations. The trip generation rates applied for typical residential developments are from the Institute of Transportation Engineers Trip Generation Rates Manual, Volume 8, as follows:

- Mid Rise Apartments (ITE Code 223), with an AM rate of 0.35 trips per unit and PM rate of 0.42 trips per unit;
- Residential Condominium / Townhouse (ITE Code 230), with an AM rate of 0.44 trips per unit and PM rate of 0.52 trips per unit.

The proposed development consists of up to 169 units, made up of 122 apartment units and 47 Town House units.

Based on the above, the Site is anticipated to generate an average of 62 additional two-way vehicle trips during the AM Peak Hour (16 inbound / 46 outbound) and 77 additional two-way vehicle trips during the PM Peak Hour (47 inbound / 30 outbound).

For most developments, there are four types of trips generated by a development:

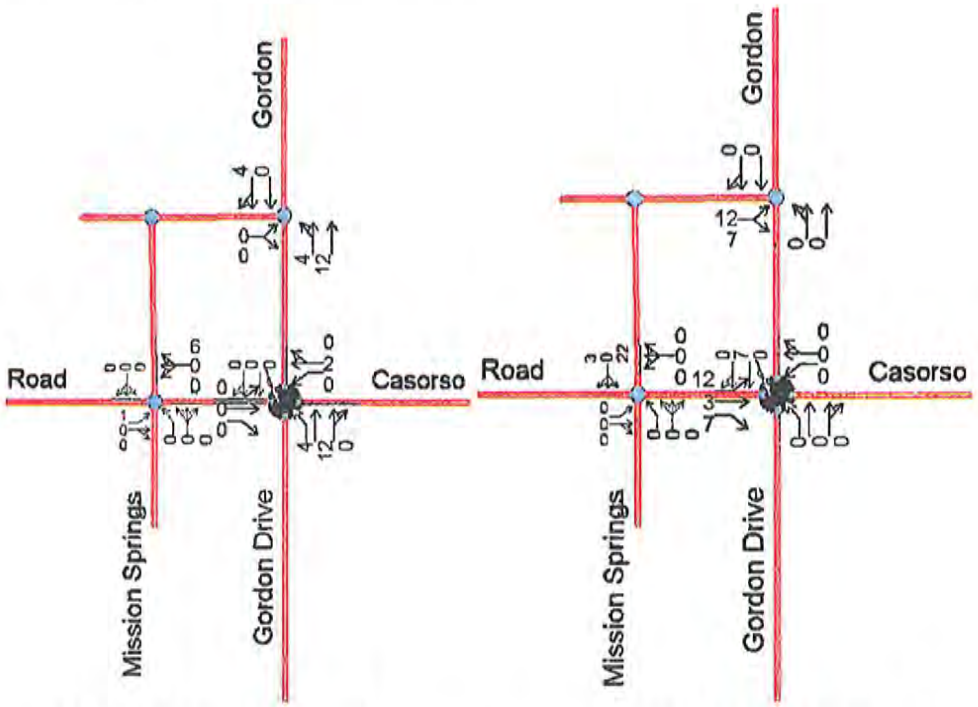
- Primary trips;
- Diverted link trips;
- Pass-by trips; and
- Internal trips.

Primary trips are trips completely devoted to the proposed development and only result because of the development. These are primarily home-based trips. Diverted link trips are made by vehicles already on the road network, but are diverting from their travel pattern to access the development. Pass-by trips are trips to the development that are caused by vehicles on the road network that pass by the development and decide to enter.

For both the pass-by trip and the diverted link trip, the vehicles are on the roadway for final destinations other than the proposed development. We have taken the conservative approach that all of the PM Peak Hour traffic is made up of home based trips.

The additional traffic generated from the proposed development is anticipated to have a similar distribution to the existing traffic patterns. The trip assignment of the inbound and outbound Weekday AM and PM Peak Hour trips resulting from the development were assigned to the road network for the study area, as presented in **Figure 4,** for the AM Peak Hour inbound and outbound trips; **Figure 5,** for the PM Peak Hour inbound and outbound trips; and **Figure 6,** for the AM and PM total Peak Hour development trips.

Reference: **Green Square Project, Kelowna BC**
Traffic Review

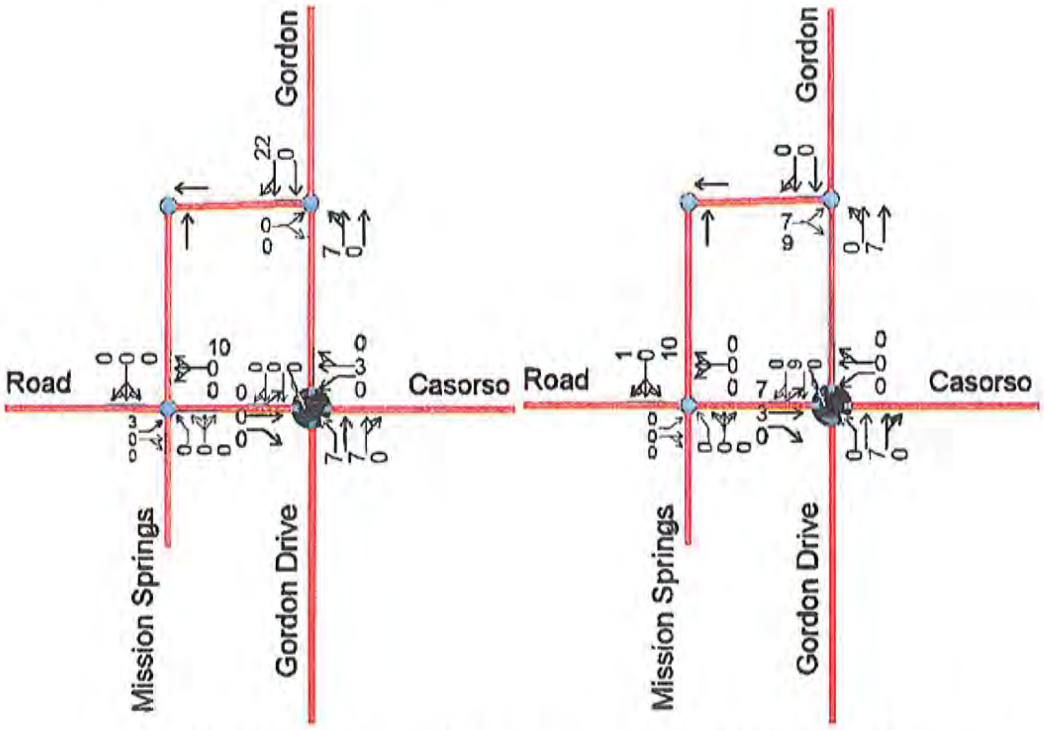


AM Peak Hour - Inbound **AM Peak Hour - Outbound**

Development Traffic Trip Assignment

Figure 4

Reference: **Green Square Project, Kelowna BC**
Traffic Review

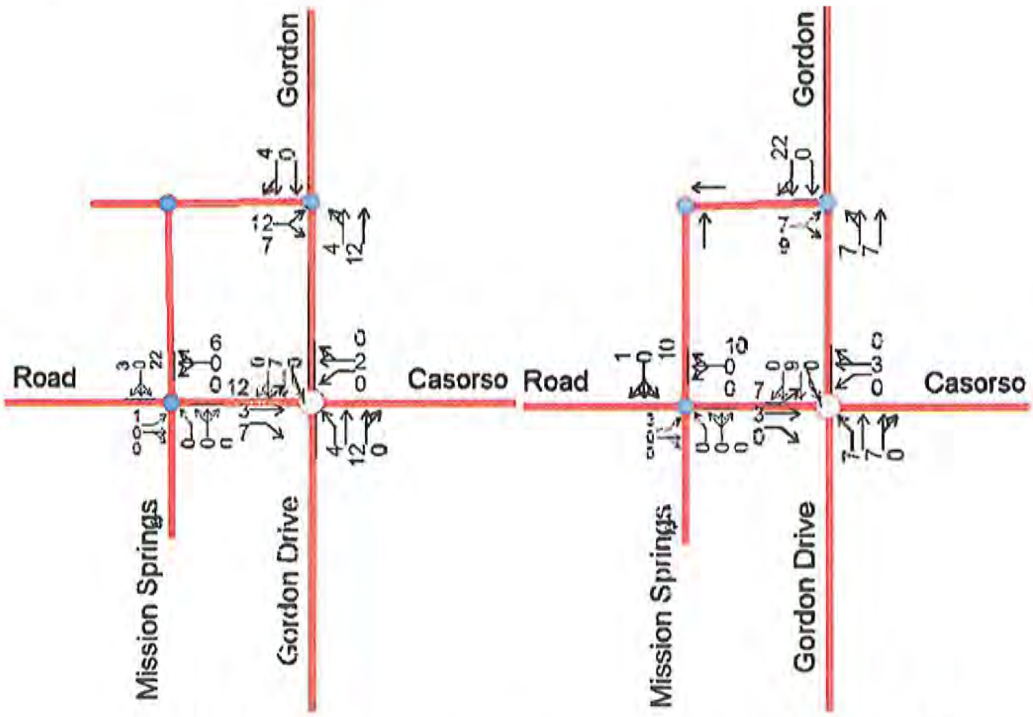


PM Peak Hour - Inbound **PM Peak Hour - Outbound**

Development Traffic Trip Assignment

Figure 5

Reference: **Green Square Project, Kelowna BC**
Traffic Review



AM Peak Hour **PM Peak Hour**

Development Traffic Trip Assignment

Figure 6

Reference: **Green Square Project, Kelowna BC**
Traffic Review

D) TRAFFIC ANALYSIS

The operations of the intersections have been analyzed utilizing Highway Capacity Manual Synchro 6 software for signalized and unsignalized intersections. An operational level of service is determined for each movement based upon the calculated delay.

The Levels of service for signalized intersections are as follows:

- Level of Service (LoS) A represents less than 10 seconds of average delay and is considered a good operating condition.
- Level of Service (LoS) B represents greater than 10 seconds and less than 20 seconds of average delay and is considered a good operating condition.
- Level of Service C represents greater than 20 seconds and less than 35 seconds of average delay and is considered a fair operating condition.
- Level of Service D represents greater than 35 seconds and less than 55 seconds of average delay and is considered a fair operating condition.
- Level of Service E represents greater than 55 seconds and less than 80 seconds of average delay and is considered a poor operating condition.
- Level of Service F represents more than 80 seconds of average delay and is considered a failed operating condition.

The Levels of service for unsignalized intersections are as follows:

- Level of Service (LoS) A represents less than 10 seconds of average delay and is considered a good operating condition.
- Level of Service (LoS) B represents greater than 10 seconds and less than 15 seconds of average delay and is considered a good operating condition.
- Level of Service C represents greater than 15 seconds and less than 25 seconds of average delay and is considered a fair operating condition.
- Level of Service D represents greater than 25 seconds and less than 35 seconds of average delay and is considered a fair operating condition.
- Level of Service E represents greater than 35 seconds and less than 50 seconds of average delay and is considered a poor operating condition.
- Level of Service F represents more than 50 seconds of average delay and is considered a failed operating condition.

Generally, and in accordance with the Ministry of Transportation Site Impact Analysis Requirements Manual, in urban areas, improvements are considered when the overall intersection performance nears Level of Service 'D' for Collector Road through traffic, and 'D' / 'E' for all other signalized and unsignalized movements. Volumes to Capacity Ratios are also reviewed. Acceptable v/c ratios of 0.85 and level of service D (based on delay) are acceptable for the overall intersection; v/c ratios of 0.90 are acceptable for individual movements.

Reference: **Green Square Project, Kelowna BC**
Traffic Review

95th percentile queues should be contained within available storage lengths for turning bays, with mitigation if the development traffic causes spill back of queues into the through lanes.

The background Weekday AM and PM Peak Hour traffic was analyzed for the 2011 and 2021 horizon years. The background plus full build out of the development was also analyzed for the Weekday PM Peak Hour traffic for the 2021 horizon year.

Background Traffic Analysis

Tables 1 and **2** present the results of the 2021 PM Peak Hour background traffic intersection analysis. The intersection Synchro analysis results are included in the **Appendix.**

Table 1
2021 Background AM Peak Hour Intersection Performance

	Control	Period	Critical V/C	Delay (Sec)	Overall LOS	Comment
Mission Springs and Casorso	Stop Sign	AM	0.06	2.1		
Barnes and Gordon	Stop Sign	AM	0.33	0.2		
Gordon and Casorso	Signal	AM	0.65	13.2	A	

Table 2
2021 Background PM Peak Hour Intersection Performance

	Control	Period	Critical V/C	Delay (Sec)	Overall LOS	Comment
Mission Springs and Casorso	Stop Sign	AM	0.16	1.5		
Barnes and Gordon	Stop Sign	AM	0.43	0.7		EB Left LoS 'E' 44 second delay
Gordon and Casorso	Signal	AM	0.65	14.3	A	

Reference: **Green Square Project, Kelowna BC**
Traffic Review

The background traffic analysis did not identify any current system deficiencies and/or operational constraints.

Background plus Development Traffic Analysis

Tables 3 and **4** presents the results of the 2021 PM Peak Hour background plus full build out of the development traffic intersection analysis. The intersection Synchro analysis results are included in **Appendix**.

Table 3
2021 Background plus Development AM Peak Hour Intersection Performance

	Control	Period	Critical V/C	Delay (Sec)	Overall LOS	Comment
Mission Springs and Casorso	Stop Sign	PM	0.07	2.7		
Barnes and Gordon	Stop Sign	AM	0.34	0.5		EB Left LoS 'C' 20 second delay
Gordon and Casorso	Signal	PM	0.66	13.3	B	

Table 4
2021 Background plus Development PM Peak Hour Intersection Performance

	Control	Period	Critical V/C	Delay (Sec)	Overall LOS	Comment
Mission Springs and Casorso	Stop Sign	PM	0.16	1.7		
Barnes and Gordon	Stop Sign	AM	0.43	1.1		EB Left LoS 'F' 51 second delay
			0.43	0.8		Addition of Raised Median on Gordon Drive EB Left LoS 'D' 32 second delay
Gordon and Casorso	Signal	PM	0.66	14.4	B	

Reference: **Green Square Project, Kelowna BC**
Traffic Review

The 2021 Background plus full build out of the development traffic analysis identified a level of service 'F' for the eastbound left turn from Barnes Avenue onto Gordon Drive. The addition of a raised median on Gordon Drive, improved the operation of the eastbound left to a level of service 'D', with a delay of 32 seconds. The raised concrete median on Gordon Drive would define the current painted left turn lane configuration for the portion of Gordon Drive adjacent to the Barnes Avenue intersection.

No other deficiencies and/or operational constraints resulted from the addition of the development traffic to the background traffic.

As an alternate the eastbound left from Barnes Avenue onto Gordon Drive could be restricted to only allow for operation between the hours of 7pm to 7am, as is the case on a number of minor street left turns onto Highway 97 in Kelowna. If the compliance with the restricted hours of operation is not satisfactory, the left turn could be closed and the exit restricted to a right out condition only. The restriction or closure of the left turn will direct traffic to the new Mission Springs Drive connection onto Casorso Road, or through the existing residential neighborhood to the north.

Table 5 presents the analysis of the adjacent intersections with the closure of the left turn and all traffic diverted to the Mission Springs Road and Casorso Road, and the Casorso Road and Gordon Drive intersections.

Table 5
2021 Background plus Development PM Peak Hour Intersection Performance
(eastbound left from Barnes Ave onto Gordon Drive restricted)

	Control	Period	Critical V/C	Delay (Sec)	Overall LOS	Comment
Mission Springs and Casorso	Stop Sign	PM	0.16	2.3		
Barnes and Gordon	Stop Sign	PM	0.43	0. 4		EB Left restricted
Gordon and Casorso	Signal	PM	0.66	14.5	B	

With the left turn restricted, the combination of the development and background traffic analysis did not identify any system deficiencies and/or operational constraints.

Reference: **Green Square Project, Kelowna BC**
Traffic Review

The City of Kelowna Traffic Branch would prefer to not restrict the left turn movements from Barnes Avenue on to Gordon Drive, and will monitor the intersection operation over time, prior to any modifications to the existing configuration being implemented.

The Barnes Avenue and Gordon Drive intersection was analyzed using the Transportation Association of Canada Canadian Traffic Signal Warrant Matrix Procedure (2005 edition). The results of the analysis are included in the appendix, and indicated a signal at the intersection was not warranted for the 2021 background plus development traffic.

E) RECOMMENDATIONS

The projected growth in background traffic will increase the side street delay along the Gordon Drive corridor, but the overall the Casorso Road and Gordon Drive area will function within acceptable operational levels through to 2021.

The addition of the development traffic will place added pressure on the operation of left turn from Barnes Avenue onto Gordon Drive. The left turn could be either restricted in the hours of operation, or closed, without impacting the operational levels of the adjacent intersections.

We would be pleased to meet and discuss the findings presented above.

Sincerely,

CTQ CONSULTANTS LTD.
Per:

Mr. David D. Cullen, P.Eng.
Transportation Engineer
DDC:ddc