

## **COMMITTEE OF THE WHOLE AUGUST 31, 2010**

### **HIGHWAY 400 IMPROVEMENTS - MAJOR MACKENZIE DRIVE TO KING ROAD TEMPORARY SEQUENTIAL ROAD CLOSURE - KING-VAUGHAN ROAD AND KIRBY ROAD WARD 1**

#### **Recommendation**

The Commissioner of Engineering and Public Works recommends:

1. That the necessary by-law be passed authorizing the temporary sequential closures of King-Vaughan Road and Kirby Road at Highway 400 to facilitate the timely replacement of the King-Vaughan Bridge structure and the widening of the Kirby Road underpass structure by the Ministry of Transportation, which could commence as early as the Fall of 2011 and take two years to complete;
2. That MTO provide a detailed traffic management plan in conjunction with the detailed design exercise for the Highway 400 Improvements to the satisfaction of the City and the Region of York; and
3. That the Region of York be requested to investigate the need for traffic signals and intersection improvements at the intersections of King-Vaughan Road/Jane Street and Kirby Road/Jane Street; and
4. That staff report to a future Committee of the Whole meeting on the road closure sequence and the proposed traffic management plan.

#### **Contribution to Sustainability**

The temporary sequential closures of King-Vaughan Road and Kirby Road at Highway 400 to facilitate the structure improvements contributes to sustainability by potentially shortening the construction duration by approximately 60 working days, and reducing the overall scope of the project.

#### **Economic Impact**

The temporary closure of King-Vaughan Road at Highway 400 will significantly reduce the overall construction cost of the structure works by approximately \$1.9 million. Since the City is funding the cost associated with over-building the substructure of the King-Vaughan Road Bridge structure, the City is expected to save about \$250,000 as a result of the temporary road closures.

#### **Communications Plan**

The Highway 400 widening project is being carried out by the Ministry of Transportation and includes a public notification/awareness plan. As part of this communication plan, all stakeholders and motorists will be informed of the temporary closure of King-Vaughan Road and Kirby Road by direct mailings, newspaper advertisements and road side signage. In addition, written notification of the road closures will be provided to emergency and public service agencies (police, fire and ambulance), transit and school bus providers.

Access Vaughan will be provided with information regarding the closure and associated contact information in order to effectively respond to enquiries from the general public. MTO will be responsible for the installation and maintenance of all barricades and construction signage in order to provide pedestrian safety and local access around the construction area. The appropriately worded road side signage will be installed a minimum of two weeks prior to each

road closure as a means of informing motorists of the temporary road closures in accordance with the Ontario Traffic Manual, Book 7.

Access to the properties along the affected sections of King-Vaughan Road and Kirby Road will be maintained during construction.

### **Purpose**

The purpose of this report is to seek Council's approval to temporarily close King-Vaughan Road and Kirby Road at Highway 400 to facilitate the timely construction of the new King-Vaughan Bridge structure and the lengthening of the Kirby Road underpass structure by the Ministry of Transportation. This work could commence as early as the Fall of 2011 and take two years to complete.

### **Background - Analysis and Options**

In 2002, the Ministry of Transportation (MTO) received approval through a Transportation Class Environmental Assessment for Highway 400 improvements from Major Mackenzie Drive to south of the South Canal Bridge. The first phase of the project, as shown on Attachment No.1, includes the reconstruction of the King Road/Highway 400 interchange, which is currently under construction. The second phase of the project generally includes the following works:

- Widening of Highway 400 from 6 to 8 lanes to accommodate new high occupancy vehicle (HOV) lanes;
- Widening and rehabilitating the existing Kirby Road underpass structure on Highway 400 to accommodate the ultimate 10 lane cross-section of Highway 400;
- Replace the King-Vaughan Road bridge over Highway 400 with a new 2-lane structure;
- New median storm sewer and upgrade drainage facilities;
- Full illumination from Major Mackenzie Drive north to Teston Road and partial illumination further north.

As part of the second phase of the project, MTO is proposing to demolish the existing King-Vaughan Road Bridge and replaced it with a new bridge to accommodate the future expansion of Highway 400 to its ultimate ten lane configuration. Based on direction from the City in November 2009, the bridge will be designed and constructed with a substructure that can readily accommodate a 4 lane cross-section in the future. In addition, MTO will be lengthening the existing Kirby Road reinforced concrete rigid frame structure under Highway 400 at both ends to accommodate the ultimate 10 lane cross-section. To accommodate a minimum vertical clearance required under the bridge structure, Kirby Road must also be lowered.

### **King-Vaughan Bridge Structure**

The proposed King-Vaughan bridge cross-section includes two 3.5 m lanes, two 1.5 m shoulders and a 1.5 m sidewalk on the south side of the interim bridge. The substructure will be overbuilt to accommodate the ultimate widening of King-Vaughan Road to four lanes. MTO's engineering consultant (SNC-Lavalin) has investigated the pros/cons of constructing the new bridge with King-Vaughan Road closed while maintaining local access during construction. The following two alternatives were developed by SNC-Lavalin based on the scope of the structure works; Option A – the replacement of the existing bridge while maintaining through traffic, and Option B – full closure of King-Vaughan Road.

#### **Option A – Traffic on King-Vaughan Road maintained during construction**

Option A provides for the construction of the new structure while maintaining though traffic on King-Vaughan Road. For this option, two retaining walls are required for the bridge replacement.

The first is located at the south-east quadrant of the Highway 400/King-Vaughan Road intersection. It is approximately 120 m long and the maximum wall height is about 4.0 m. The second is located at the south-west quadrant with an approximate length of 120 m and a maximum wall height of about 3.5 m.

Option B – King-Vaughan Road closed during construction

Option B would involve the temporary closure of King-Vaughan Road during the construction of the new structure. For this option, the centreline of the interim bridge is shifted 4.0 m to the south. King-Vaughan Road will be closed during the construction of the new interim bridge. The substructure of the bridge will be overbuilt to the north of the interim bridge to accommodate the future ultimate widening of King-Vaughan Road.

For this option, no retaining walls are required on the south side of King-Vaughan Road; however, when the City of Vaughan undertakes the ultimate widening of King-Vaughan Road in future, a retaining wall will be required in the north-west quadrant unless a road widening is obtained that can provide for an alternative grading solution. The approximate length of this retaining wall is expected to be 80 m with a maximum wall height of about 3.0 m.

Construction Cost Estimate Comparison

The preliminary construction cost estimate for Options A and B are summarized in Table 1 below.

<b>Table 1. King-Vaughan Bridge Construction Cost Estimate</b>		
<b>Item</b>	<b>Option A</b>	<b>Option B</b>
<i>Highway</i>		
Earth grading and pavement structure (including 30% contingency for other unaccounted items)	\$ 1,748,000	\$ 1,569,000
Roadway Protection at approaches	\$ 610,000	\$ 0
Traffic staging control	\$ 88,000	\$ 14,300
<i>Subtotal</i>	<i>\$ 2,446,000</i>	<i>\$ 1,583,300</i>
<i>Bridge</i>		
King-Vaughan structure	\$ 2,310,000	\$ 2,310,000
Retaining wall	\$ 700,000	\$ 0
Substructure for future widening	\$ 810,000	\$ 810,000
Roadway protection at abutments	\$ 350,000	\$ 0
<i>Subtotal</i>	<i>\$ 4,170,000</i>	<i>\$ 3,120,000</i>
<b>Total Estimated Construction Cost</b>	<b>\$ 6,616,000</b>	<b>\$ 4,703,300</b>
<b>Estimated Design Costs</b>	<b>\$ 154,100</b>	<b>\$ 111,320</b>

As shown in Table 1, the estimated construction cost difference between Option A and B is approximately \$1.9 million. The City would realize a savings of approximately \$250,000 for its component of the bridge works. This significant reduction in construction cost is due to the elimination of construction staging (requires less earth grading for staging, elimination of roadway protection on the road and at abutments as well as ease of construction of the bridge structure) and the elimination of the retaining walls on the south side of King-Vaughan Road. From a construction cost point of view, Option B is the more economical option.

In addition, the estimated design cost difference between Option A and B is approximately \$43,000. The City would realize a further savings of approximately \$26,000 for its share of the design assignment.

The construction costs presented in Table 1 do not include the future maintenance costs of the infrastructure or the superstructure and retaining wall for the north-east quadrant depending on which option the City wants to proceed with.

#### Construction Duration

For Option A, the King-Vaughan Road bridge construction would be constructed in two stages to maintain traffic on King-Vaughan Road. Sufficient space is allowed between the new and the old bridge so that construction of the new interim bridge can be completed in one stage and the substructure will be constructed in two stages. With this construction sequence, roadway protection along King-Vaughan Road at the approaches and at the abutments is required. The construction of two retaining walls in the south-east and south-west quadrants is also required. The estimated construction duration for Option A is 1 ½ construction seasons (including one winter shutdown) or 180 working days.

For Option B, the bridge would be constructed in one stage during the full closure of King-Vaughan Road with local access maintained. Roadway protection and retaining walls are not required and the estimated construction duration for Option B is one construction season or 120 working days.

From the preliminary estimates, Option A will take much longer to construct when compared with Option B. This is primarily due to the simplified construction sequence of Option B as there is no roadway protection or retaining wall work. Furthermore, the Contractor will be able to work much more efficiently and safely in a closed off site without live traffic.

#### Future Widening of the King-Vaughan Structure

Both options protect for the future widening of King-Vaughan Road to four lanes. The substructure for the ultimate cross-section will be constructed as part of this project; however only the superstructure for the interim cross-section will be constructed. The bridge structure will be designed such that adequate vertical clearance over the Highway 400 mainline is achieved not only at the interim stage, but also for the ultimate stage when the City of Vaughan proceeds to widen King-Vaughan Road including the construction of the widened bridge superstructure.

During the ultimate widening of King-Vaughan Road, minimal staging on Highway 400 will be required to widen the superstructure. The substructure will already be in place and the girders can be installed at night.

#### **Kirby Road Structure Lengthening**

As part of the Highway 400 widening, MTO will be lengthening the existing Kirby Road reinforced concrete rigid frame structure under Highway 400 at both ends to accommodate the ultimate 10 lane cross-section. To accommodate a minimum vertical clearance required under the bridge structure, Kirby Road must also be lowered. It is anticipated that the temporary closure of Kirby Road during the construction of these works will result in significant economic and construction efficiency benefits similar to the King-Vaughan Road component. MTO will be responsible for the entire cost of the Kirby Road Structure improvements.

## Traffic Impact Study

MTO's consultant (SNC-Lavalin) completed a traffic impact study to assess the impacts of closing King-Vaughan Road and Kirby Road during bridge replacement. The study scope included the following three scenarios:

1. Closure of King-Vaughan Road to facilitate the bridge replacement work;
2. Closure of Kirby Road to facilitate the bridge widening and associated lowering of Kirby Road profile; and
3. Closures under Scenarios 1 and 2 performed simultaneously.

For the purpose of this traffic study, the study area was defined by the extent of expected traffic diversions. Based on expected travel times, it was determined that in the worst case scenario, with both King-Vaughan Road and Kirby Road closed, diverted traffic will either go to King Road to the north or Teston Road to the south. The study area was thus defined by King Road to the north, Teston Road to the south, Weston Road to the west and Jane Street to the east.

King-Vaughan Road and Kirby Road are currently 2-lane roadways primarily providing local access to farmlands in the study area, with Annual Average Daily Traffic (AADT's) of approximately 2,000 vehicles per day (vpd).

According to the staging plans, even during full closures, all local access would be maintained on both sides of Highway 400 on King-Vaughan Road and Kirby Roads. Based on a quantitative engineering evaluation and also qualitative assessment, it was concluded that only the east-west through traffic on King-Vaughan Road and Kirby Road would be affected by the proposed road closures. Based on expected travel times, distances and engineering judgment, SNC-Lavalin determined that if both King-Vaughan Road and Kirby Road are closed then east-west through traffic from these two roads will either divert north to King Road or south to Teston Road only.

The relevant intersections to study were thus along King Road, King-Vaughan Road, Kirby Road and Teston Road only. The rest of the intersections are not expected to have any significant impact by traffic diversions from the proposed closures on King-Vaughan Road and/or Kirby Road. SNC-Lavalin concluded that there will be no significant traffic impact to any of the intersections of interest. All signalized intersections show acceptable levels of service both for AM and PM peak hours; i.e. at least LOS D or better.

As an output to the traffic study, SNC-Lavalin identified that during the PM peak hour, both west and east approaches at King-Vaughan Road/Jane Street and Kirby Road/Jane Street today are expected to operate poorly (Level of Service F). Because of the heavy north-south traffic at both of these intersections, east-west approaches are expected to experience significant delays and projected volumes in the PM peak were approaching thresholds for possible signalization. Accordingly, it is recommended that signal warrant analyses be completed with current volumes for the intersections of King-Vaughan Road/Jane Street and Kirby Road/Jane Street for possible signalization. The intersection of Kirby Road/Jane Street also has a jog at the east and west approaches, which pose operational problems, and these problems, may get worse with an increase in traffic.

The results of the SNC-Lavalin Traffic Study suggests that closures of King-Vaughan Road or Kirby Road, or both, with local access maintained on both sides of Highway 400, will result in minimal traffic disruption to traffic patterns in the study area, affect traffic diversions of through east-west traffic only, and will not cause significant traffic impacts at study area intersections. The new Teston Road Interchange and the completion of construction at Highway 400/King Road Interchange will have a positive impact on the traffic operations in the study area due to more available capacity. Accordingly, the proposed road closures are not expected to cause significant traffic impacts during construction.

## **Vaughan Fire and Rescue Services Comments**

Vaughan Fire and Rescue Services reviewed the options proposed by MTO and have advised as follows:

"In regards to the impact and preferential option VFRS agrees with the sequential closure of the King Vaughan Line and then Kirby Road (option B) it will have the least impact on the VFRS response times. This option allowed for a predetermined alternate response and still allowed for an east/west connection other than Teston Road or King Side road for emergency response and mutual aid. This option as indicated by the report shortens the construction period to 120 days. This also creates a determined response by VFRS as there is no concern about temporary closures as may occur with Option A. The number of businesses and residences on the King Vaughan Line are minimal. There is a residential structure on the south east corner of the King Vaughan Line and Highway 400, and the K.G. Beamish business located on the NE corner that are in very close proximity to the bridge. These two locations would be in the construction hot zone."

## **Relationship to Vaughan Vision 2020/Strategic Plan**

This report is consistent with the priorities previously set by Council and the necessary resources have been allocated and approved.

## **Regional Implications**

Region staff has reviewed the SNC-Lavalin Traffic Study and concur that the impacts of a full closure of Kirby Road and King-Vaughan Road over Highway 400 are manageable based on the current traffic count data. However, to better manage potential emergency situations (ie closure of either Teston or King Road due to a collision), the Region's preference would be that the road closures and bridge works be carried out sequentially rather than concurrently. MTO has confirmed that a sequential closure is feasible from a project delivery perspective and has agreed to include the necessary provisions in the contract package to notify the contractor of this requirement.

## **Conclusion**

The Ministry of Transportation is proposing to widen Highway 400 from 6 to 8 lanes between Major Mackenzie Drive and King Road beginning as early as the Fall of 2011, subject to funding. As a component of this road widening work, MTO is proposing to replace the existing King-Vaughan Road Bridge with a two lane structure, and lengthening the existing Highway 400 Bridge over Kirby Road to accommodate the future expansion of the highway to the ultimate 10 lane cross-section.

Based on a value engineering assessment by MTO's engineering consultant (SNC-Lavalin), it is has been determined that there are significant economic benefits if King-Vaughan Road and Kirby Road were temporarily closed at Highway 400 to facilitate the structure works. SNC-Lavalin has conducted a traffic study that suggests the closure of King-Vaughan Road and Kirby Road during construction would have minimal impact on existing traffic operations during construction and shorten the construction duration by approximately 60 working days.

Accordingly, it is recommended that a by-law be passed to implement the temporary sequential road closure King-Vaughan Road and Kirby Road at Highway 400 to facilitate the timely replacement of the King-Vaughan Bridge structure and the widening of the Kirby Road underpass structure by the Ministry of Transportation. These road closures would be in effect for the duration of the bridge works, which could commence as early as the Fall 2011.

In addition, based on the conclusions of the SNC-Lavalin traffic report, it would be appropriate for the Region of York to investigate the need for traffic signals and intersection improvements at the intersections of King-Vaughan Road/Jane Street and Kirby Road/Jane Street.

**Attachments**

Attachment No. 1 – Location Plan

**Report prepared by:**

Andrew Pearce, Director of Development & Transportation Engineering

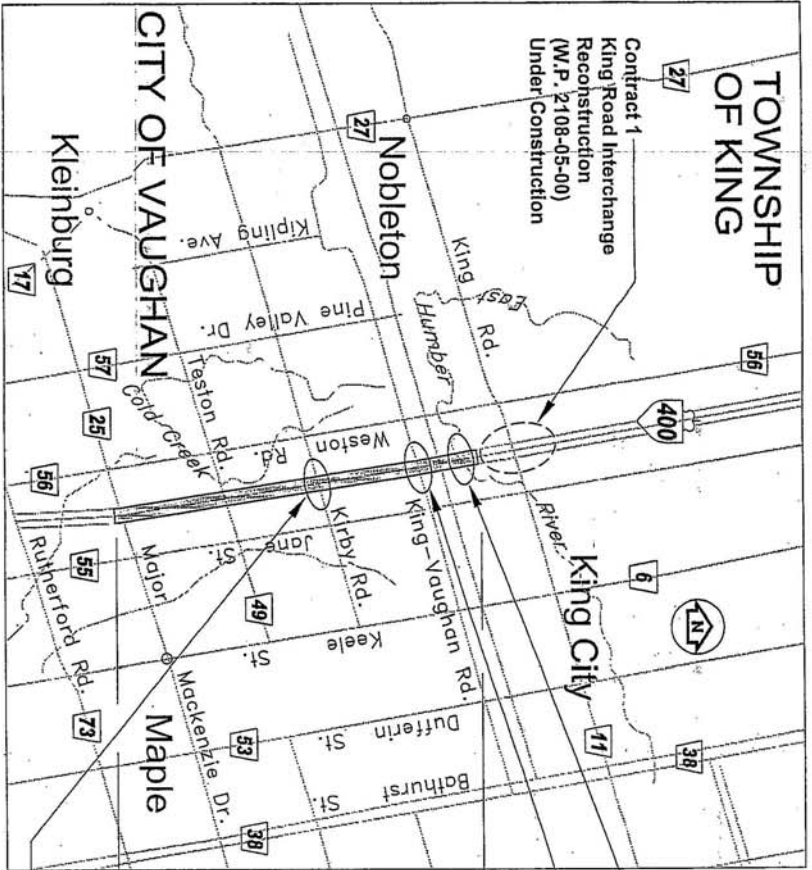
Respectfully submitted,

Bill Robinson, P.Eng.,  
Commissioner of Engineering & Public Works

Andrew Pearce, C.E.T.,  
Director of Development &  
Transportation Engineering

# ATTACHMENT NO. 1

## KEY PLAN



**Contract 1**  
 King Road Interchange  
 Reconstruction  
 (W.P. 2108-05-00)  
 Under Construction

East Humber River Arch Culvert  
 Site No. 37 - 94

King - Vaughan Underpass Bridge  
 Site No. 37 - 271

**Contract 2**  
 Widening from Major Mackenzie Drive  
 to King Road  
 (W.P.s 192-00-00 and 2539-04-00)

Kirby Overpass Bridge  
 Site No. 37 - 95/1, 37 - 95/2