Tolling evaluation for the proposed Bradford Bypass

Ministry of Transportation of Ontario

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1. Context and objectives

The Bradford Bypass is a limited-access highway that has been proposed to connect Highway 400 and Highway 404 north of the Town of Bradford. The Bypass is currently the subject of an environmental assessment and preliminary design (EA/PD) study. The location and provisional alignment of the Bypass are shown on Figure 1-1.

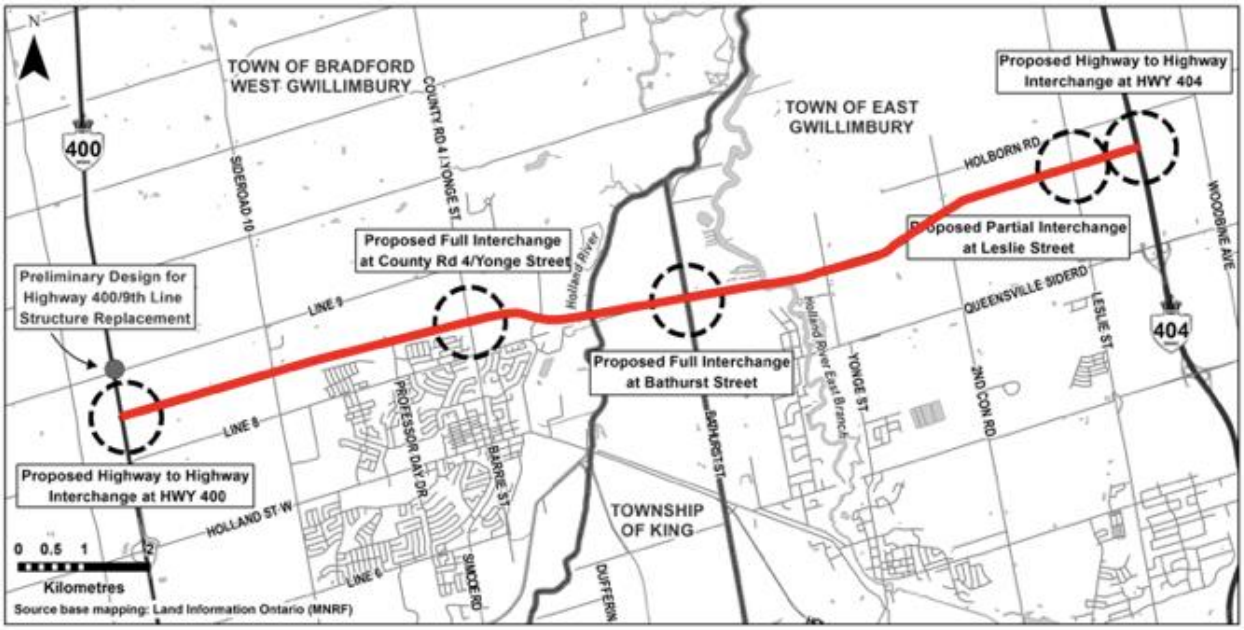

FIGURE 1-1: *BRADFORD BYPASS – LOCATION AND PROVISIONAL ALIGNMENT*

The Bypass is proposed as a 4-lane facility with a projected opening date, for the purposes of this assignment, of 2031. All four lanes will be general-purpose lanes. All-movement highway-to-highway interchanges are proposed at Highway 400 and Highway 404. Full interchanges are proposed at Yonge Street/YR4 and Bathurst Street and a partial interchange (to/from the west) is proposed at Leslie Street

For the purposes of this assignment, it is proposed that the Bypass will be widened to 8 lanes, including a single HOV lane in each direction, by 2041.

The objectives of this assignment are as follows:

- Evaluate the potential utilization and revenue for the Bypass for the 2031 and 2041 planning horizons;
- Evaluate the sensitivity of utilization and revenue to variations in the toll rates;
- Evaluate the potential benefit/disbenefit associated with tolling the Bypass;
- Develop an economic business case for tolling the Bypass;
- Develop a financial business case for tolling the Bypass;
- Estimate the capital recovery period associated with allocating the revenue to finance construction of the Bypass.

It is important to note that the economic and financial business cases have been developed relative to a constructed but untolled Bypass and do not consider the benefits associated with implementing the Bypass relative to the status quo. The capital recovery period associated with using the toll revenues to finance construction of the Bypass is a special case and exception and is considered separately.

2. Travel demand model inputs, assumptions, and calibration

2.1. Travel demand model inputs and related assumptions

MTO's GGHMv4 travel demand model was used to estimate the utilization and revenue for the Bypass for 2031 and 2041. Rather than extracting a subarea model to streamline the model runs, the entire GGHM was run for each scenario so that all possible re-routings and all benefits/disbenefits would be captured. The land use scenarios for 2031 and 2041 assumed in this model for the current assignment are base scenarios consistent with Provincial growth policies in terms of population and employment. These scenarios are consistent with those being used in the EA/PD process. The same matrix set was used for all model runs. Although the option of using enhanced land-use scenarios reflecting additional future development attracted to the Bypass corridor was considered, it was decided that the development of such scenarios was beyond the scope and timeframe for this assignment.

The 13 vehicle classes native to the GGHM were retained for the model runs - 10 auto classes and 3 truck classes. However, the outputs from the GGHM were aggregated for summarization, and for the calculation of revenue, to be consistent with the three toll rate classes currently in use, namely autos/light trucks, single unit/medium trucks and multi-unit/heavy trucks.

Modifications to the GGHM network were made to ensure it was consistent with the most current configuration envisioned for the Bypass and configuration modifications were made to represent the 4-lane cross-section for 2031, the 8-lane cross-section (including HOV lanes) for 2041, and the respective interchange locations and configurations as shown on Figure 1-1. For example, the Bathurst interchange was added, and the configurations of the other interchanges were reviewed and updated as necessary.

Originally, the intent was to run the GGHM for both the AM and PM peak hours and expand the utilization, travel time, and revenue outputs from those two peak hours to daily, weekly, and annual values. However, the decision was made by MTO, given timelines and the status of the model calibration, to run only the AM peak hour and use these outputs as the basis for expansion.

2.2. Toll-rate assumptions

The decision was made at the outset of the evaluation to use the toll rates currently in use on the MTO portion of Highway 407 (Highway 407 East), Highway 412, and Highway 418 as the baseline toll rates for the Bradford Bypass. Table 2-1 summarizes these toll rates both as they were frozen in June 2019 due to the COVID-19 pandemic (in $2019), and in $2016 as used in the modelling. The toll rates for single-unit (medium) trucks are nominally 100% greater than the rates for autos and light trucks, while the rates for multi-unit (heavy) trucks are nominally 200% greater than the rate for autos/light trucks. For reference, the rates shown in Table 2-1 are generally just less than 50% of those for a comparable situation on the 407ETR.

The weekday 6 am - 10 am rates were used in the modelling of the AM peak hour. A variety of tolling sensitivity scenarios were considered in this evaluation, using these baseline toll rates as a starting point.

TABLE 2-1: *CURRENT (AS FROZEN IN 2019) TOLL RATES ON HIGHWAY 407 EAST, HIGHWAY 412, AND HIGHWAY 418*

¢2019/km (¢2016/km)	Weekday				Weekend	
	6 am - 10 am	10 am - 3 pm	3 pm - 7 pm	7 pm - 6 am	11 am - 7 pm	7 pm - 11 am
Auto/light truck	29.66 (28.30)	23.52 (22.44)	29.66 (28.30)	19.43 (18.54)	22.50 (21.47)	19.43 (18.54)
Single-unit (medium) truck	59.32 (56.60)	47.04 (44.88)	59.32 (56.60)	38.86 (37.08)	45.00 (42.94)	38.86 (37.08)
Multi-unit (heavy) truck	88.97 (84.89)	70.57 (67.33)	88.97 (84.89)	58.29 (55.62)	67.50 (64.40)	58.29 (55.62)

2.3. Value-of-time calibration

Value-of-time (VoT also known as willingness-to-pay) is a key parameter in estimating the utilization of a tolled facility as it informs the decision on whether a driver will choose to pay the prevailing toll rate and use the Bypass or use an untolled alternative route. VoT was calibrated based on observed utilization of the 407ETR, adjusting the VOT parameter for each vehicle class until the simulated utilization of the 407ETR matched observed utilization data, again by vehicle class. In the model, the toll assessed for each link in the network is converted into an equivalent travel time, using the VoT parameters and this time is added to the estimated travel time for that link. The route choice process compares the augmented travel time for tolled links against the travel time for untolled links in assigning trips to the available routes.

The calibrated VoT values are shown in Table 2-2. The current calibration represents a pseudo (modelled) 'revealed preference' approach as the values are calibrated against observed behaviour. It has been typically found, as reported in the literature based on observations from actual tolled facilities, that drivers tend to pay more than expected for time actually saved, possibly because their decision is biased by frustration with congestion, or because they over-estimate the time savings they are likely to achieve.

TABLE 2-2: *VOT PARAMETERS*

$2016	SOV	HOV2	HOV3+	Light truck	Medium (SU) truck	Heavy (MU) truck
VoT values from current calibration	$36/h	$42/h	$47/h	$60/h	$69/h	$104/h

3. Bypass utilization and revenue

3.1. Scenarios considered

Table 3-1 summarizes the scenarios that were evaluated for this assignment. Baseline untolled and tolled scenarios, the latter using the current toll rates for Highways 407 East, 412, and 418 as summarized in Table 2-1 were identified for 2031 and 2041. For 2031, scenarios with augmented toll rates, 25%, 40%, 50%, 60%, and 75% higher than the baseline rates, were evaluated to assist in the identification of a maximum-revenue scenario and to assist in the assessment of the sensitivity of utilization and revenue to toll rates. A pre-evaluation had indicated that the point of maximum revenue lay somewhere between a 50% and 60% increase in toll rate relative to the baseline rates. For 2041, scenarios with augmented toll rates 25% and 50% higher than the baseline rates were evaluated. Two additional 2041 scenarios, using the 2031 cross-section for the Bypass, were evaluated to characterize the 'step' in the annual utilization and revenue trends resulting from the widening of the Bypass from 4 to 8 lanes.

TABLE 3-1: *SCENARIOS EVALUATED - AM PEAK HOUR*

Planning horizon	Toll rates	Notes
2031	Untolled	Baseline untolled scenario
2031	Baseline toll rates (consistent with current rates for Highways 407 East, 412, 418)	Baseline tolled scenario
2031	Baseline toll rates + 25%	Sensitivity scenario
2031	Baseline toll rates + 40%	Sensitivity scenario
2031	Baseline toll rates + 50%	Sensitivity scenario
2031	Baseline toll rates + 60%	Sensitivity scenario
2031	Baseline toll rates + 75%	Sensitivity scenario
2031	Baseline toll rates - single and multi-unit trucks at same rate as autos	Sensitivity scenario
2031	Baseline toll rates + 25% - single and multi-unit trucks at same rate as autos	Sensitivity scenario
2041	Untolled	Baseline untolled scenario
2041	Baseline toll rates (consistent with current rates for Highways 407 East, 412, 418)	Baseline tolled scenario
2041	Baseline toll rates + 25%	Sensitivity scenario
2041	Baseline toll rates + 50%	Sensitivity scenario
2041	Untolled	With 2031 Bypass cross-section - to assist in development of business case models
2041	Baseline toll rates	With 2031 Bypass cross-section - to assist in development of business case models

3.2. Expansion of utilization and revenue to annual levels

Since the travel demand forecasts cover only the morning peak hour and it is necessary to evaluate travel distance and time, benefits/disbenefits, and revenue at the annual level for business case development, it is necessary to develop an expansion process. The need for revenue expansion suggests that the expansion process be vehicle class-specific and be day-of-week/time-of-day-specific to be consistent with toll rate stratification.

Appendix E contains a detailed discussion of the expansion process developed for this evaluation. Due to variability in the supporting data and in the possible assumptions, four options for expansion have been developed, as listed below, which would lead to different estimates of VKT, VHT, and revenue. We have designated the most conservative of these, Option A, producing the lowest VKT, VHT, and revenue estimates, as the baseline. Most of the discussion in this report focuses on these ‘baseline’ results although selected sensitivity results will be presented for the other three options.

- Option A (Baseline/conservative) - calculated AM peak hour to average weekday expansion based on 407ETR data and average weekday to annual expansion using MTO’s typical 300 factor. This option produces the most conservative (lowest) estimates of VKT, VHT, and revenue for the Bypass.
- Option B - calculated AM peak hour to average weekday expansion and calculated average weekday to annual expansion based on 407ETR data. This option produces VKT and VHT estimates that are 11-14% higher than the baseline and revenue estimates that are 5-8% higher than the baseline.
- Option C - calculated AM peak hour to average weekday expansion based on a combination of Highway 407 East, Highway 400, Highway 404 and YR31 (Davis Drive) data and average weekday to annual expansion using MTO’s typical 300 factor. This option produces VKT and VHT estimates that are 19-20% higher than the baseline and revenue estimates that are 16-17% higher than the baseline.
- Option D - calculated AM peak hour to average weekday expansion based on a combination of Highway 407 East, Highway 400, Highway 404 and YR31 (Davis Drive) data and calculated average weekday to annual expansion based on 407ETR data. This option produces VKT and VHT estimates that are 45-48% higher than the baseline and revenue estimates that are 32-35% higher than the baseline.

For reference purposes, Figure 3-1 shows the relative utilization levels associated with the four different expansion options, while Figure 3-2 shows the relative revenue levels. Utilization and revenue are shown for opening day in 2031 and for various toll rate levels relative to the baseline toll rates as discussed in Section 2.2.

Unless noted otherwise, all results documented in this report utilize the more conservative Option A (Baseline) expansion process.

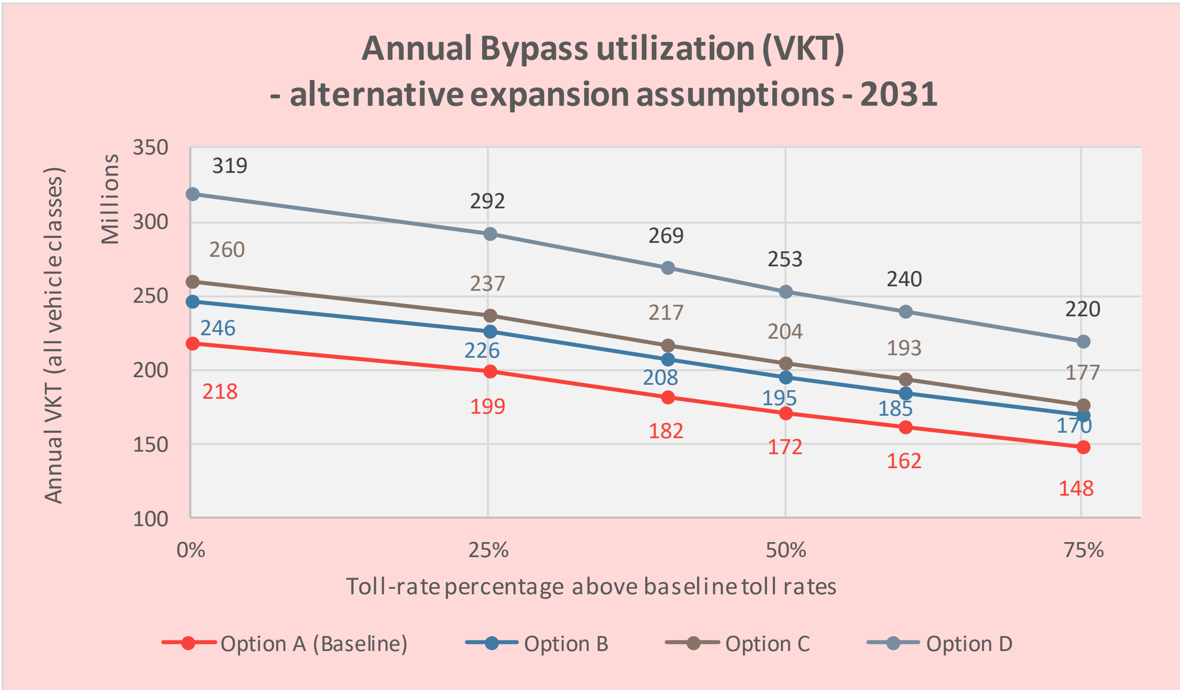

FIGURE 3-1: *VARIATION IN ANNUAL BYPASS UTILIZATION RESULTING FROM ALTERNATIVE EXPANSION ASSUMPTIONS - 2031*

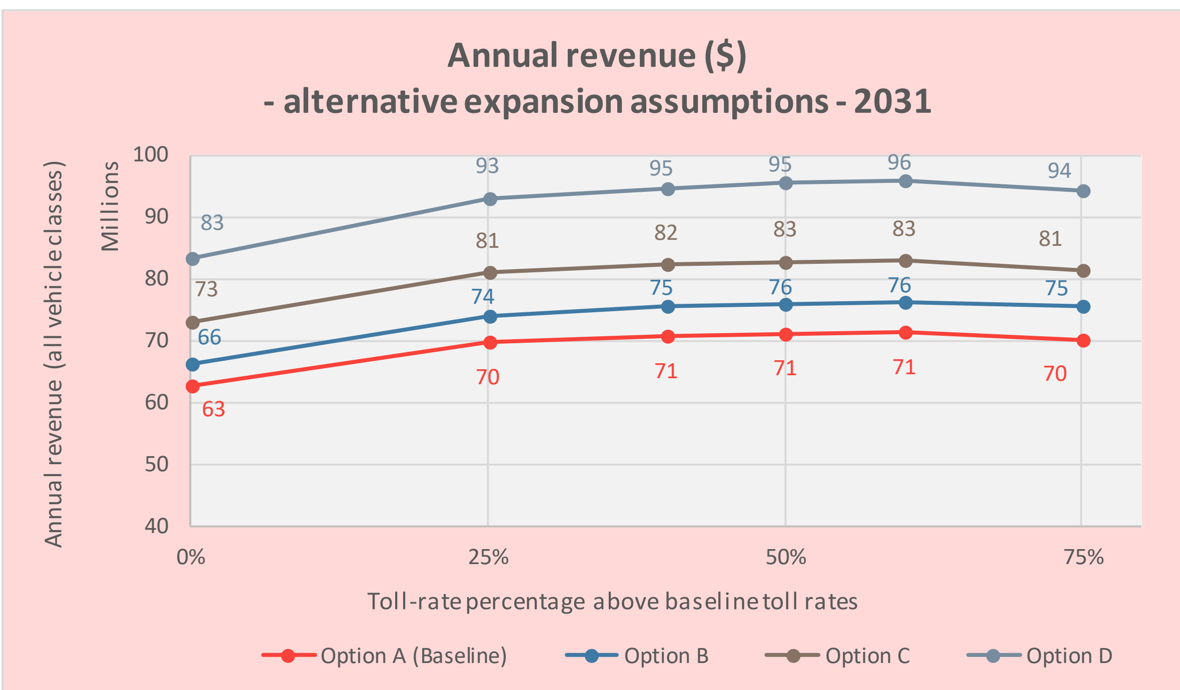

FIGURE 3-2: *VARIATION IN ANNUAL REVENUE RESULTING FROM ALTERNATIVE EXPANSION ASSUMPTIONS - 2031*

3.3. Utilization of the Bypass

The MTO's GGHMv4 travel demand model was used to evaluate utilization along the Bradford Corridor as well as to assess the impacts of tolling the corridor on the network. Figure 3-3 through Figure 3-6 summarize the traffic volumes during the AM peak hour for the untolled and baseline tolled scenarios for 2031 and 2041.

During the AM peak hour, the eastbound direction is typically the peak direction. The section between, Yonge Street and Leslie Street carry the highest volumes. As expected, when tolls are applied to the corridor, there is diversion from the corridor to alternate routes, traffic volumes on the Bypass decrease and travel speeds will tend to increase. Appendix A includes traffic volume schematics for additional scenarios.

Table 3-2 provides 2031 and 2041 VKT results by vehicle class and tolling scenario for the AM peak hour, average weekday, and annual level for the Bradford Bypass corridor. Table 3-3 provides VHT results in the same format.

The VKT estimates used for revenue estimation differ somewhat from those shown here. Tolls apply to each section of the Bypass from the centre-line of one interchanging road to the next, rather than from the on-ramp merge to the off-ramp diverge, and the VKT estimates used for revenue estimation reflect this adjustment. Traffic entering the highway would not reach the mainline until the on-ramp merge and would leave the mainline at the off-ramp entry, resulting in lower actual VKT levels.

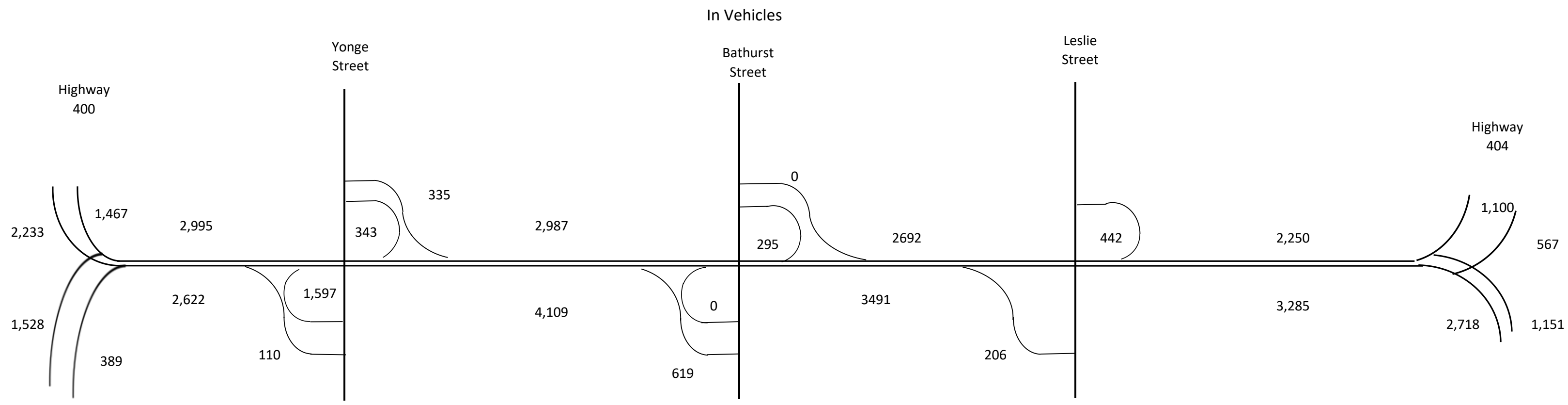

FIGURE 3-3: *AM PEAK HOUR TRAFFIC VOLUMES - 2031 - UNTOLLED SCENARIO*

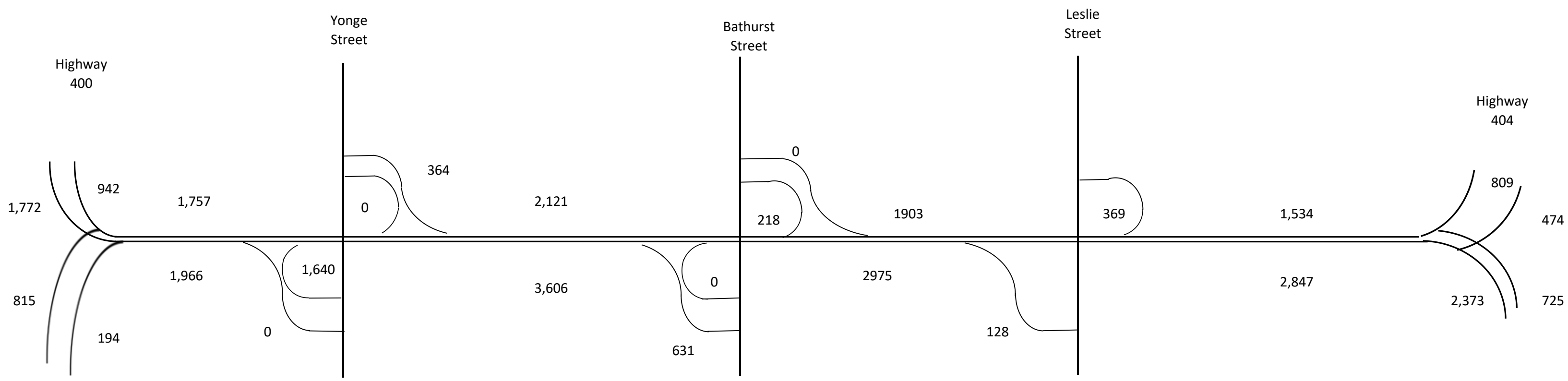

FIGURE 3-4: *AM PEAK HOUR TRAFFIC VOLUMES - 2031 - BASELINE TOLLED SCENARIO*

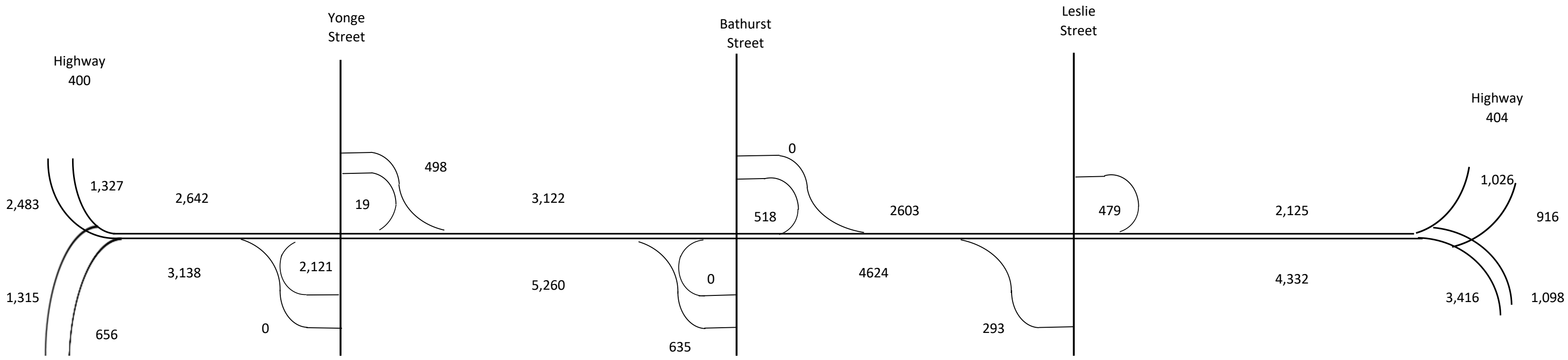

FIGURE 3-5: *AM PEAK HOUR TRAFFIC VOLUMES - 2041 - UNTOLLED SCENARIO*

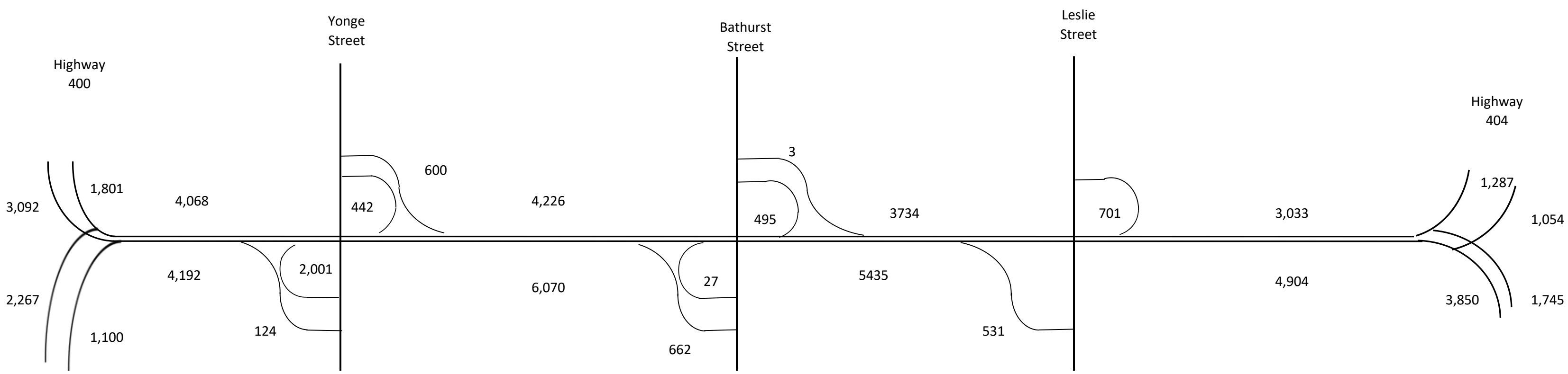

FIGURE 3-6: *AM PEAK HOUR TRAFFIC VOLUMES - 2041 - BASELINE TOLLED SCENARIO*

TABLE 3-2: *AM PEAK HOUR, WEEKDAY, ANNUAL VKT ON THE BYPASS BY VEHICLE CLASS - 2031 AND 2041*

Toll rate scenarios	AM peak hour			Average weekday			Annual (millions)		
	Auto/ light truck	Single-unit (medium) truck	Multi-unit (heavy) truck	Auto/ light truck	Single-unit (medium) truck	Multi-unit (heavy) truck	Auto/ light truck	Single-unit (medium) truck	Multi-unit (heavy) truck
2031 Untolled	86,420 (91.8%)	3,910 (4.2%)	3,820 (4.1%)	832,490	51,530	44,840	249.7	15.5	13.5
2031 Tolled - baseline	66,680 (93.6%)	2,280 (3.2%)	2,270 (3.2%)	642,310	30,130	26,670	192.7	9.0	8.0
2031 Tolled - baseline +25%	62,030 (95.1%)	1,930 (3.0%)	1,280 (2.0%)	597,510	25,510	15,040	179.3	7.7	4.5
2031 Tolled - baseline +50%	54,410 (96.2%)	1,100 (2.0%)	1,040 (1.8%)	524,140	14,530	12,160	157.2	4.4	3.6
2041 Untolled	128,620 (93.0%)	4,450 (3.2%)	5,190 (3.8%)	1,238,900	58,720	60,870	371.7	17.6	18.3
2041 Tolled - baseline	100,580 (94.4%)	2,850 (2.7%)	3,090 (2.9%)	968,800	37,590	36,250	290.6	11.3	10.9
2041 Tolled - baseline +25%	94,610 (94.6%)	2,590 (2.6%)	2,790 (2.8%)	911,290	34,210	32,770	273.4	10.3	9.8
2041 Tolled - baseline +50%	88,520 (95.0%)	2,200 (2.4%)	2,420 (2.6%)	852,650	29,030	28,340	255.8	8.7	8.5

TABLE 3-3: *AM PEAK HOUR, WEEKDAY, ANNUAL VHT ON THE BYPASS BY VEHICLE CLASS - 2031 AND 2041*

Toll rate scenarios	AM peak hour			Average weekday			Annual (millions)		
	Auto/ light truck	Single-unit (medium) truck	Multi-unit (heavy) truck	Auto/ light truck	Single-unit (medium) truck	Multi-unit (heavy) truck	Auto/ light truck	Single-unit (medium) truck	Multi-unit (heavy) truck
2031 Untolled	1,320	56	55	12,720	740	640	3.8	0.2	0.2
2031 Tolled - baseline	790	26	25	7,610	340	300	2.3	0.1	0.1
2031 Tolled - baseline +25%	710	21	15	6,800	280	170	2.0	0.1	0.1
2031 Tolled - baseline +50%	600	12	11	5,780	160	140	1.7	0.0	0.0
2041 Untolled	1,570	53	62	15,110	700	730	4.5	0.2	0.2
2041 Tolled - baseline	1,110	31	33	10,650	410	390	3.2	0.1	0.1
2041 Tolled - baseline +25%	1,020	28	30	9,830	360	350	3.0	0.1	0.1
2041 Tolled - baseline +50%	940	23	25	9,050	310	300	2.7	0.1	0.1

Additional summaries and network wide statistics of VKT and VHT, for the full GGHM are summarized in Appendix B.

Table 3-4 summarizes network-wide VKT and VHT for different tolling scenarios vs. the untolled scenario. Although the differences resulting from tolling are understandably small, since they affect only a relatively small part of the total GGHM network, they are nonetheless interesting since they suggest that tolling the

Bypass results in an overall decrease in VKT and an increase in VHT relative to the untolled scenario. The logical explanation is that tolling the Bypass results in some drivers with a lower VoT diverting to alternative routes that are shorter in distance but require more travel time than the route taken when they used the faster Bypass. In other words, drivers willing to pay the toll travel, on average, a longer distance in order to access the Bypass and take advantage of the time savings gained through use of the Bypass.

TABLE 3-4: *NETWORK-WIDE VKT AND VHT FOR VARIOUS TOLLING SCENARIOS - AM PEAK HOUR - 2031*

	VKT	Difference vs untolled scenario	VHT	Difference vs untolled scenario
Untolled	31,717,400	-	736,700	-
Baseline tolled	31,709,500	-7,950 (-0.025%)	737,000	+310 (+0.042%)
Baseline tolled + 25%	31,708,000	-9,470 (-0.030%)	737,200,	+520 (+0.070%)
Baseline tolled + 40%	31,706,500	-10,880 (-0.034%)	737,400	+720 (+0.097%)
Baseline tolled + 50%	31,705,800	-11,670 (-0.037%)	737,600	+860 (+0.116%)
Baseline tolled + 60%	31,704,800	-12,590 (-0.040%)	737,700	+1,000 (+0.136%)
Baseline tolled + 75%	31,704,200	-13,200 (-0.042%)	737,900	+1,220 (+0.166%)

3.4. Operational performance of the Bypass

Table 3-5 summarizes mean speeds and volume/capacity rations anticipated for the Bypass for the 2031 and 2041 AM peak hours.

For 2031 (opening day), the eastbound section of the Bypass, between Yonge and Bathurst, is expected to operate with a volume/capacity ratio greater than 1.0 during the AM peak hour under untolled conditions. However, with the implementation of tolling, the number of drivers choosing to use the Bypass will decrease and the volume/capacity ratio for this section drops below 1.0. With increases in the toll rates beyond baseline levels, this ratio drops even further. Otherwise, little in the way of congestion is expected for 2031.

Table 3-6 indicates that approximately 67% of the eastbound VKT during the AM peak hour in 2031 will experience a volume/capacity ratio greater than 0.9 for the untolled scenario, consistent with the observations above. This percentage drops to 27% if tolling is implemented and drops to zero if the toll rates are increased by 50% above baseline conditions. None of the VKT in the westbound direction is expected to experience congestion during the AM peak hour in 2031.

For 2041, with the assumed widening to 8 lanes, including HOV lanes, none of the VKT in either direction is expected to experience congestion during the AM peak hour.

TABLE 3-5: *AVERAGE SPEED AND VOLUME/CAPACITY RATIO ON THE BYPASS BY DIRECTION - AM PEAK HOUR - 2031, 2041*

		Untolled		Tolled							
				Baseline		Baseline + 25%		Baseline + 50%		Baseline + 75%	
		Mean speed (km/h)	Volume/capacity ratio	Mean speed (km/h)	Volume/capacity ratio	Mean speed (km/h)	Volume/capacity ratio	Mean speed (km/h)	Volume/capacity ratio	Mean speed (km/h)	Volume/capacity ratio
2031[1]											
Highway 404 - Leslie	WB	100	0.64	100	0.43	100	0.35	100	0.26	100	0.18
Leslie - Bathurst	WB	85	0.75	98	0.53	99	0.44	100	0.33	100	0.23
Bathurst - Yonge	WB	75	0.83	96	0.58	98	0.52	99	0.43	100	0.36
Yonge - Highway 400	WB	76	0.83	99	0.48	100	0.40	100	0.29	100	0.19
Highway 400 - Yonge	EB	88	0.71	98	0.53	99	0.47	100	0.42	100	0.37
Yonge - Bathurst	EB	37	1.09	59	0.94	64	0.91	71	0.86	77	0.82
Bathurst - Leslie	EB	60	0.93	82	0.77	87	0.73	91	0.68	95	0.62
Leslie - Highway 404	EB	93	0.88	97	0.74	98	0.71	99	0.66	99	0.60
2041[1]											
Highway 404 - Leslie	WB	99	0.44	100	0.31	100	0.28	100	0.24	-	-
Leslie - Bathurst	WB	95	0.54	99	0.37	99	0.34	100	0.30	-	-
Bathurst - Yonge	WB	90	0.61	97	0.44	98	0.40	99	0.37	-	-
Yonge - Highway 400	WB	93	0.58	99	0.37	99	0.33	100	0.29	-	-
Highway 400 - Yonge	EB	94	0.58	99	0.43	99	0.41	100	0.38	-	-
Yonge - Bathurst	EB	56	0.83	74	0.71	78	0.69	82	0.66	-	-
Bathurst - Leslie	EB	77	0.75	90	0.63	93	0.60	95	0.57	-	-
Leslie - Highway 404	EB	73	0.68	83	0.59	86	0.57	88	0.54	-	-

Notes:

1. *The cross-section of the Bypass is assumed to include two general-purpose lanes in each direction for 2031 and three general-purpose lanes plus an HOV lane in each direction for 2041.*
2. *The mean speeds shown are for the general-purpose lanes only - the HOV lanes would be expected to be operating under free-flow conditions (100 km/h) for the 2031 and 2041 scenarios*

TABLE 3-6: *PERCENTAGE OF TRAVEL (VKT) UNDER CONGESTED CONDITIONS (VOLUME/CAPACITY RATIO > 0.90)*

	Untolled	Tolled			
		Baseline	Baseline + 25%	Baseline + 50%	Baseline + 75%
2031[1]					
WB	0%	0%	0%	0%	0%
EB	67%	27%	27%	0%	0%
2041[1]					
WB	0%	0%	0%	0%	0%
EB	0%	0%	0%	0%	0%

Notes:

1. *The cross-section of the Bypass is assumed to include two general-purpose lanes in each direction for 2031 and three general-purpose lanes plus an HOV lane in each direction for 2041.*

3.5. Changes in travel patterns resulting from tolling the Bypass - screenline analysis

Screenlines were established to capture likely changes in travel patterns that might result from tolling the Bypass. These screenlines are described in Table 3-7: Screenline description

TABLE 3-7: *SCREENLINE DESCRIPTION*

North-south screenline east of Highway 400	
• Innisfil Beach Road	• Line 5
• 5th Line	• Canal road
• Highway 89	• Highway 9/YR31/Davis Drive
• Bradford Bypass	• Highway 407
• Highway 88	• Highway 401
North-south screenline west of Highway 404	
• Jon Dales Road	• Mount Albert Road
• Ravenshoe Road	• Green Lane
• Bradford Bypass	• Davis Drive
• Queensville Sideroad	• Highway 407
• Doane Road	• Highway 401
• Farr Avenue	
East-west screenline north of the Bradford Bypass	
• 5th Sideroad	• 2nd Concession
• Highway 400	• Leslie Street
• 10th Sideroad	• Highway 404
• Yonge Street	• Woodbine Avenue
• Bathurst Street	
East-west screenline south of the Bradford Bypass	
• 5th Sideroad	• 2nd Concession
• Highway 400	• Leslie Street
• 10th Sideroad	• Highway 404
• Yonge Street	• Woodbine Avenue
• Bathurst Street	
Note: Centroid connectors were also included in the screenlines where these might reflect movement on local roads	

Figure 3-7 through Figure 3-10 summarize the results of the screenline analysis for the key north-south screenlines east of Highway 400 and west of Highway 404. More complete information is included in Appendix C.

Interestingly, the facilities included in the north-south screenlines east of Highway 400 and West of Highway 404 captured only between 30 and 60% of the trips that would divert from the Bypass during the AM peak hour under baseline toll rate conditions. The remainder are captured under ‘other’ in these figures. This implies that the remainder may have used alternative routes beyond the screenlines. The resulting increases in traffic on roads captured by the screenline east of Highway 400 were logically focused on the major parallel roads, such as Highway 88, Highway 89, and YR31/Davis Drive with the maximum increase on any single road being 358 vehicles during the AM peak hour on Highway 88 in the eastbound direction. West of Highway 404, the diverted traffic was much more dispersed with no single road gaining more than 128 veh/h. Also, interestingly, very few trips used Highway 407 or Highway 401 as an alternative route; routes that would could have been attractive to longer-distance trips transiting between Highway 400 or Highway 404 and Highway 401 east or west of the GTA.

In the case of the facilities captured by the east-west screenlines, tolling the Bypass understandably led to reductions on roads interchanging with the Bypass but the increases on other north-south roads were well dispersed.

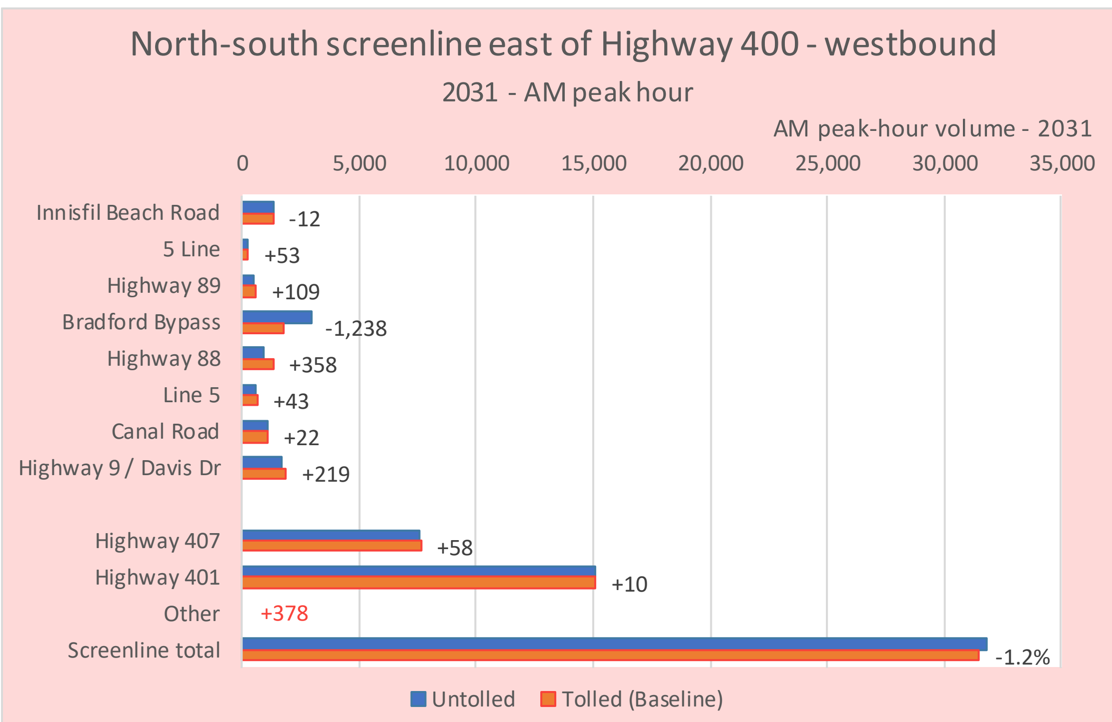

FIGURE 3-7: *TOLLING IMPLICATIONS FOR ALTERNATIVE ROUTES - HIGHWAY 400 SCREENLINE - WESTBOUND - 2031 - AM PEAK HOUR*

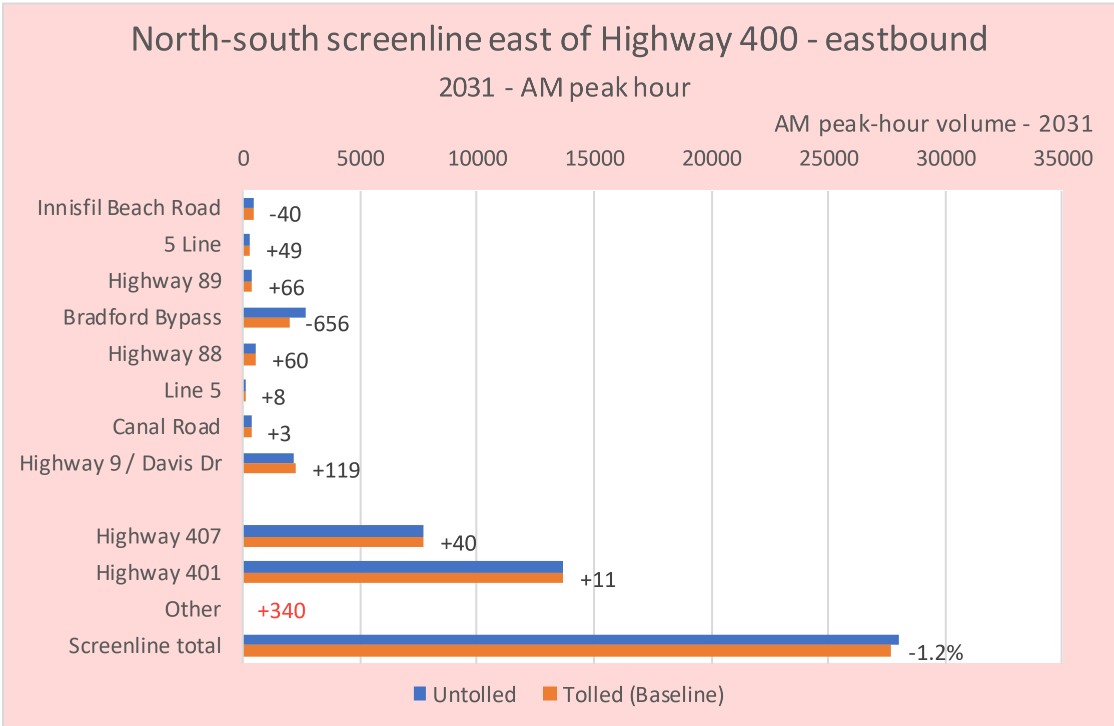

FIGURE 3-8: *TOLLING IMPLICATIONS FOR ALTERNATIVE ROUTES - HIGHWAY 400 SCREENLINE - EASTBOUND - 2031 - AM PEAK HOUR*

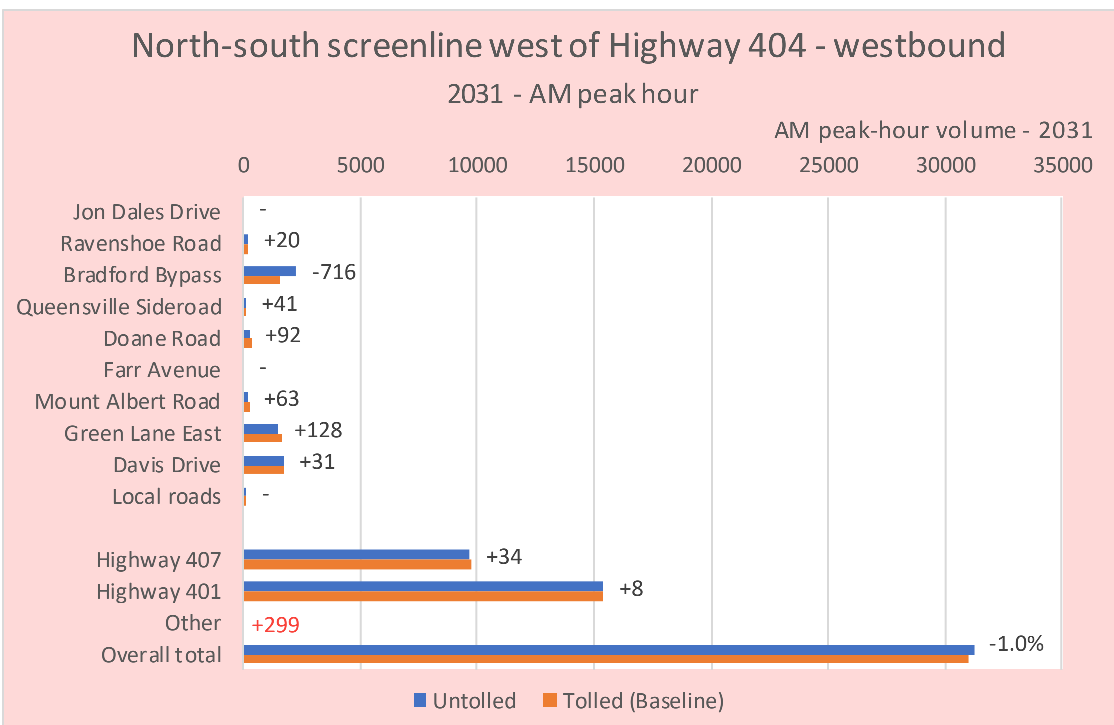

FIGURE 3-9: *TOLLING IMPLICATIONS FOR ALTERNATIVE ROUTES - HIGHWAY 404 SCREENLINE - WESTBOUND - 2031 - AM PEAK HOUR*

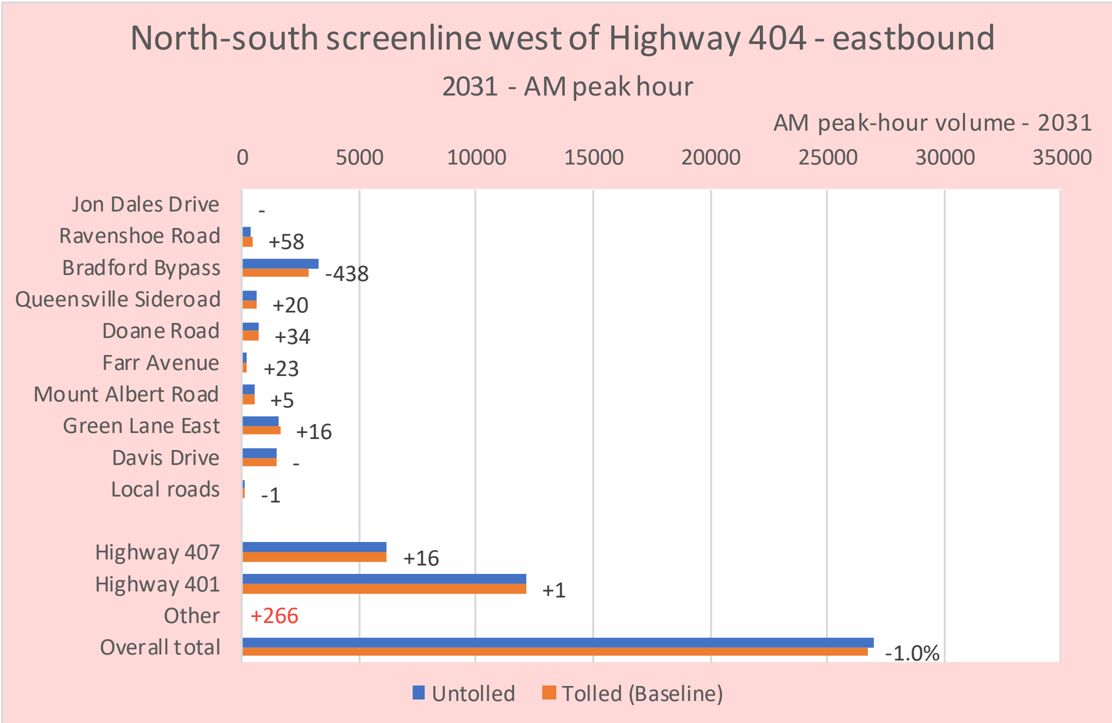

FIGURE 3-10: *TOLLING IMPLICATIONS FOR ALTERNATIVE ROUTES - HIGHWAY 400 SCREENLINE - WESTBOUND - 2031 - AM PEAK HOUR*

3.6. Incidence of travel impacts associated with tolling

Table 3-8 summarizes the changes in travel distance and travel time associated with various tolling scenarios vs. the untolled case.

For the 2031 planning horizon, the network wide VKT value decreases by 0.03% to 0.04% when comparing the non-tolled scenario to the tolled scenarios. The VHT values on the other hand increases by 0.04% to 0.17% when comparing the non-tolled scenario to the tolled scenarios. These results indicate that drivers were travelling longer distances to use the Bradford Corridor under the non-tolled scenario but as tolls are applied these drivers move away from the corridor and now experience shorter distances but longer travel times. When specifically reviewing Simcoe County, the VKT value decreases by 0.39% to 0.77% when comparing the non-tolled scenario to the tolled scenarios and the VHT value also decrease by 0.11% to 0.25% when comparing the non-tolled scenario to the tolled scenarios. These results indicate the drivers were traveling longer distances to use the Bradford Corridor for the non-tolled scenario and were not experiencing travel time benefits. For York Region, the VKT values decrease by 0.14% to 0.19% and the percent change in the VHT values range from -0.03% to +0.38% when comparing the non-tolled scenario to the tolled scenarios. These results indicate that drivers were travelling longer distances to use the Bradford Corridor but under certain scenarios there was little travel time benefits while other scenarios saw significant benefits. For the 2041 planning horizon, the network wide VKT value decreases by 0.06% to 0.08% and the VHT values on the other hand increases by 0.12% to 0.20% when comparing the non-tolled scenario to the tolled scenarios. The same results were observed when comparing these values for Simcoe County and York Region. These results echo those observed for the 2031 planning horizon where drivers were travelling longer distances to use the Bradford Corridor under the non-tolled scenario but as tolls are applied these drivers move away from the corridor and now experience longer travel times.

TABLE 3-8: *CHANGES IN VKT AND VHT IN SIMCOE COUNTY AND YORK REGION ASSOCIATED WITH TOLLING THE BYPASS*

		Untolled	Tolled					
			Baseline	Baseline + 25%	Baseline + 50%	Baseline + 75%	Baseline - all vehicles at auto/light truck rate	Baseline + 25% - all vehicles at auto/light truck rate
2031								
Network	VKT	31,717,400	31,709,500	31,708,000	31,705,800	31,704,200	31,709,400	31,708,000
			-0.03%	-0.03%	-0.04%	-0.04%	-0.03%	-0.03%
	VHT	736,700	737,000	737,200	737,600	737,900	737,000	737,200
			0.04%	0.07%	0.12%	0.17%	0.04%	0.06%
Simcoe	VKT	2,063,100	2,055,000	2,053,100	2,049,300	2,047,100	2,055,100	2,052,700
			-0.39%	-0.48%	-0.66%	-0.77%	-0.39%	-0.50%
	VHT	32,600	32,500	32,500	32,500	32,500	32,500	32,500
			-0.25%	-0.19%	-0.20%	-0.11%	-0.24%	-0.21%
York	VKT	4,261,600	4,255,500	4,254,300	4,253,800	4,253,500	4,255,300	4,254,900
			-0.14%	-0.17%	-0.18%	-0.19%	-0.15%	-0.16%
	VHT	107,100	107,100	107,200	107,300	107,500	107,100	107,200
			-0.02%	0.06%	0.22%	0.38%	-0.03%	0.04%
2041								
Network	VKT	36,074,300	36,053,200	36,049,500	36,045,200	-	-	-
			-0.06%	-0.07%	-0.08%	-	-	-
	VHT	952,400	953,500	953,900	954,300	-	-	-
			0.12%	0.16%	0.20%	-	-	-
Simcoe	VKT	2,352,900	2,352,300	2,349,300	2,345,600	-	-	-
			-0.02%	-0.15%	-0.31%	-	-	-
	VHT	40,000	40,100	40,100	40,100	-	-	-
			0.45%	0.43%	0.44%	-	-	-
York	VKT	4,750,300	4,737,200	4,735,000	4,733,700	-	-	-
			-0.28%	-0.32%	-0.35%	-	-	-
	VHT	138,300	138,500	138,700	138,900	-	-	-
			0.19%	0.30%	0.44%	-	-	-

3.7. Revenue

Table 3-9 summarizes the anticipated AM peak hour, average daily, and annual revenue for 2031 (opening day) and 2041 for all tolling scenarios evaluated and includes sensitivity to the alternative expansion assumptions (Options A through D from Section 3.2).

Revenue estimated in conjunction with the baseline toll rates shows increases of approximately 48% from $62.7M in 2031 to $92.5M in 2041. Higher Bypass utilization expected in 2041, as a result of growth in demand and an increase in the capacity of the Bypass through widening, further increases revenue estimates relative to 2031 by approximately 55% and 68% with toll-rate increases of 25% and 50%, respectively, above the baseline toll rates.

A more complete discussion of the revenue trends and the factors involved is presented in Section 3.8, in conjunction with graphical displays that illustrate these trends more clearly. However, Table 3-9 presents a comprehensive summary of all revenue estimates for reference purposes. In addition, revenue estimates, broken down by vehicle class, are found in Appendix D.

TABLE 3-9: *AM PEAK HOUR, AVERAGE WEEKDAY AND ANNUAL REVENUE ESTIMATES FOR VARIOUS TOLLING SCENARIOS, INCLUDING SENSITIVITY TO EXPANSION ASSUMPTIONS*

Expansion option (see Section 3.2)	Toll rate scenario	2031 (opening day) - $2016			2041 - $2016		
		Average weekday (thousands)	Weekly (millions)	Annual (millions)	Average weekday (thousands)	Weekly (millions)	Annual (millions)
Option A (Baseline)	Baseline	209.1	Not available - MTO 300 factor goes straight from average weekday to annual.	62.733	308.3	Not available - MTO 300 factor goes straight from average weekday to annual.	92.498
	Baseline + 25%	232.1		69.640	360.4		108.125
	Baseline + 40%	235.3		70.582	-		-
	Baseline + 50%	236.9		71.077	399.5		119.836
	Baseline + 60%	237.4		71.210	-		-
	Baseline + 75%	233.2		69.974	-		-
	Baseline - All vehicles tolled at auto/light truck rate	188.5		56.539	-		-
	Baseline + 25% - All vehicles tolled at auto/light truck rate	212.9		63.877	-		-
Option B	Baseline	209.1	1.291	66.143	308.3	1.911	97.946
	Baseline + 25%	232.1	1.444	74.000	360.4	2.236	114.610
	Baseline + 40%	235.3	1.471	75.415	-	-	-
	Baseline + 50%	236.9	1.482	75.979	399.5	2.484	127.315
	Baseline + 60%	237.4	1.487	76.273	-	-	-
	Baseline + 75%	233.2	1.469	75.356	-	-	-
	Baseline - All vehicles tolled at auto/light truck rate	188.5	1.173	60.144	-	-	-
	Baseline + 25% - All vehicles tolled at auto/light truck rate	212.9	1.321	67.706	-	-	-
Option C	Baseline	243.5	Not available - MTO 300 factor goes straight from average weekday to annual	73.060	359.3	Not available - MTO 300 factor goes straight from average weekday to annual.	107.775
	Baseline + 25%	269.7		80.901	419.9		125.974
	Baseline + 40%	273.8		82.141	-		-
	Baseline + 50%	275.8		82.731	465.4		139618
	Baseline + 60%	276.0		82.815	-		-
	Baseline + 75%	270.8		81.227	-		-
	Baseline - All vehicles tolled at auto/light truck rate	219.0		65.702	-		-
	Baseline + 25% - All vehicles tolled at auto/light truck rate	247.4		74.226	-		-

Table 3-9 is continued on the following page.

Table 3-9 (continued)

Expansion option (see Section 3.2)	Toll rate scenario	2031 (opening day) - $2016			2041 - $2016		
		Average weekday (thousands)	Weekly (millions)	Annual (millions)	Average weekday (thousands)	Weekly (millions)	Annual (millions)
Option D	Baseline	243.5	1.618	83.313	359.3	2.393	123.268
	Baseline + 25%	269.7	1.804	92.958	419.9	2.799	144.202
	Baseline + 40%	273.8	1.836	94.674	-	-	-
	Baseline + 50%	275.8	1.850	95.377	465.4	3.107	160.102
	Baseline + 60%	276.0	1.855	95.672	-	-	-
	Baseline + 75%	270.8	1.829	94.343	-	-	-
	Baseline - All vehicles tolled at auto/light truck rate	219.0	1.466	75.541	-	-	-
	Baseline + 25% - All vehicles tolled at auto/light truck rate	247.4	1.652	85.109	-	-	-

3.8. Revenue, utilization and toll rates - elasticity/sensitivity

One of the outcomes desired from this evaluation was an assessment of the sensitivity of Bypass utilization and revenue to toll rates, in effect, a form of elasticity. A series of runs were undertaken under 2031 (opening day) conditions with toll rates at differing percentages above the baseline toll rates (25, 40, 50, 60, 75%) to investigate sensitivity.

The following sections provide information on the sensitivity of utilization and revenue to toll rate levels and the tradeoff between utilization and revenue. However, no conclusion is drawn with respect to the 'best' toll rate level and/or structure. Any decision on toll rates would have to consider MTO's policy objectives and criteria.

3.8.1. Utilization vs. toll rate

Figure 3-11 illustrates the sensitivity of Bypass utilization to toll rate for 2031 (opening day) and 2041 conditions. As expected, the highest utilization would occur for the untolled case. Introducing tolling using the baseline tolls (as discussed in Section 2.2) reduces utilization by 25%, to 218 million VKT in 2031 and by 23.5% to 325 million VKT in 2041.

Table 3-10 summarizes the percentage reduction in utilization (relative to utilization at baseline toll rates) in relation to the percentage increase in toll rates (relative to baseline toll rates).

The relationship is monotonic but is not strictly linear, although in the range between a 25% increase and a 75% increase in toll rates relative to the baseline rate, it appears that for every 1% increase in toll rate, the utilization drops by an average of 0.56% in 2031. The incremental drops in utilization average 0.27% per 1% increase in toll rate for 2041 up to a 50% increase.

3.8.2. Revenue vs. toll rate

Figure 3-12 illustrates the sensitivity of revenue to toll rate for 2031 (opening day) conditions. As toll rate increases, the revenue/VKT also increases, although the VKT tends to decrease. When these influences are combined, the revenue rises to a maximum value of approximately $71.2M at a toll rate approximately 60% above the baseline rates, as shown on Figure 3-12, and declines thereafter.

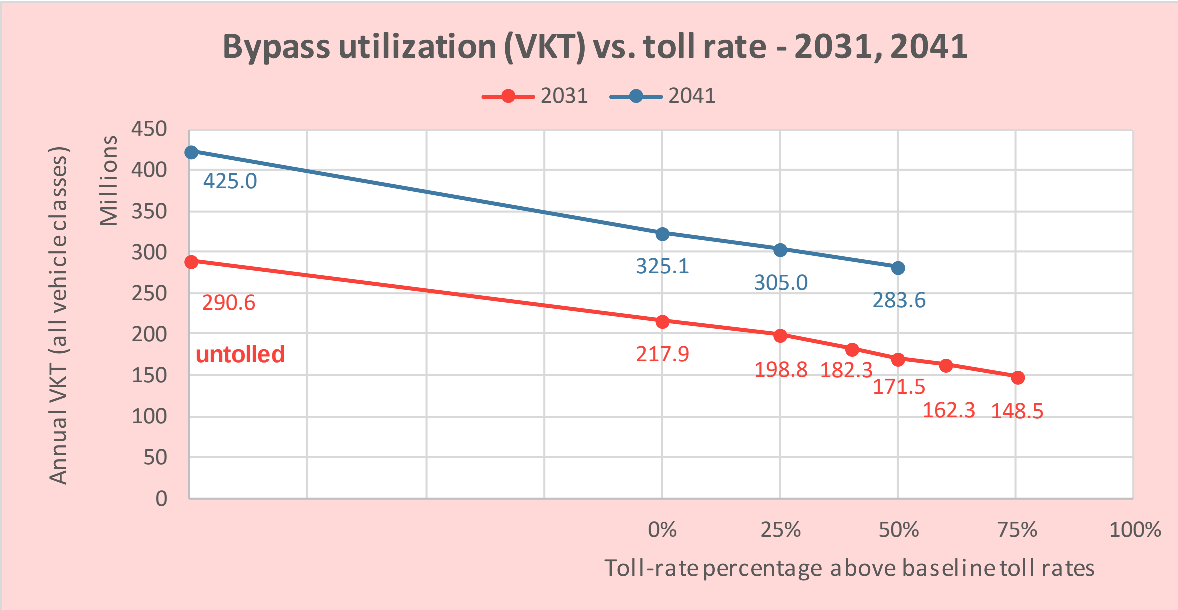

FIGURE 3-11: *SENSITIVITY OF BYPASS UTILIZATION TO TOLL RATE - 2031 - ANNUAL TOTALS - ALL VEHICLE CLASSES*

TABLE 3-10: *SENSITIVITY OF BYPASS UTILIZATION TO TOLL RATE - 2031, 2041 - ANNUAL TOTALS - ALL VEHICLE CLASSES*

Change in toll rate relative to baseline toll rates	Cumulative change in utilization (VKT) relative to utilization at baseline toll rates		Incremental change in utilization produced by 1% increase in toll rate	
	2031	2041	2031	2041
0%	-	-	-	-
25%	-8.7%	-6.2%	-0.35%	-0.25%
40%	-16.5%	-	-0.55%	-
50%	-21.1%	-12.8%	-0.59%	-0.28%
60%	-25.7%	-	-0.54%	-
75%	-32.1%	-	-0.57%	-

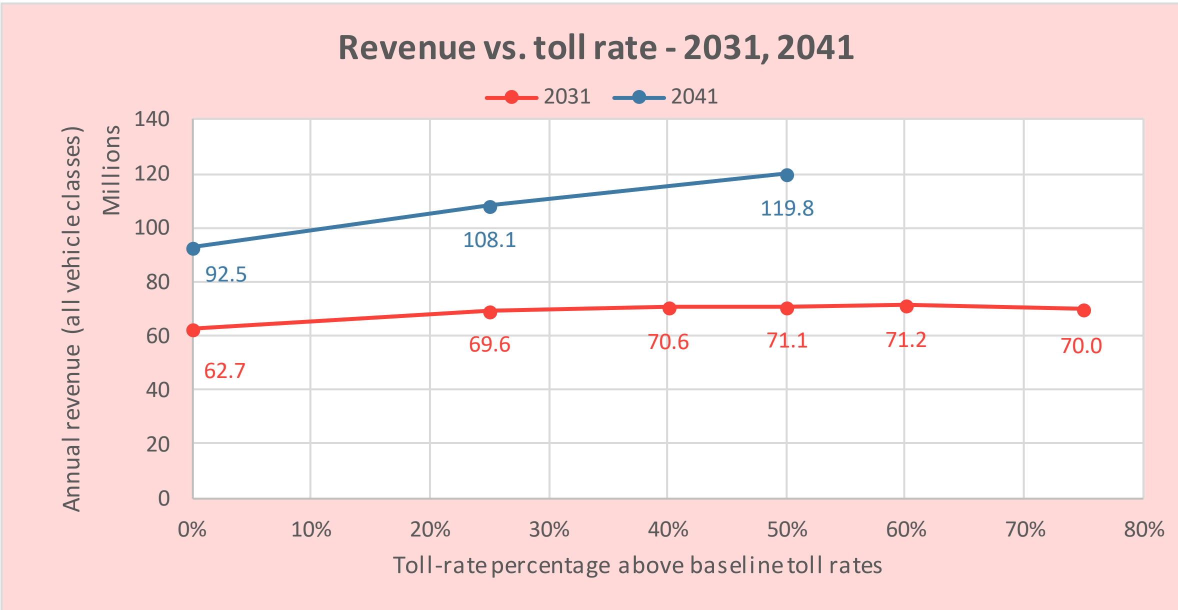

FIGURE 3-12: *SENSITIVITY OF REVENUE TO TOLL RATE - 2031, 2041 - ANNUAL TOTALS - ALL VEHICLE CLASSES*

3.8.3. Revenue vs. utilization

The final combination is that of revenue with utilization, as shown on Figure 3-13. This graph represents essentially a combination of the previous two graphs, noting that both revenue and utilization are a function of the toll rates. As before, the maximum revenue is approximately $71.2M and this coincides with a utilization (VKT) of approximately 162M in 2031. It is difficult to identify a maximum revenue point for 2041 as the graph does not 'peak' within the range of toll rates and utilization evaluated.

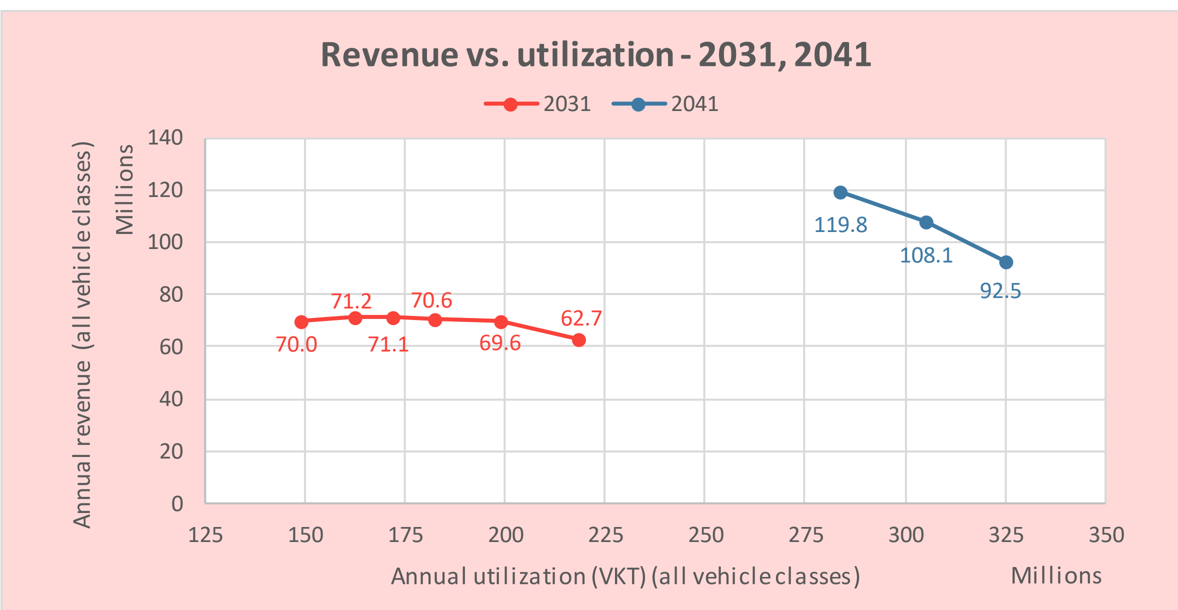

FIGURE 3-13: *SENSITIVITY OF REVENUE TO UTILIZATION - 2031 - ANNUAL TOTALS - ALL VEHICLE CLASSES*

3.8.4. Toll rate structure sensitivity

Two additional scenarios were evaluated that eliminated the higher tolling rates for single-unit (medium) trucks and multi-unit (heavy) trucks under 2031 (opening day) conditions. Instead of tolling single-unit (medium) trucks and multi-unit (heavy) trucks at rates approximately 100% higher and 200% higher, respectively, than autos/light trucks, all vehicles were tolled at the rate for autos/light trucks. The first of these scenarios used the baseline toll rates and the second used the baseline toll rate + 25%. Table 3-11 summarizes the results for these scenarios.

In both cases, eliminating the toll surcharge on trucks results in a change in VKT of less than 1% and a decrease in revenue of approximately 8-10%. However, as might be expected, there is a noticeable change in the distribution of VKT and revenue among the different vehicle classes. There is a significant increase (more than 60%) in the utilization of the Bypass by the single and multi-unit truck classes as a result of the reduced toll rates for these classes. This is offset by a decrease in utilization by the auto/light truck class. Although the net numerical difference in VKT over all vehicle classes is small, the percentage changes for the smaller truck classes are significant. The revenue associated with the single and multi-unit truck classes decreases by 18-44% under the baseline toll rate levels, not surprising since the higher toll rates for these classes have been eliminated. However, this effect is offset somewhat by the higher utilization for these classes. Under the baseline toll rate levels +25%, the changes in revenue are somewhat more muted.

TABLE 3-11: *UTILIZATION AND REVENUE FOR SCENARIOS ELIMINATING TOLL RATE SURCHARGES FOR SINGLE AND MULTI-UNIT TRUCKS - 2031*

		Baseline toll rate levels		Baseline toll rate levels + 25%	
2031		Utilization (VKT millions)	Revenue ($ millions)	Utilization (VKT millions)	Revenue ($ millions)
Toll structure with toll stratification by vehicle class	Auto/light trucks	200.2	51.8	186.0	60.2
	Single-unit (medium) trucks	9.4	4.8	8.0	5.1
	Multi-unit (heavy) trucks	8.3	6.2	4.7	4.4
	All vehicles	217.9	62.7	198.8	69.6
Toll structure with same toll rates for all vehicle classes	Auto/light trucks	189.9 (-5.1%)	49.1 (-5.2%)	168.3 (-9.5%)	54.4 (-9.6%)
	Single-unit (medium) trucks	15.3 (+62.8%)	3.9 (-18.8%)	15.5 (+93.8%)	4.9 (-3.9%)
	Multi-unit (heavy) trucks	14.2 (+71.1%)	3.5 (-43.6%)	14.6 (+210.6%)	4.6 (+4.6%)
	All vehicles	219.4 (+0.7%)	56.5 (-9.9%)	198.4 (-0.2%)	63.9 (-8.2%)

4. Business case evaluation

4.1. Overview and business case scenarios

The following section presents the results of the financial and economic business case evaluations associated with the tolling of the Bypass. Three scenarios are considered in the business cases:

1. Tolling with the baseline toll rates (as used for Highway 407 East, Highway 412, and Highway 418) vs. the untolled case
2. Tolling with rates 25% higher than the baseline toll rates vs. the untolled case
3. Tolling with rates 50% higher than the baseline toll rates vs. the untolled case.

As noted previously, the business case evaluation documented in this report does not include a case for construction of the Bypass vs. the status quo. However, an evaluation of the payback period associated with the use of the revenue generated to payback the construction costs is included. It is noted that the range of business case scenarios developed does not include the maximum revenue scenario, which appears to occur, for 2031 (opening day), at toll rates approximately 60% higher than the baseline toll rates.

The business case evaluation is predicated on the baseline (conservative) expansion of revenue, distance travelled (VKT) and travel time (VHT) to annual levels.

4.2. Cost estimation

4.2.1. Capital cost of tolling infrastructure

The capital costs of this project are associated with the construction of tolling stations, installation of a communication system, procurement of power and central systems, for a total of nearly 23.4 million in constant 2020 dollars without using a discount rate. Table 4-1 breakdowns the cost by year and by item. The capital budget will be spent 10 % in 2028, 30 % in 2029 and 60% in 2030.

TABLE 4-1: *SCHEDULE OF CAPITAL COSTS (IN 2020 DOLLARS), 2028-2030*

Cost Item	2028	2029	2030	Total (2028-2030)
Tolling Stations	1,389,843	4,169,529	8,339,057	**13,898,429**
Communications	350,000	1,050,000	2,100,000	**3,500,000**
Power	40,000	120,000	240,000	**400,000**
Central Systems (s/w & h/w)	600,000	1,800,000	3,600,000	**6,000,000**
Total (All Items)	**2,379,843**	**7,139,529**	**14,279,057**	**23,798,429**

Sources: MTO, WSP

4.2.2. Operating costs associated with tolling

Operating the tolling infrastructure and equipment will incur some annual fixed costs (maintenance of the central system and operation of the back office support), a variable transaction cost which depends on the bypass utilization, and some recurring capital costs which occur every 5 years or 10 years depending on the equipment to be replaced. Figure 4-1 shows the breakdown of the annual operating and maintenance costs by type.

Transaction costs represent costs per toll transaction, including those associated with transaction data collection and transaction processing, billing and payment processing, customer support, and overhead (e.g. administration, facilities, utilities). The majority of the transaction processing is expected to be automatic, but there will be some percentage that will require more expensive Automatic License Plate Recognition (ALPR) and manual review. Customer support includes staffing of call centres and physical locations, as well as providing websites and mobile applications. Based on similar deployments, transaction costs are estimated to be 10% of toll revenue. The jump in the transaction costs from M$8 in 2041 to $10M in 2042 reflects a higher utilization level resulting from widening the bypass.

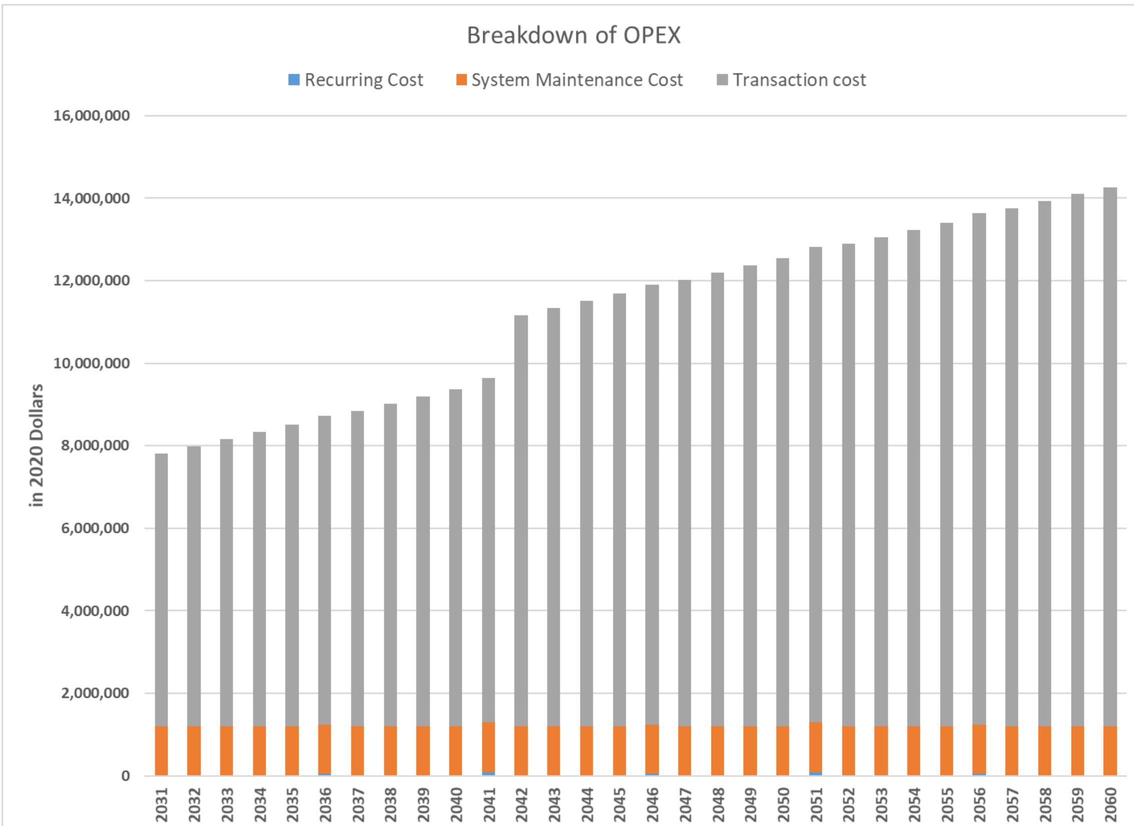

FIGURE 4-1: *ANNUAL BREAKDOWN OF TOLLING INFRASTRUCTURE OPERATING COSTS*

Source: WSP

4.3. The economic business case

The economic business case carries a Benefit-Cost Analysis (BCA) to determine the socioeconomic feasibility and relative merits of tolling the Bradford Bypass, a proposed 16.2-kilometre long freeway connecting Highway 400 and Highway 404 in the Regional Municipality of York and County of Simcoe. A BCA is an evaluation framework to assess the economic advantages (benefits) and disadvantages (costs) of an investment alternative. Benefits and costs are broadly defined and are quantified in monetary terms to the extent possible. The overall goal of a BCA is to assess whether the expected benefits of a project justify the costs from a provincial perspective. A BCA framework attempts to capture the net welfare change created by a project, including increases in welfare (benefits) as well as net cost increases where costs can be identified (e.g., project capital costs), and welfare reductions where some groups are expected to be made worse off as an outcome of the proposed project.

4.3.1. Model and Assumptions

Model

The BCA model involves defining a untolled scenario, which is compared to the tolled scenario Under the Untolled scenario, the Bradford Bypass will not be tolled. Under the tolled scenario, the Bypass will be tolled. The BCA assesses the incremental difference between the untolled scenario and the tolled scenario, which represents the net change in welfare. BCAs are forward-looking exercises which seek to assess the incremental change in welfare over a project lifecycle. The importance of future welfare changes is determined through discounting, which is meant to reflect both the opportunity cost of capital as well as the societal preference for the present.

General Assumptions

The analysis was conducted in accordance with the MTO. This includes the following analytical assumptions:

- All construction and operation costs related to the Bypass infrastructure itself are not included in economic business case. That means only construction and operation related to the tolling system were taken into consideration;
- The construction of the tolling infrastructure starts in 2028 and ends in 2030 in order to accommodate the operation of the bypass in 2031;
- All benefits/disbenefits are assumed to be fully realized in 2031 when the bypass is open for the public;
- The useful life of the tolling infrastructure is supposed to be 30 years, meaning that at the end of 2060, there will be no residual value left;
- The net change in benefits/disbenefits and costs will be calculated for 3 years of construction of the tolling system (2028-2030) and 30 years of operation (2031-2060);
- Whenever possible, using MTO recommended monetized values for travel time costs, reduced fatalities, injuries, property damage, reduced vehicle operating costs, and emissions, while relying on best practices for monetization of other benefits;
- Presenting dollar values in real 2020 dollars. In instances where cost estimates and benefits valuations are expressed in historical or future dollar years, using an appropriate inflation factor to adjust the values;
- Discounting future benefits and costs with a real discount rate of 3.5%.

Specific Assumptions

For easy reference, Table 4-2 summarizes the specific assumptions used in the economic case model.

TABLE 4-2: SUMMARY OF SPECIFIC ASSUMPTIONS

Variable	Unit	Value	Source
1) Travel Time Inputs			
Vehicle occupancy rate - light vehicle	pers/veh	1.22	Assumption
Vehicle occupancy rate - medium or heavy truck	pers/veh	1.00	Assumption
Value of time - light vehicle	$2020/hour	16.58	MTO
Value of time - medium or heavy truck	$2020/hour	84.74	MTO
2) Vehicle Operating Cost (VOC) Inputs			
VOC per km - light vehicle	$2020/veh-km	0.249	MTO
VOC per km - medium or heavy truck	$2020/veh-km	0.860	MTO
3) GHG Emission Inputs*			
Fuel efficiency factor - light vehicle	km/L	12.35	US EIA
Fuel efficiency factor - medium or heavy truck	km/L	3.46	US EIA
CO2 emission factor - light vehicle	grams/litre	2,307	Environment Canada
CO2 emission factor - medium truck	grams/litre	2,681	Environment Canada
CO2 emission factor - heavy truck	grams/litre	2,681	Environment Canada
CH4 emission factor - light vehicle	grams/litre	0.140	Environment Canada
CH4 emission factor - medium truck	grams/litre	0.068	Environment Canada
CH4 emission factor - heavy truck	grams/litre	0.110	Environment Canada
N2O emission factor - light vehicle	grams/litre	0.022	Environment Canada
N2O emission factor - medium truck	grams/litre	0.220	Environment Canada
N2O emission factor - heavy truck	grams/litre	0.151	Environment Canada
CO2 emission cost per metric tonne	2020$/metric ton	60	Environment Canada
CH4 emission cost per metric tonne	2020$/metric ton	1,914	Environment Canada
N2O emission cost per metric tonne	2020$/metric ton	22,174	Environment Canada
4) Air Pollution Inputs**			
NOX pollution factor - light vehicle	grams/km	0.027	US EIA
NOX pollution factor - medium truck	grams/km	0.151	US EIA
NOX pollution factor - heavy truck	grams/km	0.233	US EIA
PM2.5 pollution factor - light vehicle	grams/km	0.000	US EIA
PM2.5 pollution factor - medium truck	grams/km	0.004	US EIA
PM2.5 pollution factor - heavy truck	grams/km	0.009	US EIA
SOX pollution factor - light vehicle	grams/km	0.001	US EIA
SOX pollution factor - medium truck	grams/km	0.006	US EIA
SOX pollution factor - heavy truck	grams/km	0.005	US EIA
CO2 emission cost per metric tonne	$2020/metric ton	7,219	Metrolinx
CH4 emission cost per metric tonne	$2020/metric ton	35,362	Metrolinx
N2O emission cost per metric tonne	$2020/metric ton	7,923	Metrolinx

Table 4-2 is continued on the following page.

Table 4-2 (continued)

Variable	Unit	Value	Source
5) Collision Cost Inputs			
Average collision rate - Expressway	collisions/million VKT	0.453	WSP
Average collision rate - Non-Expressway	collisions/million VKT	0.635	WSP
Share of collisions - fatal	%	0.03%	MTO
Share of collisions - injuries	%	17.8%	MTO
Share of collisions - property damage only (PDO)	%	82.2%	MTO
Unit collision cost- fatal	2020$/collision	17,046,597	MTO
Unit collision cost- injuries	2020$/collision	234,871	MTO
Unit collision cost- PDO	2020$/collision	12,940	MTO
*Notes: * & ** for each type of vehicle, the reported GHG emission factor and the air contaminant pollution factor were estimated when the average speed is 66 km/h. As speed changes, those factors change accordingly.*			

4.3.2. Business case data and method

4.3.2.1. Forecast of Travel Demand, Travel Time, and Speed

A traffic forecasting was conducted by WSP for the Bradford Bypass and the rest of the Greater Toronto Area road network for both untolled and tolled scenario. Table 4-3 presents the forecasted annual vehicle-kilometers travelled (VKT) and vehicle-hours travelled (VHT) for 2031 with a four-lane bypass and 2041 with an eight-lane bypass. It was expected that tolling the highway will decrease VKT and VHT on the Bypass, while increase them on the rest of the network. The effects on VKT and VHT in percentage terms are significant on the Bypass, but not significant on the rest of the network. The net effects on the overall network are to decrease VKT, while increase VHT. The explanation for this result is when the highway is not tolled, road users prefer to take the bypass for travel time savings purpose even though they would have to travel on longer distances. When the highway is tolled, some road users will naturally find alternates with shorter distances. However, travelling on alternative routes would increase travel time due to lower speed.

TABLE 4-3: *FORECAST TRAVEL DEMAND, TRAVEL TIME AND SPEED, 2031 & 2041 FOR BASELINE TOLL RATE SCENARIO*

Scenario	Unit	Untolled	Tolled	Difference	
				Value	%
I. 2031					
1) Bradford Corridor					
VKT	Million VKT	279	210	-68.9	-24.7%
VHT	Million VHT	4.2	2.5	-1.8	-41.5%
Speed	km/h	66	85	19	28.7%
2) Rest of the network					
VKT	Million VKT	93,396	93,441	44.8	0.05%
VHT	Million VHT	2,166	2,169	2.7	0.12%
Speed	km/h	43	43	0	-0.08%
3) Total of the network					
VKT	Million VKT	93,675	93,651	-24.1	-0.03%
VHT	Million VHT	2,171	2,172	0.9	0.04%
Speed	km/h	43	43	0	-0.07%
II. 2041					
1) Bradford Corridor					
VKT	Million VKT	411	318	-92.4	-22.5%
VHT	Million VHT	5.2	3.6	-1.6	-30.2%
Speed	km/h	79	88	9	11.0%
2) Rest of the network					
VKT	Million VKT	107,828	107,858	29.7	0.03%
VHT	Million VHT	2,890	2,895	4.8	0.17%
Speed	km/h	37	37	0	-0.14%
3) Total of the network					
VKT	Million VKT	108,239	108,176	-62.7	-0.06%
VHT	Million VHT	2,895	2,898	3.3	0.11%
Speed	km/h	37	37	0	-0.17%

Since the forecast was done for only two years (2031 and 2041), one needs to expand the forecast for the entire analysis period from 2031 to 2060. Traditionally, interpolation between two data points is a common method used to derive individual year forecast from 2031 to 2041. Beyond 2041 with a jump in travel demand on the widening bypass however, no data point is available to apply the same interpolation method. We will assume that the trend (slope) between 2041 and 2060 will be the same as that between 2031 and 2041. The resulting forecast for the entire 2031-2061 period is presented in Figure 4-2, Figure 4-3 and Figure 4-4.

The following subsections use the data presented in these three figures to estimate the benefits and disbenefits of tolling the bypass. Changes in VHT will be used to estimate travel time costs; changes in VKT will be used to estimated vehicle operating costs and collision costs; and changes in VKT combined with changes in speed will be used to estimate environmental costs.

FIGURE 4-2: *TRAVEL DISTANCE BY SCENARIO: BRADFORD CORRIDOR VS. REST OF NETWORK*

Source: WSP

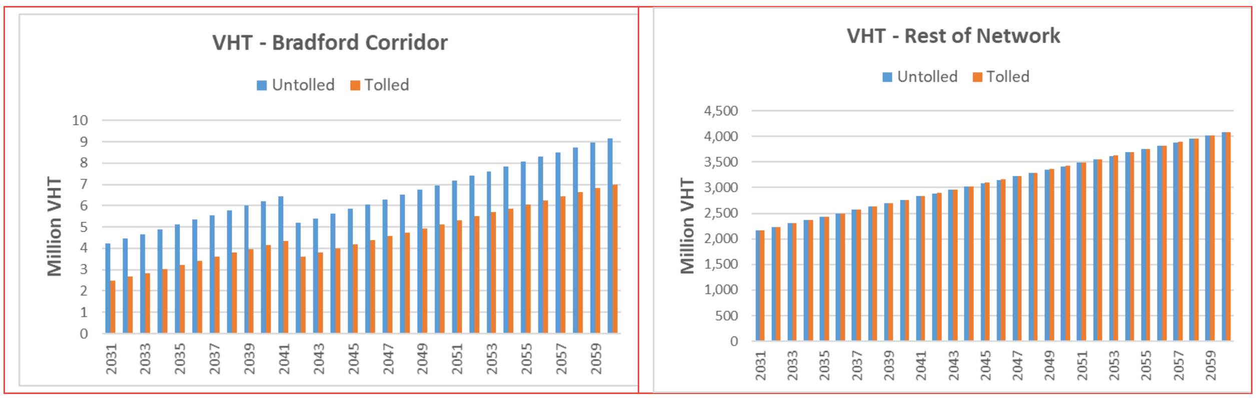

FIGURE 4-3: *TRAVEL TIME BY SCENARIO: BRADFORD CORRIDOR VS. REST OF NETWORK*

Source: WSP

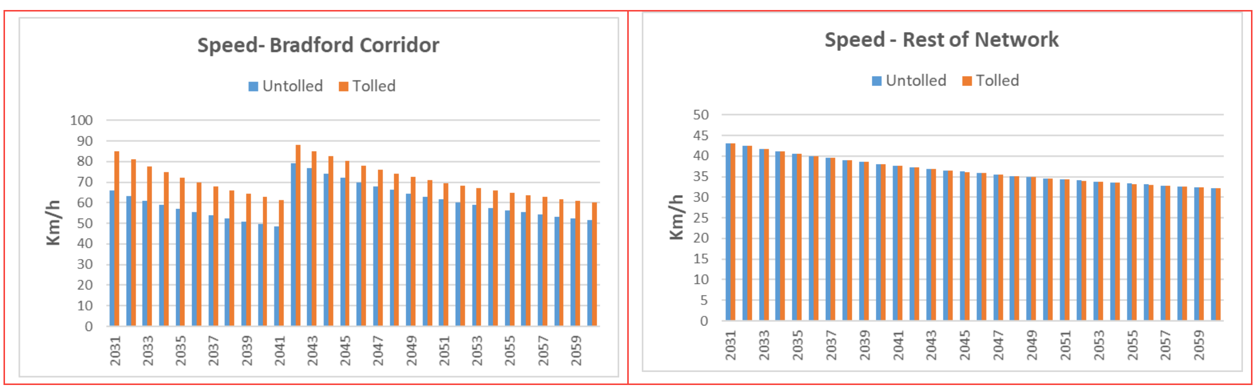

FIGURE 4-4: *SPEED BY SCENARIO: BRADFORD CORRIDOR VS. REST OF NETWORK*

Source: WSP

4.3.2.2. Travel Time Benefits/Disbenefits

As shown in Table 4-2, tolling will decrease VHT on the Bypass, but increase overall VHT on the entire road network. *Table 4-4* shows the steps to calculate the travel time disbenefit of tolling the highway. As of 2031, travel time will increase by 0.9 million VHT for all types of vehicle combined. If 1.22 is the occupancy rate for light vehicles, and 1 is for medium and heavy trucks, the total persons-hours travelled (PHT) was estimated to be more than 1.11 million person-hours by 2031. By applying the value of time for each type of vehicle, the disbenefit was monetarized to be 29.3 million dollars in undiscounted value as of 2031.

Table 4-4: *Travel Time Benefit/Disbenefit Data and Method, Undiscounted Dollar 2020*

Variable	Type of Vehicle	Unit	Value at Project Opening Year (2031)			Source
			Untolled	**Tolled**	**Difference**	
A (VHT)	Light Vehicle (LV)	Million VHT	1,987	1,988	0.77	WSP
	Medium Truck (MT)	Million VHT	98.7	98.8	0.08	WSP
	Heavy Truck (HT)	Million VHT	84.9	85.0	0.08	WSP
B (Vehicle occupancy rate)	Light Vehicle (LV)	pers/veh	1.22	1.22	0.00	Assumption
	Medium Truck (MT)	pers/veh	1.00	1.00	0.00	Assumption
	Heavy Truck (HT)	pers/veh	1.00	1.00	0.00	Assumption
C=A*B (Persons-hours travelled))	Light Vehicle (LV)	Million PHT	2424	2425	0.94	Calculation
	Medium Truck (MT)	Million PHT	98.7	98.8	0.08	Calculation
	Heavy Truck (HT)	Million PHT	84.9	85.0	0.08	Calculation
D (Value of Time)	Light Vehicle (LV)	$2020/hour	16.6	16.6	0.00	MTO
	Medium Truck (MT)	$2020/hour	84.7	84.7	0.00	MTO
	Heavy Truck (HT)	$2020/hour	84.7	84.7	0.00	MTO
E=C*D (Travel time costs)	Light Vehicle (LV)	M$2020	40,195	40,210	15.7	Calculation
	Medium Truck (MT)	M$2020	8,362	8,369	7.03	Calculation
	Heavy Truck (HT)	M$2020	7,197	7,203	6.63	Calculation
	Total	**M$2020**	**55,754**	**55,783**	**29.3**	**Calculation**
Note: For benefit/disbenefit estimation over the 2031-2060 period, the variables A, C and E vary over time, while B and D do not.						

4.3.2.3. Vehicle Operating Benefits/Disbenefits

Here the vehicle operating costs include both fixed and variable costs. Fixed costs include insurance and taxes which do not depend on distance travelled, while variables costs do (fuel, depreciation, regular maintenance, tires, etc.) . Tolling the highway will decrease the overall VKT which will decrease vehicle operating costs for road users. Table 4-5 presents the data and method used to calculate a benefit of $9.1 million as of 2031. Operating costs per kilometer were given by MTO, notably $0.249/km for a light duty vehicle (auto and light truck) and $0.86/km for a medium or heavy truck.

TABLE 4-5: *VEHICLE OPERATING BENEFIT/DISBENEFIT DATA AND METHOD, UNDISCOUNTED DOLLAR 2020*

Variable	Category	Unit	Value at Project Opening Year (2031)			Source
			Untolled	Tolled	Difference	
A (VKT)	Light Vehicle (LV)	Million VKT	84,771	84,752	-19.0	WSP
	Medium Truck (MT)	Million VKT	4,670	4,668	-2.4	WSP
	Heavy Truck (HT)	Million VKT	4,235	4,232	-2.7	WSP
B (Vehicle operating cost per km)	Light Vehicle (LV)	$2020/km	0.249	0.249	0	MTO
	Medium Truck (MT)	$2020/km	0.860	0.860	0	MTO
	Heavy Truck (HT)	$2020/km	0.860	0.860	0	MTO
C=A*B (Vehicle operating cost)	Light Vehicle (LV)	M$2020	21,108	21,103	-4.7	Calculation
	Medium Truck (MT)	M$2020	4,016	4,014	-2.1	Calculation
	Heavy Truck (HT)	M$2020	3,642	3,639	-2.3	Calculation
	Total	M$2020	28,766	28,757	-9.1	Calculation
Note: For benefit/disbenefit estimation over the 2031-2060 period, the variables A and C vary over time, while B does not.						

4.3.2.4. Road Safety Benefits/Disbenefits

Collision frequency is directly related to the distance travelled (VKT) and to the class of road and other environmental factors. In the case of the Bypass, prior expectations were that tolling would result in a reduction in travel on the Bypass itself and an offsetting increase in travel on alternative, largely non-expressway, routes. Since, historically, expressways tend to exhibit a lower frequency of collisions than non-expressway facilities, one would expect tolling to result in an increase in collision costs.

The approach to the evaluation of collision costs was driven by two factors:

- The Bypass does not currently exist so that historic collision data is not available;
- The high-level nature of the evaluation was not amenable to detailed collision analysis using SafetyAnalyst or similar methods and the proposed approach involved the use of collision rates;
- Collision data from jurisdictions other than MTO was not available due to the nature and schedule of the current assignment.

In this case, the proposed methodology involved the development of collision rates for expressways and non-expressway facilities that were presumed comparable to the Bypass and alternative routes to the Bypass and the application of these rates, in conjunction with modelled travel VKT, to estimate the change in the number of collisions. Standard MTO severity distributions and collision cost data would then be applied to estimate the change in collision costs associated with tolling the Bypass. Separate collision cost estimates were prepared using (a) the calculated expansion of VKT from AM peak hour to annual levels and (b) using a combination of MTO's standard expansion factor from average weekday to annual levels

(300) and calculated factors for AM peak hour to average weekday. Separate estimates were also prepared for the three business case scenarios (baseline toll rates, baseline toll rates + 25% and baseline toll rates + 50%).

Collision data was provided by MTO for 2015 through 2019. For this evaluation, two expressway sections were selected for the estimation of an expressway collision rate:

- Highway 400 between YR 11 and SR 21/Innisfil Beach Road (42 km)
- Highway 404 between YR40/Bloomington Rad and SR77/Queensville Road (19 km)

Three non-expressway sections were selected for the estimation of a non-expressway collision rate:

- Highway 9 between Highway 50 and Highway 400 (22 km);
- Highway 89 between SR50 and Highway 400 (15 km);
- Highway 48 between YR40/Bloomington Road and YR18/Sibbald Point Road (36 km).

Collision rates for these sections were assessed over the 5-year period 2015-2019 and weighted (by distance) average rates were calculated, yielding a collision rate of **0.453 collisions/MVKM** for expressways and **0.635 collisions/MVKM** for non-expressways. These rates are somewhat lower than typical Ontario-wide rates, but the sections evaluated are relatively rural in nature and are not generally subject to high levels of congestion.

The collision rates calculated above were then applied to the differences in VKT between the various scenarios. A standard MTO severity distribution was used and societal costs per collision by severity level based on recent MTO work were applied to yield the collision costs summarized in Table 4-6 for the baseline toll rate scenario. According to the MTO estimate over the entire GTA road network, most collisions are related to Property Damage Only (PDO). Fatal collisions account for about 0.03% of the total only, while injuries account for about 17.8%. collisions. The $199,762 reduction in collision costs results from a combination of a net reduction in VKT travelled due to tolling, partially offset by an increase in the proportion of travel on non-expressway facilities with a higher collision rate.

TABLE 4-6: *ROAD SAFETY BENEFIT/DISBENEFIT DATA AND METHOD, UNDISCOUNTED DOLLAR 2020*

Variable	Category	Unit	Value at Project Opening Year (2031)			Source
			Untolled	Tolled	Difference	
1) Expressway						
A1 (VKT)	All vehicle types	Million VKT	31,252	31,187	-65.1	WSP
B1 (Average collision rate)	All collision types	collisions/million VKT	0.453	0.453	0.0	WSP
C1=A1*B1 (Collision number)	All collision types	Collisions	14,157	14,128	-29.5	Calculation
2) Non-expressway						
A2 (VKT)	All vehicle types	Million VKT	62,423	62,464	41.0	WSP
B2 (Average collision rate)	All collision types	collisions/million VKT	0.635	0.635	0.0	WSP
C2=A2*B2 (Collision number)	All collision types	Collisions	39,638	39,664	26.0	Calculation
3) Entire network combined						
C=C1+C2 (Collision number)	All collision types	Collisions	53,796	53,792	-3.5	Calculation
D (Share of collisions by type)	Fatal	%	0.03%	0.03%	0.0	MTO
	Injuries	%	17.8%	17.8%	0.0	MTO
	PDO	%	82.2%	82.2%	0.0	MTO
E=C*D (Number of collisions by type)	Fatal	Collisions	16	16	-0.001	Calculation
	Injuries	Collisions	9,576	9,575	-0.618	Calculation
	PDO	Collisions	44,204	44,201	-2.852	Calculation
F (Collision cost per type)	Fatal	$2020/collision	17,046,597	17,046,597	0.0	MTO
	Injuries	$2020/collision	234,871	234,871	0.0	MTO
	PDO	$2020/collision	12,940	12,940	0.0	MTO
G=E*F(Total collision cost)	Fatal	$2020	275,110,225	275,092,475	-17,750	Calculation
	Injuries	$2020	2,249,040,012	2,248,894,905	-145,107	Calculation
	PDO	$2020	571,999,101	571,962,196	-36,905	Calculation
	Total	**$2020**	**3,096,149,337**	**3,095,949,575**	**-199,762**	**Calculation**

Note: For benefit/disbenefit estimation over the 2031-2060 period, the variables B1, B2 and D do not vary over time. All remaining variables vary.

4.3.2.5. *Environmental Benefits/Disbenefits*

Greenhouse gas (GHG) emissions

GHG emission benefits were calculated based on vehicle fuel consumption savings. To estimate the volume of fuel consumed, the key data here is the fuel efficiency factor per type of vehicle. According to the US Energy Information Agency, one litre of fuel consumed allows a light vehicle to run for 12.35km, while a truck can only run for about 3.46km. Tolling the highway will increase vehicle efficiency for Bradford corridor users due to higher speed. This combined with the corridor lower VKT results in a lower fuel consumption. Although tolling the highway will increase VKT for the rest of the road network, there is no effect on overall speed. Therefore, the decrease in fuel consumption over the Bradford corridor outweighs the increase in fuel consumption over the rest of the network. The net effect tolling is a decrease in fuel consumption over the entire network by one million litres of gas and 1.3 million litres of diesel by 2031 (Table 4-7).

Given the estimated fuel consumption, three forms of GHG emissions were assessed for every litre of fuel consumed: CO2, CH4 and N2O. According to Environment Canada[1], a litre of fuel burned by light vehicles produces 2.3 kg of CO2, 0.14 kg of CH4 and 0.022 kg of N2O. Medium and heavy truck release generally higher emission rates which are shown in **Error! Reference source not found.**. Environment Canada also provides the cost per ton of GHG emissions in dollar 2012 which were then inflated to 2020 dollar. Tolling the highway reduces fuel consumption and therefore GHG emission costs, estimated to be $367,525 as of 2031.

[1] Environment Canada, 2021. Canada's Official Greenhouse Gas Inventory - Emission Factors. Link: https://data.ec.gc.ca/data/substances/monitor/canada-s-official-greenhouse-gas-inventory/Emission_Factors.pdf

TABLE 4-7: *GHG EMISSION BENEFIT/DISBENEFIT DATA AND METHOD, UNDISCOUNTED DOLLAR 2020*

Variable	Category	Unit	Value at Project Opening Year (2031)			
			Untolled	Tolled	Difference	
1) Bradford Corridor						
A1 (VKT)	Light Vehicle (LV)	Million VKT	250	193	-57.1	WSP
	Medium Truck (MT)	Million VKT	15	9	-6.4	WSP
	Heavy Truck (HT)	Million VKT	13	8	-5.5	WSP
B1 (Fuel efficiency as function of speed)	Light Vehicle (LV)	km/L	12.35	12.71	0.36	US EIA
	Medium Truck (MT)	km/L	3.46	3.57	0.10	US EIA
	Heavy Truck (HT)	km/L	3.46	3.57	0.10	US EIA
C1=A1/B1 (Fuel consumption)	Light Vehicle (LV)	Million litres	20	15	-5	Calculation
	Medium Truck (MT)	Million litres	4	3	-2	Calculation
	Heavy Truck (HT)	Million litres	4	2	-2	Calculation
2) Rest of Network						
A2 (VKT)	Light Vehicle (LV)	Million VKT	84,521	84,559	38.0	WSP
	Medium Truck (MT)	Million VKT	4,655	4,659	4.0	WSP
	Heavy Truck (HT)	Million VKT	4,221	4,224	2.8	WSP
B2 (Fuel efficiency as function of speed)	Light Vehicle (LV)	km/L	9.35	9.35	0.0	US EIA
	Medium Truck (MT)	km/L	3.10	3.10	0.0	US EIA
	Heavy Truck (HT)	km/L	3.10	3.10	0.0	US EIA
C2=A2/B2 (Fuel consumption)	Light Vehicle (LV)	Million litres	9,041	9,045	4.1	Calculation
	Medium Truck (MT)	Million litres	1,500	1,502	1.3	Calculation
	Heavy Truck (HT)	Million litres	1,361	1,361	0.9	Calculation

Table 4-7 is continued on the following page.

TABLE 4-7 (CONTINUED)

Variable	Category	Unit	Value at Project Opening Year (2031)			Source
			Untolled	Tolled	Difference	
3) Entire Network						
C=C1+C2 (Fuel consumption)	Light Vehicle (LV)	Million litres	9,062	9,061	-1.0	Calculation
	Medium Truck (MT)	Million litres	1,505	1,504	-0.6	Calculation
	Heavy Truck (HT)	Million litres	1,364	1,364	-0.7	Calculation
D1 (CO2 emission factor)	Light Vehicle (LV)	grams/litre	2,307	2,307	0	Environment Canada
	Medium Truck (MT)	grams/litre	2,681	2,681	0	Environment Canada
	Heavy Truck (HT)	grams/litre	2,681	2,681	0	Environment Canada
D2 (CH4 emission factor)	Light Vehicle (LV)	grams/litre	0.140	0.140	0	Environment Canada
	Medium Truck (MT)	grams/litre	0.068	0.068	0	Environment Canada
	Heavy Truck (HT)	grams/litre	0.110	0.110	0	Environment Canada
D3 (N2O emission factor)	Light Vehicle (LV)	grams/litre	0.022	0.022	0	Environment Canada
	Medium Truck (MT)	grams/litre	0.220	0.220	0	Environment Canada
	Heavy Truck (HT)	grams/litre	0.151	0.151	0	Environment Canada
E1=C*D1 (CO2 emission)	Light Vehicle (LV)	metric tons	20,907,608	20,905,307	-2,302	Calculation
	Medium Truck (MT)	metric tons	4,033,486	4,031,768	-1,718	Calculation
	Heavy Truck (HT)	metric tons	3,657,430	3,655,426	-2,003	Calculation
	All Vehicles	**metric tons**	28,598,524	28,592,501	-6,023	**Calculation**
E2=C*D2 (CH4 emission)	Light Vehicle (LV)	metric tons	1,268.6	1,268.5	-0.14	Calculation
	Medium Truck (MT)	metric tons	102.32	102.28	-0.04	Calculation
	Heavy Truck (HT)	metric tons	150.1	150.0	-0.08	Calculation
	All Vehicles	**metric tons**	1,521.0	1,520.8	-0.3	**Calculation**
E3=C*D3 (N2O emission)	Light Vehicle (LV)	metric tons	199.35	199.33	-0.02	Calculation
	Medium Truck (MT)	metric tons	331.05	330.90	-0.14	Calculation
	Heavy Truck (HT)	metric tons	206.03	205.92	-0.11	Calculation
	All Vehicles	**metric tons**	736.43	736.16	-0.28	**Calculation**
F1 (CO2 emission unit cost)	All Vehicles	$2020/metric ton	60	60	0	Environment Canada
F2 (CH4 emission unit cost)	All Vehicles	$2020/metric ton	1,914	1,914	0	Environment Canada
F3 (N2O emission unit cost)	All Vehicles	$2020/metric ton	22,174	22,174	0	Environment Canada
G1=E1*F1/10^6 (CO2 emission cost)	All Vehicles	$2020	1,714	1,713	-0.361	Calculation
G2=E2*F2/10^6 (CH4 emission cost)	All Vehicles	$2020	3	3	-0.001	Calculation
G3=E3*F3/10^6 (N2O emission cost)	All Vehicles	$2020	16	16	-0.006	Calculation
G=G1+G2+G3	**Total**	**M$2020**	**1,733**	**1,733**	**-0.368**	**Calculation**
Note: For benefit/disbenefit estimation over the 2031-2060 period, D1, D2 and D3 are the three variables that do not vary over time. All remaining variables vary.						

Air contaminant (AC) pollutions

The method used to monetarize air contaminant pollutions and is shown in Table 4-8. Three forms of AC pollutions were assessed for every kilometer travelled: NOX, PM2.5 and SOX. Like fuel consumption efficiency factor, AC pollution factor is a function of speed. This key data, grams per VMT, is provided by the US Energy Information Agency and is converted into grams per kilometer. If tolling has an impact on speed over the Bradford Corridor, it does not have an impact on speed over the rest of the network. Therefore, the decrease in NOX and SOX pollutions over the Bradford corridor outweighs the increase in NOX and SOC pollutions over the rest of the network. Although the net effect on PM2.5 pollutions is an increase, this is however negligible. With the AC pollution unit cost estimated by Metrolinx for Ontario, the benefit of tolling the highway on AC pollutions is estimated to be $10,175 as of 2031.

TABLE 4-8: *AC POLLUTION BENEFIT/DISBENEFIT DATA AND METHOD, UNDISCOUNTED DOLLAR 2020*

Variable	Category	Unit	Value at Project Opening Year (2031)			Source
			Untolled	Tolled	Difference	
1) Bradford Corridor						
A1 (VKT)	Light Vehicle (LV)	Million VKT	250	193	-57.1	WSP
	Medium Truck (MT)	Million VKT	15	9	-6.4	WSP
	Heavy Truck (HT)	Million VKT	13	8	-5.5	WSP
B11 (NOX pollution factor as function of speed)	Light Vehicle (LV)	grams/km	0.0267	0.0269	0.0002	US EIA
	Medium Truck (MT)	grams/km	0.1514	0.1341	-0.0173	US EIA
	Heavy Truck (HT)	grams/km	0.2326	0.1914	-0.0411	US EIA
B12 (PM2.5 pollution factor as function of speed)	Light Vehicle (LV)	grams/km	0.0005	0.0004	-0.0001	US EIA
	Medium Truck (MT)	grams/km	0.0041	0.0073	0.0032	US EIA
	Heavy Truck (HT)	grams/km	0.0089	0.0134	0.0045	US EIA
B13 (SOX pollution factor as function of speed)	Light Vehicle (LV)	grams/km	0.0014	0.0015	0.0001	US EIA
	Medium Truck (MT)	grams/km	0.0057	0.0059	0.0002	US EIA
	Heavy Truck (HT)	grams/km	0.0049	0.0047	-0.0002	US EIA
C11=A1*B11 (NOX pollution)	Light Vehicle (LV)	metric tons	6.66	5.18	-1.48	Calculation
	Medium Truck (MT)	metric tons	2.34	1.21	-1.13	Calculation
	Heavy Truck (HT)	metric tons	3.13	1.53	-1.60	Calculation
	All Vehicles	**metric tons**	**12.13**	**7.92**	**-4.21**	**Calculation**
C12=A1*B12 (PM2.5 pollution)	Light Vehicle (LV)	metric tons	0.12	0.08	-0.04	Calculation
	Medium Truck (MT)	metric tons	0.06	0.07	0.00	Calculation
	Heavy Truck (HT)	metric tons	0.12	0.11	-0.01	Calculation
	All Vehicles	**metric tons**	**0.30**	**0.25**	**-0.05**	**Calculation**

Table 4-8 is continued on the following page.

Table 4-8 (continued)

Variable	Category	Unit	Value at Project Opening Year (2031)			Source
			Untolled	Tolled	Difference	
			1) Bradford Corridor			
C13=A1*B13 (SOX pollution)	Light Vehicle (LV)	metric tons	0.36	0.29	-0.07	Calculation
	Medium Truck (MT)	metric tons	0.09	0.05	-0.04	Calculation
	Heavy Truck (HT)	metric tons	0.07	0.04	-0.03	Calculation
	All Vehicles	**metric tons**	**0.51**	**0.38**	**-0.13**	**Calculation**
			2) Rest of Network			
A2 (VKT)	Light Vehicle (LV)	Million VKT	84,521	84,559	38.0	WSP
	Medium Truck (MT)	Million VKT	4,655	4,659	4.0	WSP
	Heavy Truck (HT)	Million VKT	4,221	4,224	2.8	WSP
B21 (NOX pollution factor as function of speed)	Light Vehicle (LV)	grams/km	0.030	0.030	0.00	US EIA
	Medium Truck (MT)	grams/km	0.195	0.195	0.00	US EIA
	Heavy Truck (HT)	grams/km	0.299	0.299	0.00	US EIA
B22 (PM2.5 pollution factor as function of speed)	Light Vehicle (LV)	grams/km	0.001	0.001	0.00	US EIA
	Medium Truck (MT)	grams/km	0.005	0.005	0.00	US EIA
	Heavy Truck (HT)	grams/km	0.007	0.007	0.00	US EIA
B23 (SOX pollution factor as function of speed)	Light Vehicle (LV)	grams/km	0.002	0.002	0.00	US EIA
	Medium Truck (MT)	grams/km	0.007	0.007	0.00	US EIA
	Heavy Truck (HT)	grams/km	0.005	0.005	0.00	US EIA
C21=A2*B21 (NOX pollution)	Light Vehicle (LV)	metric tons	2,506	2,507	1.13	Calculation
	Medium Truck (MT)	metric tons	907	908	0.78	Calculation
	Heavy Truck (HT)	metric tons	1,261	1,262	0.83	Calculation
	All Vehicles	**metric tons**	4,675	4,677	2.74	**Calculation**
C22=A2*B22 (PM2.5 pollutions)	Light Vehicle (LV)	metric tons	66.24	66.27	0.03	Calculation
	Medium Truck (MT)	metric tons	21.95	21.97	0.02	Calculation
	Heavy Truck (HT)	metric tons	31.59	31.61	0.02	Calculation
	All Vehicles	**metric tons**	119.78	119.85	0.07	**Calculation**
C23=A2*B23 (SOX pollution)	Light Vehicle (LV)	metric tons	144.02	144.09	0.06	Calculation
	Medium Truck (MT)	metric tons	30.65	30.68	0.03	Calculation
	Heavy Truck (HT)	metric tons	22.61	22.63	0.01	Calculation
	All Vehicles	**metric tons**	197.29	197.40	0.11	**Calculation**

Table 4-8 is continued on the following page.

Table 4-8 (continued)

Variable	Category	Unit	Value at Project Opening Year (2031)			Source
			Untolled	Tolled	Difference	
3) Entire Network						
C1=C11+C21 (NOX pollutions)	All Vehicles	metric tons	4,687	4,685	-1.47	Calculation
C2=C12+C22 (PM2.5 pollutions)	All Vehicles	metric tons	120.1	120.1	0.02	Calculation
C3=C13+C23 (SOX pollution)	All Vehicles	metric tons	197.8	197.8	-0.03	Calculation
D1 (NOX pollution unit cost)	All Vehicles	$2020/metric ton	7,219	7,219	0.00	Metrolinx
D2 (PM2.5 pollution unit cost)	All Vehicles	$2020/metric ton	35,362	35,362	0.00	Metrolinx
D3 (SOX pollution unit cost)	All Vehicles	$2020/metric ton	7,923	7,923	0.00	Metrolinx
E1=C1*D1 (NOX pollution cost)	All Vehicles	$2020	33,832,264	33,821,648	-10,616	Calculation
E2=C2*D2 (PM2.5 pollution cost)	All Vehicles	$2020	4,246,284	4,246,941	656	Calculation
E3=C3*D3 (SOX pollution cost)	All Vehicles	$2020	1,567,156	1,566,941	-215	Calculation
E=E1+E2+E3	**Total**	$2020	**39,645,704**	**39,635,530**	**-10,175**	**Calculation**
Note: For benefit/disbenefit estimation over the 2031-2060 period, D1, D2 and D3 are the three variables that do not vary over time. All remaining variables vary.						

4.4. Summary of Economic Business Case Results

As noted previously, the economic business case evaluates the benefits and costs of tolling the Bypass relative to an untolled bypass - the benefits and costs associated with constructing the Bypass are not considered. The present business case uses the net present value (NPV) and the Benefit-to-Cost Ratio (BCR) as two common benefit-cost evaluation measures. Both the NPV the BCR express the relation of discounted benefits to discounted costs as a measure of the extent to which a Project's benefits either exceed or fall short of the costs. Table 4-9 presents the evaluation results for the Project for the baseline toll rate scenarios, and two other scenarios where toll rates increase by 25% and 50%. All benefits and costs were expressed as the incremental difference between a tolled scenario and the untolled scenario. All benefits and costs were estimated over a 33-year evaluation period, including 3 years of tolling infrastructure construction (2028-2030) and 30 years of operation (2031-2060). Their values were discounted at 3.5% as prescribed by the MTO.

The Project long-term impacts are classified under three primary categories: economic competitiveness; environmental sustainability; and safety. As demonstrated in the previous sections, the project is expected to generate a disbenefit in travel time: M$783 for the baseline toll rate scenario, M$943 and M$1,133 for the other two scenarios. The most important benefit brought by the project is vehicle operating cost savings of more than M$196, followed by GHG emission cost savings (M$13.1), and injury collision cost savings (M$9). Overall, the Project will generate a disbenefit of M$561 if the baseline toll rate is kept over the entire period on analysis. With the total cost of M$156, the net present value of the

Project becomes negative with a value of -M$717 for the baseline toll rate scenario, mainly due travel time burden for the society Increase the toll rate to 25% and 50% would further increase travel time costs, although this improves other benefits for the society. The overall effect of increasing toll rates by 25% is an increase in economic loss from M$717 to M$866.

Since the Project total benefits are negative, the resulting benefit-to-cost ratio (BCR)becomes therefore negative as well. The interpretation of a negative BCR is that for every dollar investing in tolling the Bradford Bypass, the associated economic loss for the society would be equivalent to an amount of $3.6 if the baseline toll rate scenario was implemented.

TABLE 4-9: *SUMMARY OF BCA RESULTS, CUMULATIVE 2028-2060 IN DISCOUNTED 2020 DOLLAR VALUE*

Long-term Outcome	Benefits/Disbenefits	Baseline	Baseline + 25%	Baseline + 50%
Economic	Travel Time Costs	-783	-943	-1,133
	Vehicle Operating Cost Savings	196	214	240
Environment	GHG emission cost savings	13.1	14.0	15.6
	Air pollution cost savings	0.15	0.17	0.2
Safety	Fatal accident cost savings	1.10	1.25	1.41
	Injury accident cost savings	9.00	10.2	11.6
	PDO accident cost savings	2.29	2.59	2.94
Total Benefits		**-561**	**-701**	**-861**
Costs	CAPEX	17.2	17.2	17.2
	OPEX	139	148	156
Total Costs		**156**	**165**	**173**
Net Present Value (NPV)		**-717**	**-866**	**-1,034**
Benefit-to-Cost Ratio (BCR)		-3.60	-4.25	-4.98

4.5. Financial business case

The financial business case will look first at the profitability of the tolling system itself, and second at the profitability of the bypass and tolling system combined.

4.5.1. Financial analysis related to the tolling system

Model

Revenues generated from the tolling system were compared with the capital and operating costs associated with the tolling system only. The present value of the net cash flow was used to evaluate the annual net cash flow in present value terms by using a real discount rate. A capital recovery (payback) period was then calculated to count the amount of time it takes to recover the cost of the tolling system investment.

Assumptions

The financial analysis was conducted based on the revenue forecasted for the baseline scenario, the 25% increase in toll rate scenario, and the 50% increase in toll rate scenario. This includes the following additional assumptions:

- The period of analysis cover 3 years of construction from 2028 to 2030, plus 30 years of operation from 2031 to 2060;
- All revenues and costs are presented in real 2020 dollars;
- The discount rate used is 3.5%;
- The base year for discounting is 2020, meaning that one dollar in 2020 is equivalent to an amount smaller than one in the future.

The capital and operating costs of the tolling system were already shown in Section 4.2. The following subsection look at the revenue side of the system.

4.5.1.1. Revenue Forecast

The revenue forecast was presented previously in Section 3.7. Table 4-10 recaps the key numbers for the interpolation purpose between data points in time. As can be seen, increases in toll rate will increase revenues collected from all three types of vehicles. However, if the Bypass was not widened by 2041, increases in roll rates will not have an impact on revenues, with a total amount of M$83.4. Only when the Bypass is widened in 2041, then tolling revenues increase from M$83.4 to M$97.9 if toll rate was kept unchanged, to M$114.6 if toll rate was increased by 25%, and to M$127.3 if toll rate was increased by 50%.

To forecast the revenue over the 2031-2060 period, the assumption used in the forecast of travel demand was applied, i.e., that the trend (slope) between 2041 and 2060 will be the same as that between 2031 and 2041. The resulting revenue forecast for the entire 2031-2061 period is presented in the following figures.

TABLE 4-10: *REVENUE FORECAST BY YEAR AND BY SCENARIO*

Forecast Year	Unit	LV	MT	HT	Total
2031					
Baseline	Million $2020	56.6	4.0	5.5	66.1
Baseline + 25%	Million $2020	65.8	4.3	3.9	74.0
Baseline + 50%	Million $2020	69.2	3.0	3.8	76.0
2041 with 2031 bypass configuration					
All toll rate scenarios	Million $2020	73.0	4.2	6.2	83.4
2041 with widened bypass configuration					
Baseline	Million $2020	85.5	5.0	7.4	97.9
Baseline + 25%	Million $2020	100.5	5.7	8.4	114.6
Baseline + 50%	Million $2020	112.8	5.8	8.7	127.3

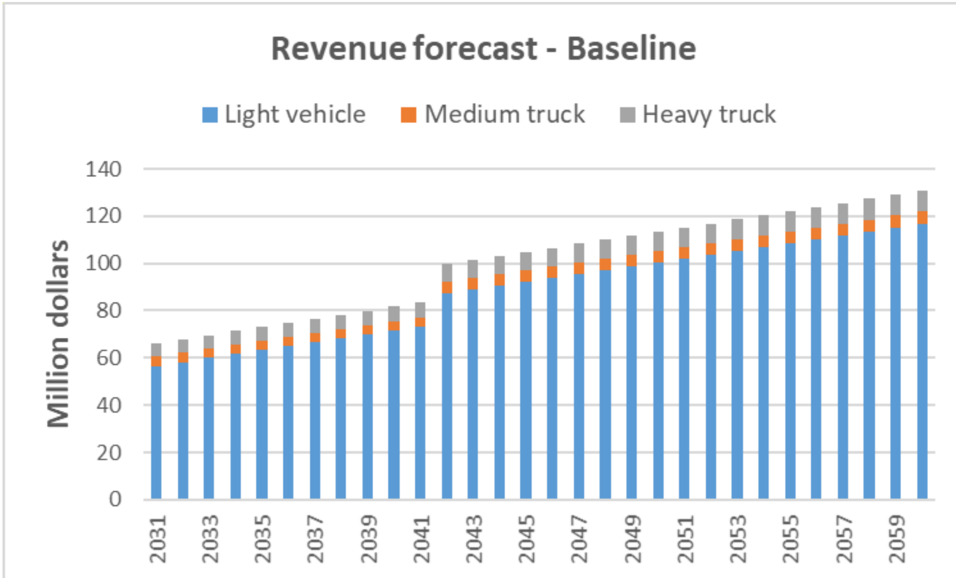

FIGURE 4-5: *REVENUE FORECAST BY TYPE OF VEHICLES: BASELINE SCENARIO*

Source: WSP

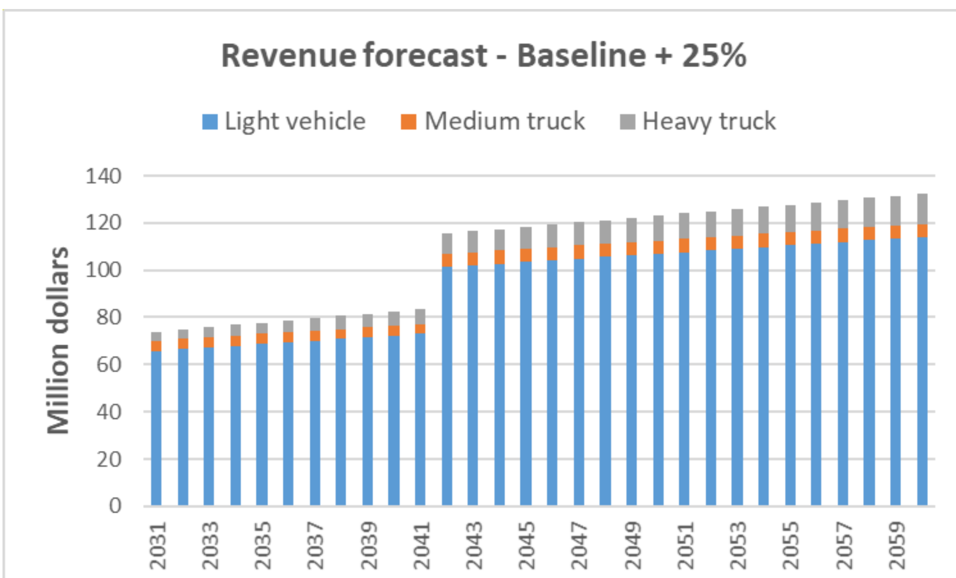

FIGURE 4-6: *REVENUE FORECAST BY TYPE OF VEHICLES: BASELINE +25% SCENARIO*

Source: WSP

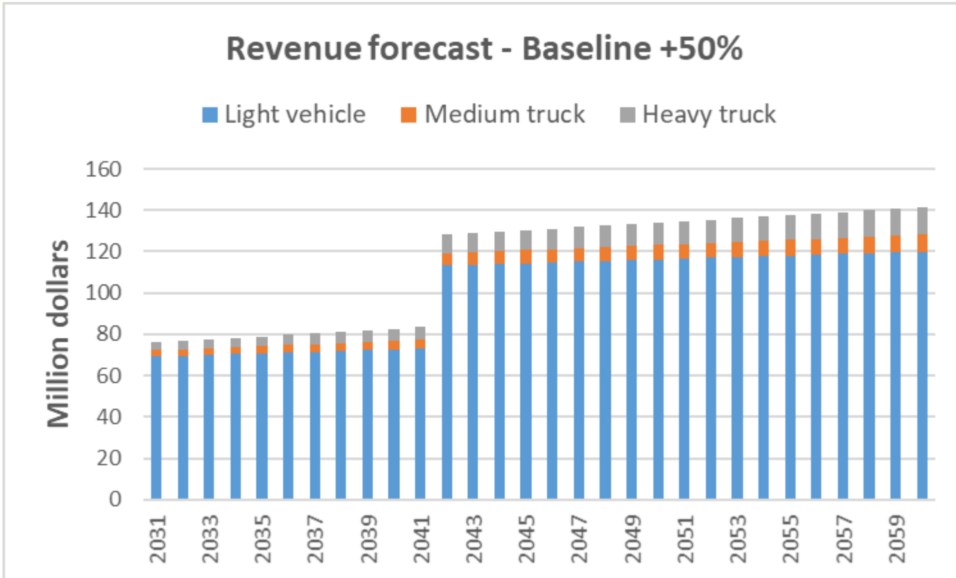

FIGURE 4-7: *REVENUE FORECAST BY TYPE OF VEHICLES: BASELINE +50% SCENARIO*

Source: WSP

4.5.1.2. Net Cash Flow and Payback Period of the Tolling Infrastructure

Table 4-11 below presents the steps to arrive at the cumulative present value of net cash flow for the baseline toll rate scenario. For the first three years of the tolling project from 2028 to 2030, no revenue is collected from the Bypass, so that annual net cash flow is all negative. From 2031 onward, the annual revenue largely exceeds the annual total cost, thus tolling the Bypass will create a positive net cash flow as of 2031. Even with the discounting factor smaller than one and decreasing over time, the present value of net cash flow of M$40 by 2031 largely exceeds the capital cost of M$17 in discounted value.

The last column of the table presents the cumulative present value of net cash flow which amounts to M$22.8 in 2031, meaning that it would take at most four years from the tolling infrastructure construction date (2028) to recover the investment of the tolling system.

The exact amount of time is calculated as follows:

Paypack period = (Number of years cumulative present value of net cash flow turns positive) + (Absolute value of the last negative cumulative net cash flow) / (Value of the first positive net cash flow)

= (2031-2028) + 17.2/40.0 = 3.4 years (or 3 years and almost 5 months),

where 17.2 and 40.0 are the values highlighted in red and green in Table 4-11 respectively.

TABLE 4-11: *PRESENT VALUE OF NET CASH FLOW - BASELINE SCENARIO*

A	B	C	D	E=B-(C+D)	F	G=E*F	H=CUM(G)
Year	Revenue (M$)	CAPEX (M$)	OPEX (M$)	Net Cash Flow (M$)	Discounting Factor	Present Value of Net Cash Flow (M$)	Cumulative Present Value of Net Cash Flow
2028		2.4		-2.4	0.759	-1.8	-1.8
2029		7.1		-7.1	0.734	-5.2	-7.0
2030		14.3		-14.3	0.709	-10.1	***-17.2***
2031	66.1		7.8	58.3	0.685	***40.0***	22.8
2032	67.9		8.0	59.9	0.662	39.6	62.4
2033	69.6		8.2	61.4	0.639	39.3	102
2034	71.3		8.3	63.0	0.618	38.9	141
2035	73.0		8.5	64.5	0.597	38.5	179
2036	74.8		8.7	66.0	0.577	38.1	217
2037	76.5		8.8	67.6	0.557	37.7	255
2038	78.2		9.0	69.2	0.538	37.2	292
2039	79.9		9.2	70.7	0.520	36.8	329
2040	81.6		9.4	72.3	0.503	36.3	365
2041	83.4		9.6	73.7	0.486	35.8	401
2042	99.7		11.2	88.5	0.469	41.5	443
2043	101.4		11.3	90.1	0.453	40.8	483
2044	103.1		11.5	91.6	0.438	40.1	524
2045	104.8		11.7	93.2	0.423	39.4	563
2046	106.6		11.9	94.7	0.409	38.7	602
2047	108.3		12.0	96.3	0.395	38.0	640
2048	110.0		12.2	97.8	0.382	37.3	677
2049	111.7		12.4	99.4	0.369	36.6	714
2050	113.5		12.5	100.9	0.356	36.0	750
2051	115.2		12.8	102.4	0.344	35.2	785
2052	116.9		12.9	104.0	0.333	34.6	819
2053	118.6		13.1	105.6	0.321	33.9	853
2054	120.3		13.2	107.1	0.310	33.3	887
2055	122.1		13.4	108.7	0.300	32.6	919
2056	123.8		13.6	110.2	0.290	31.9	951
2057	125.5		13.8	111.8	0.280	31.3	982
2058	127.2		13.9	113.3	0.271	30.7	1,013
2059	129.0		14.1	114.9	0.261	30.0	1,043
2060	130.7		14.3	116.4	0.253	29.4	1,072
Total (2028-2060)	3,011	23.8	337	2,649	N.A	1,072	N.A

Source: WSP

Using the similar method, Table 4-12 reports the net cash flows and payback periods calculated for the two other toll rate scenarios: the baseline + 25% and the baseline + 50%. Since the tolling system itself is profitable right within the first year of commissioning the Bypass, the internal rate of return (IRR) will be automatically greater than 100%. By definition, the IRR is a discount rate for the project to break even within a predefined period. The IRR should always be smaller than 100% to respect the discounting concept. Since the IRR for three toll rate scenarios are all higher than 100%, it was therefore not reported in Table 4-12.

TABLE 4-12: *SUMMARY OF FINANCIAL BUSINESS CASE RESULT BY SCENARIO*

M$2020	Baseline	Baseline +25%	Baseline +50%
Tolling Revenue (2031-2060)	3,011	3,221	3,436
CAPEX (2028-2030)	24	24	24
OPEX (2031-2060)	337	358	380
Present Value of Net Cash Flow (Discounted)	1,072	1,154	1,226
Payback Period Relative to Assumed 2028 Start of Construction (Relative to 2031 opening)	3.4 years (0.4 years)	3.4 years (0.4 years)	3.4 years (0.4 years)
Year Cumulative Present Value of Net Cash Flow Turns Positive	2031	2031	2031

Source: WSP

4.5.2. Financial analysis related to the Bypass and tolling system combined

Model

A similar financial model was built to include the capital and operating cost associated with the bypass and the tolling system combined, in order to determine the profitability of building the highway.

Assumptions

The revenues forecasted for the baseline scenario, the 25% increase in toll rate scenario, and the 50% increase in toll rate scenario were similar to the ones discussed in the previous section. The following additional assumptions were made to reflect the inclusion of the Bypass:

- The period of analysis covers 5 years of construction work of the bypass and the tolling infrastructure from 2026 to 2030, 4 years of construction work to widen the bypass from 2038 to 2041, plus 30 years of operation from 2031 to 2060;
- For the purposes of the present financial business case, the capital cost associated with Bypass construction was estimated approximately (a reliable cost estimate was not yet available; neither was information on the number and size of structures, culverts, etc.). A total cost of M$676 was estimated, including Bypass construction and tolling implementation in 2031 and Bypass widening in 2041 (refer to Appendix F). It is important to note that the estimated construction and widening costs associated with the Bypass are preliminary, serve only as a placeholder, and will almost certainly be refined as the EA/preliminary design proceeds.

4.5.2.1. Capital recovery (payback period) for Bypass construction and tolling system implementation

Table 4-13 below presents the steps to arrive at the cumulative present value of net cash flow for the baseline toll rate scenario. For the entire period of analysis from 2026 to 2041, the cumulative present value of net cash flow is all negative, meaning that it would be impossible to recover the investment of the Bypass and tolling system construction within the period of analysis.

The last row of Table 4-13 shows that not until 2065 does the cumulative present value of net cash flow turn positive. The capital recovery period is therefore

Payback period = (2065-2026) + 4.0/13.9 = 39.3 years (or 39 years and 4 months),

where 4.0 and 13.9 are the values highlighted in red and green in Table 4-13 respectively.

TABLE 4-13: *PRESENT VALUE OF NET CASH FLOW - BASELINE SCENARIO*

A Year	B Revenue (M$)	C CAPEX (M$)	D OPEX (M$)	E=B-(C+D) Net Cash Flow (M$)	F Discount Factor	G=E*F Present Value of Net Cash Flow (M$)	H=CUM(G) Cumulative Present Value of Net Cash Flow
2026	0.0	89.5	0	-89.5	0.814	-72.8	-72.8
2027	0.0	89.5	0	-89.5	0.786	-70.3	-143.1
2028	0.0	91.9	0	-91.9	0.759	-69.8	-212.9
2029	0.0	96.6	0	-96.6	0.734	-70.9	-283.8
2030	0.0	169.7	0	-169.7	0.709	-120.3	-404.1
2031	66.1	0	52.6	13.6	0.685	9.3	-394.8
2032	67.9	0	52.7	15.1	0.662	10.0	-384.8
2033	69.6	0	52.9	16.7	0.639	10.7	-374.1
2034	71.3	0	53.1	18.2	0.618	11.3	-362.8
2035	73.0	0	53.2	19.8	0.597	11.8	-351.0
2036	74.8	0	53.5	21.3	0.577	12.3	-338.7
2037	76.5	0	53.6	22.9	0.557	12.8	-326.0
2038	78.2	34.7	53.8	-10.2	0.538	-5.5	-331.5
2039	79.9	34.7	53.9	-8.7	0.520	-4.5	-336.0
2040	81.6	34.7	54.1	-7.1	0.503	-3.6	-339.6
2041	83.4	34.7	54.4	-5.7	0.486	-2.8	-342.4
2042	99.7	0	69.8	29.9	0.469	14.0	-328.3
2043	101.4	0	70.0	31.4	0.453	14.3	-314.1
2044	103.1	0	70.1	33.0	0.438	14.4	-299.6
2045	104.8	0	70.3	34.5	0.423	14.6	-285.0
2046	106.6	0	70.5	36.0	0.409	14.7	-270.3
2047	108.3	0	70.6	37.6	0.395	14.9	-255.4
2048	110.0	0	70.8	39.2	0.382	15.0	-240.5
2049	111.7	0	71.0	40.7	0.369	15.0	-225.4

Table 4-13 is continued on the following page.

Table 4-13 (continued)

A	B	C	D	E=B-(C+D)	F	G=E*F	H=CUM(G)
Year	Revenue (M$)	CAPEX (M$)	OPEX (M$)	Net Cash Flow (M$)	Discount Factor	Present Value of Net Cash Flow (M$)	Cumulative Present Value of Net Cash Flow
2050	113.5	0	71.2	42.3	0.356	15.1	-210.4
2051	115.2	0	71.4	43.7	0.344	15.1	-195.3
2052	116.9	0	71.5	45.4	0.333	15.1	-180.2
2053	118.6	0	71.7	46.9	0.321	15.1	-165.1
2054	120.3	0	71.8	48.5	0.310	15.1	-150.1
2055	122.1	0	72.0	50.0	0.300	15.0	-135.1
2056	123.8	0	72.2	51.5	0.290	14.9	-120.1
2057	125.5	0	72.4	53.1	0.280	14.9	-105.2
2058	127.2	0	72.5	54.7	0.271	14.8	-90.4
2059	129.0	0	72.7	56.2	0.261	14.7	-75.7
2060	130.7	0	72.9	57.8	0.253	14.6	-61.1
Total (2026-2060)	3010.7	676	1,943	392	n/a	-61.1	n/a
2061	132.4	0	73.2	59.2	0.244	14.5	-46.7
2062	134.1	0	73.2	60.9	0.236	14.4	-32.3
2063	135.9	0	73.4	62.5	0.228	14.2	-18.1
2064	137.6	0	73.6	64.0	0.220	14.1	***-4.0***
2065	139.3	0	73.7	65.6	0.213	***13.9***	9.9

Source: WSP

Using the similar method, Table 4-14 reports the net cash flows, payback periods, and IRR calculated for the two other toll rate scenarios. The higher the toll rate, the shorter the payback period and the higher the IRR. For the baseline + 25% toll rate scenario, it would take 33.6 years to payback the M$676 initial investment or a 3.8% discount rate for the project to break even within the 2026-2060 period. For the baseline + 50% toll rate scenario, the payback period is shortened to 29.9 years, while the IRR was improved to reach 4.7%.

TABLE 4-14: *SUMMARY OF FINANCIAL BUSINESS CASE RESULT BY SCENARIO*

M$2020	Baseline	Baseline +25%	Baseline +50%
Tolling Revenue (2031-2060)	3,011	3,221	3,436
CAPEX (2026-2030; 2038-2041)	676	676	676
OPEX (2031-2060)	1,943	1,964	1,986
Present Value of Net Cash Flow (Discounted)	-61.1	20.6	92.1
Payback Period Relative to Assumed 2026 Start of Construction	39.3	33.6	29.9
Year Cumulative Present Value of Net Cash Flow Turns Positive	2065	2059	2055
Internal Rate of Return (IRR)	2.6%	3.8%	4.7%

Source: WSP

5. Summary of business case evaluation

The following tables summarize the key outputs of the various business case analyses. The results are presented for three scenarios:

1. Baseline toll rates (as currently used on Highway 407 East, Highway 412, Highway 418)
2. Baseline toll rates + 25%
3. Baseline toll rates + 50%

A. Economic business case

What is the benefit/cost ratio associated with implementing and operating a tolling system on the Bradford Bypass?

TABLE 5-1: *SUMMARY OF BENEFIT/COST RATIO EVALUATION*

M$2020	Baseline tolls	Baseline tolls + 25%	Baseline tolls + 50%
Travel time disbenefits	-783	-943	-1,133
Vehicle operating cost benefits	196	214	240
Emissions benefits	13.3	14.2	15.8
Collision benefits	12.4	14.0	16.0
Total benefits/disbenefits	**-561**	**-701**	**-861**
Capital expenditures	17.2	17.2	17.2
Operating expenditures	139	148	156
Total expenditures	**156**	165	173
Net Present Value (NPV)	**-717**	**-866**	**-1,034**
Benefit/cost ratio (BCR)	-3.60	-4.25	-4.98

- The benefits that do occur are incidental - neither an intended nor expected result of tolling the Bypass.
- Tolling the Bypass tends to lead to trips diverted from the Bypass to shorter (travel distance) but longer (travel time) alternative routes.

B. Financial business case - implement tolling or not?

TABLE 5-2: *IS THERE A POSITIVE FINANCIAL BUSINESS CASE ASSOCIATED WITH TOLLING THE BRADFORD BYPASS VS. NOT TOLLING IT?*

M$2020 (discounted)	Baseline tolls	Baseline tolls + 25%	Baseline tolls + 50%
Tolling revenue	3,011	3,221	3,436
Capital expenditures	24	24	24
Operating expenditures	337	358	380
Total expenditures	361	382	404
Present value of net cash flow (discounted)	1,072	1,154	1,226
Payback period relative to assumed 2028 start of tolling system implementation	3.4 years	3.4 years	3.4 years
Year cumulative present value of net cash flow turns positive	2031	2031	2031

- There is a strong financial case for the implementation of tolling on the Bypass.
- The tolling system would be effectively paid for less than a year after the Bypass opens.

C. Financial business case - will toll revenue pay for the Bypass?

TABLE 5-3: *WHAT IS THE PAYBACK PERIOD ASSOCIATED WITH BYPASS CONSTRUCTION IN THE CONTEXT OF TOLLING REVENUE?*

M$2020	Baseline tolls	Baseline tolls + 25%	Baseline tolls + 50%
Tolling revenue	3,011	3,221	3,436
Capital expenditures	676	676	676
Operating expenditures	1,943	1,964	1,986
Present value of net cash flow (discounted)	-61.1	20.6	92.1
Payback period relative to assumed 2026 start of Bypass construction	39.3 years	33.6 years	29.9 years
Year cumulative present value of net cash flow turns positive	2065	2059	2055
Internal Rate of Return	2.6%	3.8%	4.7%

- The Bypass capital costs are highly speculative and serve only as a temporary placeholder.

Appendices

Appendix A
TRAFFIC VOLUME DIAGRAMS
AM peak hour conditions - 2031 (opening day) and 2041

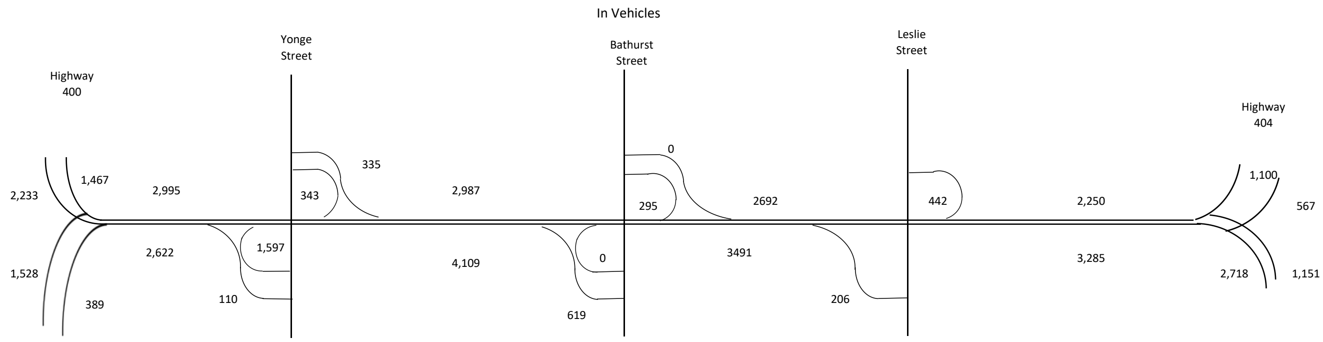

Figure A-1: 2031 AM peak hour volume schematic for the non-tolled scenario

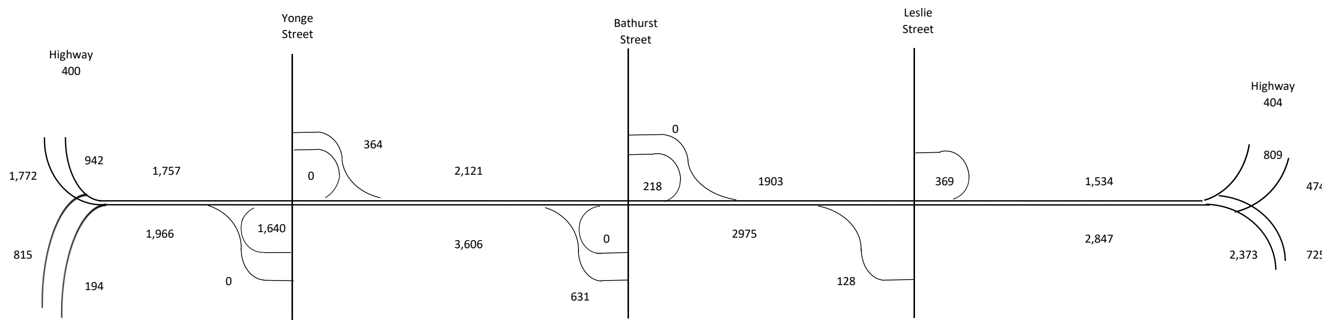

Figure A-2: 2031 AM peak hour volume schematic for the tolled scenario with the Highway 407 East 2016 toll rates (baseline scenario)

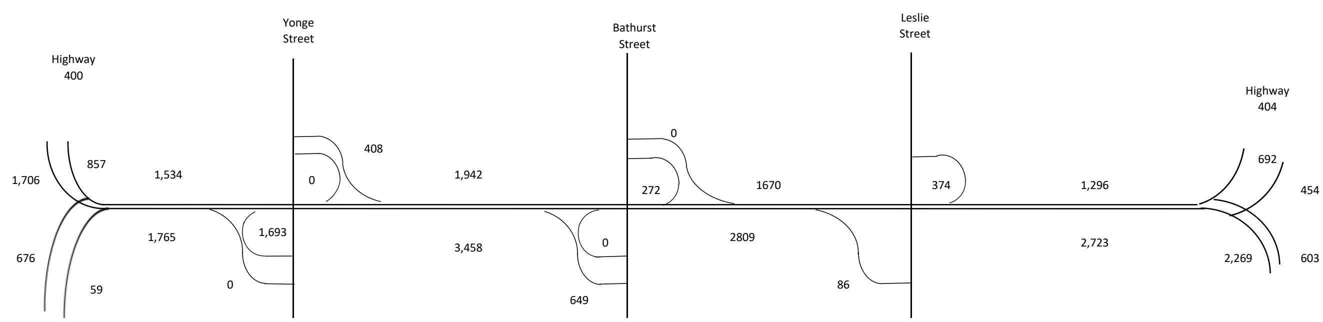

Figure A-3: 2031 AM peak hour volume schematic for the tolled scenario with a 25% increase of the Highway 407 East 2016 toll rates

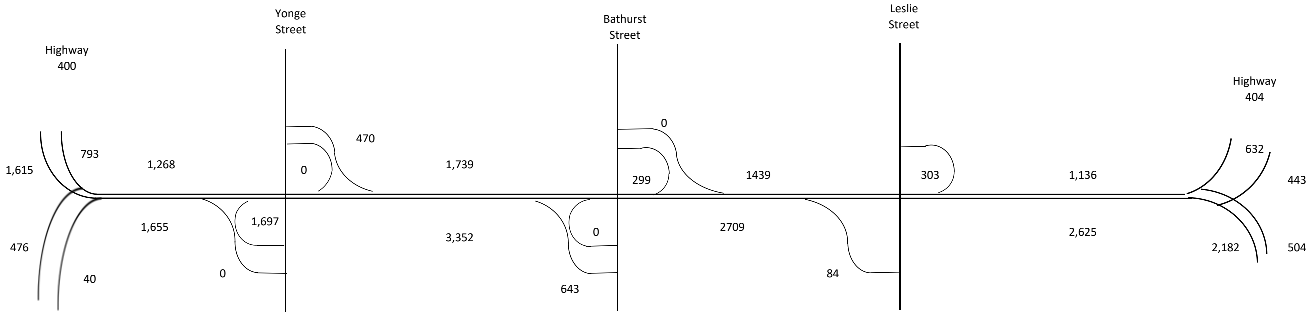

Figure A-4: 2031 AM peak hour volume schematic for the tolled scenario with a 40% increase of the Highway 407 East 2016 toll rates

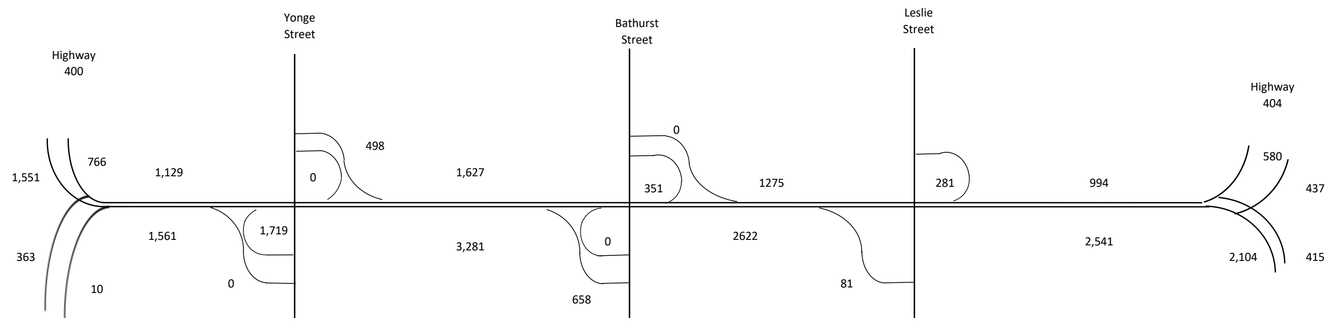

Figure A-5: 2031 AM peak hour volume schematic for the tolled scenario with a 50% increase of the Highway 407 East 2016 toll rates

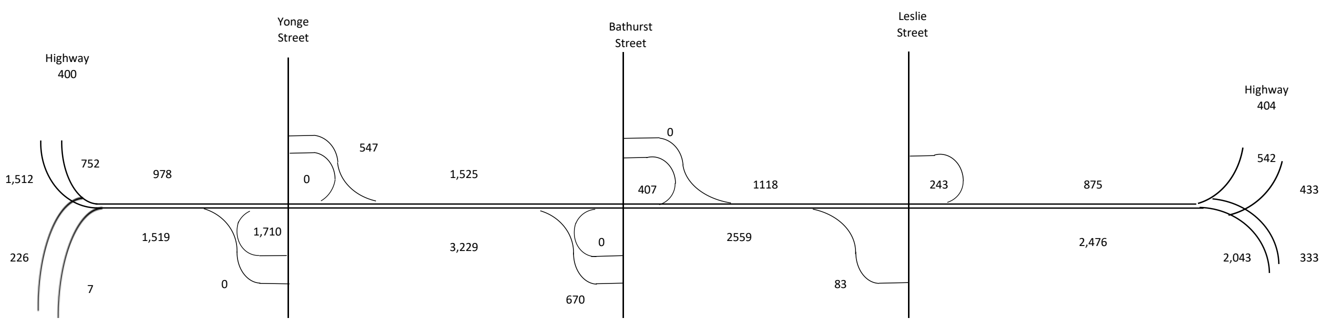

Figure A-6: 2031 AM peak hour volume schematic for the tolled scenario with a 60% increase of the Highway 407 East 2016 toll rates

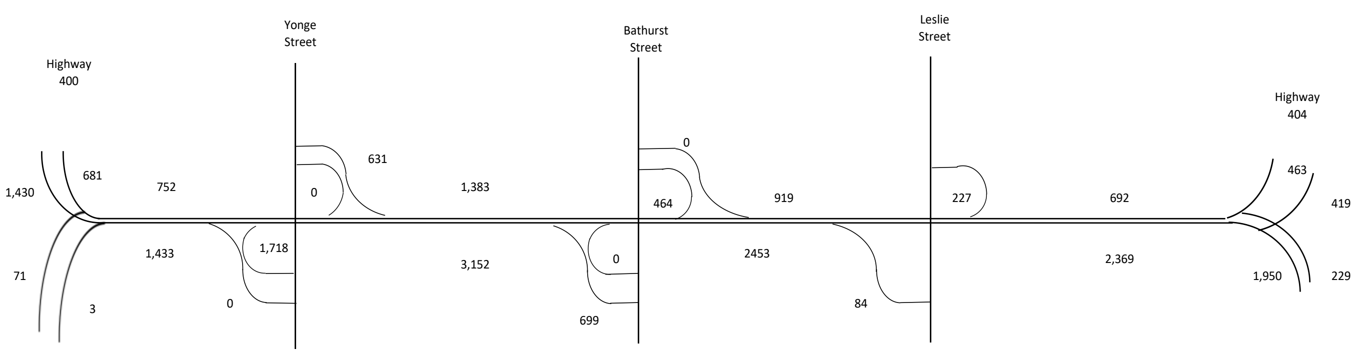

Figure A-7: 2031 AM peak hour volume schematic for the tolled scenario with a 75% increase of the Highway 407 East 2016 toll rates

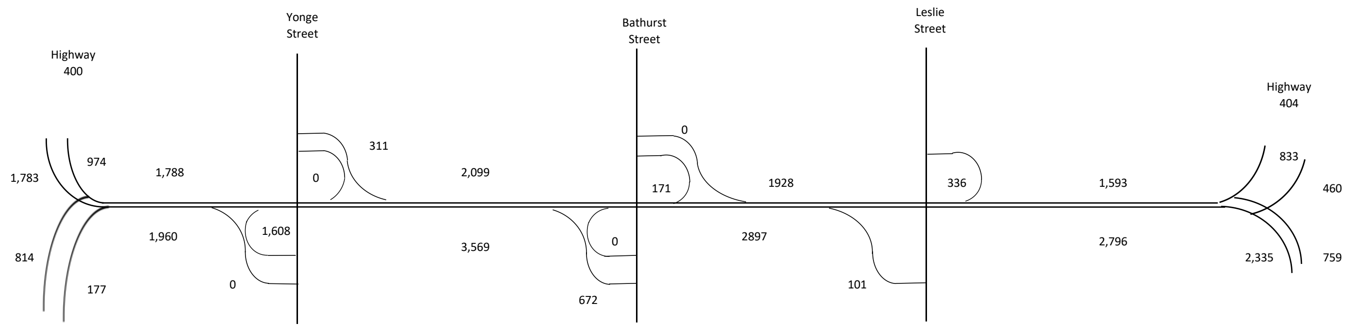

Figure A-8: 2031 AM peak hour volume schematic for the tolled scenario with all vehicles tolled at the same auto/light truck Highway 407 East 2016 toll rate

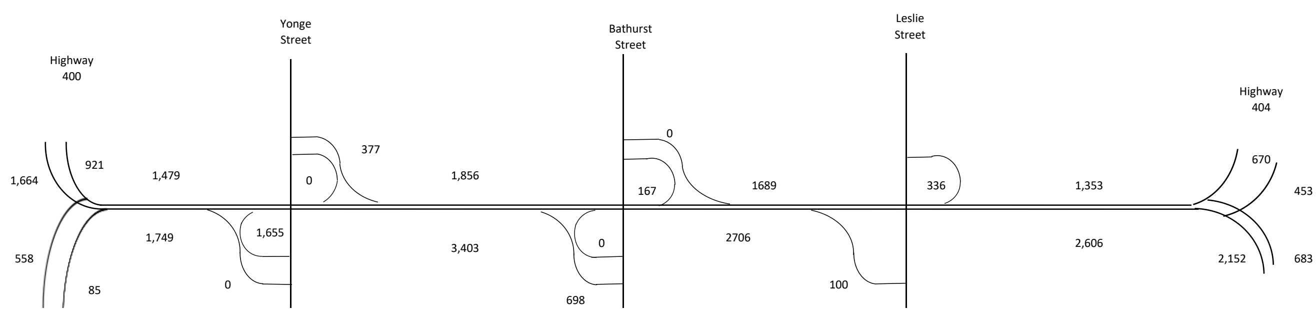

Figure A-9: 2031 AM peak hour volume schematic for the tolled scenario with all vehicles tolled at a 25% increase of the auto/light truck Highway 407 East 2016 toll rate

Note: for the 2041 scenarios, although the cross-section is 3 general-purpose lanes and 1 high-occupancy lane per direction, the schematic illustrates the aggregated volume between interchanges.

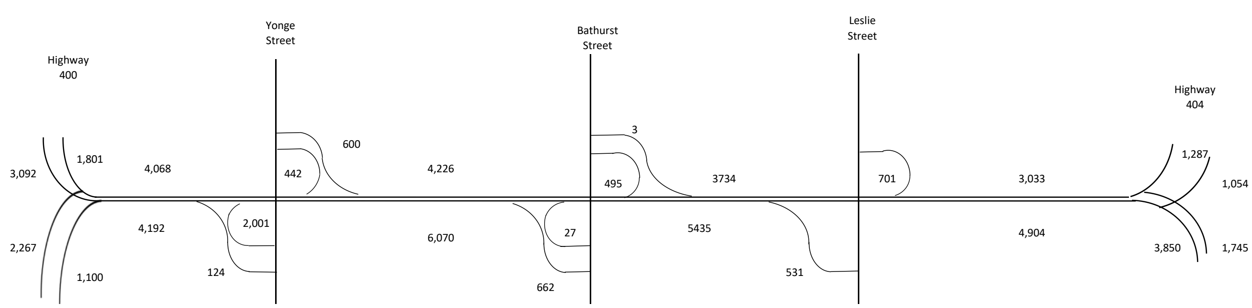

Figure A-10: 2041 AM peak hour volume schematic for the non-tolled scenario

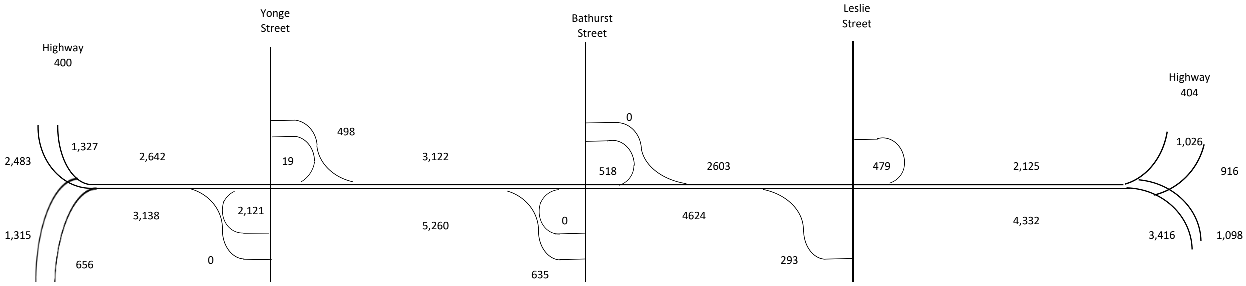

Figure A-11: 2041 AM peak hour volume schematic for the tolled scenario with the Highway 407 East 2016 toll rates (baseline scenario)

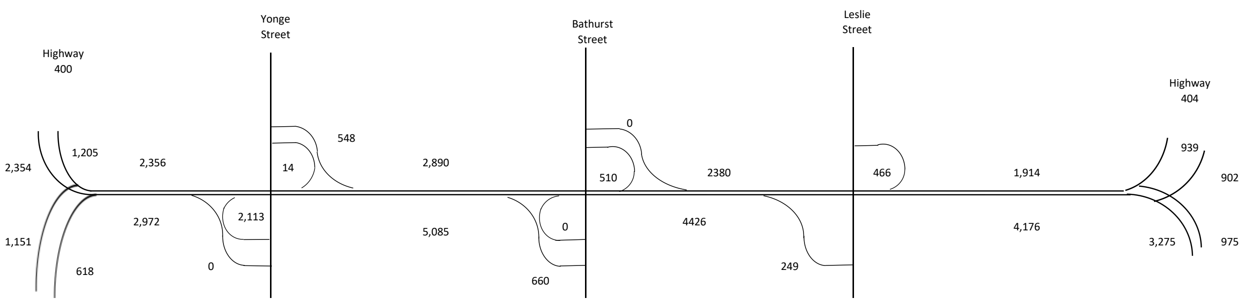

Figure A-12: 2041 AM peak hour volume schematic for the tolled scenario with a 25% increase of the Highway 407 East 2016 toll rates

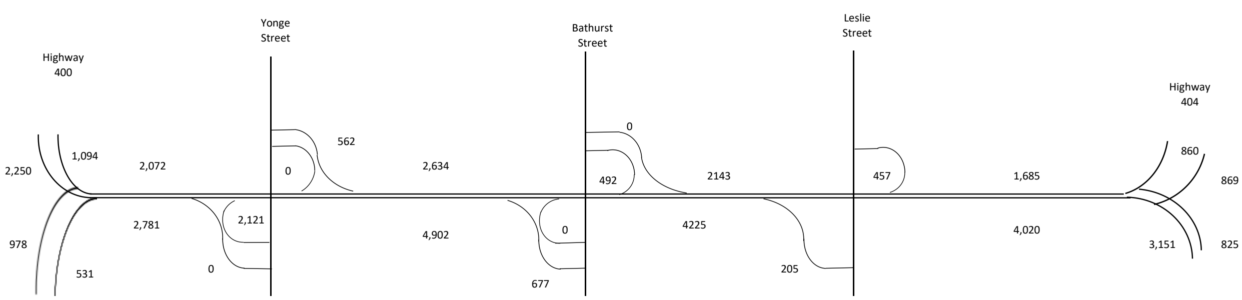

Figure A-13: 2041 AM peak hour volume schematic for the tolled scenario with a 50% increase of the Highway 407 East 2016 toll rates

Appendix B
NETWORK TRAVEL METRICS

AM peak hour conditions - 2031 (opening day) and 2041

network-wide and for Simcoe County and York Region

The following scenarios are summarized:

1. Non-tolled scenario
2. Tolled scenario - baseline (with the current Highway 407 East toll rates)
3. Tolled scenario - baseline toll rates +25%
4. Tolled scenario - baseline toll rates +40%
5. Tolled scenario - baseline toll rates +50%
6. Tolled scenario - baseline toll rates +60%
7. Tolled scenario - baseline toll rates +75%
8. Tolled scenario - baseline toll rates - all vehicles tolled using the auto/light truck rates
9. Tolled scenario - baseline toll rates + 25% - all vehicles tolled using the auto/light truck rates

Table B-1: 2031 AM peak hour vehicle*kilometer and vehicle*hour by scenario for the whole network

	non-tolled	tolled baseline	tolled baseline +25%	tolled baseline +40%	tolled baseline +50%	tolled baseline +60%	tolled baseline +75%	tolled with all vehicles tolled at the same auto/light truck baseline	tolled with all vehicles toll +25% auto/light truck baseline
VKM	31,717,423	31,709,469	31,707,952	31,706,541	31,705,757	31,704,838	31,704,196	31,709,398	31,707,947
VHR	736,695	737,006	737,212	737,410	737,550	737,697	737,916	736,960	737,157

Table B-2: 2031 AM peak hour vehicle*kilometer and vehicle*hour by scenario for Simcoe County

	non-tolled	tolled baseline	tolled baseline +25%	tolled baseline +40%	tolled baseline +50%	tolled baseline +60%	tolled baseline +75%	tolled with all vehicles tolled at the same auto/light truck baseline	tolled with all vehicles toll +25% auto/light truck baseline
VKM	2,063,052	2,054,968	2,053,112	2,050,520	2,049,348	2,048,514	2,047,121	2,055,100	2,052,726
VHR	32,576	32,494	32,513	32,501	32,511	32,520	32,539	32,497	32,509

Table B-3: 2031 AM peak hour vehicle*kilometer and vehicle*hour by scenario for York Region

	non-tolled	tolled baseline	tolled baseline +25%	tolled baseline +40%	tolled baseline +50%	tolled baseline +60%	tolled baseline +75%	tolled with all vehicles tolled at the same auto/light truck baseline	tolled with all vehicles toll +25% auto/light truck baseline
VKM	4,261,548	4,255,517	4,254,340	4,254,214	4,253,817	4,253,457	4,253,453	4,255,345	4,254,853
VHR	107,112	107,094	107,171	107,280	107,345	107,418	107,518	107,081	107,160

Table B-4: 2041 AM peak hour vehicle*kilometer and vehicle*hour by scenario for the whole network

	non-tolled	tolled baseline	tolled baseline +25%	tolled baseline +50%
VKM	36,074,304	36,053,224	36,049,518	36,045,202
VHR	952,415	953,513	953,893	954,328

Table B-5: 2041 AM peak hour vehicle*kilometer and vehicle*hour by scenario for Simcoe County

	non-tolled	tolled baseline	tolled baseline +25%	tolled baseline +50%
VKM	2,352,865	2,352,277	2,349,317	2,345,645
VHR	39,956	40,136	40,126	40,130

Table B-6: 2041 AM peak hour vehicle*kilometer and vehicle*hour by scenario for York Region

	non-tolled	tolled baseline	tolled baseline +25%	tolled baseline +50%
VKM	4,750,317	4,737,230	4,734,981	4,733,651
VHR	138,265	138,525	138,679	138,880

Appendix C
SCREENLINE ANALYSES
AM peak hour conditions - 2031 (opening day) and 2041

Table C-1: 2031 AM peak hour volumes along the north-south screenline east of Highway 400

Locations are: Innisfil Beach Road, 5 Line, Highway 89, Bradford Corridor, Highway 88, Line 5, Canal Road, Highway 9/Davis Dr W

										Percent change relative to the non-tolled scenario							
		non-tolled	tolled baseline	tolled baseline +25%	tolled baseline +40%	tolled baseline +50%	tolled baseline +60%	tolled baseline +75%	tolled with all vehicles tolled at the same auto/light truck baseline	tolled with all vehicles toll +25% auto/light truck baseline	tolled baseline	tolled baseline +25%	tolled baseline +40%	tolled baseline +50%	tolled baseline +60%	tolled baseline +75%	tolled with all vehicles tolled at the same auto/light truck baseline	tolled with all vehicles toll +25% auto/light truck baseline
Innisfil Beach Road	WB	1,319	1,307	1,304	1,298	1,289	1,284	1,286	1,314	1,310	-1%	-1%	-2%	-2%	-3%	-2%	0%	-1%
	EB	462	422	422	422	422	422	430	427	421	-9%	-9%	-9%	-9%	-9%	-7%	-8%	-9%
5 Line	WB	201	254	256	257	249	248	269	253	262	27%	27%	28%	24%	23%	34%	26%	30%
	EB	242	291	291	296	284	281	293	294	309	20%	20%	22%	17%	16%	21%	21%	28%
Highway 89	WB	468	577	599	636	647	660	704	561	614	23%	28%	36%	38%	41%	50%	20%	31%
	EB	326	392	403	439	449	458	461	376	422	20%	24%	35%	38%	41%	42%	15%	30%
Bradford Corridor	WB	2,995	1,757	1,534	1,268	1,129	978	752	1,788	1,479	-41%	-49%	-58%	-62%	-67%	-75%	-40%	-51%
	EB	2,622	1,966	1,765	1,655	1,561	1,519	1,433	1,960	1,749	-25%	-33%	-37%	-40%	-42%	-45%	-25%	-33%
Highway 88	WB	950	1,308	1,323	1,361	1,381	1,399	1,417	1,317	1,387	38%	39%	43%	45%	47%	49%	39%	46%
	EB	487	547	633	630	655	649	642	563	622	12%	30%	29%	34%	33%	32%	16%	28%
Line 5	WB	595	638	674	714	733	760	781	637	677	7%	13%	20%	23%	28%	31%	7%	14%
	EB	78	86	86	97	99	102	115	85	89	9%	10%	23%	26%	30%	46%	8%	13%
Canal Road	WB	1,060	1,082	1,090	1,097	1,104	1,107	1,110	1,085	1,101	2%	3%	3%	4%	4%	5%	2%	4%
	EB	340	343	344	346	347	349	350	343	344	1%	1%	2%	2%	2%	3%	1%	1%
Highway 9 / Davis Dr W	WB	1,643	1,862	1,907	1,957	1,973	1,995	2,017	1,875	1,930	13%	16%	19%	20%	21%	23%	14%	17%
	EB	2,139	2,258	2,284	2,301	2,310	2,315	2,315	2,281	2,324	6%	7%	8%	8%	8%	8%	7%	9%
Total	WB	9,232	8,786	8,687	8,588	8,504	8,431	8,338	8,830	8,760								
	EB	6,697	6,303	6,229	6,186	6,127	6,094	6,039	6,329	6,279								

Table C-2: 2031 AM peak hour volumes along the north-south screenline west of Highway 404

Locations are: Jon Dales Drive, Ravenshoe Road, Centroid connector, Bradford Corridor, Centroid connector, Queensville Sideroad, Doane Road, Centroid connector, Farr Avenue, Mount Albert

											Percent change relative to the non-tolled scenario							
		non-tolled	tolled baseline	tolled baseline +25%	tolled baseline +40%	tolled baseline +50%	tolled baseline +60%	tolled baseline +75%	tolled with all vehicles tolled at the same auto/light truck baseline	tolled with all vehicles toll +25% auto/light truck baseline	tolled baseline	tolled baseline +25%	tolled baseline +40%	tolled baseline +50%	tolled baseline +60%	tolled baseline +75%	tolled with all vehicles tolled at the same auto/light truck baseline	tolled with all vehicles toll +25% auto/light truck baseline
Jon Dales Drive	WB	0	0	0	0	0	0	0	0	0	-	-	-	-	-	-	-	-
	EB	0	0	0	0	0	0	0	0	0	-	-	-	-	-	-	-	-
Ravenshoe Road	WB	182	202	214	227	224	223	222	162	215	11%	18%	25%	23%	23%	22%	-11%	18%
	EB	368	426	453	465	471	474	482	388	445	16%	23%	27%	28%	29%	31%	6%	21%
Bradford Corridor	WB	2,250	1,534	1,296	1,136	994	875	692	1,593	1,353	-32%	-42%	-50%	-56%	-61%	-69%	-29%	-40%
	EB	3,285	2,847	2,723	2,625	2,541	2,476	2,369	2,796	2,606	-13%	-17%	-20%	-23%	-25%	-28%	-15%	-21%
Queensville Sideroad	WB	90	131	189	227	282	314	379	143	204	46%	111%	153%	215%	250%	323%	60%	128%
	EB	573	593	586	601	604	610	632	638	662	3%	2%	5%	5%	6%	10%	11%	15%
Doane Road	WB	242	334	367	352	349	342	339	334	348	38%	52%	46%	44%	42%	40%	38%	44%
	EB	653	687	695	699	703	707	714	696	704	5%	6%	7%	8%	8%	9%	7%	8%
Farr Avenue	WB	0	0	0	0	0	0	0	0	0	-	-	-	-	-	-	-	-
	EB	193	216	220	220	223	223	226	211	216	11%	14%	14%	15%	15%	17%	9%	12%
Mount Albert Road	WB	179	242	266	272	277	285	284	234	233	35%	48%	52%	55%	59%	59%	30%	30%
	EB	506	511	515	518	518	520	514	523	526	1%	2%	2%	2%	3%	2%	3%	4%
Green Lane East	WB	1,481	1,609	1,603	1,605	1,610	1,609	1,620	1,616	1,635	9%	8%	8%	9%	9%	9%	9%	10%
	EB	1,591	1,607	1,611	1,615	1,614	1,613	1,615	1,624	1,630	1%	1%	1%	1%	1%	1%	2%	2%
+Davis Drive	WB	1,697	1,728	1,743	1,749	1,738	1,744	1,749	1,725	1,734	2%	3%	3%	2%	3%	3%	2%	2%
	EB	1,467	1,467	1,467	1,466	1,464	1,464	1,466	1,467	1,465	0%	0%	0%	0%	0%	0%	0%	0%
Local Roads (centriod connectors)	WB	126	126	126	127	130	135	142	126	126	0%	0%	1%	3%	7%	13%	0%	0%
	EB	120	119	117	119	123	124	127	117	125	-1%	-3%	-1%	3%	3%	6%	-2%	4%
Total	WB	6,246	5,906	5,803	5,695	5,604	5,527	5,427	5,933	5,849								
	EB	8,756	8,473	8,386	8,327	8,261	8,209	8,146	8,460	8,377								

Road, Connection over Highway 404, Green Lane East, Davis Drive

Table C-3: 2031 AM peak hour volumes along the east-west screenline north of the Bradford corridor

Locations are: 5th Side Road, Highway 400, 10th Side Road, Yonge Street, Bathurst Street, 2 Concession Road, Leslie Street, Highway 404, Centroid connector, Woodbine Avenue

											Percent change relative to the non-tolled scenario							
		non-tolled	tolled baseline	tolled baseline +25%	tolled baseline +40%	tolled baseline +50%	tolled baseline +60%	tolled baseline +75%	tolled with all vehicles tolled at the same auto/light truck baseline	tolled with all vehicles toll +25% auto/light truck baseline	tolled baseline	tolled baseline +25%	tolled baseline +40%	tolled baseline +50%	tolled baseline +60%	tolled baseline +75%	tolled with all vehicles tolled at the same auto/light truck baseline	tolled with all vehicles toll +25% auto/light truck baseline
5th Side Road	SB	901	896	893	889	889	889	881	903	897	-1%	-1%	-1%	-1%	-1%	-2%	0%	0%
	NB	0	0	0	0	0	0	0	0	0	-	-	-	-	-	-	-	-
Highway 400	SB	5,182	5,249	5,259	5,272	5,272	5,287	5,297	5,230	5,237	1%	1%	2%	2%	2%	2%	1%	1%
	NB	3,272	3,205	3,193	3,174	3,168	3,164	3,114	3,218	3,200	-2%	-2%	-3%	-3%	-3%	-5%	-2%	-2%
10th Side Road	SB	505	509	496	492	483	469	447	522	515	1%	-2%	-3%	-4%	-7%	-11%	3%	2%
	NB	68	16	16	16	16	16	16	16	16	-76%	-76%	-76%	-76%	-76%	-76%	-76%	-76%
Yonge Street	SB	1,563	1,476	1,474	1,481	1,492	1,497	1,512	1,470	1,477	-6%	-6%	-5%	-5%	-4%	-3%	-6%	-6%
	NB	203	271	273	272	272	272	325	262	270	33%	34%	34%	34%	34%	60%	29%	33%
Bathurst Street	SB	0	0	0	0	0	0	0	0	0	-	-	-	-	-	-	-	-
	NB	0	0	0	0	0	0	0	0	0	-	-	-	-	-	-	-	-
2 Concession Road	SB	434	427	417	480	497	526	544	421	451	-2%	-4%	11%	14%	21%	25%	-3%	4%
	NB	251	291	305	306	313	316	322	282	287	16%	22%	22%	25%	26%	29%	13%	14%
Leslie Street	SB	749	698	687	607	580	544	519	707	653	-7%	-8%	-19%	-23%	-27%	-31%	-6%	-13%
	NB	331	309	307	309	306	307	308	326	324	-7%	-7%	-7%	-8%	-7%	-7%	-1%	-2%
Highway 404	SB	2,041	1,914	1,861	1,836	1,824	1,818	1,815	1,892	1,834	-6%	-9%	-10%	-11%	-11%	-11%	-7%	-10%
	NB	1,184	1,126	1,109	1,111	1,098	1,093	1,083	1,110	1,103	-5%	-6%	-6%	-7%	-8%	-9%	-6%	-7%
Local Road (centriod)	SB	0	0	0	0	0	0	0	0	0	-	-	-	-	-	-	-	-
	NB	0	0	0	0	0	0	0	0	0	-	-	-	-	-	-	-	-
Woodbine Avenue	SB	247	235	239	240	239	240	239	237	237	-5%	-3%	-3%	-3%	-3%	-3%	-4%	-4%
	NB	94	82	82	83	89	89	90	82	82	-12%	-13%	-12%	-6%	-6%	-5%	-13%	-13%
Total	SB	11,622	11,403	11,326	11,297	11,277	11,269	11,255	11,380	11,302								
	NB	5,404	5,301	5,285	5,271	5,262	5,257	5,259	5,297	5,283								

Table C-4: 2031 AM peak hour volumes along the east-west screenline south of the Bradford corridor

Locations are: 5th Side Road, Highway 400, 10th Side Road, Yonge Street, Bathurst Street, 2 Concession Road, Leslie Street, Highway 404, Centroid connector, Woodbine Avenue

											Percent change relative to the non-tolled scenario							
		non-tolled	tolled baseline	tolled baseline +25%	tolled baseline +40%	tolled baseline +50%	tolled baseline +60%	tolled baseline +75%	tolled with all vehicles tolled at the same auto/light truck baseline	tolled with all vehicles toll +25% auto/light truck baseline	tolled baseline	tolled baseline +25%	tolled baseline +40%	tolled baseline +50%	tolled baseline +60%	tolled baseline +75%	tolled with all vehicles tolled at the same auto/light truck baseline	tolled with all vehicles toll +25% auto/light truck baseline
5th Side Road	SB	901	896	893	889	889	889	881	903	897	-1%	-1%	-1%	-1%	-1%	-2%	0%	0%
	NB	0	0	0	0	0	0	0	0	0	-	-	-	-	-	-	-	-
Highway 400	SB	4,477	4,292	4,229	4,133	4,084	4,000	3,938	4,261	4,131	-4%	-6%	-8%	-9%	-11%	-12%	-5%	-8%
	NB	2,194	2,458	2,394	2,422	2,412	2,419	2,436	2,421	2,364	12%	9%	10%	10%	10%	11%	10%	8%
10th Side Road	SB	505	509	496	492	483	469	447	522	515	1%	-2%	-3%	-4%	-7%	-11%	3%	2%
	NB	68	16	16	16	16	16	16	16	16	-76%	-76%	-76%	-76%	-76%	-76%	-76%	-76%
Yonge Street	SB	413	279	316	378	405	465	498	275	342	-33%	-24%	-9%	-2%	13%	21%	-33%	-17%
	NB	549	350	398	396	407	403	398	365	413	-36%	-27%	-28%	-26%	-27%	-27%	-34%	-25%
Bathurst Street	SB	619	631	649	643	658	670	699	672	698	2%	5%	4%	6%	8%	13%	9%	13%
	NB	295	218	272	299	351	407	464	171	167	-26%	-8%	2%	19%	38%	58%	-42%	-43%
2 Concession Road	SB	434	427	417	480	497	526	544	421	451	-2%	-4%	11%	14%	21%	25%	-3%	4%
	NB	251	291	305	306	313	316	322	282	287	16%	22%	22%	25%	26%	29%	13%	14%
Leslie Street	SB	502	413	355	343	339	340	330	412	356	-18%	-29%	-32%	-33%	-32%	-34%	-18%	-29%
	NB	319	265	264	264	264	264	262	265	263	-17%	-17%	-17%	-17%	-17%	-18%	-17%	-18%
Highway 404	SB	3,659	3,478	3,437	3,387	3,348	3,320	3,303	3,394	3,316	-5%	-6%	-7%	-8%	-9%	-10%	-7%	-9%
	NB	1,767	1,377	1,258	1,172	1,076	993	893	1,409	1,333	-22%	-29%	-34%	-39%	-44%	-49%	-20%	-25%
Local Road (centriod)	SB	0	0	0	0	0	0	0	0	0	-	-	-	-	-	-	-	-
	NB	0	0	0	0	0	0	0	0	0	-	-	-	-	-	-	-	-
Woodbine Avenue	SB	247	235	239	240	239	239	239	237	237	-5%	-3%	-3%	-3%	-3%	-3%	-4%	-4%
	NB	52	40	40	41	47	47	48	40	40	-23%	-23%	-21%	-10%	-10%	-9%	-24%	-23%
Total	SB	11,756	11,160	11,031	10,985	10,943	10,919	10,879	11,095	10,943								
	NB	5,496	5,016	4,948	4,916	4,886	4,865	4,841	4,970	4,883								

Table C-5: 2031 AM peak hour volumes along the north-south screenline east of Highway 400 along Highway 407

										Percent change relative to the non-tolled scenario							
		non-tolled	tolled baseline	tolled baseline +25%	tolled baseline +40%	tolled baseline +50%	tolled baseline +60%	tolled baseline +75%	tolled with all vehicles tolled at the same auto/light truck baseline	tolled with all vehicles toll +25% auto/light truck baseline	tolled baseline	tolled baseline +25%	tolled baseline +40%	tolled baseline +50%	tolled baseline +60%	tolled baseline +75%	tolled with all vehicles tolled at the same auto/light truck baseline	tolled with all vehicles toll +25% auto/light truck baseline
Highway 407	WB	7,562	7,620	7,639	7,660	7,678	7,696	7,720	7,615	7,630	1%	1%	1%	2%	2%	2%	1%	1%
	EB	7,690	7,730	7,743	7,753	7,764	7,771	7,783	7,726	7,739	1%	1%	1%	1%	1%	1%	0%	1%

Table C-6: 2031 AM peak hour volumes along the north-south screenline east of Highway 400 along Highway 401

										Percent change relative to the non-tolled scenario							
		non-tolled	tolled baseline	tolled baseline +25%	tolled baseline +40%	tolled baseline +50%	tolled baseline +60%	tolled baseline +75%	tolled with all vehicles tolled at the same auto/light truck baseline	tolled with all vehicles toll +25% auto/light truck baseline	tolled baseline	tolled baseline +25%	tolled baseline +40%	tolled baseline +50%	tolled baseline +60%	tolled baseline +75%	tolled with all vehicles tolled at the same auto/light truck baseline	tolled with all vehicles toll +25% auto/light truck baseline
Highway 401	WB	15,065	15,075	15,081	15,085	15,089	15,095	15,104	15,074	15,084	0.1%	0.1%	0.1%	0.2%	0.2%	0.3%	0.1%	0.1%
	EB	13,682	13,693	13,694	13,697	13,700	13,702	13,705	13,697	13,700	0.1%	0.1%	0.1%	0.1%	0.1%	0.2%	0.1%	0.1%

Table C-7: 2031 AM peak hour volumes along the north-south screenline west of Highway 404 along Highway 407

										Percent change relative to the non-tolled scenario							
		non-tolled	tolled baseline	tolled baseline +25%	tolled baseline +40%	tolled baseline +50%	tolled baseline +60%	tolled baseline +75%	tolled with all vehicles tolled at the same auto/light truck baseline	tolled with all vehicles toll +25% auto/light truck baseline	tolled baseline	tolled baseline +25%	tolled baseline +40%	tolled baseline +50%	tolled baseline +60%	tolled baseline +75%	tolled with all vehicles tolled at the same auto/light truck baseline	tolled with all vehicles toll +25% auto/light truck baseline
Highway 407	WB	9,675	9,709	9,720	9,732	9,741	9,751	9,764	9,706	9,717	0.4%	0.5%	0.6%	0.7%	0.8%	0.9%	0.3%	0.4%
	EB	6,165	6,181	6,188	6,192	6,198	6,201	6,211	6,181	6,186	0.3%	0.4%	0.4%	0.5%	0.6%	0.7%	0.3%	0.3%

Table C-8: 2031 AM peak hour volumes along the north-south screenline west of Highway 404 along Highway 401

										Percent change relative to the non-tolled scenario							
		non-tolled	tolled baseline	tolled baseline +25%	tolled baseline +40%	tolled baseline +50%	tolled baseline +60%	tolled baseline +75%	tolled with all vehicles tolled at the same auto/light truck baseline	tolled with all vehicles toll +25% auto/light truck baseline	tolled baseline	tolled baseline +25%	tolled baseline +40%	tolled baseline +50%	tolled baseline +60%	tolled baseline +75%	tolled with all vehicles tolled at the same auto/light truck baseline	tolled with all vehicles toll +25% auto/light truck baseline
Highway 401	WB	15,366	15,374	15,375	15,374	15,379	15,380	15,386	15,372	15,375	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.0%	0.1%
	EB	12,113	12,114	12,116	12,113	12,114	12,115	12,118	12,114	12,117	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%

Table C-9: 2041 AM peak hour volumes along the north-south screenline east of Highway 400

Locations are: Innisfil Beach Road, 5 Line, Highway 89, Bradford Corridor, Highway 88, Line 5, Canal Road, Highway 9/Davis Dr W

						Percent change relative to the non-tolled scenario		
		non-tolled	tolled baseline	tolled baseline +25%	tolled baseline +50%	tolled baseline	tolled baseline +25%	tolled baseline +50%
Innisfil Beach Road	WB	1,523	1,526	1,528	1,532	0%	0%	1%
	EB	572	534	530	533	-7%	-7%	-7%
5 Line	WB	158	372	368	366	135%	133%	131%
	EB	247	405	405	401	64%	64%	63%
Highway 89	WB	601	530	545	555	-12%	-9%	-8%
	EB	550	473	474	480	-14%	-14%	-13%
Bradford Corridor	WB	4,068	2,642	2,356	2,072	-35%	-42%	-49%
	EB	4,192	3,138	2,972	2,781	-25%	-29%	-34%
Highway 88	WB	1,362	1,450	1,519	1,568	6%	12%	15%
	EB	584	640	643	652	10%	10%	12%
Line 5	WB	660	723	740	764	10%	12%	16%
	EB	84	98	100	110	17%	19%	31%
Canal Road	WB	1,102	1,113	1,115	1,121	1%	1%	2%
	EB	385	381	384	388	-1%	0%	1%
Highway 9 / Davis Dr W	WB	1,635	1,917	1,981	2,038	17%	21%	25%
	EB	2,336	2,482	2,517	2,555	6%	8%	9%
Total	WB	11,110	10,273	10,152	10,017			
	EB	8,950	8,151	8,026	7,901			

Table C-10: 2041 AM peak hour volumes along the north-south screenline west of Highway 404

Locations are: Jon Dales Drive, Ravenshoe Road, Centroid connector, Bradford Corridor, Centroid connector, Queensville Sideroad, Doane Road, Centroid connector, Farr Avenue, Mount Albert Road, Connection over Highway 404, Green Lane East, Davis Drive

						Percent change relative to the non-tolled scenario		
		non-tolled	tolled baseline	tolled baseline +25%	tolled baseline +50%	tolled baseline	tolled baseline +25%	tolled baseline +50%
Jon Dales Drive	WB	0	0	0	0	-	-	-
	EB	0	0	0	0	-	-	-
Ravenshoe Road	WB	293	289	299	302	-1%	2%	3%
	EB	659	678	692	690	3%	5%	5%
Bradford Corridor	WB	3,033	2,125	1,914	1,685	-30%	-37%	-44%
	EB	4,904	4,332	4,176	4,020	-12%	-15%	-18%
Queensville Sideroad	WB	115	153	178	216	33%	55%	88%
	EB	864	898	904	909	4%	5%	5%
Doane Road	WB	446	425	459	475	-5%	3%	7%
	EB	1,066	1,051	1,060	1,066	-1%	-1%	0%
Farr Avenue	WB	0	0	0	0	-	-	-
	EB	383	390	397	401	2%	4%	5%
Mount Albert Road	WB	272	334	340	348	23%	25%	28%
	EB	705	708	713	718	0%	1%	2%
Green Lane East	WB	1,436	1,575	1,589	1,603	10%	11%	12%
	EB	1,838	1,819	1,838	1,840	-1%	0%	0%
Davis Drive	WB	1,903	1,905	1,928	1,945	0%	1%	2%
	EB	1,567	1,590	1,608	1,612	1%	3%	3%
Local Road (centroids)	WB	246	287	288	293	17%	17%	19%
	EB	617	626	630	636	2%	2%	3%
Total	WB	7,744	7,094	6,994	6,868			
	EB	12,602	12,092	12,017	11,891			

Table C-11: 2041 AM peak hour volumes along the east-west screenline north of the Bradford corridor

Locations are: 5th Side Road, Highway 400, 10th Side Road, Yonge Street, Bathurst Street, 2 Concession Road, Leslie Street, Highway 404, Centroid connector, Woodbine Avenue

						Percent change relative to the non-tolled scenario		
		non-tolled	tolled baseline	tolled baseline +25%	tolled baseline +50%	tolled baseline	tolled baseline +25%	tolled baseline +50%
5th Side Road	SB	994	1,004	1,002	998	1%	1%	0%
	NB	17	0	0	0	-	-	-
Highway 400	SB	5,502	5,548	5,550	5,548	1%	1%	1%
	NB	3,630	3,554	3,535	3,499	-2%	-3%	-4%
10th Side Road	SB	644	652	643	622	1%	0%	-3%
	NB	27	18	18	18	-32%	-32%	-32%
Yonge Street	SB	1,787	1,695	1,690	1,713	-5%	-5%	-4%
	NB	298	329	331	339	10%	11%	14%
Bathurst Street	SB	0	0	0	0	-	-	-
	NB	0	0	0	0	-	-	-
2 Concession Road	SB	484	393	388	390	-19%	-20%	-19%
	NB	553	484	492	503	-12%	-11%	-9%
Leslie Street	SB	774	840	834	820	9%	8%	6%
	NB	372	462	454	439	24%	22%	18%
Highway 404	SB	1,739	1,759	1,749	1,739	1%	1%	0%
	NB	1,653	1,598	1,597	1,599	-3%	-3%	-3%
Local Road (centriod)	SB	8	0	0	0	-100%	-100%	-100%
	NB	0	0	0	0	-	-	-
Woodbine Avenue	SB	761	653	642	625	-14%	-16%	-18%
	NB	192	192	192	199	0%	0%	3%
Total	SB	12,693	12,544	12,497	12,455			
	NB	6,374	6,638	6,619	6,596			

Table C-12: 2041 AM peak hour volumes along the east-west screenline south of the Bradford corridor

Locations are: 5th Side Road, Highway 400, 10th Side Road, Yonge Street, Bathurst Street, 2 Concession Road, Leslie Street, Highway 404, Centroid connector, Woodbine Avenue

						Percent change relative to the non-tolled scenario		
		non-tolled	tolled baseline	tolled baseline +25%	tolled baseline +50%	tolled baseline	tolled baseline +25%	tolled baseline +50%
5th Side Road	SB	994	1,004	1,002	998	1%	1%	0%
	NB	17	0	0	0	-100%	-100%	-100%
Highway 400	SB	4,678	4,381	4,347	4,277	-6%	-7%	-9%
	NB	2,930	2,883	2,948	2,936	-2%	1%	0%
10th Side Road	SB	644	652	643	622	1%	0%	-3%
	NB	27	18	18	18	-32%	-32%	-32%
Yonge Street	SB	821	522	498	507	-36%	-39%	-38%
	NB	1,052	798	719	692	-24%	-32%	-34%
Bathurst Street	SB	666	635	660	677	-5%	-1%	2%
	NB	522	518	510	492	-1%	-2%	-6%
2 Concession Road	SB	484	393	388	390	-19%	-20%	-19%
	NB	553	484	492	503	-12%	-11%	-9%
Leslie Street	SB	706	602	562	517	-15%	-20%	-27%
	NB	475	410	399	389	-14%	-16%	-18%
Highway 404	SB	4,301	4,149	4,084	4,030	-4%	-5%	-6%
	NB	2,344	1,780	1,670	1,555	-24%	-29%	-34%
Local Road (centriod)	SB	152	85	85	88	-44%	-44%	-42%
	NB	26	26	26	26	0%	0%	0%
Woodbine Avenue	SB	690	577	567	546	-16%	-18%	-21%
	NB	199	132	132	138	-34%	-34%	-31%
Total	SB	14,136	12,999	12,834	12,651			
	NB	8,145	7,050	6,912	6,748			

Table C-13: 2041 AM peak hour volumes along the north-south screenline east of Highway 400 along Highway 407

						Percent change relative to the non-tolled scenario		
		non-tolled	tolled baseline	tolled baseline +25%	tolled baseline +50%	tolled baseline	tolled baseline +25%	tolled baseline +50%
Highway 407	WB	8,294	8,347	8,359	8,383	1%	1%	1%
	EB	8,580	8,647	8,660	8,671	1%	1%	1%

Table C-14: 2041 AM peak hour volumes along the north-south screenline east of Highway 400 along Highway 401

						Percent change relative to the non-tolled scenario		
		non-tolled	tolled baseline	tolled baseline +25%	tolled baseline +50%	tolled baseline	tolled baseline +25%	tolled baseline +50%
Highway 401	WB	15,677	15,703	15,713	15,715	0.2%	0.2%	0.2%
	EB	13,767	13,778	13,783	13,786	0.1%	0.1%	0.1%

Table C-15: 2041 AM peak hour volumes along the north-south screenline west of Highway 404 along Highway 407

						Percent change relative to the non-tolled scenario		
		non-tolled	tolled baseline	tolled baseline +25%	tolled baseline +50%	tolled baseline	tolled baseline +25%	tolled baseline +50%
Highway 407	WB	10,477	10,518	10,533	10,545	0%	1%	1%
	EB	7,531	7,579	7,593	7,603	1%	1%	1%

Table C-15: 2041 AM peak hour volumes along the north-south screenline west of Highway 404 along Highway 401

						Percent change relative to the non-tolled scenario		
		non-tolled	tolled baseline	tolled baseline +25%	tolled baseline +50%	tolled baseline	tolled baseline +25%	tolled baseline +50%
Highway 401	WB	15,987	15,997	16,004	16,010	0.1%	0.1%	0.1%
	EB	12,578	12,585	12,588	12,592	0.1%	0.1%	0.1%

Appendix D

UTILIZATION AND REVENUE SUMMARIES BY VEHICLE CLASS

AM peak hour conditions - 2031 (opening day) and 2041

Table D-1: Summary of utilization (VKT) for each scenario by vehicle class – AM peak hour and average weekday – 2031

							Daily VKT[3] (veh-km)					
	AM Peak VKT (veh-km)						Options A and B			Options C and D		
Toll rate scenarios[1]	Auto/light truck	Single-unit (medium) truck	Multi-unit (heavy) truck	Auto/light truck	Single-unit (medium) truck	Multi-unit (heavy) truck	Auto/light truck	Single-unit (medium) truck	Multi-unit (heavy) truck	Auto/light truck	Single-unit (medium) truck	Multi-unit (heavy) truck
Non-tolled	90,138	4,066	3,978	92%	4%	4%	868,265	53,647	46,673	1,035,378	57,524	61,213
Baseline	69,265	2,375	2,359	94%	3%	3%	667,203	31,336	27,678	795,619	33,600	36,300
Baseline +25%	64,387	2,021	1,342	95%	3%	2%	620,215	26,665	15,746	739,587	28,592	20,651
Baseline +40%	59,911	1,285	1,163	96%	2%	2%	577,100	16,954	13,645	688,173	18,180	17,896
Baseline +50%	56,435	1,163	1,092	96%	2%	2%	543,617	15,345	12,812	648,246	16,454	16,804
Baseline +60%	53,623	1,096	848	97%	2%	2%	516,530	14,461	9,949	615,945	15,506	13,049
Baseline +75%	49,634	948	373	97%	2%	1%	478,105	12,508	4,376	570,125	13,412	5,740

Table D-2: Summary of utilization (VKT) for each scenario by vehicle class – Annual – 2031

	Annual VKT (million veh-km)											
	Option A			Option B			Option C			Option D		
Toll rate scenarios[1]	Auto/ light truck	Single-unit (medium) truck	Multi-unit (heavy) truck	Auto/ light truck	Single-unit (medium) truck	Multi-unit (heavy) truck	Auto/ light truck	Single-unit (medium) truck	Multi-unit (heavy) truck	Auto/ light truck	Single-unit (medium) truck	Multi-unit (heavy) truck
Non-tolled	260.5	16.1	14.0	300.3	13.9	12.5	310.6	17.3	18.4	387.9	18.4	17.9
Baseline	200.2	9.4	8.3	230.8	8.1	7.4	238.7	10.1	10.9	298.1	10.8	10.6
Baseline +25%	186.1	8.0	4.7	214.5	6.9	4.2	221.9	8.6	6.2	277.1	9.2	6.0
Baseline +40%	173.1	5.1	4.1	199.6	4.4	3.7	206.5	5.5	5.4	257.8	5.8	5.2
Baseline +50%	163.1	4.6	3.8	188.0	4.0	3.4	194.5	4.9	5.0	242.9	5.3	4.9
Baseline +60%	155.0	4.3	3.0	178.6	3.7	2.7	184.8	4.7	3.9	230.8	5.0	3.8
Baseline +75%	143.4	3.8	1.3	165.4	3.2	1.2	171.0	4.0	1.7	213.6	4.3	1.7

Table D-3: Summary of revenue ($2016) for each scenario by vehicle class – Average weekday – 2031

Toll rate scenarios[1]	Daily Revenue[2,3] - typical weekday (in $2016)					
	Options A and B			Options C and D		
	Auto/ light truck	Single-unit (medium) truck	Multi-unit (heavy) truck	Auto/ light truck	Single-unit (medium) truck	Multi-unit (heavy) truck
Baseline	172,582	15,885	20,643	200,823	16,793	25,918
Baseline +25%	200,558	16,896	14,680	233,379	17,862	18,431
Baseline +40%	208,993	12,032	14,249	243,195	12,720	17,889
Baseline +50%	210,921	11,668	14,335	245,437	12,335	17,997
Baseline +60%	213,765	11,729	11,873	248,744	12,399	14,907
Baseline +75%	216,439	11,096	5,712	251,858	11,730	7,172

Table D-4: Summary of revenue ($2016) for each scenario by vehicle class – Annual – 2031

Toll rate scenarios[1]	Annual Revenue[2] ($million in $2016)											
	Option A			Option B			Option C			Option D		
	Auto/ light truck	Single-unit (medium) truck	Multi-unit (heavy) truck	Auto/ light truck	Single-unit (medium) truck	Multi-unit (heavy) truck	Auto/ light truck	Single-unit (medium) truck	Multi-unit (heavy) truck	Auto/ light truck	Single-unit (medium) truck	Multi-unit (heavy) truck
Non-tolled	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Baseline	51.8	4.8	6.2	56.6	4.0	5.5	60.2	5.0	7.8	70.7	5.2	7.4
Baseline +25%	60.2	5.1	4.4	65.8	4.3	3.9	70.0	5.4	5.5	82.2	5.5	5.3
Baseline +40%	62.7	3.6	4.3	68.6	3.1	3.8	73.0	3.8	5.4	85.6	3.9	5.1
Baseline +50%	63.3	3.5	4.3	69.2	3.0	3.8	73.6	3.7	5.4	86.4	3.8	5.2
Baseline +60%	64.1	3.5	3.6	70.1	3.0	3.1	74.6	3.7	4.5	87.6	3.8	4.3
Baseline +75%	64.9	3.3	1.7	71.0	2.8	1.5	75.6	3.5	2.2	88.7	3.6	2.1

Table D-5: Percentage changes in utilization (VKT) and revenue, relative to the baseline scenario, for toll-rate increase scenarios

Toll rate scenarios	AM Peak VKT			Daily and Annual VKT			Daily and Annual Revenue		
	Auto/ light truck	Single-unit (medium) truck	Multi-unit (heavy) truck	Auto/ light truck	Single-unit (medium) truck	Multi-unit (heavy) truck	Auto/ light truck	Single-unit (medium) truck	Multi-unit (heavy) truck
Baseline +25%	-7%	-15%	-43%	-7%	-15%	-43%	16%	6%	-29%
Baseline +40%	-14%	-46%	-51%	-14%	-46%	-51%	21%	-24%	-31%
Baseline +50%	-19%	-51%	-54%	-19%	-51%	-54%	22%	-27%	-31%
Baseline +60%	-23%	-54%	-64%	-23%	-54%	-64%	24%	-26%	-42%
Baseline +75%	-28%	-60%	-84%	-28%	-60%	-84%	25%	-30%	-72%

Notes:

1. *The baseline toll rates are those used by MTO for Highway 407 East as of February 2019 and converted to $2016*
2. *Revenue is gross revenue – tolling-related cost have not been accounted for*
3. *Daily VKT is based on a typical weekday (Tuesday-Thursday)*

Table D-6: Summary of utilization (VKT) for each scenario by vehicle class – AM peak hour and average weekday – 2041

Toll rate scenarios[1]	AM Peak VKT (veh-km)						Daily VKT[3] (veh-km)					
							Options A and B			Options C and D		
	Auto/ light truck	Single-unit (medium) truck	Multi-unit (heavy) truck	Auto/ light truck%	Single-unit (medium) truck%	Multi-unit (heavy) truck%	Auto/ light truck	Single-unit (medium) truck	Multi-unit (heavy) truck	Auto/ light truck	Single-unit (medium) truck	Multi-unit (heavy) truck
Non-tolled	134,155	4,635	5,400	93%	3%	4%	1,292,264	61,154	63,358	1,540,983	65,574	83,095
Baseline	104,560	2,955	3,204	94%	3%	3%	1,007,186	38,988	37,592	1,201,038	41,806	49,303
Baseline +25%	98,324	2,689	2,895	95%	3%	3%	947,117	35,479	33,967	1,129,407	38,043	44,548
Baseline +50%	91,960	2,287	2,500	95%	2%	3%	885,815	30,175	29,332	1,056,307	32,355	38,470

Table D-7: Summary of utilization (VKT) for each scenario by vehicle class – Annual – 2041

Toll rate scenarios[1]	Annual VKT (million veh-km)											
	Option A			Option B			Option C			Option D		
	Auto/ light truck	Single-unit (medium) truck	Multi-unit (heavy) truck	Auto/ light truck	Single-unit (medium) truck	Multi-unit (heavy) truck	Auto/ light truck	Single-unit (medium) truck	Multi-unit (heavy) truck	Auto/ light truck	Single-unit (medium) truck	Multi-unit (heavy) truck
Non-tolled	387.7	18.3	19.0	446.9	15.9	17.0	462.3	19.7	24.9	577.3	21.0	24.3
Baseline	302.2	11.7	11.3	348.3	10.1	10.1	360.3	12.5	14.8	450.0	13.4	14.4
Baseline +25%	284.1	10.6	10.2	327.6	9.2	9.1	338.8	11.4	13.4	423.1	12.2	13.0
Baseline +50%	265.7	9.1	8.8	306.4	7.8	7.9	316.9	9.7	11.5	395.7	10.4	11.2

Table D-8: Summary or revenue ($2016) for each scenario by vehicle class – Average weekday – 2041

Toll rate scenarios[1]	Daily Revenue[2,3] - typical weekday (in $2016)					
	Options A and B			Options C and D		
	Auto/ light truck	Single-unit (medium) truck	Multi-unit (heavy) truck	Auto/ light truck	Single-unit (medium) truck	Multi-unit (heavy) truck
Non-tolled	0	0	0	0	0	0
Baseline	260,523	19,764	28,038	303,155	20,893	35,202
Baseline +25%	306,268	22,481	31,667	356,388	23,766	39,759
Baseline +50%	343,693	22,944	32,817	399,935	24,256	41,203

Table D-9: Summary of revenue ($2016) for each scenario by vehicle class – Annual – 2041

Toll rate scenarios[1]	Annual Revenue[2] ($million in $2016) Option A Auto/ light truck	Option A Single-unit (medium) truck	Option A Multi-unit (heavy) truck	Option B Auto/ light truck	Option B Single-unit (medium) truck	Option B Multi-unit (heavy) truck	Option C Auto/ light truck	Option C Single-unit (medium) truck	Option C Multi-unit (heavy) truck	Option D Auto/ light truck	Option D Single-unit (medium) truck	Option D Multi-unit (heavy) truck
Non-tolled	0	0	0	0	0	0	0	0	0	0	0	0
Baseline	78.2	5.9	8.4	85.5	5.0	7.4	90.9	6.3	10.6	106.7	6.4	10.1
Baseline +25%	91.9	6.7	9.5	100.5	5.7	8.4	106.9	7.1	11.9	125.5	7.3	11.4
Baseline +50%	103.1	6.9	9.8	112.8	5.8	8.7	120.0	7.3	12.4	140.8	7.5	11.8

Table D-10: Percentage changes in utilization (VKT) and revenue to the baseline scenario, for toll-rate increase scenarios

Toll rate scenarios	AM Peak VKT Auto/ light truck	AM Peak VKT Single-unit (medium) truck	AM Peak VKT Multi-unit (heavy) truck	Daily and Annual VKT Auto/ light truck	Daily and Annual VKT Single-unit (medium) truck	Daily and Annual VKT Multi-unit (heavy) truck	Daily and Annual Revenue Auto/ light truck	Daily and Annual Revenue Single-unit (medium) truck	Daily and Annual Revenue Multi-unit (heavy) truck
Baseline +25%	-6%	-9%	-10%	-6%	-9%	-10%	18%	14%	13%
Baseline +50%	-12%	-23%	-22%	-12%	-23%	-22%	32%	16%	17%

Notes:

1. *The baseline toll rates are those used by MTO for Highway 407 East as of February 2019 and converted to $2016*
2. *Revenue is gross revenue – tolling-related cost have not been accounted for*
3. *Daily VKT is based on a typical weekday (Tuesday-Thursday)*

Appendix E
EXPANSION OF VKT, VHT, AND REVENUE FROM AM PEAK HOUR TO ANNUAL LEVELS

E-1 Need for expansion

Since the travel demand forecasts cover only the morning peak hour and it is necessary to evaluate travel distance and time, benefits/disbenefits, and revenue at the annual level for business case development, it is necessary to develop an expansion process. The need for revenue expansion suggests that the expansion process be vehicle class-specific and be day-of-week/time-of-day-specific to be consistent with the toll rate stratification.

E-2 Utilization/VKT expansion

The expansion process for utilization (VKT) also covers the expansion of benefits, where these are based on VKT.

There are several factors influencing the expansion process for utilization (VKT):

- The Bypass does not currently exist so that traffic patterns must be determined 'by analogy' with other, existing facilities;
- The evaluation considers the Bypass as a tolled facility and it might be expected that drivers would be less willing to use a tolled facility under off-peak/uncongested conditions, when there would be less of a travel-time advantage relative to the competing untolled;
- The time distribution of traffic volume on the Bypass might be expected to be comparable to that on alternative and connecting routes in the area of the Bypass since it is traffic diverting from those routes or connecting with those routes which will represent a significant portion of the utilization of the Bypass. For example, the Bypass will be connected to Highway 400 (Intermediate Commuter/Commuter Tourist Recreation traffic pattern in that area) and Highway 404 (Intermediate Commuter traffic pattern in that area) and might be expected to exhibit comparable volume and vehicle class distributions over time to these facilities;
- Expressway-oriented trips, such as long-distance commercial vehicle trips using the proposed Bypass to connect between Highways 400 and 404, might be expected to use the Bypass, regardless of the time of day and provided the toll is not excessive, to avoid leaving the expressway system. In addition, there is typically a higher proportion of commercial vehicles (relative to autos) using the expressway system during off-peak periods, including the overnight period.

In terms of the selection of analogous highways, the following were identified for consideration:

- ***407ETR*** - selected since it is a tolled highway and traverses areas covering a variety of levels of urban intensity. However, it is also an alternative route for Highway 401, which is a major corridor for both urban and long-distance/international traffic, which may bias the time-distribution of traffic.
- ***Highway 407 East*** - selected since it is a tolled highway and traverses areas of lower urban intensity. However, as an extension of the Highway 407ETR corridor, it also serves as an alternative route for Highway 401;
- ***Highway 400 and Highway 404 in the vicinity of the Bypass*** - although these highways are untolled, they were selected since they are reflective of travel patterns in the area of the Bypass and traffic on the Bypass will likely also be using one or both of these highways;

- ***York Road 31 (Davis Drive) between Highway 400 and Highway 404*** - although this road is not an expressway and is not tolled, it is the most proximate and most obvious alternative route for traffic that might otherwise use the Bypass.

Available traffic count data was compiled for these analogous facilities as follows:

407ETR:

- Cordon Count data for 18 stations distributed across the GTA - class-specific data, available hourly between 6 AM and 8 PM for an average weekday;
- 24/7 class-specific MTO VDS data for a single station located just north of the Freeman interchange.

Highway 407 East:

- 24/7 MTO VDS data for 3 stations.

Highway 400:

- Cordon Count data for 2 stations in the vicinity of the Bypass;
- 24/7 MTO VDS data for 2 stations in the vicinity of the Bypass;
- Commercial Vehicle Survey data - class-specific 24/7 VDS data for a single station near King Road.

Highway 404:

- Cordon Count data for 2 stations in the vicinity of the Bypass;
- 24/7 VDS data for 2 stations in the vicinity of the Bypass.

York 31/Davis Dr:

- Cordon Count data for 2 stations parallel to the Bypass

A comparison of hypothetical expansion factors based on observed traffic volume time distributions for the above analogous highways was conducted, yielding Table B-1 and Figure B-1. All factors are based on the total of all vehicle classes and both directions of travel to facilitate comparison. Blank cells indicate that the data was not available. These factors are not used directly in the expansion process but they have been derived from that process to facilitate comparison. The AM peak hour to annual expansion has been subdivided, based on the data available, and for discussion purposes, into four steps: AM peak hour to 14-h, 14-h to 24-h (average weekday), average weekday to average week, and average week to annual.

AM peak hour to 14-h (6 am to 8 pm): It is observed that the 407ETR is characterized by lower implied expansion factors in the range of 8.0 to 9.5 for the AM peak hour to 14-h expansion, while all of the other 'candidate' facilities are in the range of 10.3 to 12.6. As discussed above, this is not unexpected in the case of a tolled facility. Traditionally, the peak hour has been considered to include about 10% of the daily volume, implying an expansion factor from the AM peak hour to 24 hours of 10. In urban areas, such as the GTA, peak spreading due to congestion, an increase in 'non-traditional' working hours, and other factors have reduced this over time to about 8-9%, increasing the expansion factor from the AM peak hour to 24 hours to somewhere between 11 and 12. However, in areas outside the GTA, especially for a tolled facility, somewhat lower factors might be more appropriate.

14-h to 24-h (average weekday): The tolled facilities exhibit a lower factor here (around 1.1) relative to the untolled facilities (around 1.2), not unexpected given the discussion above.

Average weekday to average week: There is less variation among these factors, all being between 6.4 and 7.2.

Average week to annual: For this factor, weeks with statutory holidays (10 holidays annually) were adjusted by substituting a typical Sunday pattern for the holiday, yielding a calculated factor of 51.25.

MTO indicated that they have a standard expansion factor for average weekday to annual of 300. Table B-3 provides a comparison between this value and the equivalent 'calculated' factors based on the above discussion.

Table E-1: *Comparison of expansion factors based on observed time distributions*

Highway/section				
	AM peak hour ⇨ 14-h	14-h ⇨ 24-h	AM peak hour ⇨ 24-h	24-h ⇨ 7 days
407ETR in the Region of Halton (Cordon Count data - 6 stations)	8.33			
407ETR in the Region of Peel (Cordon Count data - 5 stations)	8.39			
407ETR in the Region of York (Cordon Count data - 6 stations)	8.86			
407ETR in the Region of Durham (Cordon Count data - 1 station)	8.04			
407ETR north of Hwy 403/QEW (MTO VDS data - 1 station)	9.56	1.09	10.4*	6.39
Highway 407 East (MTO VDS data - 3 stations)	10.29	1.10	11.3*	6.97
Highway 400 near the Bypass (Cordon Count data - 2 stations)	12.64			
Highway 400 near the Bypass (MTO VDS data - 2 stations)	12.53	1.20	15.0*	6.84
Highway 400 at King Road (CVS data - 1 station)	12.06	1.21	14.6*	7.18
Highway 404 near the Bypass (Cordon Count data - 2 stations)	12.91			
Highway 404 near the Bypass (MTO VDS data - 2 stations)	11.11	1.18	13.1*	6.54
* derived from the AM peak hour ⇨ 14-h and 14-h ⇨ 24-h factors				
York 31/Davis Dr near the Bypass (Cordon Count - 2 stations)	12.16			

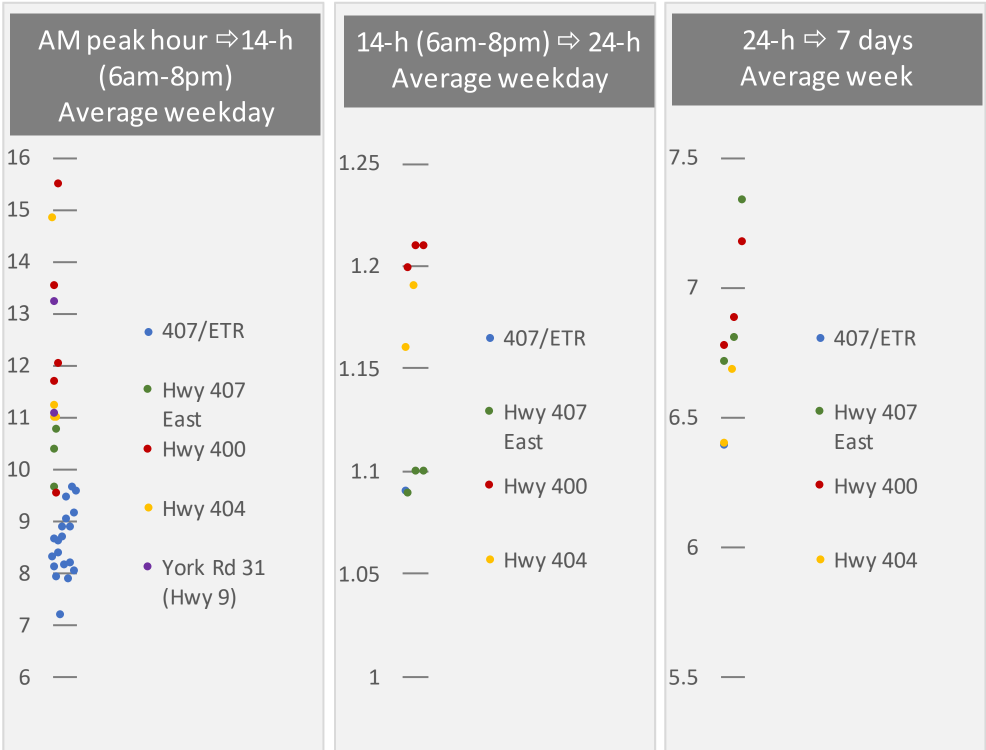

Figure E-1: *Comparison of expansion factors based on observed time distributions*

Table E-2: Comparison of equivalent expansion factors (VKT) from an average weekday to annual

	Baseline calculated factors based on observed data		MTO factor
	Average weekday to annual	Average week to annual	Average weekday to annual
Autos/light trucks	346	51.6	
Medium (single-unit) trucks	259	50.7	
Heavy (multi-unit) trucks	268	50.4	
All vehicle classes combined	339	51.6	300

Notes:
1 An average weekday is considered the average of Tuesday, Wednesday, and Thursday
2 An average week does not include a statutory holiday
3 Annual includes substitution of Sunday conditions for statutory holiday conditions

After considering all of the above, the expansion process for utilization/VKT adopted for the purposes of this evaluation is as follows:

Two options were developed for the AM peak hour to average weekday portion of the expansion:

- Baseline (conservative) - based on observed data for the 407ETR

- High - based on a combination of observed data for Highway 407 East, Highway 400, Highway 404, and YR31

Two options were also developed for the average weekday to annual portion of the expansion:

- Baseline (conservative) - using the MTO factor of 300
- High - based on observed data for 407ETR

Combining the above component options yields four 'overall' options. From (nominally) most conservative (lowest annual VKT, revenue, etc.) to least conservative (highest annual VKT, revenue, etc.)

- A (Baseline/conservative) - AM peak hour to average weekday expansion based on 407ETR data and average weekday to annual expansion based on MTO's 300 factor;
- B - AM peak hour to average weekday expansion and average weekday to annual expansion based on 407ETR data;
- C - AM peak hour to average weekday expansion based on a combination of Highway 407 East, Highway 400, Highway 404 and YR31 data and average weekday to annual expansion based on MTO's 300 factor;
- D - AM peak hour to average weekday expansion based on a combination of Highway 407 East, Highway 400, Highway 404 and YR31 data and average weekday to annual expansion based on 407ETR data;

Components of the process that are based on observed data utilize a spreadsheet tool based on vehicle class-specific hourly traffic volume distributions over an average week that are expressed as a ratio relative to the AM peak hour for an average weekday. The following assumptions were incorporated in this process:

- All calculations in the expansion process utilize bi-directional traffic volumes.
- All data used is representative of spring and/or fall conditions to approximate average seasonal conditions. In some cases, spring data was not considered since the March Break was included.
- The vehicle classes considered are autos/light trucks, medium (single-unit) trucks and heavy (multi-unit) trucks to be consistent with the current tolling structure for 407ETR and Highways 407 East, 412, and 418.

E-3 Revenue expansion

The expansion process for revenue is similar to that for VKT except that the hourly traffic volume factors are 'weighted' by the appropriate day of week/time of day/vehicle class toll rates from the Highway 407 East tolling structure (see Table 2-1).

E-4 Travel time/VHT expansion

For the evaluation of travel time benefits, it is necessary to have a means of expanding VHT from AM peak hour to annual levels. While a variety of sources of hourly traffic volume data could be utilized in the development of a VKT (and revenue) expansion process, no comparable sources of hourly travel time distribution data are available. In general, and particularly in the case of facilities that are heavily congested during the peak periods, it would be expected that VHT would be more heavily concentrated in the peak periods.

For the AM peak hour to 14-h (6 am to 8 pm) portion of the expansion, we investigated the use of hourly traffic volume distributions produced via traffic micro-simulation for the more northerly portions of Highway 410 and Highway 404 during the Managed (HOT) Lanes study. However, these distributions were not found to be representative, in that peaking in the northbound direction during the PM peak period was 'muted' due to traffic metering further south.

It was therefore decided to use the VKT expansion process for the expansion of VHT values. Given that the changes in traffic volume patterns that occur as a result of tolling the Bypass are largely focused on facilities in the area of the Bypass, which are typically only moderately congested, this was believed to be a reasonable approach.

Appendix F
ASSUMED BYPASS CONSTRUCTION COSTS

Bypass construction cost estimate

Neither a construction cost estimate, nor a preliminary design, was available for the evaluation of the payback period for Bypass construction in the context of potential revenue available through tolling of the Bypass. Therefore, a rough cost estimate was prepared as a placeholder based on the assumptions outlined below, in conjunction with MTO's Parametric Estimating Guide (2016).

Cost	Item	Quantity/notes
Initial construction of 4-lane Bypass in 2031		
$73M	Roadway/interchange construction cost	14.5 km of 4-lane highway @ $5.005M/km
$295M	Structure costs (assuming interchange structures are included in the roadway/interchange construction cost) Note that these costs are based on a 'line on a map' that shows only interchange locations. There is no information currently available on the number and size of structures.	Holland River E - 550m x 35m (Bypass over) Holland River W - 920m x 35m (Bypass over) Yonge - 25m x 35m - (Bypass over) Holborn - 35m x x25m (Bypass under) Railway - 15m x 35m (Bypass over) Artesian Industrial Pkwy - 32m x 35m (Bypass over) 10th Sideroad - 35m x 25m (Bypass under) Total 55,720 sq.m. deck area @ $5,300/sq.m.
$80M	Culvert costs The number of culverts was estimated based on the number of streams crossing the Bypass alignment as shown on a map.	Approximately 11 culverts - 3.6m x 37.9m Total 15,000 sq.m. deck area @ $5,300/sq.m.
$448M	Subtotal	
$45M	Add 10% for engineering costs	
$14M	Add 3% for lighting costs	
$9M	Add 2% for signing and related costs	
$24M	Tolling system costs	
$540M	Total	
Widening from 4 to 8 lanes in 2041		
$139M	Roadway widening cost	14.5 km of 4-lane widening @$9.57M/km