

Bradford Bypass Tolling Evaluation - Development of scenarios, including sensitivity analysis.

Background notes - Toll rate and value-of-time/willingness-to-pay sensitivity:

- Theoretically, value of time (VoT) and willingness-to-pay are not necessarily the same. However, in the context of this evaluation and related discussion, they both refer to the same value so that the term VOT will be used for simplicity. Tables 1 and 2 summarize some recent relevant information on toll rates and VoT values. Note that the toll rates currently in use for Highway 407 East/412/418 will be used as a starting point for the proposed Bradford Bypass and that the underlying modelling will be undertaken for the AM peak hour.

Table 1: Current AM peak period toll rates for Highway 407 East/412/418

	autos/light trucks (LV)	single-unit trucks (SU)	multiple-unit trucks (MU)
2017 (opening)	29 ¢/km	58 ¢/km	87 ¢/km
June 2019*	29.66 ¢/km	59.32 ¢/km	88.97 ¢/km

* Note that the toll rates for Highway 407 East/412/418 have been frozen at the June 2019 levels due to the COVID pandemic.

Table 2: Relevant VOT estimates

	single-occupant auto (SOV)	auto with 2 persons (HOV2)	auto with 3 or more persons (HOV3+)	light truck (LT)	medium truck (MT)	heavy truck (HT)
Based on stated-preference survey conducted in 2015 for 5-corridor HOTL evaluation	\$20.25/h	\$23.30/h	\$26.12/h	Not surveyed/not used		
Starting (default) values for calibration of GGHM for current evaluation	\$20/h	\$23/h	\$26/h	\$35/h	\$50/h	\$70/h
As adjusted during GGHM calibration process to obtain appropriate allocation of traffic to tolled highways vs. untolled highways. Used as baseline for current evaluation - in \$2016.	\$36/h	\$42/h	\$47/h	\$54/h	\$81/h	\$97/h
<p>Note that:</p> <p>LV (autos/light trucks) ~ Σ (SOV, HOV2+, HOV3+, LT)</p> <p>SU (single-unit trucks) ~ MT (medium trucks)</p> <p>MU (multiple-unit trucks) ~ HT (heavy trucks)</p>						

- Toll rates and the value of time (VOT) are both represented in the generalized cost equation (below) used in the GGHM as the basis for assigning traffic to tolled vs. untolled route alternatives. Note that the perception factor (Perc. Factor) has been used as a calibration factor in attempting to achieve the appropriate balance between the utilization of tolled vs. untolled route alternatives. This factor can also be interpreted as incorporating the inability of many drivers to be able to accurately estimate the time they will save by using a tolled route over an untolled route and/or the value to them of this time savings. Observations reported in the literature suggest that drivers tend to overestimate the value of the time saved and overpay for the savings they actually achieve.

$$\text{Generalized Cost} = \frac{\text{Rate} * \text{length} * 60}{\text{VOT}} * \text{Perc.Factor}$$

(Rate = toll rate, VOT = value of time)

An increase in toll rate or a decrease in VOT would both lead to a decrease in utilization and vice versa. However, there is a slight asymmetry in the effect calculation so that an X% increase in toll rate would not have precisely the same effect as an X% decrease in VOT. In addition, although toll rates and VOT are both vehicle-class-specific, the class structure is slightly different in each case. However, it is still redundant to evaluate sensitivity with respect to both toll rate and VOT since an increase in toll rate can be expressed as an equivalent (in terms of the impact on utilization) decrease in VOT. The results from the sensitivity scenarios with respect to toll rate will be used to construct a pseudo-elasticity relationship between toll rate and utilization and to facilitate the selection of a pseudo-optimum combination of toll rate and utilization in the context of policy objectives.

Specification of scenarios for evaluation

The following discussion covers the selection of baseline and sensitivity scenarios for evaluation. All scenario evaluation will be based on \$2016 and any adjustments required will be based on the 1.56% rate of inflation assumed by MTO for similar calculations.

A table summarizing the scenarios is also provided.

Scenario 1: a 2031 baseline scenario without any tolls.

Scenario 2: a 2031 tolled baseline scenario where:

- Toll rates are those currently used for Highway 407 East/412/418 (2019 rates adjusted to \$2016);
- VoT values are those adjusted through the GGHMv4 calibration/validation process;

Scenarios 3 through 9: 2031 toll rate sensitivity scenarios where:

- Toll rates by vehicle class are varied relative to those used for the baseline scenario Highway 407 East/412/418. Note that the original intention was to vary the rates by ±10%, ±20%, etc. However, due to a misunderstanding concerning the rates built into the GGHM model provided by MTO, these variations are somewhat different for scenarios already run. The only implication is that the resulting toll rate/utilization/revenue points on any curves graphed from these points will be located differently along such curves - the curves themselves will be unaffected.;
- VoT values are those developed through the GGHMv4 calibration process;
- Table 3 shows resulting toll rate assumptions for the AM peak hour and shows AM peak hour 407ETR toll rates for the 'light zone' for 2016 for comparison. Rates at other times of the day (outside the AM peak period) would be adjusted similarly for revenue calculation purposes.

By varying the toll rate, and estimating the utilization of the Bypass and the revenue at each toll rate level, it is anticipated that relationships between these (pseudo-elasticities) can be identified and 'optimum' conditions can potentially be identified in accordance with MTO objectives concerning utilization and revenue.

Table 3: Sensitivity toll rate assumptions, including comparable 407/ETR toll rates, for the AM peak hour in 2016

Scenario		autos/light trucks (LV)	single-unit trucks (SU)	multiple-unit trucks (MU)
all rates in ¢/km2016				
3	Baseline rate -54%	13.0	26.0	39.0
4	Baseline rate -27%	20.8	41.6	62.4
5	Baseline rate -17%	23.4	46.8	70.2
6	Baseline rate -8%	26.0	52.0	78.0
2	Baseline rate (2019 rates for Hwy 407 East/412/418 adjusted to \$2016)	28.3	56.6	84.9
7	Baseline rate +1%	28.6	57.2	85.8
8	Baseline rate +10%	31.2	62.4	93.6
9	2016 rate for 407/ETR (equivalent to baseline rate +26%)	35.7	71.3	107.0
10	Baseline rate +38%	39.0	78.0	117.0
11	Baseline rate +84%	52.0	104.0	156.0

Scenario 12: a 2031 scenario approximating the 'optimum' balance between utilization and revenue as identified from evaluation of Scenarios 3 through 11. Where this optimum balance lies with respect to toll rate vs. utilization vs. revenue will have to be discussed with MTO staff in the context of their policy objectives.

Scenario 13: a 2041 baseline scenario without any tolls. Note that the cross-section of the Bypass will be increased to 3 general-purpose lanes plus a single HOV lane in each direction for this scenario. The outcome will be reviewed to confirm or modify the use of this cross-section for other 2041 scenarios.

Scenario 14: a 2041 tolled baseline scenario where:

- Toll rates are those currently used for Highway 407 East/412/418 (2019 rates adjusted to \$2016);
- VoT values are those adjusted through the GGHM calibration process;

Other sensitivity scenarios:

For example:

- Truck toll rates increased or decreased relative to light vehicle toll rates - to be discussed with MTO.
- Distinct toll rates for HOV2 and/or HOV3+ autos for 2041 in conjunction with the proposed HOV lanes - to be discussed with MTO. There is currently no precedent for this on the Provincial highway system. On the one hand, toll rates could be increased for HOVs in

recognition of the higher VoT (and the passengers accommodated within the toll) - on the other hand, toll rates could be reduced for HOVs in recognition of MTO policy objectives.

Toll rate sensitivity testing for 2041 is not proposed - such sensitivity can be inferred from the 2031 scenarios.

Separate VoT sensitivity testing is not proposed. As noted previously, sensitivity to changes in VoT can be expressed as sensitivity to equivalent changes in the toll rates.