Toll Revenue and Traffic Study of Highway 407 in Toronto

ALI MEKKY

The Greater Toronto Area (GTA) is one of the fastest growing urban areas in North America, with a population of about 5 million, growing at the rate of 3 percent per year. Highway 407 (a six/four-lane freeway), in the GTA has been considered for many years as a relief for Highway 401, the busiest highway in North America, which is used by more than 1 million vehicles per day. Highway 407 is being planned and constructed as a toll highway. This paper includes results of a study to estimate Highway 407 future traffic and toll revenues. GTA mathematical model, within the EMME/2 environment, was used to estimate the travel conditions in the network and the revenue potential under various scenarios of horizon years/network combinations (5), time periods (3), toll levels (8), and toll collection technologies (3). The demand and the toll revenue estimation processes are described. The solutions adopted for the problems of overassignment, the estimation of the value of time, participation rates, and the ramp-up effect are explained. It is concluded that Highway 407 can generate substantial revenues, which might make it a self-financing facility. It will relieve Highway 401 and Highway 7 from part of their volumes and will decrease travel time for its users and some of the nonusers. It will also decrease travel time variability, improve accessibility to Pearson International Airport, and create jobs. On bad-weather days, some of the benefits are expected to increase.

The Greater Toronto Area (GTA) is one of the major urban areas in North America, with a population of about 5 million (1994), increasing at the rate of 3 percent per year (1986 to 1991). It is located in the southwestern part of Ontario, Canada (Figure 1). It extends over 8,200 sq km and consists of Metropolitan Toronto (population 2,400,000) and the Regional Municipalities of Peel (760,000), York (530,000), Durham (430,000), Halton (330,000), and Hamilton-Wentworth (460,000).

In the late 1950s, the Province of Ontario started the planning process for the development of Highway 407, a 130-km multilane freeway, to the immediate north of Metropolitan Toronto (Figure 1). Initially, the highway was envisaged as a new Toronto bypass that would provide relief to the congested Highway 401, which could not be widened in most of its sections in the GTA. At present, and after the high growth that occurred during the last three decades, Highway 407 is in the heart of the urban area of the GTA. The highway is considered to have urban, regional, interregional, interprovincial, and international functions for both person and freight traffic (*1*).

The entire Highway 407 extends from Highway 403 in the west near the Peel/Halton regional boundary to Highway 35/115 in the east, west of the Durham/Northumberland boundary. At present, the section under consideration extends over 67 km from Highway 403 in the west (at Halton/Peel boundary) to Highway 48 in the east, west of the York/Durham boundary (Figure 1). Over the last 6 years, a short section (8 km) of Highway 407 has been under construction. However, at that rate of construction, it could take more than 25 years to complete the highway.

Growing travel demand in the Highway 407 corridor, coupled with the unavailability of funds to speed up the construction of the highway has prompted the Ontario government to consider entering into a private/public joint venture to build the highway as a toll facility. In February 1993, the Premier of Ontario announced the provincial government's decision to accelerate the construction of Highway 407 using toll revenues.

In August 1993, two consortia completed a value engineering assessment of the project. This process identified savings of about $200 million on the Highway 407 project aside from $100 million in savings, which was identified through competitive bidding. The consortia then submitted proposals to finance, design, build, maintain, and operate the highway. After a comprehensive evaluation process, Canadian Highways International Corporation was selected and a contract worth $929.8 million was signed in May 1994. Financing the construction of the highway, however, will be done through a Crown agency (Ontario Transportation Capital Corporation).

Highway 407 will be constructed as a six/four-lane freeway. The first sections to be opened by the end of 1996 are from Highway 410 to Highway 404 (36 km). This will be followed by the sections to the east of Highway 404 to Highway 48 and to the west of Highway 410 to Highway 403, which will be opened by the end of 1998.

Several studies have been initiated by the Ontario government to determine the optimal geometrics of the highway as well as the traffic, toll levels, toll technology, etc. Also, various surveys were conducted to collect needed data and information—for example, focus group surveys (100 people surveyed), origin-destination surveys (21,000 questionnaires returned and coded), an incidence survey (1,000 people surveyed), and a stated preference survey (1,850 surveyed).

The objective of this paper is to describe the methodology and the results of one of those studies, namely, the traffic and revenue study. A similar study commissioned by the Ministry of Transportation, Ontario (MTO) was carried out simultaneously yet independently by a consultant (Wilbur Smith Associates). The results of that study are not reported in this paper.

Initially, three toll collection technologies were considered: (*a*) the closed cash-barrier system, (*b*) the fully electronic system, and (*c*) the "mixed" system. The latter is a combination of the fully electronic and the cash systems. At a later stage of the study, it became apparent that the electronic system has many advantages, and accordingly, the manual one was dropped from further consideration.

The traffic and revenue estimation study for Highway 407 in the GTA began in January 1993, and included the following objectives:

Transportation Demand & Forecasting Office, Transportation Systems Planning Branch, Ministry of Transportation, West Tower, 3rd Floor, 1201 Wilson Avenue, Downsview, Ontario M3M 1J8, Canada.

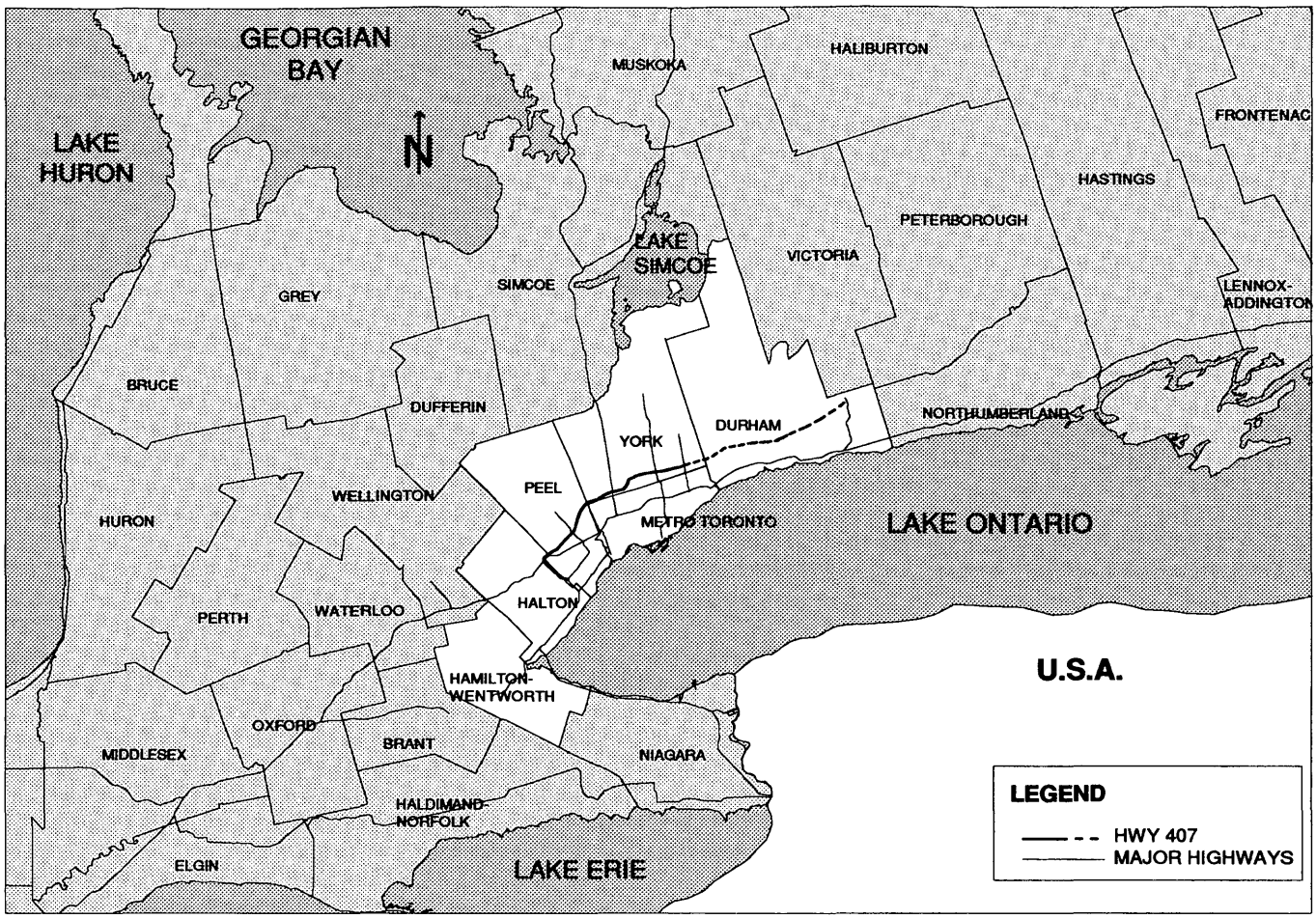


FIGURE 1 Highway 407 project.

- To evaluate the travel and traffic conditions on Highway 407;
- To estimate the highway toll revenues;
- To evaluate the effect of Highway 407 on the major provincial facilities in the area particularly on Highway 401 and Highway 7. Both highways are aligned in an east-west orientation; and
- To evaluate the effects of Highway 407 on municipal facilities.

Many scenarios were expected to be evaluated. They included combinations of networks, time periods, toll levels, and toll technologies.

This study has an emphasis on describing the activities and some of the results related to the first two objectives.

THE GREATER TORONTO AREA

Population, Employment, and Car Ownership Growth, 1986 to 1991

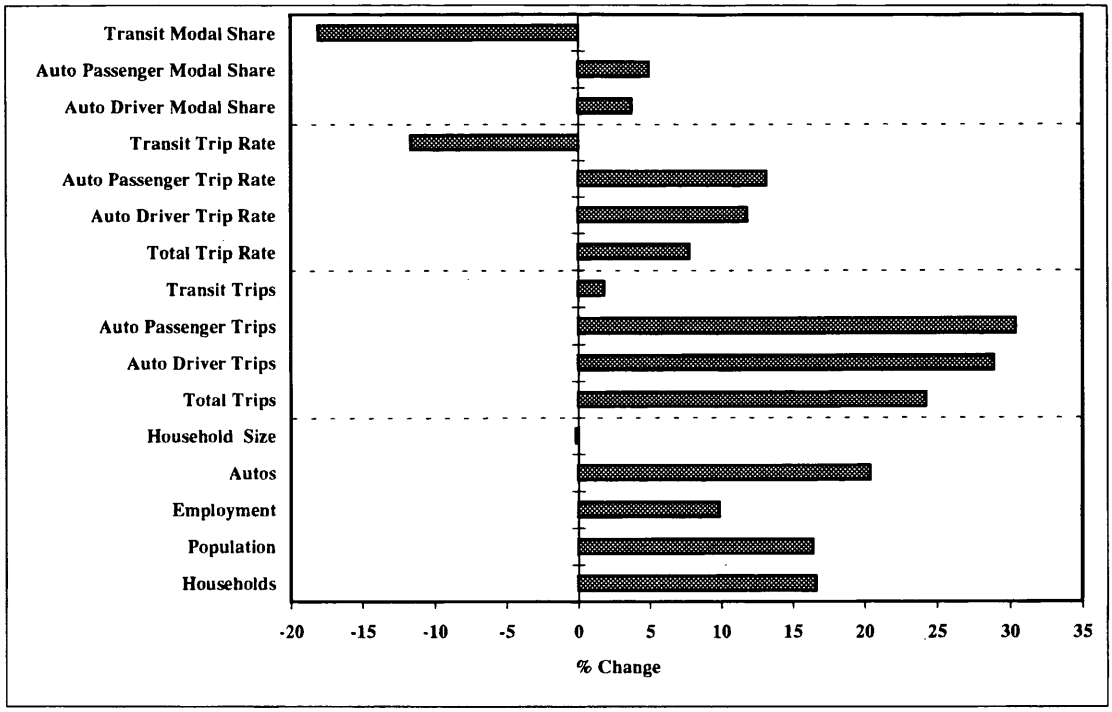
Over the last few years, the GTA has been experiencing significant growth in population, employment, and car ownership. Between 1986 and 1991, as shown in Figure 2, population and employment grew by 16 percent and 10 percent, respectively. The number of active automobiles increased by 20 percent. Accordingly, automobile driver trips grew by about 29 percent whereas transit trips grew by only 2 percent. As a result, the automobile driver and passenger modal shares grew by about 4 percent and 5 percent, respectively, whereas the transit modal share declined by 18 percent.

The population growth has not been uniformly distributed throughout the area. Between 1986 and 1991, Metropolitan Toronto population grew by about 4 percent while York experienced an explosive growth of about 43 percent. The regions of Peel and Durham increased by about 23 percent and 27 percent, respectively.

Currently, approximately 10 million person-trips are made daily in the GTA. One of the reasons for the large number of interregional trips in the GTA is the imbalance between jobs and the labor force. Metro Toronto had a significantly higher jobs/1,000 population ratio than any of the other regions in the area (601 in 1991). For the same year, that ratio was 521 for Peel, 500 for York, 390 for Durham, 452 for Halton, and 415 for Hamilton-Wentworth.

Travel Conditions in the Greater Toronto Area

As previously discussed, the rapid growth in the GTA has taken place in the regions west (Peel) and north (York) of Metro Toronto. This has resulted in a significant increase in the number of trips in the area, particularly the east-west ones. Those movements are



	1986	1991	Change	% Change
Households	1,466,000	1,710,000	244,000	17
Population	4,063,000	4,729,000	666,000	16
Employment	2,237,000	2,458,000	221,000	10
Autos	1,852,000	2,230,000	378,000	20
Household Size	2.77	2.77	0.00	0
Daily Person Trips for 11+:				
Total Trips	8,161,000	10,140,000	1,979,000	24
Auto Driver Trips	4,930,000	6,356,000	1,426,000	29
Auto Passenger Trips	1,160,000	1,513,000	353,000	30
Transit Trips	1,342,000	1,367,000	25,000	2
Daily Person Trip Rates for 11+:				
Total Trip Rate	2.34	2.52	0.18	8
Auto Driver Trip Rate	1.41	1.58	0.17	12
Auto Passenger Trip Rate	0.33	0.38	0.04	13
Transit Trip Rate	0.38	0.34	-0.04	-12
Modal Shares:				
Auto Driver Modal Share	0.60	0.63	0.02	4
Auto Passenger Modal Share	0.14	0.15	0.01	5
Transit Modal Share	0.16	0.13	-0.03	-18

Source: Transportation Tomorrow Surveys, 1986 and 1991

FIGURE 2 Changes in travel-related characteristics in the GTA between 1986 and 1991.

served by several facilities, the most notable ones are Highway 401, mainly a 12-lane freeway, and Highway 7, a 6-lane arterial. Highway 401 is the busiest highway in North America. It carries more than 1 million vehicle trips every day over its Peel/Metro portion. The annual average daily traffic (AADT), at its maximum point, was 351,000 vehicles in 1992, where the highway has 14 lanes. The summer annual weekday traffic at that location was 404,000 vehicles in the same year. The rate of growth over the past 15 years was 2.8 percent.

Highway 7, a six-lane, east-west arterial is also very busy. The AADT, at its maximum point, was about 61,000 vehicles in 1992. The summer annual weekday traffic at that location was 67,000 vehicles in the same year. The rate of growth over the past 15 years was 2.5 percent.

Currently, the volumes on some sections of the major highways in the GTA are at or near capacity. That is particularly true for Highway 401 and Highway 7 in the Metro/York and Peel regions. One of the recent studies in the GTA has estimated that congestion costs the GTA economy about $2 billion every year in wasted activities and lost productivity.

Therefore, in view of the current levels of congestion and the expected growth in population and employment, the need for

improving both the highway and the transit systems has become increasingly necessary. Particularly, the need for a major east-west facility, Highway 407, has become urgent.

THE MATHEMATICAL MODEL

The MTO maintains a strategic mathematical model covering the entire GTA. The model has 1,366 zones, about 5,000 nodes, and 19,000 links. It is continuously updated and used in various planning and policy studies undertaken by the MTO, the regional municipalities, or both. One of the current studies using that model is the planning for Highway 407 and the evaluation of the effects of tolling it.

The GTA model is a traditional sequential four-stage model (Figure 3). It contains modules for the a.m. peak hour, the p.m. peak hour, and the off-peak hour. It uses regression analysis for trip generation, a Gravity model for trip distribution of work trips (and Fur-

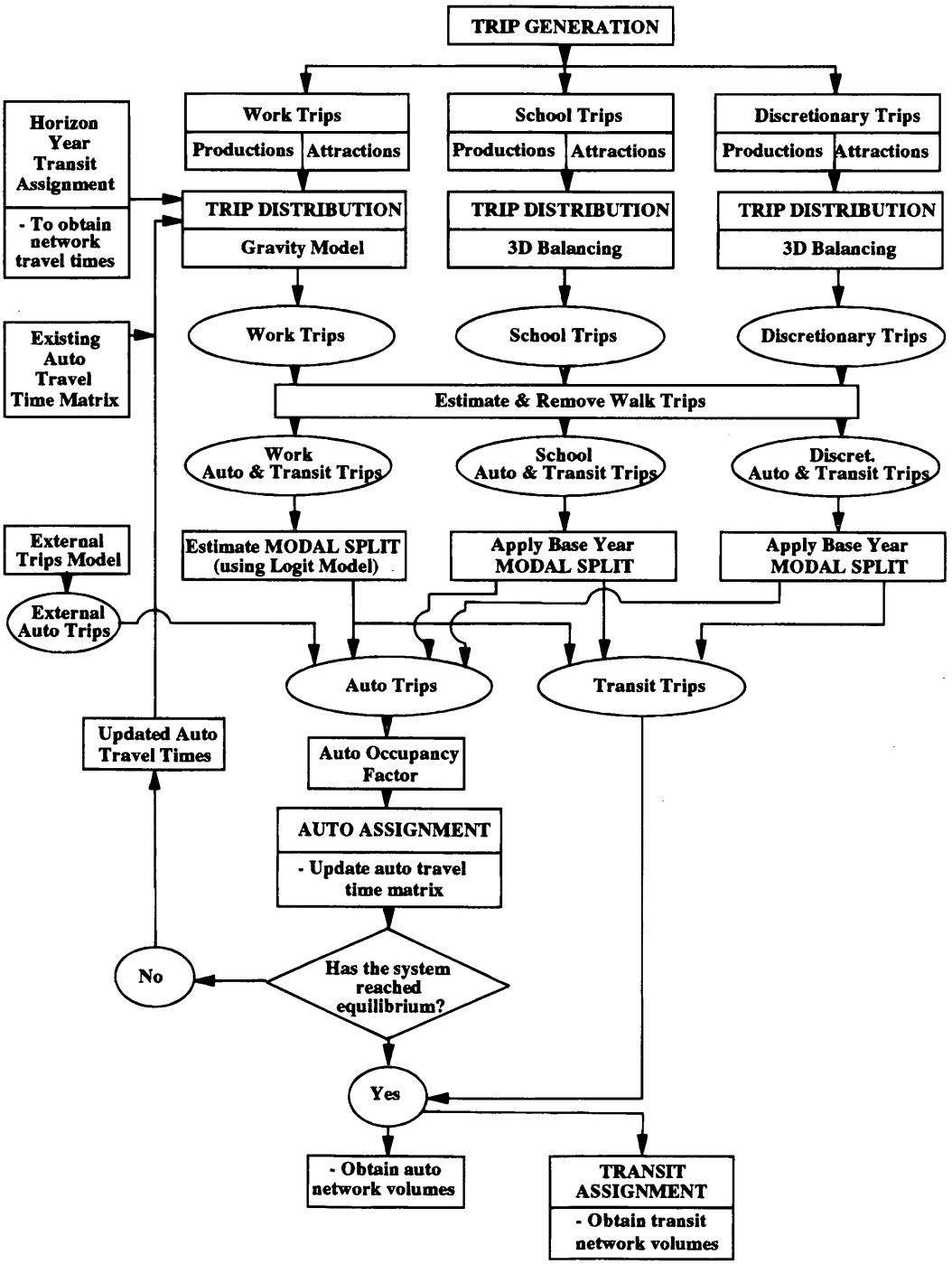


FIGURE 3 GTA travel forecasting model.

ness method for the other purposes), a Logit model for modal split of work trips, and an Equilibrium Assignment for trip assignment. The model operates within the transportation planning package EMME/2.

The main source of travel data available for transportation planning studies in the area is the Transportation Tomorrow Survey (TTS), a household telephone survey conducted in 1986. The coded data base includes the travel patterns for about 61,000 households. The technique included the tolling effect on Highway 407 by adjusting its volume-delay function (which accounts for the effects of distance and congestion only) to incorporate the effect of the tolls.

Effective Delay = Distance and Congestion Effects + Toll Effect

The Distance and Congestion effects were taken to be a Bureau of Public Roads (BPR) function of the form

$$\tau = \tau_0[1 + \alpha(v/c)^{\beta}]^*L$$

where τ and τ_0 are the link actual travel time and free flow travel time, respectively: $\alpha = 1$, $\beta = 6$.

The toll effect was taken to be

$$T^*L/V$$

where

T = toll in cents/km;
L = link length;
v = volume;
c = capacity; and
V = value of time.

VALUE OF TIME

Studies in travel behavior cited by Langdon (*2*) indicate that the value of time in travel is about one-quarter the wage rate (post tax). Other studies in San Francisco indicate half of the wage rate. Other studies confirm the use of factors from a half to a quarter. In the first phase of the Highway 407 study, the factor "half" was adopted. Sensitivity runs around that value were carried out. It became clear that the revenue results were very sensitive to the value of time assumed. Therefore, it was important to conduct a survey to measure that value.

Resource Systems Group (RSG) was retained to conduct the survey using an interactive video interview station (IVIS) system and stated preference technique. A self-administered computer-based questionnaire was developed (*3*). For each respondent, information was collected about a recent trip in the Highway 407 corridor, the time/cost trade-offs for that trip, and reactions to features of the proposed electronic system. The IVIS system has the capability of adapting to responses by branching around questions and providing detailed information about choice alternatives based on responses. The exercise was completed for car and commercial vehicle drivers separately. The results showed that the value of time varied by trip purpose, household income, and vehicle type. Travelers on non-work trips were found to have generally lower values of time than work commuters. For work commuting trips, the value of time was found to increase, but less than linearly with household income. For commercial truck trips, the value of time was similarly found to increase, but less than linearly with the number of vehicle axles (*3*).

The final (weighted) estimates of the values of time for the a.m., p.m., and off-peak periods were \$0.17, \$0.19, and \$0.15/min. For commercial vehicles, the calculated value was \$0.33/min. The weights used were the proportions of trips for the various trip purposes within the time periods under consideration.

SCENARIOS INVESTIGATED

The scenarios initially proposed were the combination of horizon years population and employment growth, network improvements, toll technologies, and toll levels.

Population and Employment Growth, 1991 to 2011

In the summer of 1993, the GTA land use planners finalized their work on the expected growth in the area for the horizon years 2001, 2011, and 2021. Five scenarios were produced. Scenario 1 was regarded as the most probable and was used accordingly in this study. Figure 4 shows the regions surrounding Metro Toronto growing at a higher pace than Metro. In fact a significant drop is expected in the Metro share of the population in the region from 54 percent in 1991 to 42 percent in 2011. Similar employment growth is expected in the area, with Metro's employment share dropping from 60 percent in 1991 to 50 percent in 2011.

It is interesting to note that the employment/1,000 population for Metro Toronto is expected to rise even more from 601 to 661, Peel from 521 to 539, York from 500 to 511, and Halton from 452 to 504. The ratio is expected to drop in Durham from 390 to 381 and in Hamilton-Wentworth from 415 to 398. Therefore, the growth patterns are conducive to more growth in the a.m. inbound trips to Metro Toronto.

Future Network Improvements

From the beginning of the study, it became apparent that there are at least two network scenarios that should be considered: (*a*) the base scenario, which included committed and almost committed improvements to the network for the near future (interpreted as the year 1998), with no more improvements until 2021; and (*b*) the sensitivity scenario, which included all the expected improvements at both the provincial and the municipal levels until the year 2021. Officials from the provincial and regional governments were consulted, and the networks were produced.

Time Periods

The a.m. and p.m. peak periods as well as the off-peak period were used.

Toll Technologies

Initially, three toll technologies were investigated; (*a*) manual/automatic coin machines, (*b*) the electronic, with automatic vehicle identification (AVI), and (*c*) mixed systems (AVI with manual/auto-

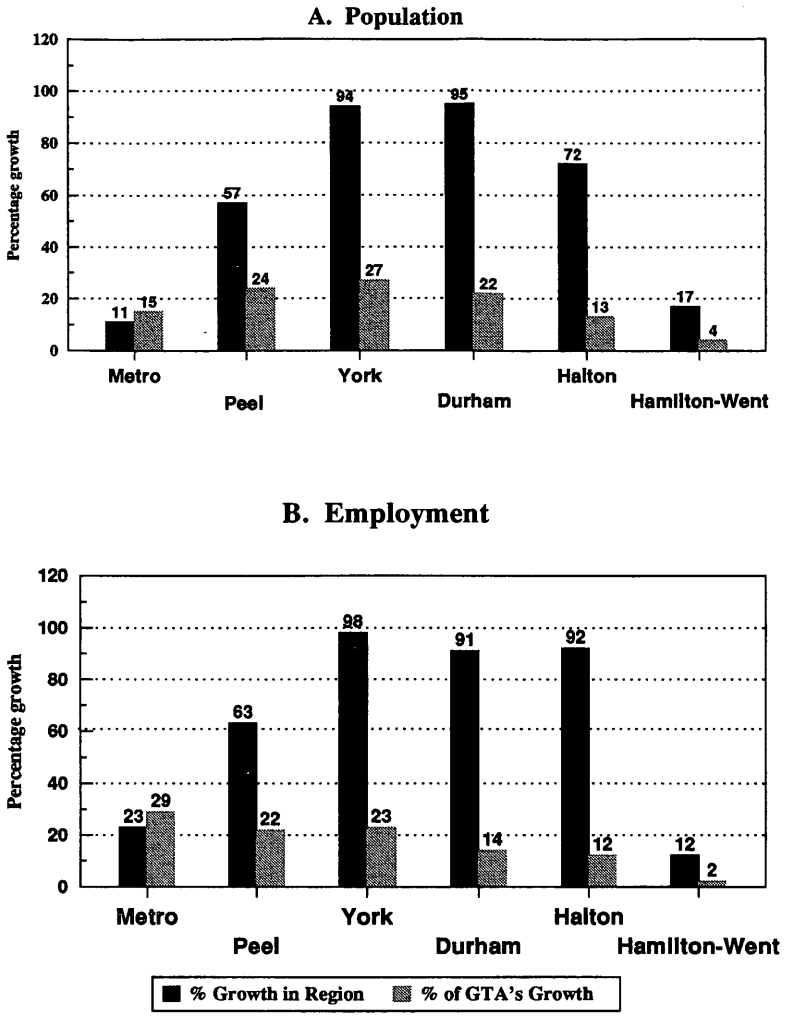


FIGURE 4 Percentage population and employment growth and share of growth in the GTA, 1991 to 2011.

matic coin machines). A later stage of the study concentrated only on the fully electronic technology, and only those results are given.

Toll Levels

Eight toll levels (0, 5, 5.5, 7.5, 10, 15, 20, and 25 cents/km) were considered. The reason for choosing 5 and 5.5 cents/km was to compare the results of the final runs with some previous results.

Summary of Scenarios

At the beginning of the study, the following scenarios were suggested:

- Five horizon years/network improvements combinations: 1998-Base, 2001-Base, 2011-Base, 2011-Sensitivity, and 2021-Base.
- Three time periods: a.m. peak period, p.m. peak period, and off-peak period.
- Three toll collection technologies: manual, electronic, and mixed.
- Eight toll levels: 0, 5, 5.5, 7.5, 10, 15, 20, and 25 cents/km.

These combinations total 360 scenarios. Not all of those scenarios were actually tested using model runs. For instance, the mixed technology scenario was evaluated by weighing the results of the fully electronic and the manual technologies in a worksheet. Based on a survey of a sample of the potential users, assumptions were made to estimate the market share of each technology.

DEALING WITH OVERASSIGNMENT

Overassignment occurs when flows on links exceed their capacities during the modeling process. It takes place, particularly when forecasting travel in congested high-growth areas (*4,5*). Overassignment might happen with almost any assignment technique. Attempting to dampen the overassignment effect by doing more assignment iterations might result in circuitous routes and unrealistically low speeds on the links. Such results are unreasonable in a "steady state" situation, which is the usual operating mode of the majority of the available packages (e.g., EMME/2). Accordingly, the results of such simulation runs are unreliable.

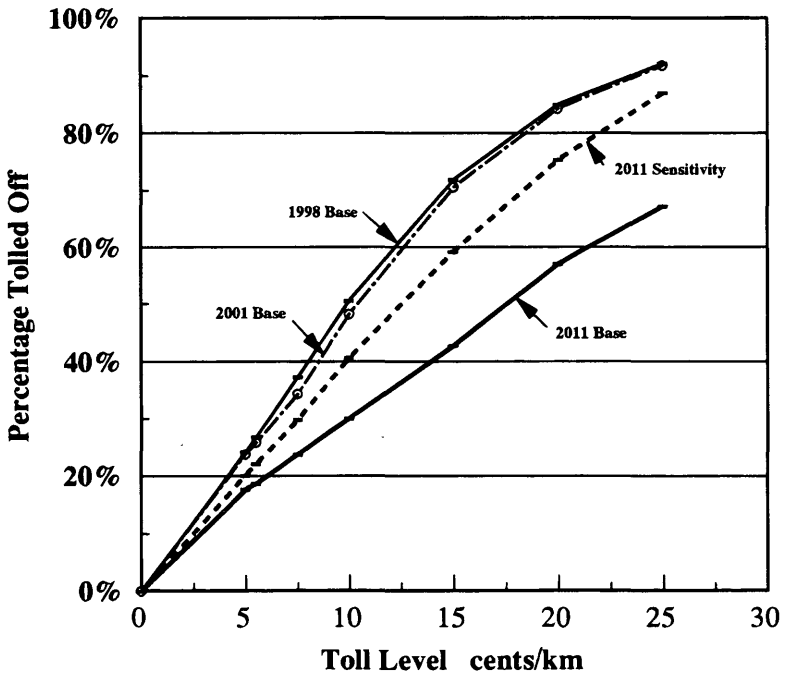
The Matrix Capping technique was used to alleviate the effect of overassignment and is discussed in the literature (*4,5*). Briefly, the steps are:

1. Assign the forecasting year matrix to the network.
2. Identify the links where the volumes (V) significantly exceed the capacities (C), defined as $V/C > 1.1$.
3. Adjust the forecasting year matrix using the capacities of the links where the volumes exceed capacities ($V/C > 1.1$), as the volumes that ought to be reproduced by the adjusted matrix.
4. Go to Step 1 and repeat the iterations until the volumes assigned to the links of the network do not significantly exceed the corresponding capacities.

TRAVEL DEMAND ANALYSIS

Although tolls, in the long run, might affect trip distribution and modal split, an assumption in this study was made that the effect is small because of the availability of reasonable alternatives to Highway 407 (e.g., Highway 7 and Highway 401). Therefore, the main effect of tolls was considered to be on the choice of routes (trip assignment).

Equilibrium assignment was carried out using EMME/2 for various scenarios. The "toll diversion effect" of some of those scenarios is shown in Figure 5. The effect of tolls is very dramatic, especially in the early years. A toll of 5 cents/km in 1998 could divert about 24 percent while a toll of 10 cents/km in 1998 could divert about half of the vehicle km away from Highway 407. The percentage of diversion increases with the increase of the toll level and with the decrease in congestion on the alternative roads. For the same toll level, the percentage diversion in the year 2011 (base network) is less than that in 1998 because in 2011 the congestion levels on alternative routes are worse than in 1998. Accordingly, a higher percentage of the travelers would find it more beneficial to use Highway 407 and pay tolls than to divert and experience long delays. The same idea applies for the year 2011 sensitivity network, which contains more improvements to the network than that of the 2011 base.



Toll	1998 Base	2001 Base	2011 Base	2011 Sen
0.00	00.00 %	00.00 %	00.00 %	00.00 %
5.00	24.17 %	23.72 %	17.61 %	20.04 %
5.50	26.78 %	25.84 %	18.61 %	21.99 %
7.50	37.24 %	34.31 %	23.68 %	29.78 %
10.00	50.55 %	48.24 %	30.01 %	40.67 %
15.00	71.86 %	70.55 %	42.78 %	59.17 %
20.00	84.98 %	84.28 %	57.07 %	75.33 %
25.00	92.17 %	91.80 %	67.17 %	86.98 %

FIGURE 5 Percentage of vehicle.km tolled off Highway 407 as a result of applying tolls, morning peak period.

TOLL REVENUE ANALYSIS

Revenues Under Limited Participation and No Ramp-Up

Preliminary estimates of revenues could be calculated using the simple equation:

Revenue = Vehicle·km * Toll Rate

In dealing with electronic revenue collection, a survey commissioned by MTO has shown that there is a certain percentage of the population that would not accept using transponders for privacy reasons. Therefore, the vehicle.km and the revenues should be adjusted at this stage to account for that limited participation.

In this study, the level of participation was assumed to be 75 percent in 1998. That figure was assumed to increase over time until it reaches 90 percent in the year 2021. These results were based on the stated preference survey discussed above.

Figure 6 shows the vehicle.km driven on Highway 407 during the a.m. peak period for various scenarios. As expected, the number of vehicle.km on Highway 407 decreases with the increase in the toll level. However, that decrease becomes smaller with more growth and less network improvements.

As shown in Figure 7, the revenue increases with the increase in the toll level up to a certain maximum. As the toll level increases further, the revenue decreases. The location of the maximum seems to depend on the degree of congestion in the network. The maximum revenue toll increases over time because of the increase in population and employment and it decreases with more improvement to the network. The latter is shown in Figure 7 with the maximum for the 2011 sensitivity network significantly lower than that for the 2011 base network.

The Effect of Ramp-Up

Like in many other projects, not all the potential users of a highway will start using it from the first day of its opening. This is particularly true for toll projects. To include that effect in the revenue estimation, the so-called "ramp-up" factors were used. Ramp-up factors decrease over time.

For the Highway 407 project the ramp-up factors were applied only to the first 4 years, starting in 1998 with a value of 13 percent (i.e., the revenues were reduced by that amount). That factor decreased over time and reached zero by the year 2003.

Revenue Stream Calculations

Figure 8 shows the growth in revenues from 1998 to 2021 for the toll levels 5.5, 7.5, and 10.0 cents/km for the base network scenario. Two groups of curves are shown, with no phototracking, no ramp-up (NT) and with phototracking and ramp-up (WT).

Simulation runs were carried out for the years 1998, 2001, 2011, and 2021 and for various toll levels. Revenues were calculated for the intervening years by interpolation.

As shown, between 1998 and 2021 for 7.5 and 10 cents/km, the (gross) revenues are expected to more than double. One can also see that there is a substantial increase in revenue if the toll is increased from 5.5 to 7.5 cents/km. However, increasing the toll from 7.5 to 10 cents/km does not cause a major change in revenues. This might have some policy implications. At a later stage of the project, the phototracking concept became an option. Under the phototracking system, passenger cars (trucks excluded) without transponders are allowed to use the road. Their license plates would be "phototracked" from the point of entry to the point of exit from the high-

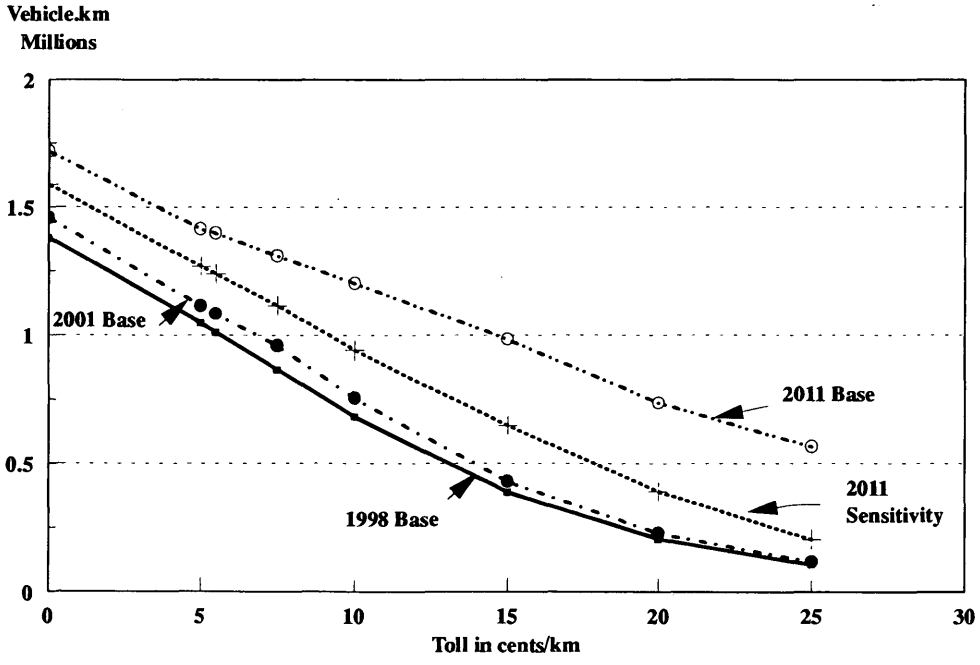


FIGURE 6 Highway 407 morning peak period usage; vehicle.km at various electronic toll levels.

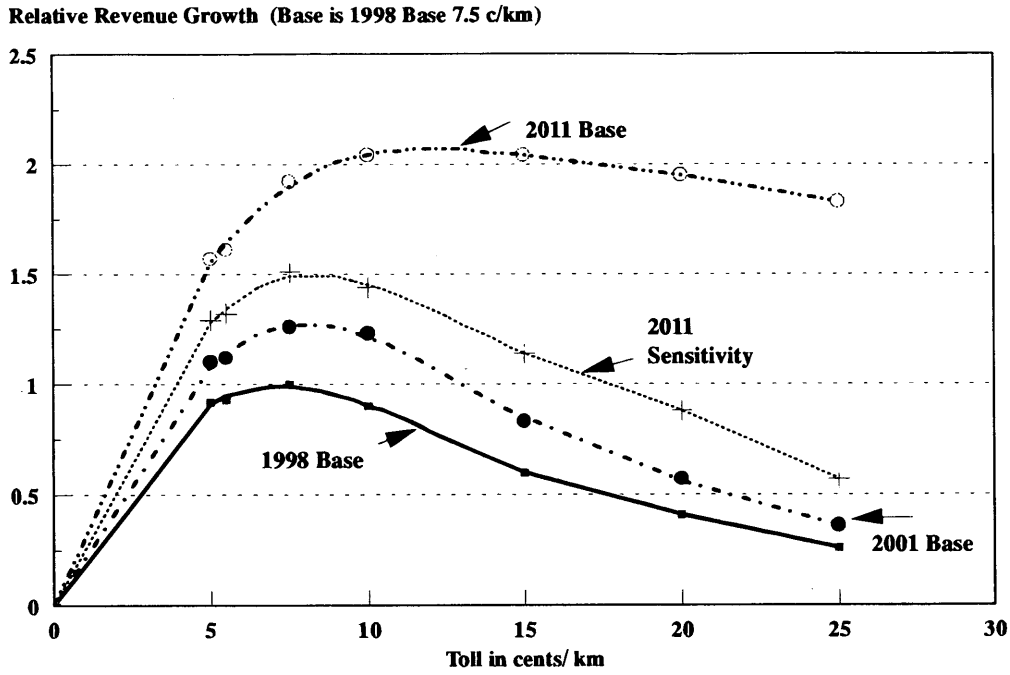


FIGURE 7 Highway 407 annual relative revenue; limited participation, no ramp-up.

way. The vehicle owner will be post-billed. To discourage too many cars from using this system and to cover the extra cost of photo-tracking, its toll rate is taken to be higher than the "transponder" tracking one.

Cost benefit analysis has shown that there is a reasonable chance that the revenues would cover all the costs of the project construction, which has been estimated to be slightly under 1 billion dollars. Runs with more optimistic land uses have shown that the toll revenues might cover even the operations and maintenance costs as well. However, this depends on the stability of interest rates, the inflation rate and the level of tolls in the various years.

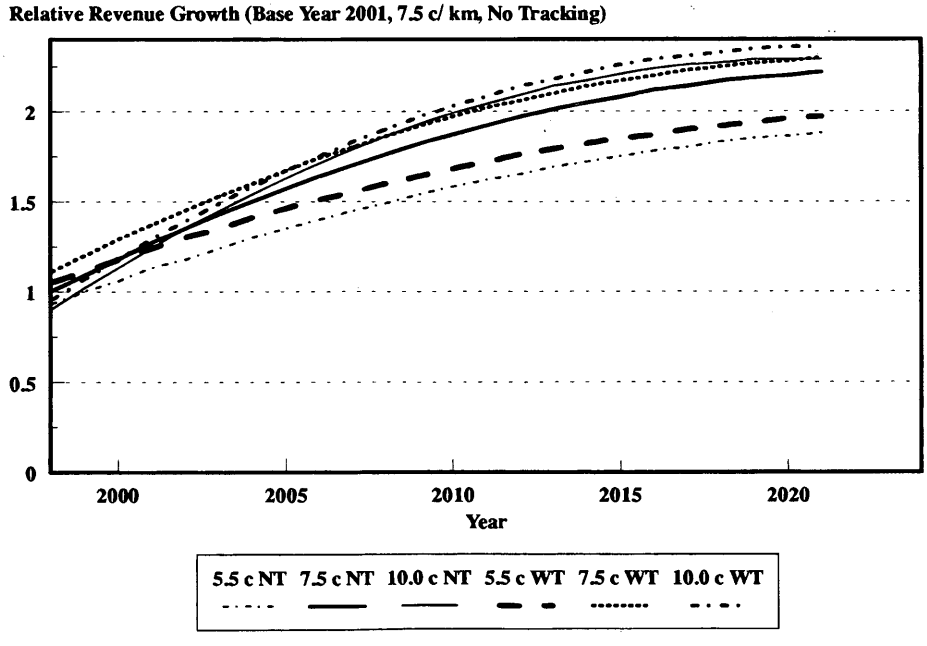


FIGURE 8 Highway 407 revenue growth forecast.

BENEFITS OF HIGHWAY 407

Decrease in Travel Time

One of the main benefits of Highway 407 is to save travel time. If all the highways are operating under ideal conditions (good weather, no accidents/incidents), travel time savings of Highway 407 users could be up to about 25 min. The average is about 5 min. Some nonusers of Highway 407 might also experience improvements in their travel times by shifting vehicles to the highway.

Highway 401 operates at full capacity during the peak periods, and any incident is likely to cause a prolonged delay on the highway. Accordingly, travelers would shift to the alternatives (e.g., Highway 407). Therefore, the actual travel time savings are expected to be much higher than what was calculated under ideal conditions.

During and shortly after rain- and snowstorms, the operating characteristics of highways differ significantly from the regular ones (during favorable weather conditions). Bad weather conditions were simulated by decreasing the free flow speeds by 10 percent and decreasing link capacity by 10 percent. Results showed that under those conditions, more travelers would shift to Highway 407. For instance, during the morning peak hour, the number of users would increase from 34,000 vehicles to about 41,000 vehicles, an increase of about 20 percent.

Decrease in Volumes on Highway 401 and Highway 7

As a result of building Highway 407, the most significant percentage decrease in other highway volumes is on Highway 7 (Figure 9). That decrease (in the morning peak hour) for Highway 7 eastbound reaches around 31 percent near Highway 404 and 33 percent at Highway 427. Generally, the decrease in volume on other facilities is larger in the inbound direction.

It is clear from Figure 9 that the most significant percentage decrease in Highway 7 volume takes place between Highway 427 and Highway 404. One of the reasons is that in that area Highway 407 runs very close to Highway 7 and offers a significantly better level of service. Volumes on Highway 401 also decrease with the construction of Highway 407. The decrease is the greatest in the eastbound movement in Peel. One of the reasons for that decrease is that the two highways (407 and 401) are near each other in that area.

Increase in Travel Time Reliability

It is expected that volumes on Highway 407 will be monitored and not allowed to exceed a certain maximum to maintain a good level

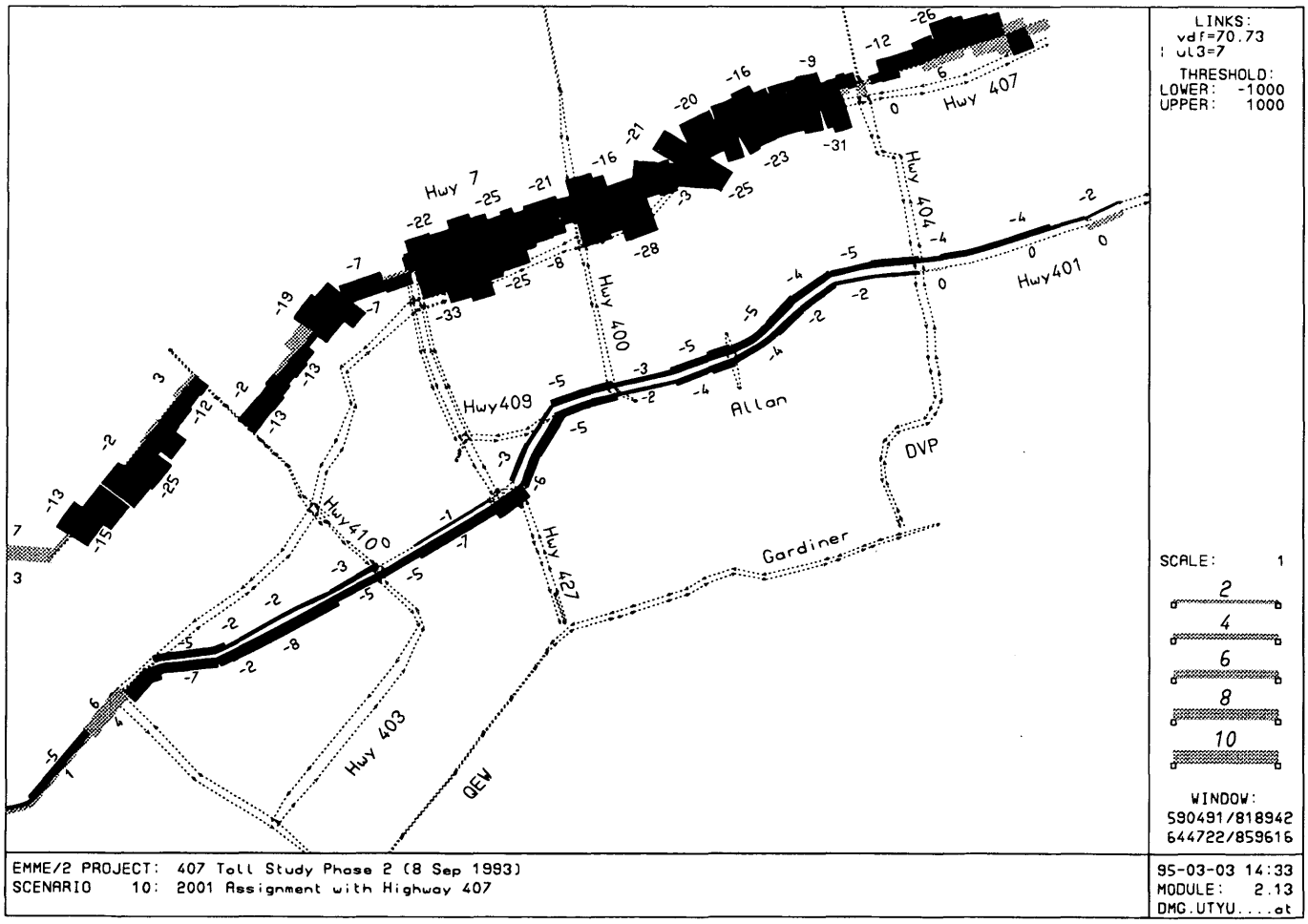


FIGURE 9 Percentage decrease in Highway 401 and Highway 7 volumes after Highway 407 is built; morning peak hour (2001).

of service that would attract travelers to use the highway. Previous studies (*6,7*) have shown that travelers highly value the facilities that offer reliable travel times. In fact, the benefit of offering more reliable travel time (with less variability) can be very substantial even if the (mean) travel time itself does not change. This happens as individuals usually allow extra time (safety margin) to avoid the possibility of arriving late at the destinations. Highways with less variability in their travel time allow individuals to reduce their "safety margins," which is a real time savings. This benefit was acknowledged in the Highway 407 study. However, no attempt was made to quantify it.

Other Benefits of Highway 407

The construction of the highway will enhance the economic growth of Metro Toronto as well as the regions of York and Peel. It will create about 20,000 jobs during the construction period. It will improve the accessibility to Toronto's Pearson International Airport.

SUMMARY AND CONCLUSIONS

The GTA is growing at a fast rate in terms of population, employment, and car ownership and availability. This led to some deterioration in the level of service on some sections of the highways. Highway 407 represents an opportunity to help improve travel conditions in the GTA. Highway 407 can generate substantial revenues, which might make it a self-financing facility. It will relieve Highway 401 and Highway 7 and will decrease travel time and improve its reliability. On bad weather days, some of the benefits are expected to increase.

ACKNOWLEDGMENTS

The author wishes to thank two anonymous referees for their helpful comments on an earlier draft of this paper.

REFERENCES

1. Mekky, A. *Peel Transportation Problems and the Urgent Need for Highway 407 in Peel.* Report Regional Municipality of Peel, Planning Department, Transportation Policy Division, 1988.
2. Langdon, M. G. Review of Modal Split Models, Transportation & Road Research Laboratory, Working Paper 82, Crowthorne, Berkshire, 1981.
3. Adler, T. *Highway 407 IVIS Survey Results.* Resource Systems Group Report for the Ministry of Transportation Ontario, Toronto, December 1993.
4. Mekky, A. Forecasting Travel in High Growth Areas. In *Proc., Transportation Association of Canada Annual Conference,* Quebec City, 1992.
5. Mekky, A. The Over-assignment Problem. *Traffic Engineering and Control,* No. 11, November 1994, pp. 614–619.
6. Knight, T. E. An Approach to the Evaluation of Changes in Travel Unreliability: A Safety Margin Hypothesis. *Transportation,* Vol. 3, 1976, pp. 393–408.
7. Senna, L. A. The Influence of Travel Time Variability on the Value of Time. *Transportation,* Vol. 21, 1994, pp. 203–228.

The views expressed and the figures included in this paper are not necessarily those of the Ministry of Transportation, Ontario. Currently, Wilbur Smith Associates are working on Phase Two of the project to produce final forecasts for MTO.

Publication of this paper sponsored by Committee on Taxation and Finance.