Partnership of

Canada-United States-Ontario-Michigan
Border Transportation Partnership

DETROIT RIVER INTERNATIONAL CROSSING STUDY
TRAVEL DEMAND MODEL UPDATE

WORKING PAPER

SEPTEMBER 2005

Prepared by IBI Group for URS Canada

PREFACE

The Border Transportation Partnership representing the governments of Canada, the United States, Ontario and Michigan is undertaking the Environmental Assessment/Environmental Impact Statement phase of the Detroit River International Crossing (DRIC) project. The EA/EIS phase will include the completion of environmental and technical work to allow the governments to decide on the location of a new or expanded crossing in an environmentally responsible manner. The Ontario Ministry of Transportation is leading the Canadian work program in coordination with Transport Canada. The Michigan Department of Transportation, in coordination with the U.S. Federal Highway Administration, is leading the U.S. work program. URS Canada is the Canadian prime consultant, with IBI Group part of URS Team and responsible for Transportation (Systems) Planning aspects of the Project under the Canadian work program. The Corradino Group is the U.S. prime consultant.

The purpose of this ***Travel Demand Update Working Paper*** is to describe the development of the DRIC Travel Demand Model, involving an update of the model developed for the ***Planning/Need and Feasibility Study*** from a 2000 to a 2004 base year to capture the unique events of recent years that have dramatically affected cross-border flows (e.g. 9-11, SARS, Iraq War, etc) and to incorporate various model enhancements. The companion ***Travel Demand Model Forecasts Working Paper*** presents the passenger car and commercial vehicle forecasts for Detroit River Crossings prepared using the DRIC Model and presents the border infrastructure needs and implications associated with the projected demand. The Travel Demand Update and Travel Demand Forecasts Working Papers were prepared by IBI Group with the assistance of The Corradino Group, who was responsible for the US-side model validation and assessment of traffic conditions on US approach roads.

TABLE OF CONTENTS

TABLE OF CONTENTS (CONT'D)

TABLE OF CONTENTS (CONT'D)

TABLE OF CONTENTS (CONT'D)

LIST OF EXHIBITS

TABLE OF CONTENTS (CONT'D)

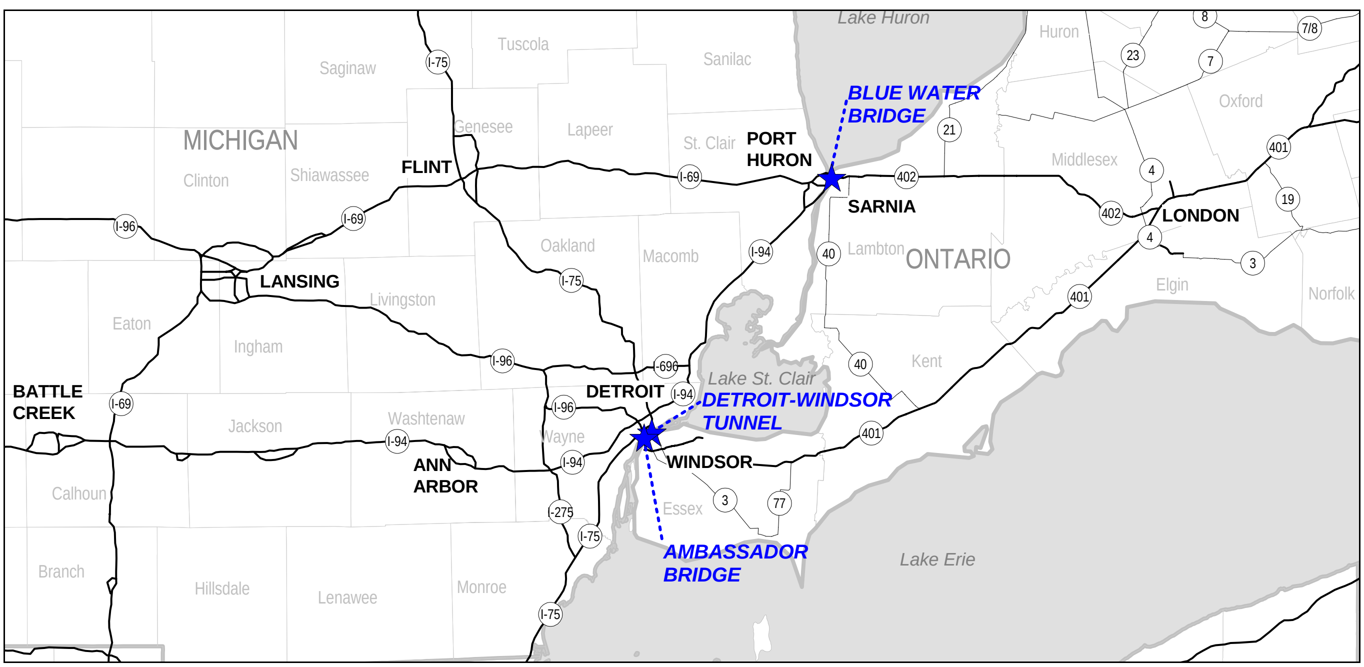
1. INTRODUCTION

1.1 Background

The two international border crossings at the Detroit River – the Ambassador Bridge and the Detroit-Windsor Tunnel – are the two highest-volume crossings between Canada and the US. An extensive amount of effort was undertaken in the ***Planning/Need & Feasibility (P/N&F) Study*** to develop a comprehensive travel demand analysis process for these crossings, resulting in an unprecedented ability to estimate cross-border commercial vehicle and passenger car traffic and diversion impacts, and to assess alternative solutions to anticipated transportation needs through a thirty-year time horizon to 2030, including new or expanded crossings and alternative modes. This detailed level-of-analysis was made possible through origin-destination data collection efforts undertaken for international passenger car and commercial vehicle traffic at Detroit River and St. Clair River crossings in 1999/2000. The conclusion of the P/N&F Study was that additional cross-border road-based capacity was needed at the Detroit River within the study horizon.

The analysis area for the P/N&F Study and the current Detroit River International Crossing (DRIC) Study is broad enough to include decision points where drivers of long-distance trips may decide to use either the Ambassador Bridge/Detroit Windsor Tunnel crossings between Windsor and Detroit or the Blue Water Bridge crossing between Sarnia and Port Huron (see Exhibit 1.1).

Exhibit 1.1: Analysis Area



For the Detroit River International Crossing (DRIC) Study, travel demand forecasts must be updated to reflect new knowledge and data which has become available since the previous P/N&F Study, with the updated Travel Demand Model applied to provide forecasts and associated analyses to support several key aspects of the study, including:

- Development of Illustrative and Practical Alternatives;
- Identification of traffic impacts of alternatives;
- Identification of facility and system needs related to cross border traffic mobility;
- Identification of key freight mobility issues;
- Evaluation of alternatives;
- Refinement, evaluation and documentation of the Technical Preferred Alternative; and
- Concept design of the proposed plaza, customs and tolling operations.

1.2 Need for a Model Update

The travel demand estimates for the P/N&F Study were carried out in 2002. At the time, the only practical choice for a base year for travel demand analysis was 2000, as 2001 was severely affected by the events of 9/11. It was anticipated that, after recovering from 9/11-related fears and increased border-crossing difficulties, traffic volumes would, in time, recovery to match the traffic levels projected from pre-2001 trends. At the time, it was recognised that 9/11 and other events might have long-reaching impacts that may have structurally changed cross-border travel demand in the study area and increasing the level of uncertainty in the travel demand forecasts. As such, many sensitivity analyses were performed at the time, some of which included a 2002 base year, which meant that the forecasts started from a lower level of traffic than those of 2000.

Three years have passed since the development of the P/N&F study travel demand model, bringing with them the ability to better incorporate the most current knowledge on the impacts of 9/11 and of other extreme events (the War in Iraq, and SARS), changing socio-economic trends (e.g. Canada-US exchange rate, fuel prices), the opening of casinos in the Detroit area, and changing attitudes on cross-border travel behaviour. More recent traffic and trade data reveal that cross-border passenger car traffic, in particular, has declined dramatically in the study area, while commercial vehicle traffic has shown a stronger recovery.

There is a need to update existing travel patterns and characteristics to reflect the above changes to provide a new 2004 Base Year for this study. The analysis and update requires a detailed assessment of recent travel trends to determine the extent of the changes, if any, in the absolute number of trips, trip patterns and travel behaviour characteristics and use by the different modes over the 2000 and 2004 period. While year 2000 O-D surveys were available for the 2000 Base Year model developed in the

P/N&F Study, no new O-D surveys have been undertaken since, requiring that the update of travel demand be based on analysis of the available data and statistics.

1.3 Update Approach

The modelling approach for the current study builds extensively on the P/N&F Study, but with a review of key assumptions, and with modifications reflecting current data and assumptions and the latest US-Canada trade projections. The approach to the model update includes the following components:

- Determining appropriate time periods to be modelled, as changes in traffic can result in changes to the time period that poses the greatest constraints on crossing and network capacities;

- Updating the 2000 passenger car trip tables to the 2004 base year to reflect changing travel patterns by trip purpose;

- Updating the 2000 commercial vehicle trip tables to the 2004 base year to reflect changes in trade flows by commodity type;

- Updating the transportation network representation, in terms of both the changes that have occurred between 2000 and 2004 and the future assumptions regarding facilities and border processing;

- Incorporating passenger car and commercial crossing choice models to more accurately determine the proportion of the total Detroit River/St. Clair River cross-border traffic that uses the Ambassador Bridge/Detroit-Windsor Tunnel crossings versus the Blue Water Bridge. Discrete choice logit models have been developed for this application, with sensitivity to travel time (for both models) and cost (for the commercial vehicle model); and

- Validating the updated model for the 2004 base year using traffic counts at the crossings and along screenlines within the urban areas.

An updated travel demand model reflecting the above will support the traffic analyses that will be used to address traffic issues identified in the Canadian Terms of Reference and US Purpose and Need statement. The three levels of transportation analyses that will be undertaken to support the Study at major stages are:

- **Level 1: Transportation Demand Model and Measures of Effectiveness** – Application of the updated IBI Transportation Demand Model to generate traffic data to assess cross-border and system-level transportation impacts and which feeds into the analysis of preliminary illustrative alternatives and the subsequent Evaluation of Illustrative Alternatives;

- **Level 2: Highway Capacity Analysis** – Refinement of the Level 1 forecasts through more detailed traffic analysis using Highway Capacity Analysis techniques, as defined in the Highway Capacity Manual 2000 and implemented by several software programs (e.g. HCS, Synchro). This represents a traffic operations analysis at a link-by-link and intersection level and will be applied to the list of Practical Alternatives to support the Evaluation of Illustrative Alternatives and List of Practical Alternatives; and

- **Level 3: Micro-Simulation** – Use of traffic simulation software to further analyse traffic operations on a microscopic level for the Technically Preferred Alternative(s). The Travel Demand Model outputs refined in the Level 2 analysis, are used as inputs to simulate the behavior of each vehicle at any given point in time in the border crossing system. Traffic performance for each vehicle is evaluated over specified time periods in the simulation, capturing the dynamic aspects of traffic on a network and helping to identify specific areas of traffic congestion and its upstream and downstream effects on traffic operations. This will provide level of detail and accuracy required to verify and refine the Technically Preferred Alternative(s) and to develop a concept design for the proposed plaza, customs and tolling operations. Traffic micro-simulation software will also provide a highly effective tool in graphically displaying the operations and impacts to all audiences.

The Highway Capacity Analysis and Micro-Simulation will involve the development and application of detailed traffic engineering and micro-simulation techniques, which will be based on and consistent with results from the Model Update. These analyses will be documented under separate cover.

1.4 Organisation of Working Paper

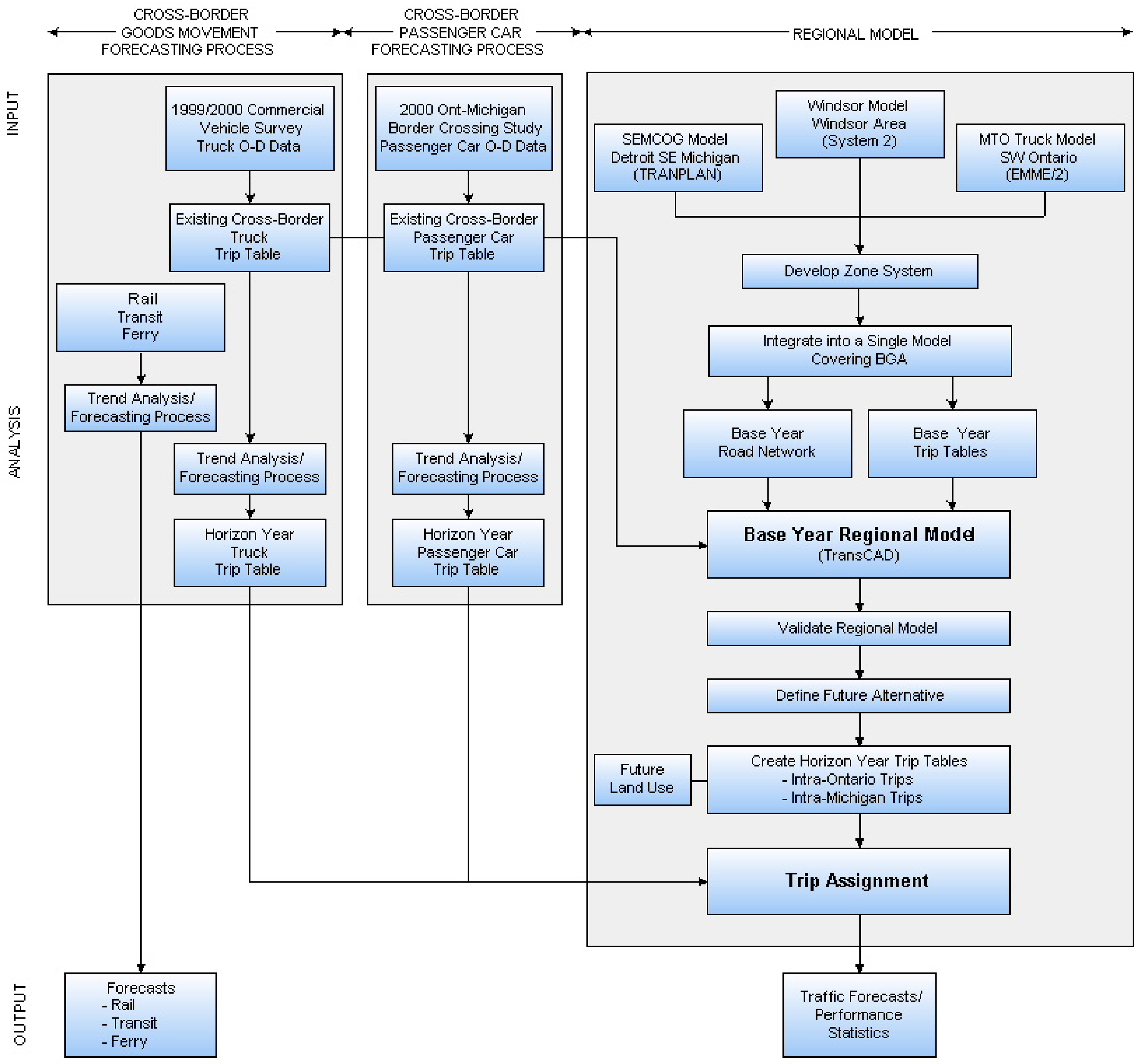
This Working Paper is organised into nine chapters. Following this introduction, the remaining chapters of this report are as follows:

- Chapter 2 describes an overview of the preceding 2002 P/N&F study travel demand model process that forms the basis of the model process used within this study;
- Chapter 3 discusses the selection of time periods for modelling;
- Chapters 4 and 5 discuss the update of 2000 trip matrices to 2004 for passenger cars and for commercial vehicles, respectively;
- Chapter 6 describes updates made to the modelled transportation networks and zone systems;
- Chapter 7 describes the updated crossing choice/traffic assignment process;
- Chapter 8 discusses the validation of the updated model; and
- Chapter 9 provides a summary of the report.

2. OVERVIEW OF P/N&F TRAVEL DEMAND MODEL PROCESS

The following provides an overview of the preceding 2002 P/N&F Study travel demand model process that forms the basis of the model process used within this study. The P/N&F Study model process consisted of an integrated modelling framework involving several inter-related processes. Exhibit 2.1 provides an overview of this model process and the stages leading to the development of traffic forecasts, including the key model inputs and forecasting processes.

Exhibit 2.1: 2002 P/N&F Study Travel Demand Model Process Flowchart



Three components were defined in the P/N&F model process that combined to provide total vehicular traffic and rail freight movements, including the:

- **Regional Model** – This was the primary demand analysis tool, which provided network assignment capabilities for domestic background and cross-border traffic within and between Ontario and Michigan for the study area;
- **Cross-Border Passenger Forecasting Process** – This was required to estimate the total demand for persons crossing the Detroit and St. Clair Rivers. Passenger car demands were estimated by trip purpose and imported into the regional model to be assigned to the transportation network; and
- **Cross-Border Goods Movement Forecasting Process** – This was required to estimate rail and commercial vehicle flows across the border. Truck results were imported into the main regional model and assigned to the transportation network.

The following summarises each of the above P/N&F travel demand model process components and then presents the updated process used within this study.

2.1 P/N&F Study Regional Model

The P/N&F Regional Model provided network assignment capabilities that were used to estimate flows and routings for passenger cars and commercial vehicles. The Regional Model was constructed by combining elements from three pre-existing models, consisting of the:

- **SEMCOG Model** – Tranplan-based model covering Southeast Michigan;
- **City of Windsor (WALTS) Model** – System II-based model covering the Greater Windsor Area. This model preceded the current EWRTMP model; and
- **MTO Truck Model** – Emme/2-based model focused on Ontario, but covering North America.

The Regional Model provided two levels of transportation network detail. The minimum level of network detail reflected a strategic transportation network of provincial/state highways and major regional/county roads leading to the Detroit River and St. Clair River border crossings. A refined level of network detail was required to perform sub-area level analyses, which were undertaken in the study for areas identified as Focused Analysis Areas based on existing and future needs/deficiencies. The level of detail in a Focused Analysis Area corresponded to the level of accuracy typically provided in comprehensive urban transportation models, which included all collector and arterial roads and highways and a detailed traffic zone system. This level of detail allowed analyses of traffic flows and conditions on all roads/highways in the vicinity of the border crossings in the Focused Analysis Area(s), as well as the impact of diversions from existing to proposed cross-border facilities.

Background vehicular traffic was included in the Regional Model to ensure that delays on routes to and from border crossings and interactions with non-border-crossing traffic were adequately reflected. Peak-hour trip data from the SEMCOG and the Windsor models were used to estimate background traffic volumes. Both of the SEMCOG and Windsor models include border crossing trips, but without detailed origin or destination information on the other side of the border. These trips were therefore extracted from the respective trip matrices and replaced with the results of the cross-border passenger car and goods movement forecasting processes discussed below.

2.2 P/N&F Study Cross-Border Passengers

The cross-border passenger forecasting process provided estimates of future cross-border person-trips by the passenger car, bus and passenger rail modes. Recognising future uncertainties, a forecasting approach based on expert opinion, consensus on key assumptions, sensitivity testing and a solid fundamental understanding of the factors and rationale behind key assumptions was applied. The approach focused on establishing an understanding of past trends and causal relationships influencing Ontario-Michigan cross-border traffic in qualitative terms, with quantitative techniques used where appropriate to supplement the knowledge. Trend/causal factor analysis and various statistical analysis and estimation techniques, including multivariate regression analysis, were used to help establish relationships to predict future cross-border traffic by mode/market.

This general methodology was applied to each of the passenger car, passenger rail and bus modes to the extent possible with available data. Given the large uncertainty in predicting key input variables (e.g. value of Canadian dollar), sensitivity analyses were undertaken on these key variables to examine the possible range in the forecasts.

The result of the trend analysis/forecasting process was growth rates by trip purpose (e.g. commute, vacation/recreation) for passenger car trips by decade, with a qualitative rationale and justification for the selection of the given growth rates. For the passenger rail and bus modes, overall growth rates by decade were developed because of the lack of available detailed market data for these modes. The resulting growth rates were applied to the trip table describing existing cross-border travel flows (i.e. travel data from the Ontario-Michigan Border Study Traffic Survey) to represent the horizon year cross-border traffic levels.

The future distribution of productions and attractions were adjusted proportionately to reflect relative increases in population and employment in various areas and expected growth areas in vacation/recreation traffic. The resulting horizon year cross-border trip tables for passenger cars were input into the Regional Model and assigned to the road network with other local and intra-state/provincial traffic (described above) and cross-border commercial vehicle traffic (described below).

2.3 P/N&F Study Cross-Border Goods Movement

Following a similar approach and rationale to that described above for the Cross-Border Passenger Forecasting Process, the goods movement forecasting process involved a trend/causal factor analysis supplemented by other available information sources (e.g. employment by sector, economic forecasts, international trade data/reports/forecasts, etc.) executed within a spreadsheet. This approach reflected the large uncertainties and difficulties in predicting goods movement flows and cross-border traffic, with emphasis on developing a strong qualitative understanding of cross-border movements. Historic trend data and other data were used to develop relationships and factors, supplemented with discussions with agency staff knowledgeable in the goods movement area. Multivariate regression analysis was also used to provide insight into the relative contributions of the various factors influencing demand. In addition, a significant amount of research was undertaken in the areas of US-Canada trade, the impacts of Free Trade and future directions for cross-border trade and travel.

The impacts of new technologies were also examined when considering future characteristics of commercial vehicle and rail systems (i.e. intermodal rail). This required insights with respect to the impacts on the economy (e.g. new spatial patterns of the auto industry) and their related transportation impacts (e.g. just-in-time delivery and e-commerce impacts) and the impacts of new technology on border crossing and management (e.g. pre-clearance). Combining planning judgement, the study team's understanding of the factors influencing past trends and how those factors will change in the future, and other available information, a procedure was developed that was traceable with identified markets, factors and relationships used to determine growth.

A key challenge in goods movement forecasting was in establishing the relative distribution of goods carried by rail versus commercial vehicle. Again, the development of a detailed statistical model to determine rail/commercial vehicle shares was not considered appropriate since it is dependent upon policy, economic competitiveness issues, industry trends, and major infrastructure decisions, among others, which are highly unknown and which are beyond the ability to model credibly. The approach of the P/N&F study was to develop a "most probable" future scenario of the future characteristics of the commercial vehicle and rail systems and, combined with trend data, to make reasonable judgements using expert opinion supported by analysis, where possible. The process involved the following:

- A review of literature describing current commercial vehicle, rail and intermodal goods movement trends and projections;
- Discussions with representatives of government, the carriers and other stakeholders;
- Identification of major issues and discussion of the policy environment; and
- Review of costs and constraints/opportunities influencing modal shares and volumes.

Sensitivity analyses and discussion of the possible future ranges were also provided to bracket the range of future uncertainty.

2.4 Summary of P/N&F Study Model Process

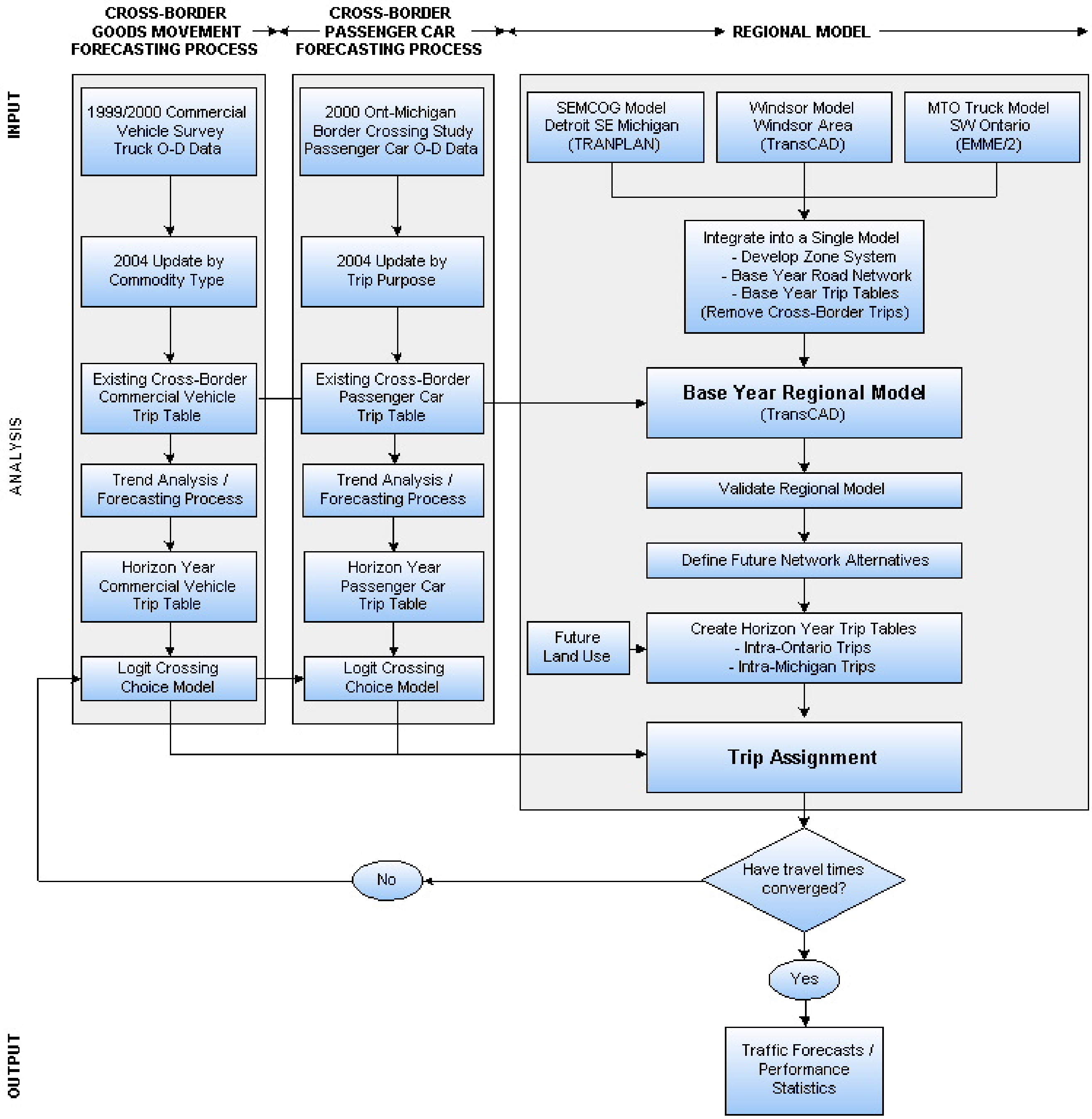
The product of the above steps was a TransCAD model of peak hour traffic conditions for auto and commercial vehicle traffic for the study area. The trip tables combined local travel (as provided from the SEMCOG and Windsor Models) and cross-border passenger car and commercial vehicle travel from the respective forecasting processes. These were simultaneously assigned to the road network within the Regional Model. Rail and ferry travel were not included in the Regional Model assignment process.

Much more detailed documentation of the P/N&F Study travel demand model process can be found in the ***Travel Demand Analysis Process Working Paper*** and the ***Existing and Future Travel Demand Working Paper***, both of which were most recently issued in January of 2004.

2.5 DRIC Study Model Process

The model process utilised within this study is illustrated in Exhibit 2.2. The differences between this process and that of the P/N&F Study, as outlined above, are discussed and detailed in the following chapters.

Exhibit 2.2: 2004 DRIC Study Travel Demand Model Process Flowchart



3. MODELLED TIME PERIODS

The selection of time periods for analysis is one of the most important considerations in the modelling process. For modelling purposes, it is necessary to simulate the peak hours that dictate transportation infrastructure requirements for the crossings and access roads and highways to the crossings. It is also necessary to understand the different temporal distributions and peaking characteristics of the varied users of the border crossings (commercial vehicles, daily commuters, vacationers, etc.) to ensure an appropriate representation of each during the time period selected for modelling. This chapter describes how the time periods for regional travel demand modelling were selected for the DRIC Transportation Demand Model.

3.1 Seasonal Trends

Seasonal, daily and hourly volumes and trends were examined to determine an appropriate modelling period. Exhibit 3.1 shows seasonal trends for Detroit River cross-border traffic via plots of monthly traffic for the years 2000 and 2004, for passenger vehicles, commercial vehicles, and total vehicles in passenger car equivalents (PCEs).

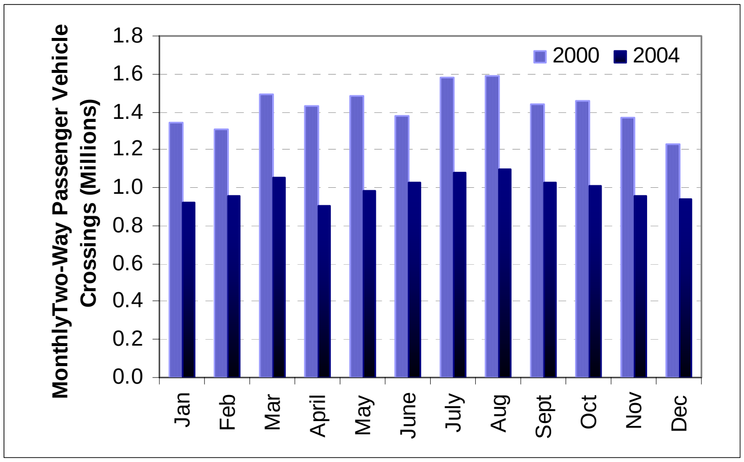
Monthly passenger-car volumes were 23% to 37% less by month in 2004 compared to 2000. In both years, July and August had the highest levels of passenger-car volumes, followed by March, corresponding to peak travel/vacation periods. With lower proportions of discretionary travel in 2004 compared to 2000, monthly variation is less in 2004 (22%) than in 2000 (29%). This decrease in monthly variation reflects the lower number of same-day discretionary and vacation trips that are being made post 9/11.

For commercial vehicle traffic, July has lowest traffic volumes due to annual plant shutdowns and employee vacations. Highest traffic volumes tend to occur in spring, and occurred in March in 2000 and 2004. Monthly commercial vehicle volumes for 2004 were generally slightly less than corresponding 2000 volumes, except for the lowest-volume months of July and December.

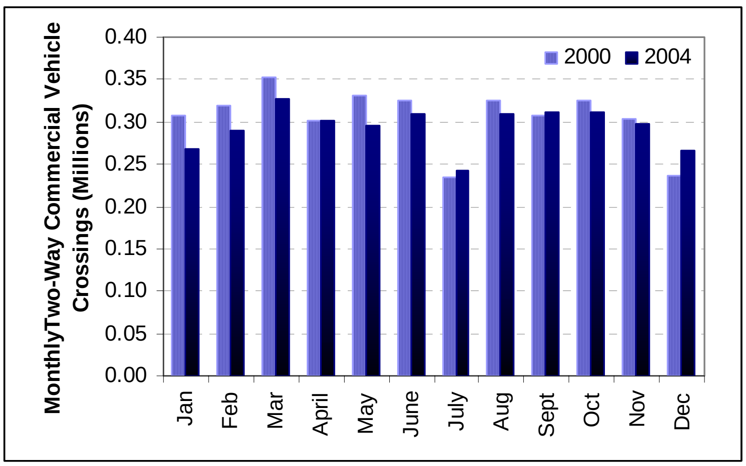
When passenger and commercial vehicle traffic are combined, the highest total traffic volumes in terms of PCEs are in March and August, with late spring and early fall volumes close behind. Monthly total PCE volumes are 10% to 25% less in 2004 compared to the corresponding month in 2000.

Exhibit 3.1: Monthly Detroit River Cross-Border Vehicle Volumes, 2000 & 2004

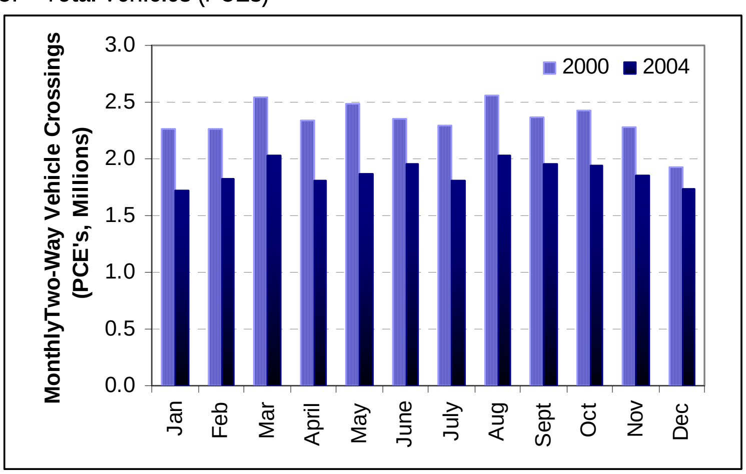
A. Passenger Vehicles



B. Commercial Vehicles



C. Total Vehicles (PCEs)



Source: BTOA
Note: One commercial vehicle is assumed to be equivalent to three passenger cars.

3.2 Daily Trends

Daily two-way totals were examined for two months: August, to capture summer peak passenger-car travel while avoiding the reduced commercial-vehicle activity that occurs in July; and September, to capture increased work/commuter activity and corresponding higher morning and afternoon peak volumes. These are plotted for available data in Exhibit 3.2.

For passenger cars, volumes are generally highest on Fridays, with weekday work travel combined with increased recreational/vacation travel at the beginning of the weekend, followed by Saturdays. Commercial vehicle volumes are highest mid-week (generally Wednesday or Thursday), roughly half of weekday volumes on Saturdays, and roughly one-quarter of weekday volumes on Sundays. Combined in terms of PCEs, Fridays have the highest volumes, followed by Thursdays. In August 2000, however, Thursday volumes were very slightly higher.

3.3 Hourly Profiles & Trends

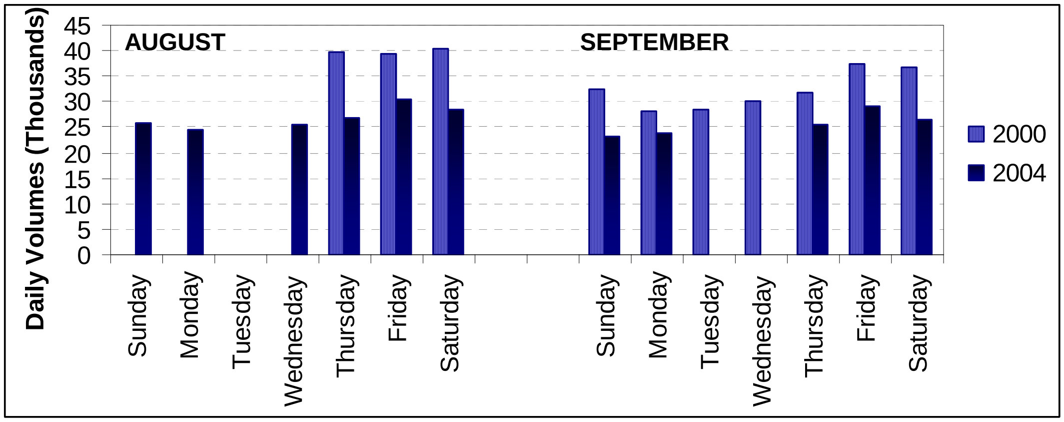
Hourly Detroit River cross-border traffic flows in PCEs by direction are shown over four consecutive August and September days in Exhibit 3.3. As indicated in the graphs, the peak hours expressed in PCE terms occur during the traditional morning and afternoon peak periods, given the heavy peaking of passenger cars, while commercial vehicles are more uniformly distributed throughout the day. The magnitude of the peak hours is very similar, with 2004 PCE peak hour volumes only approximately 3% lower than the comparable peaks in 2000.

Given the similarity in daily volumes and morning and afternoon peak volumes for Thursdays and Fridays, a Thursday-Friday average day travel characteristics and volumes were used as the basis for travel modelling. Hourly traffic profiles for the Detroit River crossings for a Thursday-Friday average day are shown in Exhibit 3.4 for August and September, 2000 and 2004, including passenger cars, commercial vehicles, and PCEs.

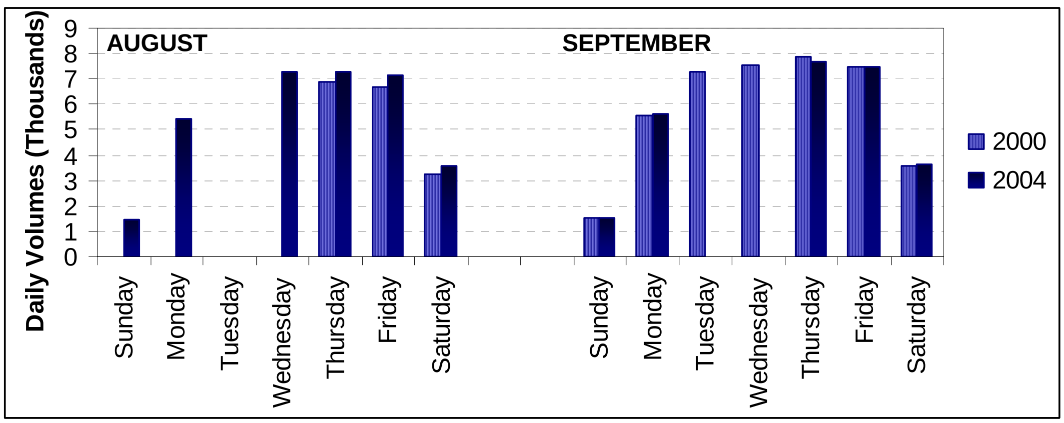
In all cases, the peak in US-bound passenger vehicle traffic occurs in the early morning, 6 to 9 a.m.; a high proportion of this travel includes Canadian residents commuting to US work locations. The peak in Canada-bound traffic occurs in the late afternoon (4 to 7 p.m.) with many Canadian commuters returning home. The morning and afternoon peaks are higher in September, while the mid-day volumes and total daily volumes are higher in August. This is due to increased discretionary travel (e.g. vacation/recreation travel) and a corresponding decrease in commuter travel while workers are on vacation in the summer months.

Exhibit 3.2: Daily Detroit River Cross-Border Vehicle Volumes, August & September 2000 & 2004

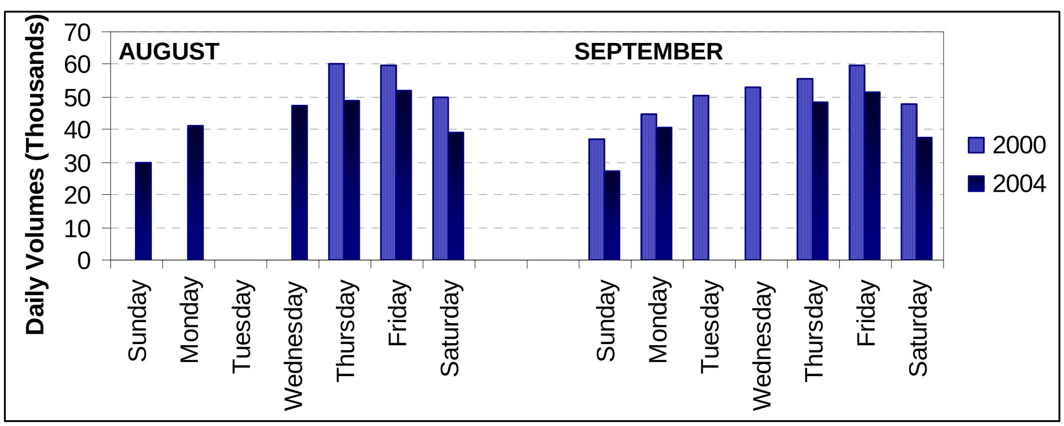
A. Passenger Vehicles



B. Commercial Vehicles



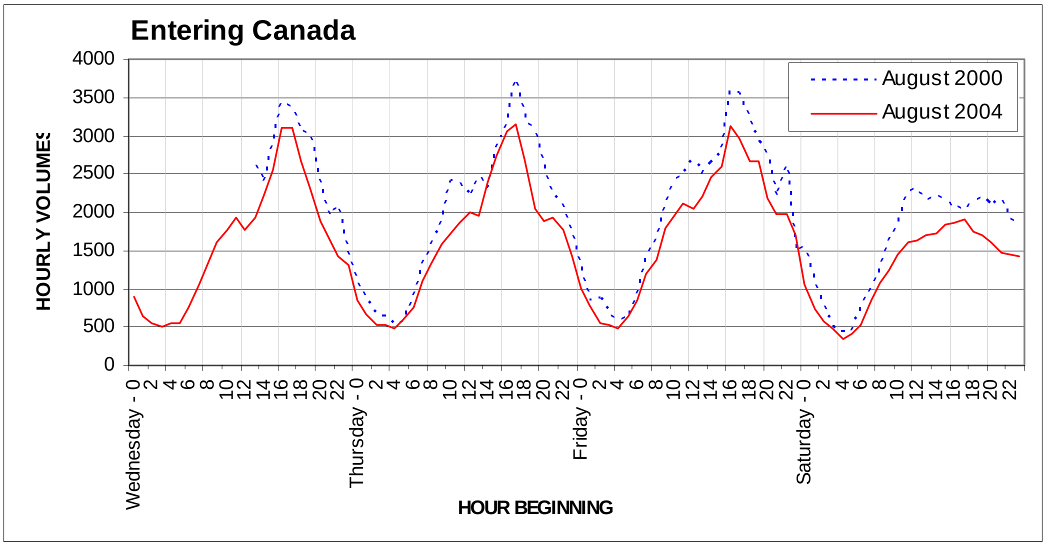
C. Total Vehicles (PCEs)

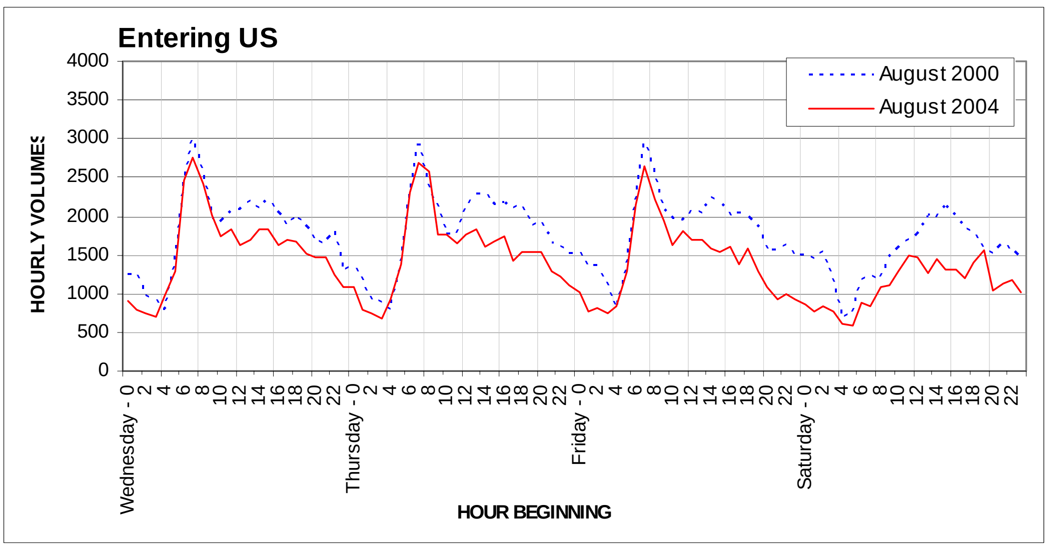


Note: Zero volumes indicate that data were not available. One commercial vehicle is assumed to be equivalent to three passenger cars.

Exhibit 3.3: Hourly PCE Traffic Distribution, 2000 & 2004

A. August 2000 & August 2004

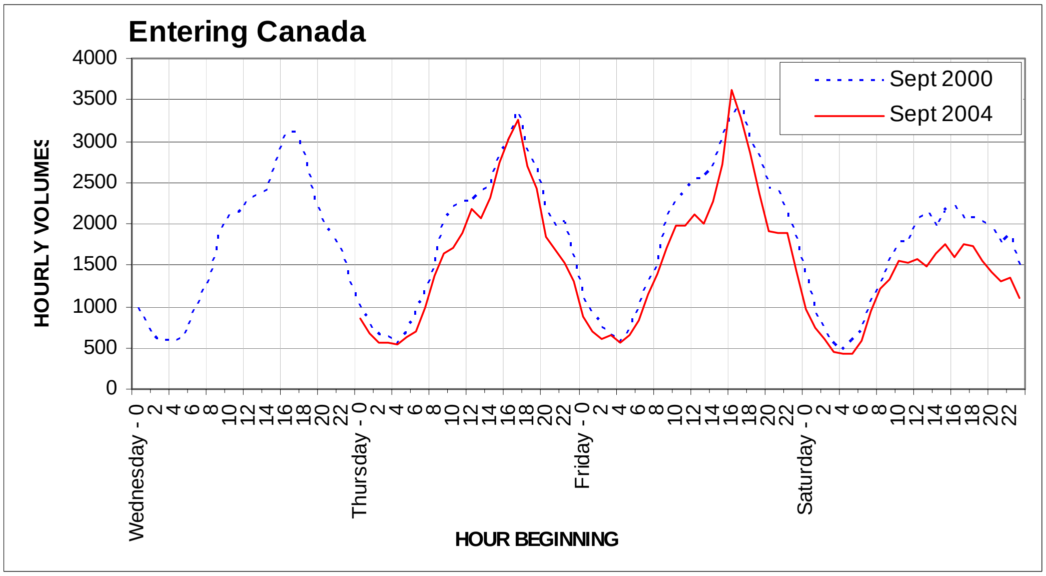


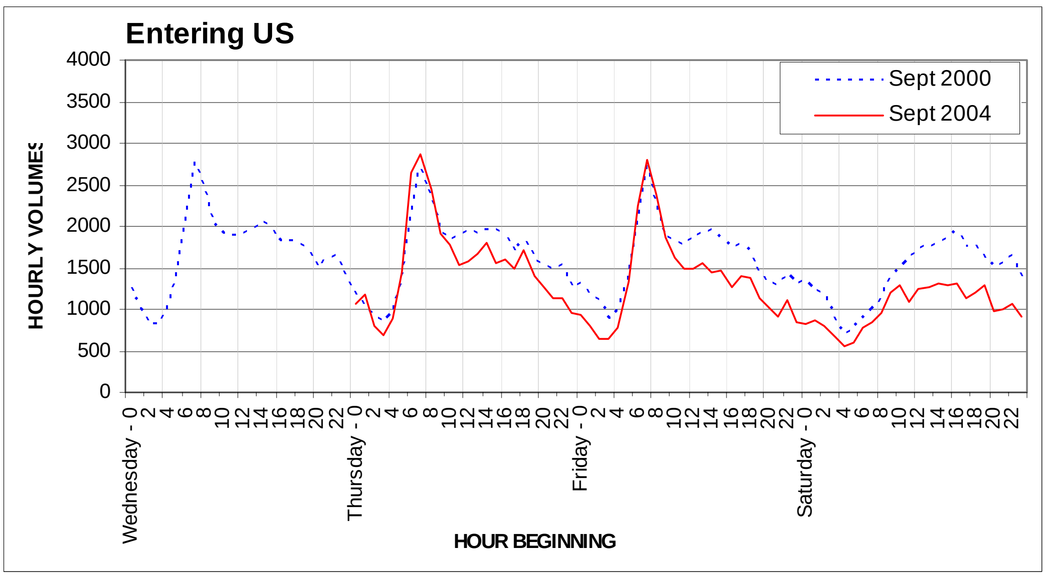


Note: One commercial vehicle is assumed to be equivalent to three passenger cars.

Exhibit 3.3 (Cont.): Hourly PCE Traffic Distribution, 2000 & 2004

B. September 2000 & September 2004



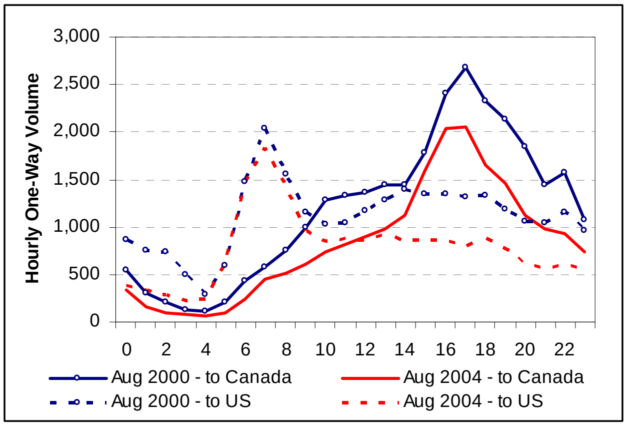


Note: One commercial vehicle is assumed to be equivalent to three passenger cars.

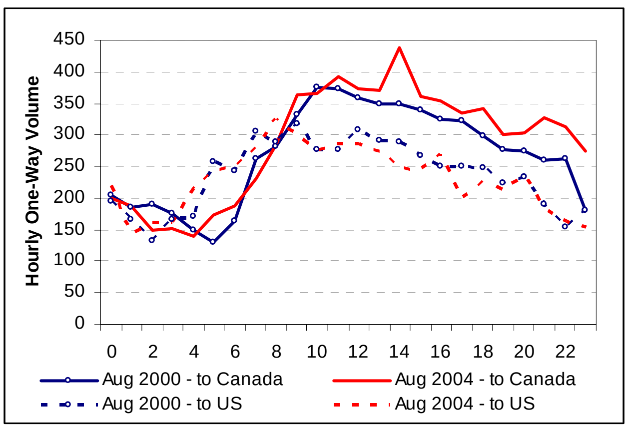
Exhibit 3.4: Hourly Detroit River Cross-Border Traffic Profiles, August & September Weekdays, 2000 & 2004

AUGUST 2000 and 2004

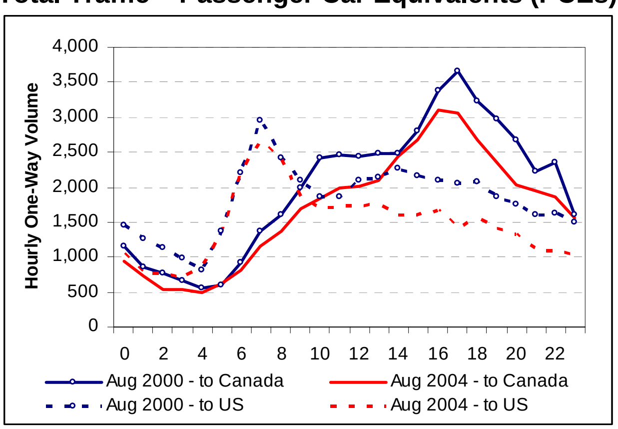
Passenger Vehicles



Commercial Vehicles

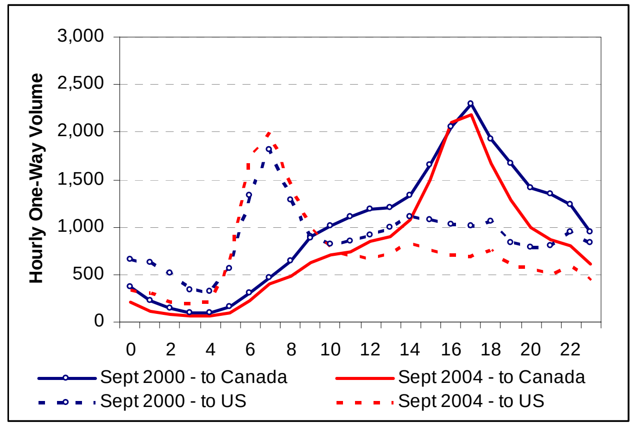


Total Traffic – Passenger Car Equivalents (PCEs)

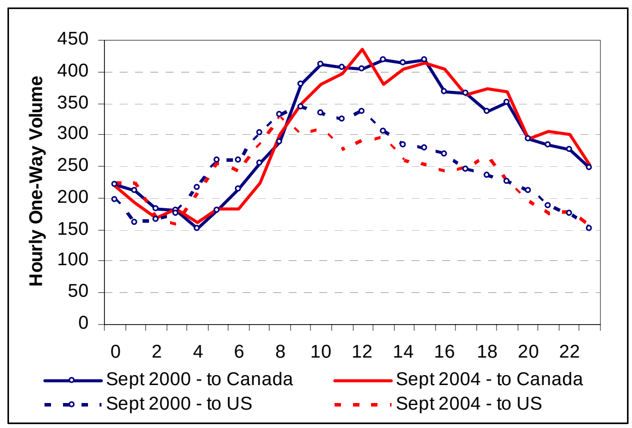


SEPTEMBER 2000 and 2004

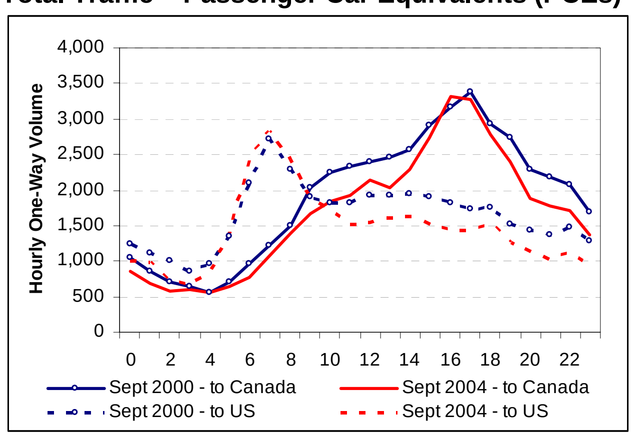
Passenger Vehicles



Commercial Vehicles



Total Traffic – Passenger Car Equivalents (PCEs)



Note: One commercial vehicle is assumed to be equivalent to three passenger cars.

Commercial vehicles show a more uniform distribution of traffic throughout the day, growing slowly throughout the morning and peaking during the mid-day. Canada-bound commercial vehicle traffic generally peaks around noon, while US-bound commercial vehicle traffic generally peaks earlier, in the mid-to-late morning. The total and distribution of commercial vehicle traffic is relatively similar when comparing 2000 and 2004 volumes. There is also consistency between August and September traffic volumes. The volume and peaking of commercial traffic is noticeably higher in the US to Canada direction than the reverse direction. This reflects the nature of cross-border trucking patterns, with vehicles crossing into the US at one crossing and returning at another to improve efficiency. This triangulation results in the directional imbalances at the Ambassador Bridge and the higher commercial volume flows to Canada than to the US on this facility.

As indicated in the graphs, the peak hours expressed in PCE terms still occur during the traditional morning and afternoon peak periods, given the heavy peaking of passenger cars, while commercial vehicles are more uniformly distributed throughout the day. The magnitude of the peak hours is very similar with 2004 PCE peak hour volumes only approximately 3% lower than the comparable peaks in 2000.

The peak hour and peak period traffic volumes by direction shown in Exhibit 3.4 are also summarised numerically in Exhibit 3.5. In the morning period, the September 2004 peak hour is 2,864 PCEs per hour (Thursday) for Canada to US travel. The August 2004 morning peak hour is marginally lower at 2,678 PCEs per hour (Thursday). Traffic is higher during the PM peak period, and the 2004 peak hour, peak direction volume is for US to Canada travel in September (Friday) at 3,614 PCEs per hour. This compares to the September 2000 afternoon peak hour of 3,409 PCEs per hour (Friday) and the August 2000 afternoon peak of 3,752 PCEs per hour (Thursday).

September 2004 is therefore the basis of modelling and analysis for this study. Peak traffic volumes for a Thursday-Friday average weekday are as follows:

- For **US-bound** traffic, the peak hour of **2,833 PCEs** occurs at **7:00 to 8:00 a.m.** This corresponds to the peak hour for passenger car traffic (1,982 vehicles). The commercial vehicle volume at this hour is 284 vehicles, while the peak hour for commercial vehicles occurs slightly later at 8:00 a.m. to 9:00 a.m. (327 vehicles). The peak hours for US-bound traffic are consistent at both crossings for passenger cars, commercial vehicles and total vehicles; and

- For **Canada-bound traffic**, the peak hour of **3,319 PCEs** occurs at **4:00 to 5:00 p.m.**, at which time there are 2,107 passenger cars and 404 commercial vehicles crossing the Detroit River to Canada. The peak hour for passenger cars is 5:00 to 6:00 p.m. at 2,178 vehicles, but the volume of trucks at this hour is slightly lower (363 vehicles). The peak hour of 435 commercial vehicles occurs at 12:00 to 1:00 p.m. The peak hours for Canada-bound traffic are consistent at both crossings for passenger cars, commercial vehicles and total vehicles.

Exhibit 3.5: Peak Hour at Detroit River Crossings, PCEs, 2000 & 2004

TIME PERIOD	AMBASSADOR BRIDGE		DETROIT-WINDSOR		DETROIT RIVER	
	to Canada	to US	to Canada	to US	to Canada	to US
	AUGUST 2000					
Weekday AM Peak						
Thursday Peak Hour (7:00-8:00)	978	1,908	335	1,036	1,313	2,944
Friday Peak Hour (7:00-8:00)	1,027	1,945	382	1,006	1,409	2,951
AVG. DAY Peak Hour (7:00-8:00)	1,003	1,927	359	1,021	1,361	2,948
Weekday PM Peak						
Thursday Peak Hour (17:00-18:00)	2,513	1,412	1,239	680	3,752	2,092
Friday Peak Hour (16:00-17:00)	2,581	1,366	1,015	652	3,596	2,018
AVG. DAY Peak Hour (17:00-18:00)	2,519	1,396	1,136	665	3,654	2,060
24-Hour Volumes						
Thursday	32,587	30,003	13,879	13,535	46,466	43,538
Friday	34,790	29,279	14,093	14,464	48,883	43,743
AVERAGE DAY	33,689	29,641	13,986	14,000	47,675	43,641
	AUGUST 2004					
Weekday AM Peak						
Thursday Peak Hour (7:00-8:00)	843	1,897	256	781	1,099	2,678
Friday Peak Hour (7:00-8:00)	926	1,798	276	843	1,202	2,641
AVG. DAY Peak Hour (7:00-8:00)	885	1,848	266	812	1,151	2,660
Weekday PM Peak						
Thursday Peak Hour (17:00-18:00)	2,233	1,089	906	338	3,139	1,427
Friday Peak Hour (16:00-17:00)	2,288	1,250	849	352	3,137	1,602
AVG. DAY Peak Hour (16:00-17:00)	2,225	1,321	873	348	3,098	1,668
24-Hour Volumes						
Thursday	29,468	27,620	9,630	8,966	39,098	36,586
Friday	31,997	24,835	9,887	9,362	41,884	34,197
AVERAGE DAY	30,733	26,228	9,759	9,164	40,491	35,392
	SEPTEMBER 2000					
Weekday AM Peak						
Thursday Peak Hour (7:00-8:00)	884	1,888	287	824	1,171	2,712
Friday Peak Hour (7:00-8:00)	980	1,943	295	785	1,275	2,728
AVG. DAY Peak Hour (7:00-8:00)	932	1,915	291	805	1,223	2,720
Weekday PM Peak						
Thursday Peak Hour (17:00-18:00)	2,466	1,226	904	467	3,370	1,693
Friday Peak Hour (17:00-18:00)	2,520	1,244	889	543	3,409	1,787
AVG. DAY Peak Hour (16:00-17:00)	2,493	1,235	897	505	3,389	1,740
24-Hour Volumes						
Thursday	32,274	28,630	11,596	11,075	43,869	39,704
Friday	34,861	27,391	12,434	11,552	47,295	38,943
AVERAGE DAY	33,567	28,010	12,015	11,314	45,582	39,324
	SEPTEMBER 2004					
Weekday AM Peak						
Thursday Peak Hour (7:00-8:00)	771	1,914	228	950	999	2,864
Friday Peak Hour (7:00-8:00)	895	1,948	251	853	1,146	2,801
AVG. DAY Peak Hour (7:00-8:00)	833	1,931	240	902	1,073	2,833
Weekday PM Peak						
Thursday Peak Hour (17:00-18:00)	2,325	1,176	936	302	3,261	1,478
Friday Peak Hour (16:00-17:00)	2,575	958	1,039	316	3,614	1,274
AVG. DAY Peak Hour (16:00-17:00)	2,346	1,113	973	324	3,319	1,436
24-Hour Volumes						
Thursday	29,848	27,382	9,364	9,154	39,212	36,536
Friday	31,371	23,606	10,029	8,988	41,400	32,594
AVERAGE DAY	30,610	25,494	9,697	9,071	40,306	34,565

Note: One commercial vehicle is assumed to be equivalent to three passenger cars.

Significant decreases in passenger car traffic between 2000 and 2004 are evident during the off-peak periods and on weekend days: total summer and Fall weekday volumes decreased by 17% and 12%, respectively, while summer and fall monthly volumes were reduced by 21% and 17%, respectively. However, peak period volumes remained relatively stable, given the consistency of commuter travel over this time period. This is a very important finding, as it indicates that peak hour traffic levels have not decreased significantly in recent years despite large decreases in passenger car traffic.

The change in travel characteristics between 2000 and 2004 indicates a change in the peak hour from a summer afternoon weekday to a Fall afternoon weekday, although the differences are not large. The peak hour remains during the a.m. or morning for travel from Canada to US and in the p.m. or afternoon for US to Canada travel. The commercial vehicle pattern is more uniform throughout the day with the peak hour occurring in the early afternoon, although the increase over the a.m. and p.m. peak hours is marginal.

3.4 Summary & Peak Hours for Modelling

The peak hours for demand modelling in this study are representative of a Fall Thursday-Friday average weekday and include the following:

- A **weekday morning peak hour of 7:00 a.m. to 8:00 a.m.** (2,800 PCEs), representing the peak hour for cross-border traffic in terms of passenger car equivalents leaving Canada and entering the United States;

- A **weekday afternoon peak hour of 4:00 p.m. to 5:00 p.m.** (3,300 PCEs), representing the peak hour for cross-border traffic in passenger car equivalents leaving the United States and entering Canada

- A **weekday mid-day and commercial vehicle peak hour of 12:00 p.m. to 1:00 p.m.** (365 commercial vehicles), representing the peak hour for cross-border commercial vehicle traffic destined for the US. The peak commercial vehicle time for Canada-bound vehicles (330 vehicles) is 8:00 a.m. to 9:00 a.m.

The above reflects the peak hours in terms of total vehicle demands (cars and commercial vehicles) and therefore will dictate infrastructure requirements for the road, highway and bridge/tunnel infrastructure. The use of a Fall weekday in the DRIC Study reflects a change from the summer weekday used in the P/N&F Study.

4. UPDATE OF PASSENGER CAR TRAVEL DEMAND

4.1 2000 to 2004 Trend Analysis

The ***Ontario-Michigan Border Crossing Traffic Study***, carried out in August 2000, provided a rich source of cross-border passenger car origin-destination data and travel characteristics. This survey provided the basis for establishing the 2000 Base Year travel demand in the P/N&F Study. The completed dataset consists of trip characteristics obtained from 22,310 roadside surveys of passenger-vehicles crossing the Ambassador, Blue Water and International (Sault Ste. Marie) Bridges as well as the Detroit-Windsor Tunnel, coded and expanded to represent the total auto volumes at each crossing. This passenger car travel database, cleaned and re-geocoded as described in the P/N&F report, formed the basis of passenger-car travel matrices for the 2004 update. Comparing hourly, seasonal and annual passenger-car travel profiles for the Detroit River crossings between 2000 and 2004, and informed by the factors driving changes in travel behaviour for different trip purposes as derived from a variety of sources as described in this chapter, growth/adjustment factors by trip purpose were applied to update the passenger-car travel matrices by purpose for a Fall Thursday-Friday average weekday.

The following describes overall passenger and passenger-car traffic trends, and trends by trip purpose for 2000 to 2004 that informed the update of the passenger-car matrices by trip purpose from a Summer 2000 weekday in the P/N&F Study to a Fall 2004 weekday in the DRIC Study (See selection of Fall weekday in Chapter 3).

4.1.1 PASSENGER TRAFFIC BY ALL MODES

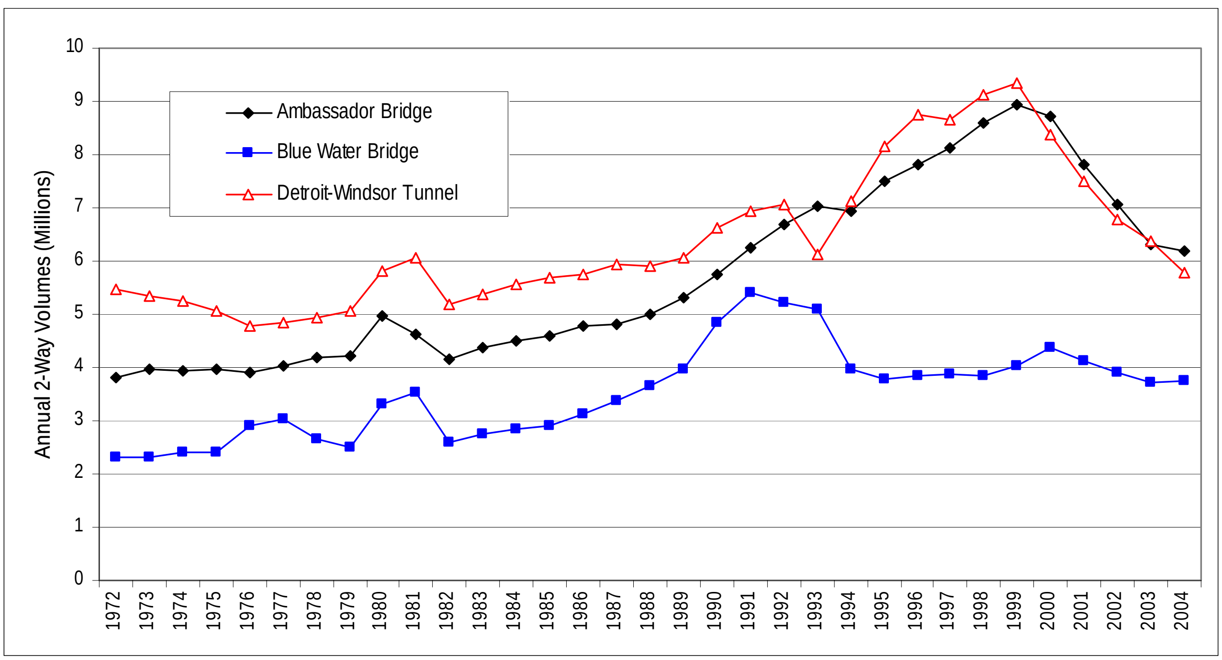
Annual passenger vehicle crossing volumes from 1972 to 2004 for the Detroit River crossings are shown in Exhibit 4.1, together with data for Blue Water Bridge. Passenger car volumes have grown steadily over the past 30 years, but peaked in 1999 and have declined significantly by approximately 30% since then.

Since 2000 and the year O-D data was collected, cross-border travel has been decreased dramatically both nationally and at the Detroit River crossings, due to the effects of 9/11, a perception of increased border-crossing delays, SARS, fears related to the US-led War in Iraq, and other factors. This decrease is more marked for US travellers than for Canadian travellers, as the Canadian dollar has appreciated significantly against the US dollar since 2000, making Canadian recreational activities less attractive to US residents, and perhaps due to fears relating to the impact of SARS in the Toronto area in 2003. However, the rising Canadian dollar has resulted in very slightly more travel by Canadians to the US in 2004 compared to 2003, though far from the increase in travel seen in the early 1990s during a comparable rise in exchange rates.

While passenger car volumes have shown large variations in past, the 2000 to 2004 changes are the first major sustained decline in traffic levels at the Detroit River crossings. Many events have resulted in large surges and increases in traffic levels followed by lower growth or declines, but an overall increasing trend. As shown in Exhibit 4.1, the Detroit and St. Clair River crossings showed steady growth during the twenty-year period from 1972 to 1992 with short traffic peaks in the early 1980s. There was dramatic growth between 1992 and 1999 followed by the above noted drop in volume since 2000. The traffic trends at Detroit River crossings have been consistent with national trends in visitation between the US and Canada by country of residence, as shown in Exhibit 4.2 from 1986 to 2004 same-day and overnight trips. The exhibit indicates that the changes in cross-border traffic are largely due to large variations in same-day trips, with overnight travel being more consistent over time.

Examining major events that have had large impacts on cross-border traffic levels in past, the Iran-Iraq war in the early 1980s led to a 150% price rise in crude oil in the US, which resulted in a short-term 20% increase in 1980/81 for travel to Canada to take advantage of the availability and lower gasoline prices in Canada. At that time, Canada's National Energy Program was in place to control increases in domestic oil prices, with reliance on oil from Western Canada. A falling Canadian dollar, valued at approximately $0.85 US in the early 1980s after being on par with the US dollar for much of the 1970s (see Exhibit 4.3 for historic Canada-US exchange rates), contributed to increased cross-border travel by Americans.

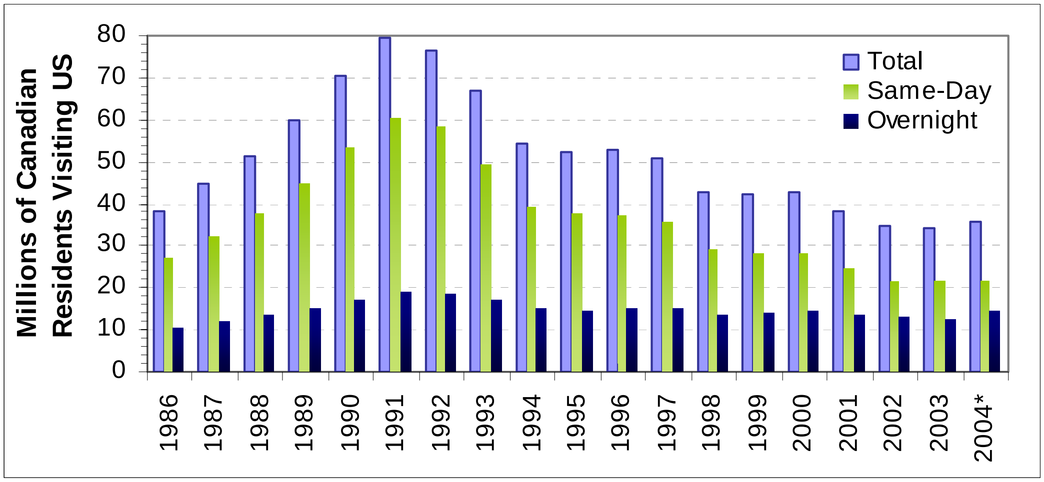
Exhibit 4.1: Annual Passenger Car Volumes, 1972-2004



Source: Bridge and Tunnel Operators Association (BTOA)

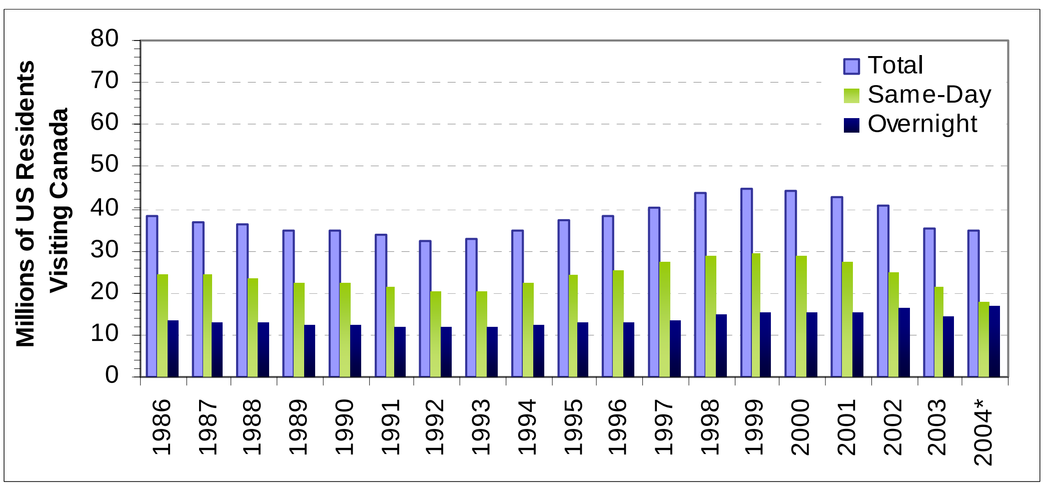
Exhibit 4.2: Visitation between Canada-US at Detroit-Windsor, All Modes

A. Number of Canadian Residents Visiting US, All Modes



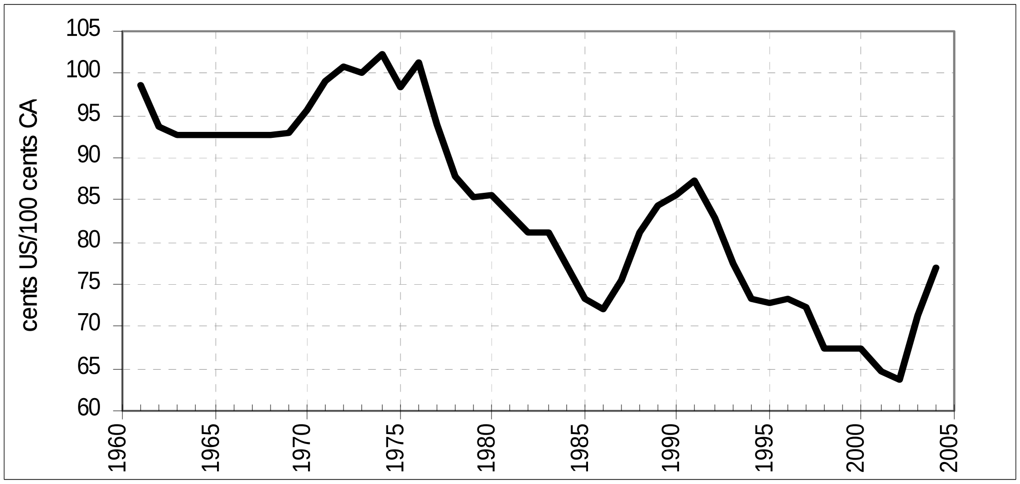
* First 11 months, annualised.
Source: Statistics Canada International Travel Survey, Table 387-0004

B. Number of US Residents Visiting Canada, All Modes



* First 11 months, annualised.
Source: Statistics Canada International Travel Survey, Table 387-0004

Exhibit 4.3: Canada-US Exchange Rate, 1960 to 2004



Source: Statistics Canada

During the late 1980s, an increase in the Canada-to-US currency exchange rates, differences in prices and taxes on many goods, Sunday closing laws in Canada, and the introduction of the Canadian Goods and Services Tax (GST) in January 1991 led to the cross-border shopping phenomenon, with Canadian residents shopping in the US to realise price savings on items such as gasoline, tobacco and various consumer goods. This resulted in an approximate twofold increase in same-day trips to the US, while the level of Americans travelling to Canada remained relatively constant.

Decreasing value and purchasing power of the Canadian dollar ($0.73 US by 1994), relaxation of Sunday closing laws in Ontario, reduced duties and tariffs on consumer items in Canada, improved competitiveness and more aggressive marketing by Canadian retailers, and other factors resulted in a very sudden drop in cross-border shopping between 1992 and 1994. Dramatic reductions in cross-border traffic were exhibited among almost all of the US-Canada crossings.

In contrast to national trends, passenger travel at the Detroit crossings, while very negatively affected by the sudden drop in cross-border shopping, managed to continue strong growth in the 1990s, largely attributable to opening of the Windsor Casino and the popularity of Canadian restaurants/bars, bingo and other entertainment establishments frequented by American residents. As well, the integration of the local Windsor and Detroit economies and strength of the auto and other sectors has promoted continued work/business commuting between the two border cities. Detroit River passenger car traffic peaked in 1999, the year when the first of four Detroit-area casinos opened, drawing patrons away from the Windsor casino. In 2000, casino trips still represented almost one-quarter of summer weekday passenger-car trips across the Detroit River.

In comparing growth trends before and after 2000, average annual growth rates by crossing between 1972 and 2000 were 3.0% for the Ambassador Bridge, 2.3% for the Detroit-Windsor Tunnel, and 1.5% for the Blue Water Bridge. For 2000 to 2004, average annual growth has been -8.3% for the Ambassador Bridge, -8.8% for the Detroit-Windsor Tunnel, and -3.8% for the Blue Water Bridge. Further, traffic statistics for early

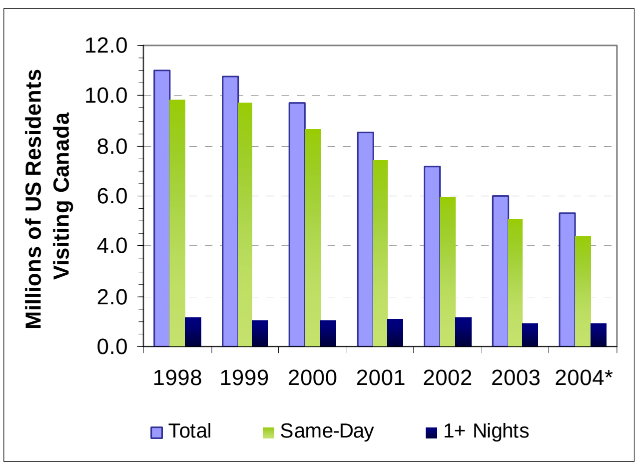
2005 indicate that passenger car traffic continues to decline, with no indication that it has bottomed out. The post-2000 era is clearly a very unique time period for cross-border traffic and unprecedented in the degree of change, despite the large variations that have occurred in past. There will likely be a future recovery. However, as in the past, the timing and extent of future large changes are not possible to predict using traditional socio-economic indicators given the nature of the events that caused them (e.g. gas shortages, cross-border shopping, etc.).

4.1.2 PASSENGER CAR TRIP PURPOSE TRENDS

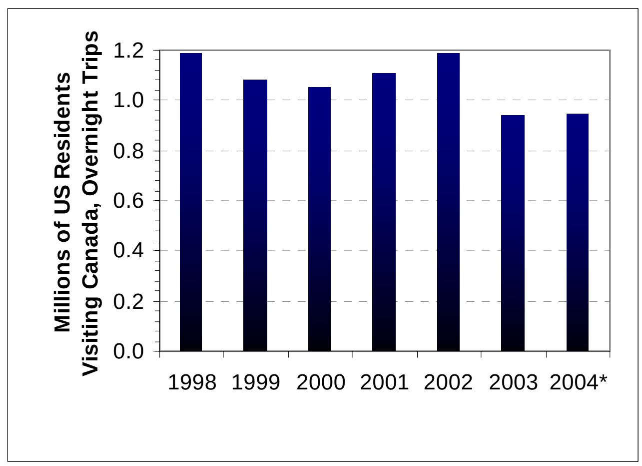
National data on length of stay by travellers between the US and Canada are available from the Statistics Canada International Travel Survey, and were presented previously as Exhibit 4.2. For US residents visiting Canada, information on length of stay is available for travel specific to the Detroit River crossings[1]; these figures are shown in Exhibit 4.4 for same-day, overnight, and total crossings, and were used to inform the updating of 2000 Detroit River passenger-car trip matrices by trip purpose to 2004.

Exhibit 4.4: Number of US Residents Visiting Canada by Automobile via Detroit River Crossings, by Duration of Stay

A. Total, Same-Day, Overnight



B. Overnight Only (change of scale)



* First 11 months, annualised.
Source: Statistics Canada International Travel Survey, Table 387-0004

At Detroit-Windsor, same-day trips by US residents form the bulk of cross-border passenger travel, making up 82% of visitors in 2004 (much higher than the national cross-border travel average of 52%). Same-day trips have been steadily decreasing over the past six years. In 2004, same-day trips at the Detroit River crossings totalled only 51% of same-day trips in 2000 (4.37 million versus 8.63 million trips). Overnight trips by US residents to Canada at the Detroit River crossings in 2004 total 90% of 2000 levels (0.94 million versus 1.05 million trips).

[1] Data for the Ambassador Bridge and Detroit-Windsor Tunnel could not be provided separately for privacy reasons.

In comparison, same-day trips by US residents to Canada at the St. Clair River in 2004 have dropped only to 75% of 2000 levels (1.30 million versus 1.74 million trips). Overnight trips by US residents at the St. Clair River have actually increased 8% (867,000 versus 806,000 trips), so that they now total 48% of overnight trips for the combined Detroit River and St. Clair River crossings.

The updating of the 2000 passenger car matrices (summer weekday) to 2004 (Fall weekday) was carried out in two stages. First, growth factors were developed to update August 2000 to August 2004 weekday matrices that would result in a reasonable match of predicted vs. actual hourly profiles for August 2004. Next, because the 2004 matrices are based on a Fall weekday, seasonal adjustment factors were applied to the August 2004 matrices to result in a reasonable match of predicted versus actual hourly profiles for September 2004. It was assumed that the hourly trip distribution by trip purpose did not change between 2000 and 2004; trips were factored up or down by the same factor for the entire day and for both crossings equally. The development of these factors is discussed by trip purpose in the following sections.

4.1.3 PASSENGER CAR – COMMUTING

The number of Windsor-area residents who work in the United States has increased from 2,500 to 7,000 between 1991 and 2001, corresponding to an absolute increase of 170% over this ten-year period or 10.6% per year annually, as can be seen in Exhibit 4.5. The majority of these cross-border jobs are in manufacturing (23%), professional services (21%) and in health care (20%). The Canada-US Free Trade Agreement of 1988 and the North American Free Trade Agreement of 1994 has facilitated work travel between the two countries. It is supported by NEXUS and predecessor voluntary programs established by Canada and US border inspection agencies to provide frequent, low-risk travellers with reduced inspection times and priority treatments.

While there was a significant increase in cross-border commuting between 1996 and 2001, commuting levels are felt to have been relatively constant between 2001 and 2004 based on an examination of traffic levels for the international crossings during peak commuting periods. This levelling off is considered, in part, due to actual and perceived increases in border delays associated with heightened security levels due to 9/11, the Iraq War, SARS and other events. The recent rise in the Canadian dollar relative to the US dollar from below US$0.70 to a over US$0.80 has also significantly reduced the earning levels of Canadians working in the US.

Reflecting the above, growth factors of 1.0 for Canadian work locations and 1.02 for US work locations were applied to update travel matrices from August 2000 to 2004. A seasonal adjustment of 1.10 was applied to develop September 2004 matrices, reflecting the reduced likelihood to take vacation days in the fall compared to summer.

Exhibit 4.5: Place of Work for City of Windsor & Windsor CMA Workers

A. Windsor Workers Employed in the US, 1981 2001

Year	Place of Residence	To all work destinations	To Work Destinations Outside Canada	% Outside Canada
1981	City of Windsor	80,170	2,690	3.4%
	Windsor CMA	102,805	3,165	3.1%
1991	City of Windsor	83,095	1,915	2.3%
	Windsor CMA	117,710	2,545	2.2%
1996	City of Windsor	89,275	2,545	2.9%
	Windsor CMA	130,775	3,545	2.7%
2001	City of Windsor	97,500	4,825	4.9%
	Windsor CMA	149,810	6,975	4.7%

Source: Statistics Canada Census Place-of-Work

B. Industry of Work for City of Windsor Residents Working Outside Canada, 2001

Industry	Jobs	Percent
Manufacturing	1,130	23.4%
Professional, scientific and technical services	1,025	21.2%
Health care and social assistance	945	19.6%
Educational services	330	6.8%
Retail trade	205	4.2%
Transportation and warehousing	170	3.5%
Other	1,030	21.3%
Total Windsor residents working outside of Canada	4,825	100%

Source: Statistics Canada Census Place-of-Work

4.1.4 PASSENGER CAR – TOURISM

Detroit River cross-border vacation travel has been much less affected by 9/11, SARS, the Iraq War and overall heightened security levels at the border as compared to same-day discretionary trips. In part, this is because border delays represent a much smaller proportion of the travel time for longer-distance overnight trips than for same-day trips.

Updating passenger travel vacation travel trip matrices from 2000 was based largely on the Statistics Canada International Travel Survey data for overnight trip trends, a large proportion of which are vacation trips. Between 2000 and 2004, overnight trips by US residents to Canada via the Detroit River decreased by 10%. In the same time, overnight trips by Canadian residents to the US nationally decreased only a net 1% overall, although a slightly greater drop in vacation trips resulted in a better match to the Detroit River hourly cross-border traffic profile. Therefore an August 2000 to 2004 growth/adjustment factor of 0.9 was applied for trips to/from vacation areas in the US, and 0.95 for trips to/from vacation areas in Canada. People are much more likely to take vacation time in the summer than in the fall months, therefore a 0.50 factor was applied in updating August 2004 to September 2004 passenger-car matrices for the vacation trip purpose.

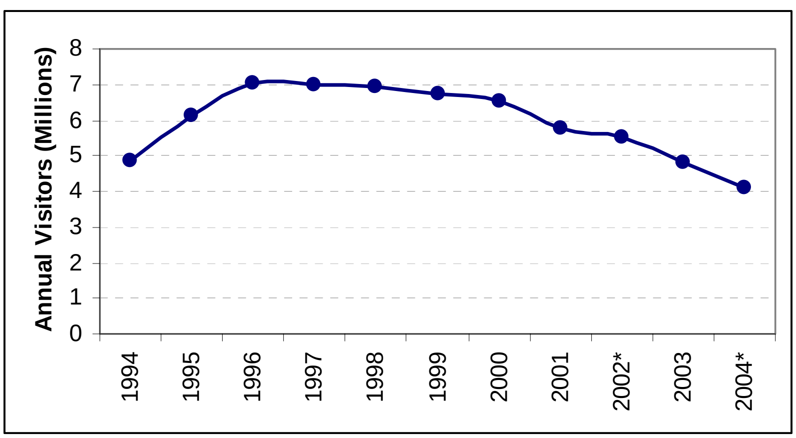
4.1.5 PASSENGER CAR – RECREATION

There has been a dramatic 49% drop in US residents crossing the border at the Detroit River for same-day trips, as was shown in Exhibit 4.4. Given that the number of same-day commuting trips has been steadier, the drop in same-day discretionary trips is still greater and the main reason for the large recent declines.

The dramatic drop in same-day discretionary trips has been caused by the confluence of extreme events consisting of 9/11, SARS, the Iraq War that have resulted in overall heightened security, border crossing delays and increased inspection levels. While delays to passenger cars crossing into Canada or the US are currently very low (less than five minutes during peak periods), there are still strong perceptions of delay or inconvenience associated with crossing the border that are contributing to the continuing decline in passenger car traffic.

A major attraction for Americans in the Windsor area is Casino Windsor. Between 2000 and 2004, Casino Windsor attendance has declined by approximately 38% (see Exhibit 4.6), with Americans representing approximately 80% of Casino Windsor attendance in 2000 based on Ontario Lottery Corporation estimates. Three new casinos have opened in Detroit since 1999 and a 42-day Casino Windsor strike in 2004 contributed to further Casino Windsor attendance declines. However, Casino Windsor maintains significant patronage among US residents for the following reasons[2]:

Exhibit 4.6: Casino Windsor Patronage



* 2004 values are annualised from nine-months of data.
Source: 1994 to 2001 – Previous Windsor Casino website; 2002 to 2004 – Ontario Lottery and Gaming Corp.

[2] **Detroit News Entertainment Insider** (Detnews.com). Joel J. Smith: "Casino Windsor bets on growth." September 5, 2004

- Casino Windsor operates under the laws/legislation of the Ontario government and therefore does not report winnings to the US Internal Revenue Service;

- Its location in downtown Windsor is one where patrons can feel comfortable walking the streets with many restaurants/bars, entertainment and retail establishments in close proximity; and

- Casino Windsor's permanent facilities include hotel facilities that the Detroit casinos cannot offer in their temporary buildings. In addition, an aggressive expansion plan announced by the provincial government in February 2005 includes a new hotel tower, theatre and extensive convention space.

If the entire 2000 to 2004 decline in Casino-Windsor patronage (38%) attendance is attributed to a decrease in patronage by US residents, the corresponding August 2000 to 2004 growth rate for casino cross-border Canadian casino traffic would be approximately 0.52. A factor of 0.50 was applied for a slightly better fit of the actual August 2004 traffic profile.

Other Windsor-area attractions include the Windsor Racetrack, bingo and the many restaurants, bars, entertainment venues and shops in the downtown area, which have seen significant declines in American patrons. In January 2005, several Windsor businesses estimated a 10% loss in total business due to the rising Canadian dollar[3]; if, say, one-fifth of their clients were US residents, the corresponding decline in cross-border shopping traffic would be 50%. Decreases in the US-to-Canada currency exchange rate have resulted in decreased buying power for US residents shopping in Canada, but the current rate is still considered good value based on discussions with the local Windsor tourism office. A factor of 0.45 was applied to update August 2000 to 2004 trip matrices for same-day trips to/from other Canadian recreation/entertainment shopping locations other than Casino Windsor.

Among Canadians, a stronger Canadian dollar typically translates to higher levels of discretionary travel to the US, but this has not occurred with the recent large increase the Canadian dollar based on a recent Statistics Canada report[4]. The lack of responsiveness may be due to real/perceived border crossing inconvenience, as described above, and/or that the incentive for cross-border travel is limited or no longer exists for many Canadians. The latter may be due to increased economic integration of retail/shopping industries in both countries, which has greatly reduced or eliminated potential price savings after exchange and/or the need to travel for a variety of selection, with common stores in both countries. This is a very different situation from the late 1980s when the cross-border shopping phenomenon was occurring due to significant cost savings to Canadian shoppers in a pre-NAFTA era, a wider selection of stores in the US, and significantly lower taxes on gasoline and tobacco products, among other reasons. According to the Statistics Canada International Travel Survey, nation-wide, Canadians made 24% fewer same-day trips to the US in 2004 compared to 2000. An August 2000 to 2004 growth factor of 0.70 therefore seemed reasonable and helped result in a good match of the actual August 2004 profile.

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[3] **Detroit News Business** (Detnews.com). Louis Aguilar: "Windsor not much of a bargain, eh?" January 18, 2005

[4] "The Soaring Loonie and International Travel", **Canadian Economic Observer**, Statistics Canada (Catalogue no. 11-010), February, 2005.

Many of the trips with "other" designated trip purposes in the Ontario-Michigan cross-border travel survey indicated that they were social trips, or were for drop-off or pick-up of other passengers. These trips would therefore be influenced by the trends in recreational travel described above, perhaps more so as these are quite discretionary and may be the first to be dropped in the face of border delays, etc. A growth/adjustment factor of 0.40 was applied to these trips, as it helped to create a good fit of the resulting August 2004 profile to observed counts.

4.1.6 2004 PASSENGER CAR TRIP PURPOSE SUMMARY

A seasonal adjustment factor of 0.90 was applied to all August recreation/entertainment/shopping/other trips to obtain September travel characteristics. The following can be noted from the updated 2004 travel matrices:

- Work/business trips represent 16,000 to 18,000 weekday trips in 2004, or almost half of the traffic using the Detroit River crossings on a typical Fall weekday;
- There were an estimated 2,000 Fall weekday and 4,000 summer weekday vacation trips using the Detroit River crossings, which represents 5% of the international passenger car traffic on a typical Fall weekday; and
- There were approximately 15,000 same-day recreation, entertainment, and shopping trips using the Detroit River crossings on a summer weekday and 14,000 on a Fall weekday in 2004. This represents 40% of cross-border travel on a summer 2004 weekday, but is a dramatic decrease from 27,000 trips and 49% of summer 2000 weekday trips.

4.2 Development of 2004 Passenger Car Trip Tables

4.2.1 RE-EXPANSION OF SURVEY

As discussed in Chapter 3, the period chosen for modelling cross-border travel activity at the Detroit River crossings was to be representative of a Thursday-Friday average Fall weekday. To make best use of the available weekday travel data, which included partial Wednesday data, all weekday data were included, but re-expanded to sum to Thursday-Friday average-day trip totals by purpose for the following time periods:

- A.M. Peak (6:00 a.m. to 9:00 a.m.);
- Mid-Day (9:00 a.m. to 3:00 p.m.);
- P.M. Peak (3:00 p.m. to 7:00 p.m.);
- Evening (7:00 p.m. to 11:00 p.m.); and
- Night (11:00 p.m. to 6:00 a.m.).

A total of 12,681 weekday trip records representing Detroit River and St. Clair River passenger car border crossings were used, with the resulting expansion factors ranging from 2.09 to 14.76.

4.2.2 2000 TO 2004 GROWTH FACTORS BY TRIP PURPOSE

The growth/adjustment factors shown for the eight trip purposes in Exhibit 4.7 were applied to the trip records in the Ontario-Michigan O-D survey to provide updated travel characteristics for the Detroit Windsor crossings. These factors were discussed for each trip purpose in Section 4.1. The resulting trip purpose breakdowns for August and September 2004 are shown in Exhibit 4.8, and hourly trip purpose breakdowns for September 2004 are shown in Exhibit 4.9.

The eight 2004 passenger car trip matrices by trip purpose were also summed to provide total passenger car trips and compared to actual cross-border passenger car traffic counts from the BTOA for the Fall weekday control totals for daily traffic and a.m. peak hour, p.m. peak hour and mid-day peak hour, as derived in Chapter 3. The number of cross-border trips by direction compared very closely to the BTOA counts, with minor adjustments made to match the BTOA counts.

Exhibit 4.7: Growth Factors to Update August 2000 to September 2004 Detroit River Cross-Border Passenger Car Volumes by Trip Purpose

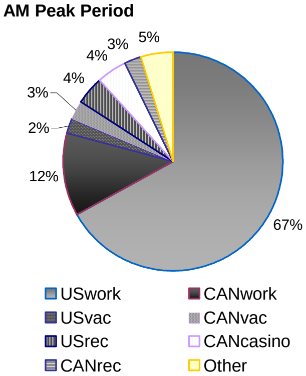
Trip Purpose (trips to/from:)	August 2000 to August 2004 Increase	August to September Seasonal Increase
USwork – US work locations	1.02	1.1
CANwork – Canadian work locations	1.0	1.1
USvac – US vacation destinations	0.95	0.5
CANvac – Canadian vacation destinations	0.90	0.5
USrec – US recreation/entertainment/shopping	0.70	0.9
CANcasino – Canadian casino/gaming locations	0.50	0.9
CANrec – Canadian recreation/entertainment/shopping	0.45	0.9
Other – includes social visits/pick-up or drop-off	0.40	0.9

Exhibit 4.8: 2004 Trip Purpose by Time Period, August & September Weekdays

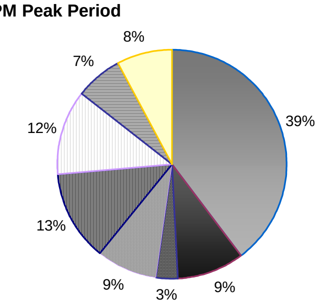
	VOLUMES						PERCENTAGES					
	August 2004			September 2004			August 2004			September 2004		
Purpose	Entering Canada	Entering US	TOTAL	Entering Canada	Entering US	TOTAL	Entering Canada	Entering US	TOTAL	Entering Canada	Entering US	TOTAL
AM Peak	**1,390**	**4,520**	**5,920**	**1,370**	**4,760**	**6,140**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**
USwork	230	3,740	3,970	250	4,110	4,370	17%	83%	67%	18%	86%	71%
CANwork	630	80	710	690	90	780	45%	1.8%	12.0%	50%	1.9%	12.7%
USvac	10	120	130	10	60	70	0.8%	3%	2%	0.4%	1.3%	1.1%
CANvac	130	50	180	60	30	90	9%	1.2%	3.1%	5%	0.6%	1.5%
USrec	160	80	240	150	70	210	12%	2%	4%	11%	1.4%	3.5%
CANcasino	110	160	260	100	140	240	8%	3%	4%	7%	3%	4%
CANrec	30	110	150	30	100	130	2%	2%	2%	2%	2%	2%
Other	100	180	280	90	160	250	7%	4%	5%	6%	3%	4%
PM Peak	**7,110**	**3,450**	**10,560**	**6,860**	**3,190**	**10,050**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**
USwork	3,730	470	4,200	4,100	520	4,620	52%	14%	40%	60%	16%	46%
CANwork	270	720	990	290	790	1,080	4%	21%	9%	4%	25%	11%
USvac	140	180	320	70	90	160	2.0%	5%	3%	1.0%	3%	1.6%
CANvac	700	200	900	350	100	450	10%	6%	9%	5%	3%	4%
USrec	810	540	1,350	730	490	1,220	11%	16%	13%	11%	15%	12%
CANcasino	750	540	1,280	670	480	1,160	11%	16%	12%	10%	15%	12%
CANrec	260	430	700	240	390	630	4%	13%	7%	3%	12%	6%
Other	440	370	820	400	330	730	6%	11%	8%	6%	10%	7%
24-Hour	**20,160**	**18,370**	**38,540**	**18,810**	**17,550**	**36,360**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**
USwork	6,140	6,500	12,650	6,760	7,150	13,910	30%	35%	33%	36%	41%	38%
CANwork	2,090	1,570	3,660	2,300	1,730	4,030	10%	9%	10%	12%	10%	11%
USvac	450	710	1,160	230	360	580	2.2%	4%	3%	1.2%	2%	1.6%
CANvac	2,010	800	2,810	1,010	400	1,410	10%	4%	7%	5%	2%	4%
USrec	3,920	2,830	6,750	3,530	2,550	6,080	19%	15%	18%	19%	15%	17%
CANcasino	3,280	3,060	6,340	2,950	2,760	5,700	16%	17%	16%	16%	16%	16%
CANrec	820	1,350	2,170	730	1,220	1,950	4%	7%	6%	4%	7%	5%
Other	1,460	1,540	3,000	1,310	1,390	2,700	7%	8%	8%	7%	8%	7%

AUGUST 2004

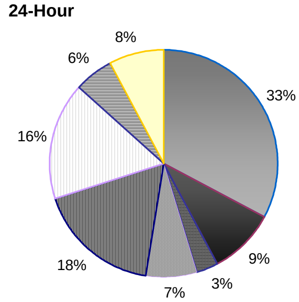
AM Peak Period



PM Peak Period

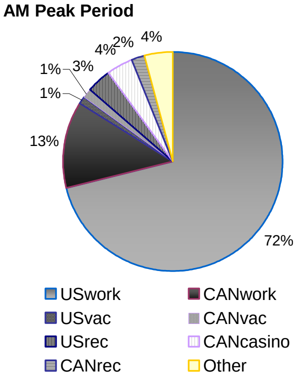


24-Hour

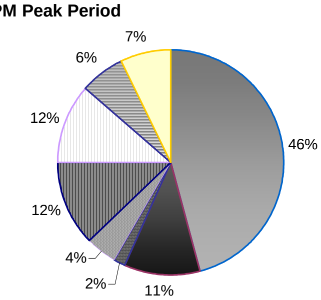


SEPTEMBER 2004

AM Peak Period



PM Peak Period



24-Hour

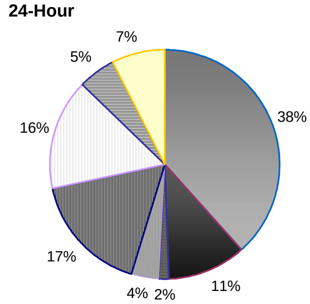
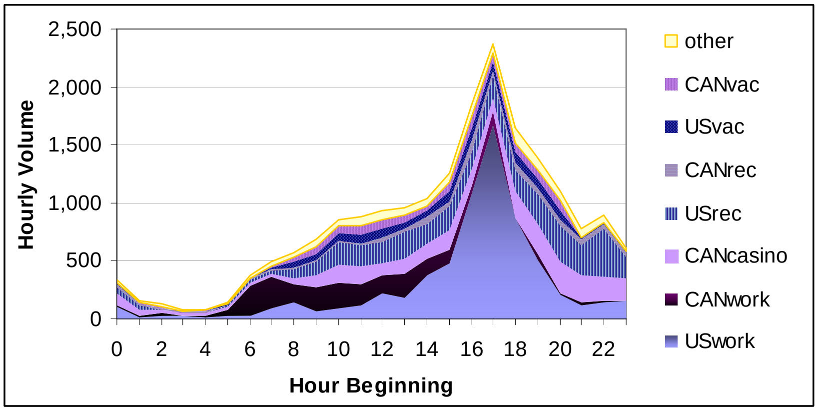
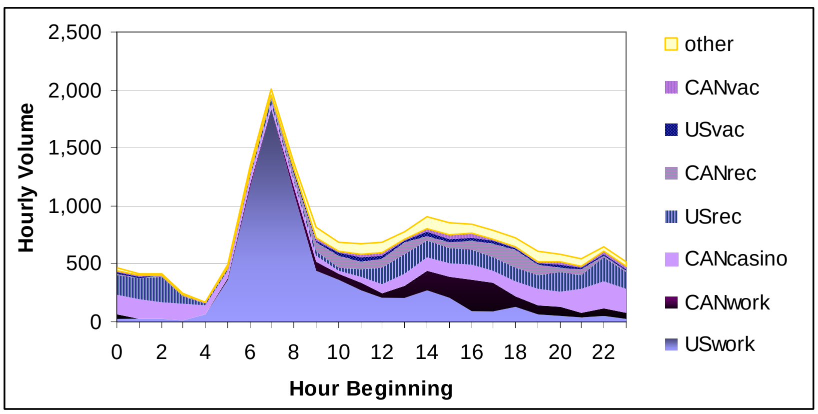


Exhibit 4.9: Hourly Traffic Profile for Detroit River Crossings by Direction, September 2004

A. To Canada



B. To US



4.2.3 SPATIAL TRAVEL PATTERNS

Exhibit 4.10 presents a summary of the origin-destination patterns for passenger car traffic at Detroit and St. Clair River Crossings for August, 2000, while Exhibit 4.11 updates the table for Fall 2004 travel. Despite the 35% decrease in passenger car trips over the Detroit River, the macro travel pattern distribution is very similar, given the high proportion of same day trips made and focus of activity on Windsor and Detroit.

On a Fall weekday, there were approximately 35,850 passenger car trips at Detroit River crossings, comprising the Ambassador Bridge and Detroit-Windsor Tunnel. Almost 80% of these trips were local in nature between greater Windsor and greater Detroit. Approximately 15% of the trips started or ended in the greater Windsor/Detroit area, but involved long-distance travel to other parts of the US or Canada. Only a small proportion of the passenger car trips (6%) represented long distance travel that passed through the Windsor-Detroit area. The Detroit-Windsor Tunnel serves a higher proportion of local Windsor-Detroit travel compared to the Ambassador Bridge (88% vs. 71%), but less long distance to long distance traffic travelling through Windsor-Detroit

(0.9% vs. 10%). This reflects the highly localised nature of passenger car travel using the Detroit River crossings, with limited ability for these trips to use other international crossings (i.e. Blue Water Bridge).

Exhibit 4.10: Weekday Passenger Car Trips Trip Patterns at Detroit River & St. Clair River Crossings, August 2004

Trip Type	Crossing							
	Ambassador Bridge		Detroit-Windsor Tunnel		Detroit River Crossings		Blue Water Bridge[1]	
	Volume	%	Volume	%	Volume	%	Volume	%
LOCAL to LOCAL	19,800	68	22,400	86	42,200	77	6,900	45
LOCAL (Southeast Michigan) to/from LONG-DISTANCE (beyond Windsor-Essex)	3,000	10	1,450	6	4,450	8	3,550	23
LOCAL (Windsor-Essex) to/from LONG-DISTANCE (beyond Southeastern)	2,950	10	1,700	7	4,650	8	1,550	10
LONG-DISTANCE to LONG-DISTANCE	3,250	11	300	1.2	3,550	6	3,200	21
OTHER[2]	120	0.4	70	0.3	200	0.3	100	0.6
TOTAL TRIPS	29,150	100	25,900	100	55,050	100	15,300	100

[1] The local trip area for Blue Water Bridge crossings is Sarnia and area (Lambton County) in Canada.
[2] This includes unexpected/atypical trips where the shortest route is not taken.

Exhibit 4.11: Weekday Passenger Car Trips Trip Patterns at Detroit River & St. Clair River Crossings, Fall 2004

Trip Type	Crossing							
	Ambassador Bridge		Detroit-Windsor Tunnel		Detroit River Crossings		Blue Water Bridge[1]	
	Volume	%	Volume	%	Volume	%	Volume	%
LOCAL to LOCAL	13,450	71	15,000	88	28,450	79	4,550	46
LOCAL (Southeast Michigan) to/from LONG-DISTANCE (beyond Windsor-Essex)	1,850	10	900	5	2,700	8	2,400	24
LOCAL (Windsor-Essex) LONG-DISTANCE (beyond Southeast Michigan)	1,700	9	900	5	2,600	7	900	9
LONG-DISTANCE to LONG-DISTANCE	1,800	10	150	0.9	2,000	6	2,050	20
OTHER[2]	70	0.4	50	0.3	120	0.3	60	0.6
TOTAL TRIPS	18,850	100	17,000	100	35,850	100	10,000	100

[1] The local trip area for Blue Water Bridge crossings is Sarnia and area (Lambton County) in Canada.
[2] This includes unexpected/atypical trips where the shortest route is not taken.

At the St. Clair River crossing, the Blue Water Bridge, there were approximately 10,000 passenger car trips on a weekday in Fall 2004. The travel consisted of a higher proportion of longer distance travel, although 80% of the traffic still has a trip start or trip end in the Sarnia-Port Huron area. Approximately one-half of the travel involved short distance travel between the greater Sarnia and Port Huron areas.

4.3 Domestic Traffic

Background or domestic passenger car traffic is required in the model to ensure that delays on routes to and from border crossings and interactions with non-border-crossing traffic are adequately reflected. This section describes the development of domestic Canadian traffic, which is derived from the Essex-Windsor Regional Transportation Master Plan model. US domestic traffic is derived from the SEMCOG model and has been prepared by the US-based DRIC consultant, The Corradino Group.

4.3.1 PM PEAK HOUR TRIPS

Domestic Canadian trips are based on the 1997 Windsor Household Travel Survey. This O-D survey includes over 4,000 trip records for p.m. peak period trips within a study area of Windsor, Lasalle and Tecumseh (north of County Road 8 and west of the Belle River), and over 5,000 trip records from a cordon survey of trips entering and exiting the study area. These data were used to develop trip matrices for the 1999 Windsor Area Long Range Transportation Study (WALTS) and the 2005 Essex-Windsor Regional Transportation Master Plan (EWRTMP). A small mail-back survey was carried out to supplement the 1997 travel survey with trips within Essex but outside the WALTS study area.

For trips entirely within the former WALTS area, the 1997 household survey was used to develop a p.m. peak period trip with four purposes: home-based work, home-based school, home-based other and non-home-based. Trips productions and attractions were calibrated with 1996 population and employment and expanded using a Fratar process to a 2004 horizon year. This process uses the 1996 trip distribution is used as a basis for future years, with changes in origin-destination pairs proportionately increased in relation to the change in distribution of population and employment.

For trips to/from and within the rest of Essex County (i.e. external WALTS area trips), the 1997 cordon survey and mail-back survey were used to estimate trips for these areas. The original PN/F Study pre-dated this development of the outer area; therefore domestic trips external to the WALTS area were previously included by adding them as cordon volumes entering/exiting at the WALTS boundary (i.e. cordon “zones” 5001 to 5013). For the 2004 update, the Essex trips from the cordon and mail back surveys were allocated to an actual geographic zone, with some scaling applied to better match traffic volumes on Essex roads. Trips to/from other parts of Canada were also allocated to a geographic zone from the town of origin or destination recorded in the 1997 cordon survey. The addition of all Essex trips and the re-allocation of former “external Canadian domestic” trips to geographic zones provided much more refined geographic detail to traffic zones within Essex.

4.3.2 AM PEAK HOUR TRIPS

The 1997 travel surveys and the subsequent mail-back survey were carried out for the p.m. peak period only, so a process was developed to create a.m. peak hour trip matrices for domestic travel. The procedure was based on the proportion of trips travelling between production and the attraction and vice versa; in the p.m. peak most trips are destined to home, whereas in the a.m. peak hour, most trips are from home.

Given that relationships between a.m. and p.m. peak hour travel characteristics are not available for Windsor-Essex, relationships from the City of London 2003 household survey were applied. For the same trip purposes, the relative size and direction of production-attractions between the a.m. and p.m. peak were determined and applied to create an a.m. peak period matrix for the former internal WALTS area. Production-attraction data were not available for trips to and from other areas of Essex and Canada and these trips were simply transposed and factored by 80% based on traffic counts in the rural areas of Essex.

4.3.3 MID-DAY PEAK HOUR TRIPS

For trips within the Windsor area, travel demand for the mid-day peak hour was derived in the same manner as for the a.m. peak period. Data from the London survey was used to calculate the size and directionality of demand for each trip purpose during the mid-day relative to the p.m.

Travel demand in Essex County outside of Windsor was estimated based upon a combination of the a.m. and p.m. trip matrices. The resulting matrix was then multiplied by a factor to reduce the mid-day demand to 60% of the p.m. peak demand.

Trips originating from or destined to the rest of Canada represent a very small percentage of total travel demand in the region. These trips were taken from the cordon survey undertaken as part of the Windsor Household Travel Survey.

5. UPDATE OF COMMERCIAL VEHICLE TRAVEL DEMAND

5.1 2000 to 2004 Trend Analysis

The primary source of data for developing cross-border commercial vehicle trip matrices for the P/N&F study was the Commercial Vehicle Survey database provided by the MTO. This data set is based on the 1999 National Roadside Survey (NRS), combined with results from the 2000 MTO Commercial Vehicle Survey (CVS), which provides an extremely rich sample of more than 13,500 actual records collected for truck trips crossing between Ontario and Michigan. Because this represents the most comprehensive and recent data set on Detroit River crossings, commercial vehicle travel characteristics available, it is used as the basis for the 2004 model update. Adjustments are made to reflect changes in overall truck freight flows, trends for different commodity types, and interactions with other modes, as described in this chapter. The US Bureau of Transportation Statistics Transborder Freight Database and other sources are used to inform the 2000 to 2004 update.

5.1.1 FREIGHT FLOWS BY ALL MODES

The relative importance of the rail and truck transport modes to Canada-US trade across the Detroit River and across the St. Clair River can be seen in Exhibit 5.1 in terms of the value of trade. Both crossing areas are shown, as the Ambassador Bridge and Blue Water Bridge operate as a system, with many long-distance trips being able to use either crossing without significant differences in total travel time.

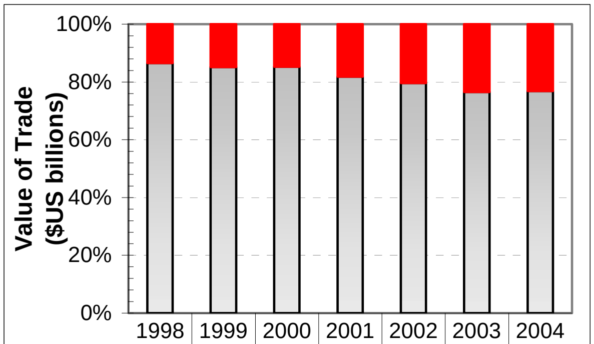
At 83% of freight by value, trucking is the dominant mode for shipping freight across the Detroit River. The value of truck trade across the Detroit River has seen a slight increase since 2000, although its share by trade value has dropped from 91% in 1998 to 83% in 2004, given a doubling in rail trade by value across the Detroit River since 2000. (The increase in rail trade across the Detroit and St. Clair Rivers combined is only 18%, as part of this increase can be attributed to a shifting of a portion of rail goods movement from the St. Clair River to the Detroit River.) In 2004, trucks carried 77% of the value of Canadian freight exports to the US ($US 43 billion) and 89% of the value of US freight exports to Canada ($US 51 billion) via the Detroit River, whereas in 2000, trucks carried 85% of Canadian freight exports to the US and 96% of US freight exports to Canada.

Exhibit 5.2 shows the value of truck trade transported from 1998 to 2004. The total value of trade carried by truck at Detroit River crossings over the last few years has been somewhat steady but has not quite returned to 1999 values. Meanwhile, the value of trade transported by the Blue Water Bridge has been steadily increasing, the only deviation from the trend being in 2001. In 2004, the total value of truck trade at Blue Water Bridge was 42% compared to Detroit-Windsor, although commercial vehicle volumes are 53% compared to Detroit-Windsor. This suggests that trucks passing Detroit-Windsor have significantly higher freight value per truck than the Blue Water Bridge. US exports to Canada exceed imports at the Detroit River crossings, although flows are much more balanced at the St. Clair River crossings.

Exhibit 5.1: Value of Trade by Mode for Detroit & St. Clair River Crossings, 1998 to 2004

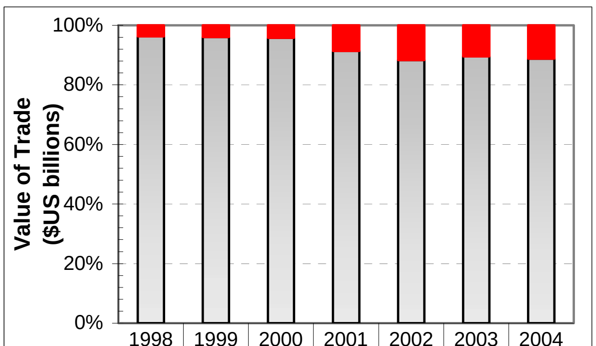
DETROIT RIVER

Canada to US



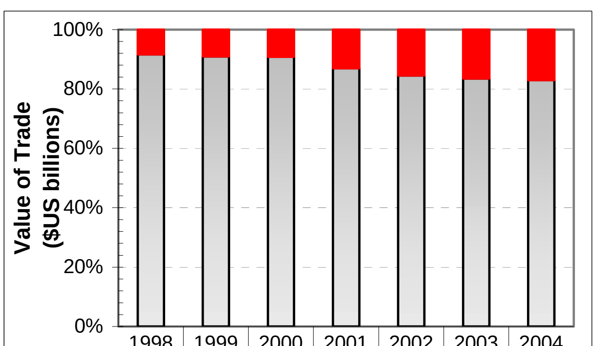
	1998	1999	2000	2001	2002	2003	2004
Rail	5.3	6.5	6.5	7.7	9.1	11.0	12.8
Truck	34.0	37.2	38.0	34.9	35.4	36.1	42.5

US to Canada



	1998	1999	2000	2001	2002	2003	2004
Rail	1.6	1.9	2.1	4.2	6.5	5.7	6.4
Truck	41.8	46.6	47.4	44.8	49.6	48.6	51.0

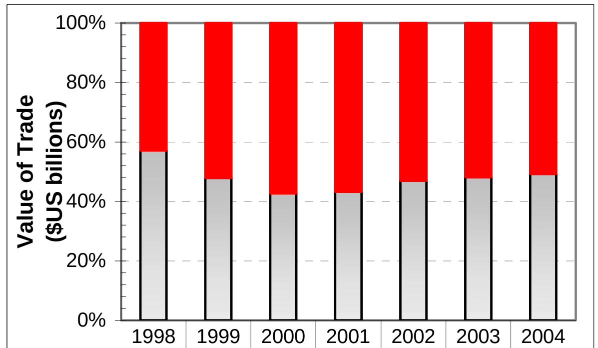
Total Two-Way Trade



	1998	1999	2000	2001	2002	2003	2004
Rail	6.9	8.3	8.6	11.9	15.6	16.7	19.2
Truck	75.8	83.8	85.4	79.7	85.0	84.7	93.6

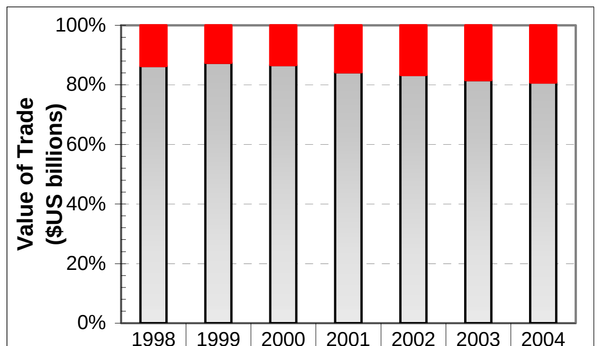
ST CLAIR RIVER

Canada to US



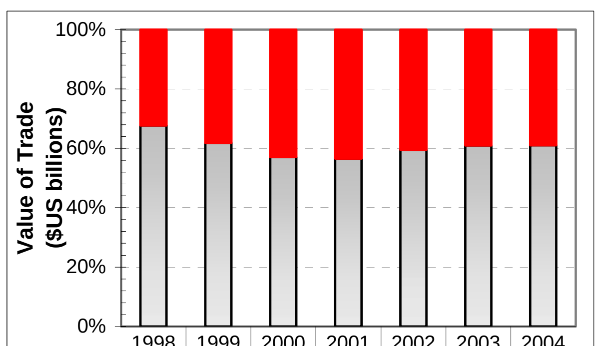
	1998	1999	2000	2001	2002	2003	2004
Rail	10.9	16.4	22.2	20.2	19.2	18.8	19.5
Truck	14.6	15.1	16.6	15.4	17.0	17.5	19.0

US to Canada



	1998	1999	2000	2001	2002	2003	2004
Rail	1.9	2.2	2.5	2.7	3.2	4.1	4.4
Truck	12.3	15.1	16.1	14.5	15.8	18.2	18.6

Total Two-Way Trade

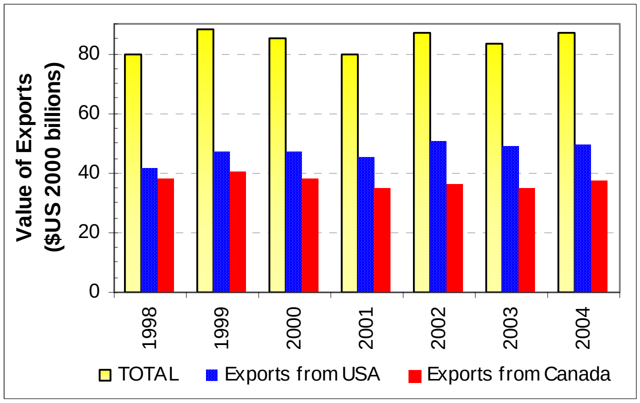


	1998	1999	2000	2001	2002	2003	2004
Rail	12.9	18.6	24.6	22.9	22.4	22.9	23.9
Truck	26.9	30.2	32.7	29.8	32.8	35.7	37.6

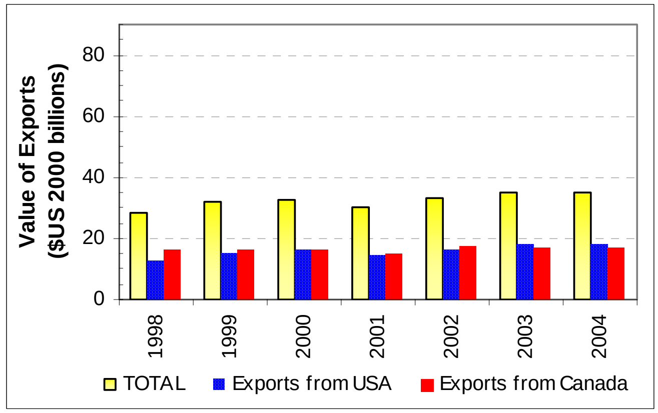
Source: BTS Transborder Surface Freight Database

Exhibit 5.2: Value of Annual Canada-US Trade Transported by Truck

A. Detroit River



B. St. Clair River

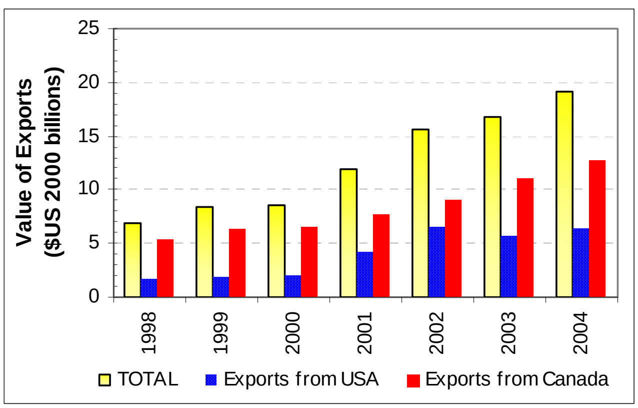


Source: US Bureau of Transportation Statistics Transborder Surface Freight Database

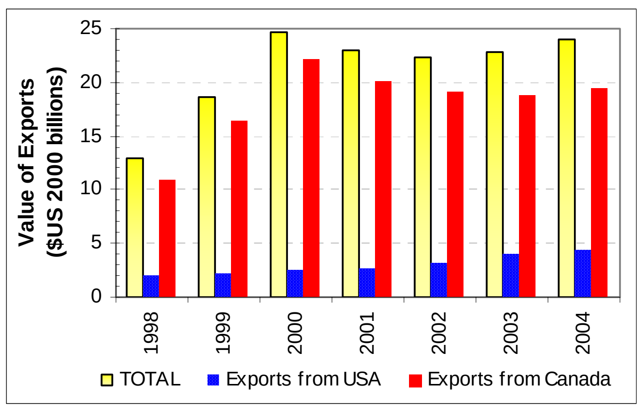
In comparison, Exhibit 5.3 shows the value of rail trade for the same years. The value of rail trade transported via the Detroit River crossing has been steadily increasing and has more than doubled since 1998, although this growth trend is not considered to continue, as described below. The Detroit River crossing now carries more rail freight from the US to Canada than the St. Clair River crossing, and 80% of the total value of Canada-US trade compared to the St. Clair River.

Exhibit 5.3: Value of Annual Canada-US Trade Transported by Rail

A. Detroit River



B. St. Clair River



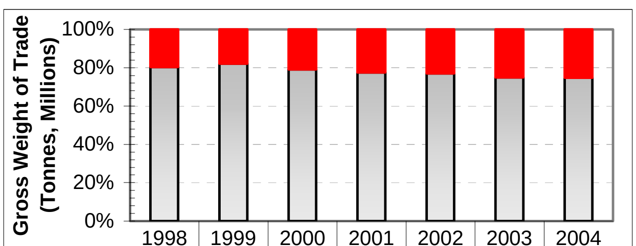
Source: US Bureau of Transportation Statistics Transborder Surface Freight Database

The St. Clair River crossings have historically had higher rail volumes. Rail has carried over half of the US-bound freight in terms of value, and almost 20% of Canada-bound freight. Rail freight across the St. Clair River has not grown as quickly as at the Detroit River, such that the Detroit River now carries more rail freight from the US to Canada than the St. Clair River, and 80% of the total value of Canada-US trade compared to the St. Clair River. Part of the reason for the increase in usage of the Detroit-Windsor Rail Tunnel is due to the operational changes. The St. Clair Rail Tunnel is owned and controlled by Canadian National (CN); the Detroit-Windsor Rail Tunnel is controlled by Canadian Pacific Railway (CPR). The two railways have made a number of agreements to allow them to use each other's routings. Much of CN's traffic destined to Detroit used to go to the Sarnia tunnel but now can go through the Windsor tunnel.

Information on the weight of shipments is available from the Bureau of Transportation Statistics (BTS) Transborder Surface Freight database only for Canadian exports to the US. The mode shares for the Detroit River and St. Clair River crossings are shown based on weight in Exhibit 5.4. It shows a similar trend as the above modal share data expressed in trade value, with growth in the rail mode but with absolute rail volume very small compared to the truck mode. Based on weight at Detroit River crossings, truck modal shares have dropped to a lesser extent, from 79% to 75%, than as expressed in term of value (85% to 77%) between 2000 and 2004, respectively. In 2004, the St. Clair US-bound truck mode share was 49% by value, and 26% by weight.

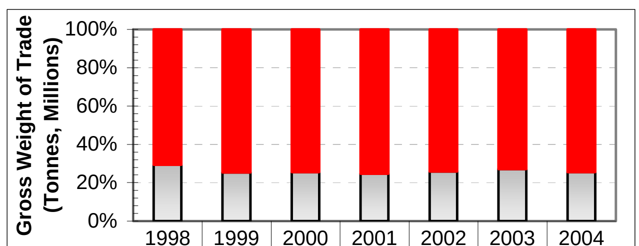
Exhibit 5.4: Gross Shipping Weight of Trade by Mode for Detroit & St. Clair River Crossings, 1998 to 2004, Canada to US

DETROIT RIVER



	1998	1999	2000	2001	2002	2003	2004
Rail	3.2	3.1	3.6	3.6	3.9	4.4	4.7
Truck	13.0	14.1	13.7	12.5	13.1	13.2	14.0

ST CLAIR RIVER



	1998	1999	2000	2001	2002	2003	2004
Rail	7.7	9.0	10.6	11.1	11.2	11.8	13.7
Truck	3.2	3.1	3.6	3.6	3.9	4.4	4.7

Source: BTS Transborder Surface Freight Database

Examining the Detroit River and St. Clair River crossings as a combined system indicates that the modal trends over the 2000 to 2004 period have been relatively stable. The intermodal rail modal share (based on value) has been constant at approximately 35% between 2000 and 2004 for the peak Canada to US direction. As noted above, the intermodal share at Detroit River crossings increased over this time period due to an operational change between CN and CPR.

While the two major Canadian Railways have traditionally done very well at attracting intermodal rail traffic, this has been achieved in long-distance traffic in Canada, with much less success in attracting cross-border intermodal traffic. In recent year, the railways have used innovative technology to attempt make inroads into the market of relatively short distance trips (500 km or less). For example, CPR started an intermodal service Montreal/Toronto and Detroit using its Xpressway technology. However, after operating for several years, this service was discontinued in the Fall of 2004. Reasons given for the discontinuance include the following:

- Low margins;
- A lack of capacity on the mainline through Southwestern Ontario (single track line); and
- Problems with US Immigration with respect to Canadian drivers delivering trailers from the Detroit yard.

The above indicates that intermodal rail has not increased its market share at Detroit River and St. Clair River crossings between 2000 and 2004 and there appears to be no inherent structural changes in the manner freight is transported at the Detroit River and St. Clair River crossings. However, the continued growth in intermodal rail to maintain its market share will require infrastructure improvements, notably increases in Canadian mainline capacity.

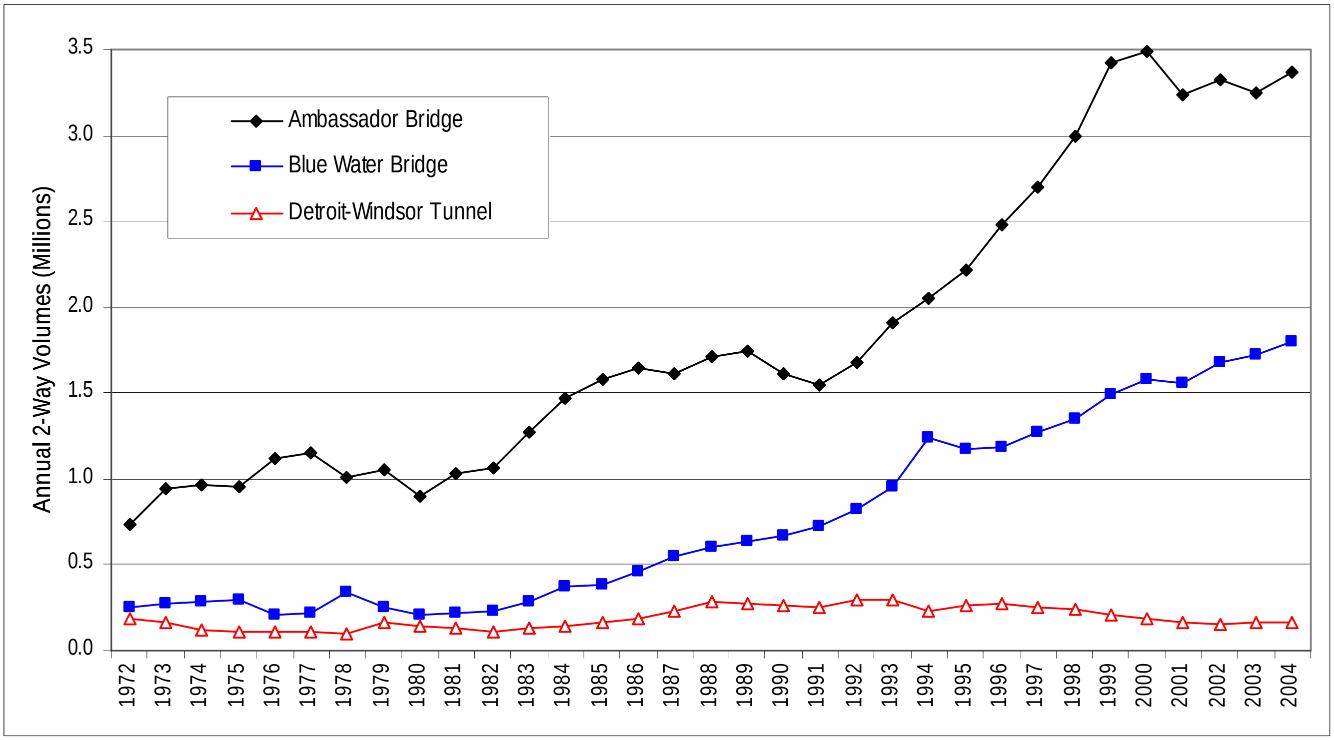
5.1.2 COMMERCIAL VEHICLE CROSSING VOLUMES

Exhibit 5.5 shows annual commercial vehicle volumes for the Detroit River crossings and the Blue Water Bridge from 1972 to 2004. Previous to 2000, commercial vehicle volumes had increased very rapidly in the 1990's and more than doubled at Ambassador Bridge and Blue Water Bridge, to 3.49 million commercial vehicles at Ambassador Bridge in 2000 and 1.58 million at Blue Water Bridge. Volumes at the Detroit-Windsor Tunnel, however, steadily decreased over the same period to 182,000 commercial vehicles in 2000, about half of the volume in 1990. Volumes at all crossings are lower in 2001 than in 2000 by 6% due to the effects of 9/11: 7.1% lower at the Ambassador Bridge, 6.8% lower at the Detroit–Windsor Tunnel and 1.3% lower at the Blue Water Bridge.

Between 2000 and 2004, annual commercial vehicle traffic at the Ambassador Bridge has decreased by 0.12 million vehicles or 3.4%. The Blue Water Bridge has increased by 0.32 million vehicles over this same time period, representing a 22% increase. The Ambassador Bridge and the Blue Water Bridge operate as a system, as many long distance trips can use either crossing and the combined Detroit River and St. Clair River crossings experienced a net growth of 0.18 million vehicles. A proportion of Ambassador Bridge trips have diverted to the Blue Water Bridge, owing to the actual and perceived delays at border inspection at Windsor-Detroit, as well as a small shift in travel patterns between 2000 and 2004 (see Section 5.3.1), with a slightly higher proportion of trade to mid-western states that are more easily accessed via the Blue Water Bridge.

Compared to passenger car traffic, commercial vehicle traffic has been much less affected by major events since 2000, with a slow-down in growth rather than a major decline and with prospects to return to previous growth trends pre-9/11.

Exhibit 5.5: Annual Commercial Vehicle Volumes, 1972 – 2004



Source: Bridge and Tunnel Operators Association (BTOA)

In total, since 1994, growth in commercial vehicle volumes exhibited at the Detroit River crossings has been much stronger than that of other Canada-US border regions. The rate of growth has been strong and continuous over the past 30-year period, owing to increases in industrial production in both Canada and the US. Growth in the auto sector and increases in Canadian assembly plant activity have particularly influenced the growth in commercial vehicle traffic between Southeast Michigan and Southwest Ontario, largely due to the 1965 Auto Pact between the US and Canada, which has since been superseded by the North American Free Trade Agreement (NAFTA). In terms of overall levels of commercial vehicle traffic, the movement to just-in-time inventories has resulted in significantly increased demand in the trucking industry in general, and increased competitiveness of the trucking mode relative to rail. This trend to just-in-time inventories is most prevalent in the auto industry, which is the dominant industry in the region. This, together with general trends to more frequent shipments of smaller quantities, has led to increased commercial vehicle traffic through North America, which is very much reflected at the Detroit and St. Clair River crossings.

Trade agreements have also positively influenced the rate of growth in commercial vehicles across the border, most notably due to the United States–Canada Free Trade Agreement (FTA), which came into effect in January 1989. This agreement eliminated barriers to trade in goods and services between the two countries and provided a more open environment for cross-border investment. It resulted in the elimination and/or reduction of tariffs, the settlement of trade disputes and the facilitation of business travel.

As well, the North American Free Trade Agreement (NAFTA) between the US, Canada and Mexico came into effect in January of 1994. Prior to NAFTA, Mexico had highly restrictive trade barrier and entrance into its market place was difficult and commercial vehicles are now able to drive across North America with virtually no border restrictions. The full benefits of NAFTA are still being realised, which are expected by most economists to facilitate trade growing between Canada and the US at a rate greater than Gross National Product.

5.1.3 COMMERCIAL VEHICLE FLOWS BY ORIGIN-DESTINATION

An analysis of changes in origin-destination patterns between 2000 and 2004 is possible through an examination of Bureau of Transportation Statistics (BTS) Transborder Freight database. This database includes freight flows between and the US by commodity group and by port of entry, including the state/province of origin and destination. While the spatial detail is at the state/province level, it provides a macro-level indication in potential shifts in origin-destination patterns between 2000 and 2004, which can be applied to update the 2000 trip matrices from the P/N&F to a 2004 base year.

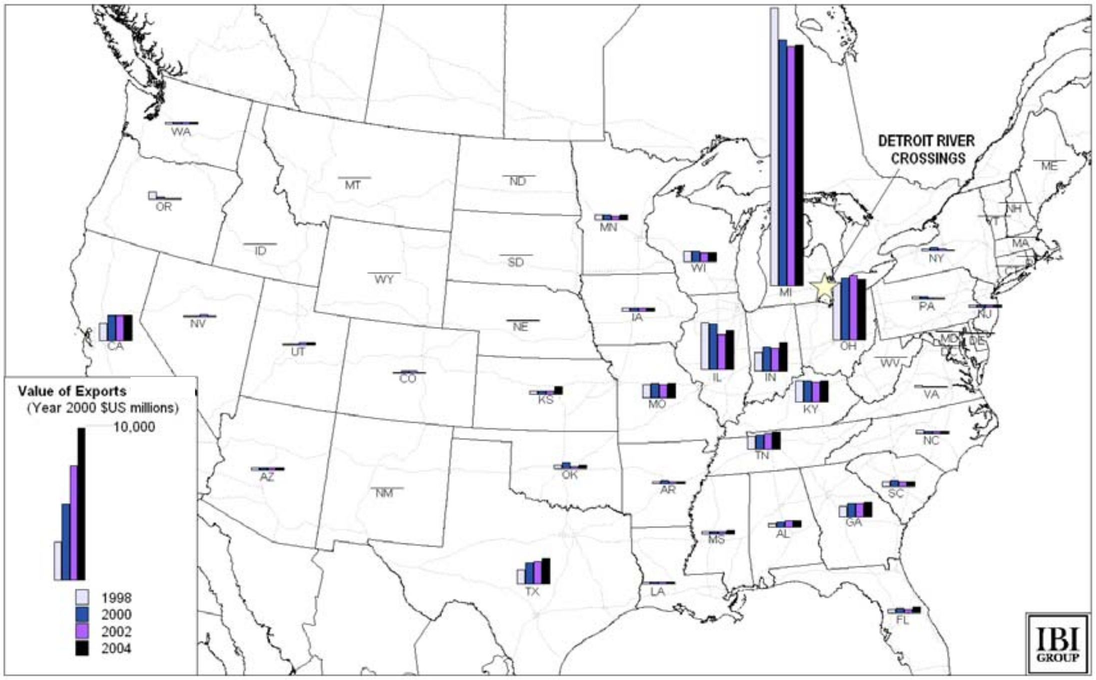
Exhibit 5.6 graphically shows the amount of trade by value by state of origin and state of destination for commercial vehicle traffic crossing at the Detroit River crossings. The commercial vehicle freight flows are also summarised numerically for 9 US zones and 3 Canadian zones in Exhibit 5.7, for years 2000 and 2004. The same tabulation is provided for the St. Clair River crossings in Exhibit 5.8.

The geographic distribution indicates a strong focus in Michigan and the Interstate-75 and Interstate-69 corridors, extending south to Texas, Mexico and southern US states. There is also significant trade interaction with California. Virtually all of the commercial vehicle freight crossing the Detroit River from the US is destined for Ontario, while freight exports from Canada to the US include approximately 10% of freight from Quebec.

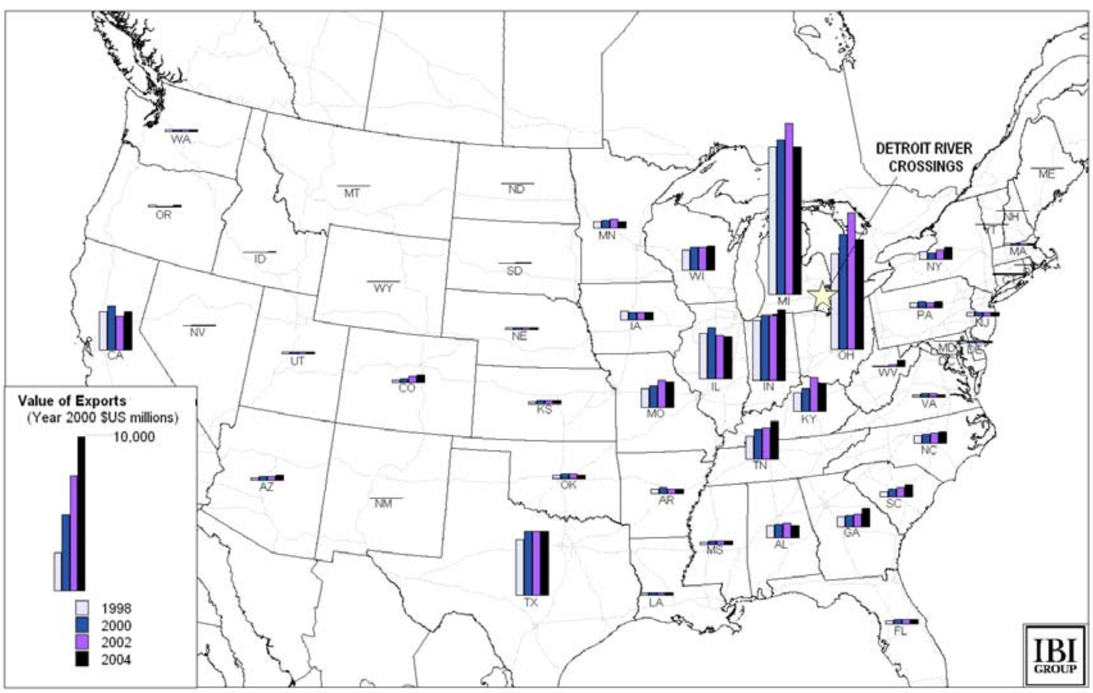
The examination of origin-destination patterns of commercial vehicle freight between 2000 and 2004 did not indicate any significant change in travel patterns or structural changes in the manner in which goods were being manufactured and/or shipped. Overall origin-destination patterns of commercial vehicle movements by commodity group have essentially remained constant, although there have been changes in the overall distribution of commercial vehicle movements given different relative growths of the commodity groups over the 1998 to 2004 time period. Origin-destination flows by commodity group are discussed in the following section.

Exhibit 5.6: Value of Trade between Canada & US at Detroit River Crossings, Truck Mode, 1998 to 2004

A. Canada to US



B. US to Canada



Source: BTS Transborder Surface Freight database

Exhibit 5.7: Flows of Freight Shipped by Truck via Detroit River by Value, 2000 & 2004

A. US to Canada

	DESTINATION				DESTINATION			
ORIGIN	ONTARIO	QUEBEC	Other	TOTAL	ONTARIO	QUEBEC	Other	TOTAL
2000	**Value ($US millions)**				**Percentage**			
MICHIGAN	9,877	5	4	9,886	20.8	0.0	0.0	20.9
IL, IN, OH, WI	16,401	30	44	16,475	34.6	0.1	0.1	34.8
West North Central	3,060	6	14	3,079	6.5	0.0	0.0	6.5
Mountain	739	5	4	748	1.6	0.0	0.0	1.6
Pacific	3,030	18	43	3,092	6.4	0.0	0.1	6.5
West South Central	5,032	17	22	5,070	10.6	0.0	0.0	10.7
East South Central	4,624	11	6	4,641	9.8	0.0	0.0	9.8
South Atlantic	2,873	20	14	2,906	6.1	0.0	0.0	6.1
Northeast	1,435	42	13	1,490	3.0	0.1	0.0	3.1
2000 TOTAL	47,072	154	163	47,388	99.3	0.3	0.3	100.0
2004	**Value ($US millions)**				**Percentage**			
MICHIGAN	9,769	4	2	9,776	19.2	0.0	0.0	19.2
IL, IN, OH, WI	16,558	24	29	16,611	32.5	0.0	0.1	32.6
West North Central	3,369	6	16	3,390	6.6	0.0	0.0	6.7
Mountain	1,180	4	6	1,190	2.3	0.0	0.0	2.3
Pacific	2,956	21	41	3,018	5.8	0.0	0.1	5.9
West South Central	5,163	11	17	5,191	10.1	0.0	0.0	10.2
East South Central	5,640	9	13	5,662	11.1	0.0	0.0	11.1
South Atlantic	4,268	11	17	4,296	8.4	0.0	0.0	8.4
Northeast	1,779	24	10	1,813	3.5	0.0	0.0	3.6
2004 TOTAL	50,681	115	152	50,947	99.5	0.2	0.3	100.0

B. Canada to US

	ORIGIN				ORIGIN			
DESTINATION	ONTARIO	QUEBEC	Other	TOTAL	ONTARIO	QUEBEC	Other	TOTAL
2000	**Value ($US millions)**				**Percentage**			
MICHIGAN	15,431	370	85	15,886	40.6	1.0	0.2	41.8
IL, IN, OH, WI	7,890	1,210	135	9,235	20.8	3.2	0.4	24.3
West North Central	1,597	366	22	1,985	4.2	1.0	0.1	5.2
Mountain	483	159	7	649	1.3	0.4	0.0	1.7
Pacific	1,712	400	33	2,145	4.5	1.1	0.1	5.6
West South Central	1,832	500	15	2,348	4.8	1.3	0.0	6.2
East South Central	2,287	534	32	2,853	6.0	1.4	0.1	7.5
South Atlantic	1,837	177	154	2,167	4.8	0.5	0.4	5.7
Northeast	496	192	12	700	1.3	0.5	0.0	1.8
2000 TOTAL	33,566	3,907	495	37,968	88.4	10.3	1.3	100.0
2004	**Value ($US millions)**				**Percentage**			
MICHIGAN	17,028	399	120	17,548	40.0	0.9	0.3	41.3
IL, IN, OH, WI	8,747	1,330	143	10,220	20.6	3.1	0.3	24.0
West North Central	2,104	449	22	2,575	4.9	1.1	0.1	6.1
Mountain	536	147	26	709	1.3	0.3	0.1	1.7
Pacific	1,781	382	54	2,218	4.2	0.9	0.1	5.2
West South Central	2,031	504	55	2,590	4.8	1.2	0.1	6.1
East South Central	3,046	599	38	3,683	7.2	1.4	0.1	8.7
South Atlantic	2,203	157	116	2,476	5.2	0.4	0.3	5.8
Northeast	414	92	7	513	1.0	0.2	0.0	1.2
2004 TOTAL	37,891	4,059	581	42,531	89.1	9.5	1.4	100.0

US Regions/Divisions:
West North Central: IA, KS, ND, NE, MN, MO, SD
Mountain: AZ, CO, ID, MT, NM, NV, UT, WY
Pacific: AK, CA, HI, OR, WA
West South Central: AR, LA, OK, TX
East South Central: AL, KY, MS, TN
South Atlantic: DC, DE, FL, GA, MD, NC, SC, WV
Northeast: CT, MA, ME, NH, NJ, NY, PA, RI, VT

Source: US Bureau of Transportation Statistics Transborder Surface Freight Database

Exhibit 5.8: Flows of Freight Shipped by Truck via St. Clair River by Value, 2000 & 2004

A. US to Canada

	DESTINATION				DESTINATION			
ORIGIN	ONTARIO	QUEBEC	Other	TOTAL	ONTARIO	QUEBEC	Other	TOTAL
2000	**Value ($US millions)**				**Percentage**			
MICHIGAN	6,068	1	3	6,072	37.6	0.0	0.0	37.7
IL, IN, OH, WI	4,541	17	16	4,574	28.2	0.1	0.1	28.4
West North Central	1,115	6	7	1,128	6.9	0.0	0.0	7.0
Mountain	353	3	14	370	2.2	0.0	0.1	2.3
Pacific	1,220	7	14	1,241	7.6	0.0	0.1	7.7
West South Central	986	7	5	998	6.1	0.0	0.0	6.2
East South Central	721	4	3	728	4.5	0.0	0.0	4.5
South Atlantic	477	15	7	499	3.0	0.1	0.0	3.1
Northeast	487	13	10	509	3.0	0.1	0.1	3.2
2000 TOTAL	15,967	72	78	16,117	99.1	0.4	0.5	100.0
2004	**Value ($US millions)**				**Percentage**			
MICHIGAN	5,764	3	3	5,770	31.0	0.0	0.0	31.0
IL, IN, OH, WI	5,801	17	15	5,833	31.2	0.1	0.1	31.4
West North Central	1,727	8	6	1,742	9.3	0.0	0.0	9.4
Mountain	381	2	2	385	2.0	0.0	0.0	2.1
Pacific	1,456	10	14	1,480	7.8	0.1	0.1	8.0
West South Central	1,326	8	8	1,343	7.1	0.0	0.0	7.2
East South Central	992	4	3	999	5.3	0.0	0.0	5.4
South Atlantic	557	4	5	567	3.0	0.0	0.0	3.0
Northeast	466	10	4	481	2.5	0.1	0.0	2.6
2004 TOTAL	18,471	67	62	18,599	99.3	0.4	0.3	100.0

B. Canada to US

	ORIGIN				ORIGIN			
DESTINATION	ONTARIO	QUEBEC	Other	TOTAL	ONTARIO	QUEBEC	Other	TOTAL
2000	**Value ($US millions)**				**Percentage**			
MICHIGAN	4,771	399	44	5,214	28.8	2.4	0.3	31.5
IL, IN, OH, WI	3,459	833	79	4,371	20.9	5.0	0.5	26.4
West North Central	1,081	336	27	1,445	6.5	2.0	0.2	8.7
Mountain	322	185	8	515	1.9	1.1	0.1	3.1
Pacific	1,003	359	34	1,396	6.1	2.2	0.2	8.4
West South Central	726	436	9	1,171	4.4	2.6	0.1	7.1
East South Central	506	135	8	649	3.1	0.8	0.1	3.9
South Atlantic	431	98	130	658	2.6	0.6	0.8	4.0
Northeast	287	837	24	1,148	1.7	5.0	0.1	6.9
2000 TOTAL	12,585	3,618	364	16,567	76.0	21.8	2.2	100.0
2004	**Value ($US millions)**				**Percentage**			
MICHIGAN	5,408	506	42	5,956	28.5	2.7	0.2	31.4
IL, IN, OH, WI	4,351	1,128	114	5,592	23.0	5.9	0.6	29.5
West North Central	1,289	391	39	1,718	6.8	2.1	0.2	9.1
Mountain	432	177	21	630	2.3	0.9	0.1	3.3
Pacific	977	408	74	1,459	5.2	2.2	0.4	7.7
West South Central	991	270	31	1,291	5.2	1.4	0.2	6.8
East South Central	921	171	15	1,106	4.9	0.9	0.1	5.8
South Atlantic	630	68	27	726	3.3	0.4	0.1	3.8
Northeast	277	148	52	476	1.5	0.8	0.3	2.5
2004 TOTAL	15,275	3,266	414	18,955	80.6	17.2	2.2	100.0

US Regions/Divisions:
West North Central: IA, KS, ND, NE, MN, MO, SD
Mountain: AZ, CO, ID, MT, NM, NV, UT, WY
Pacific: AK, CA, HI, OR, WA
West South Central: AR, LA, OK, TX
East South Central: AL, KY, MS, TN
South Atlantic: DC, DE, FL, GA, MD, NC, SC, WV
Northeast: CT, MA, ME, NH, NJ, NY, PA, RI, VT

Source: US Bureau of Transportation Statistics Transborder Surface Freight Database

5.1.4 COMMERCIAL VEHICLE FLOWS BY COMMODITY GROUPS

The BTS Transborder Surface Freight database provides freight data by commodity and by state/province of origin/destination, but a breakdown of the commodity information by port is not available. For commercial vehicle trade crossing the Detroit and St. Clair Rivers, the main travel movements are between Ontario and the East North Central States (Michigan, Ohio, Indiana, Illinois and Wisconsin). These five states account for about 56% of the commercial vehicle freight shipped across the Detroit River and St. Clair River crossings. Therefore, Exhibit 5.9 presents the percentage trade by value of commodities transported by commercial vehicle from 1998 to 2004 between Ontario and these five states, while Exhibit 5.10 presents the value of trade between these same areas by commodity type for 2000 and 2004 (indexed to year 2000 values).

The commodity trade trends reveal the steady importance of the auto industry to Ontario-US trade. In 2004, the auto/metal industries represented almost 60% of Ontario's exports to the East North Central states and 45% of the East North Central states' exports to Ontario by value.

To reveal differences between trade patterns between 2000 and 2004 by commodity, Exhibits 5.11 through 5.15 summarise the freight flows for the five commodity groups for these two years. These tables summarise national trade and are not port-specific; therefore, changes in trade shown in the tables can reflect changes in crossing activity at any border crossing, not necessarily at the Detroit River. Examination of the specific origins and destinations and the reasonableness of using the Detroit River crossings is necessary.

Exhibit 5.11 shows that auto-metal freight flows are similarly distributed in 2000 versus 2004, except for a reduction of exports to the northeast states and a slight shift of destination of Canadian exports from the central states to the west north central states. In recent years, there have been structural changes in the auto industry with new plants being constructed in the southern US and Mexico. However, this has resulted in intra-US commercial vehicle and Mexico-US commercial vehicle movements that are not reflected in the Canada-US trade volumes that are presented. While affected in overall magnitude by these changes, the auto related commercial vehicle movements that continue to cross the Canada-US border have maintained the same general origin-destination patterns.

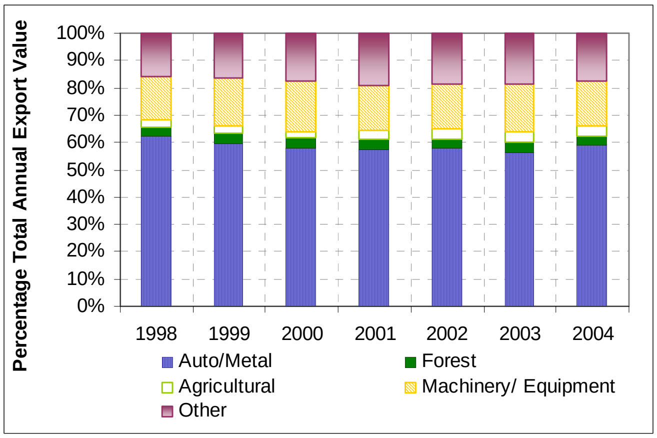
Exhibit 5.12 shows that machinery-equipment trade was similarly distributed in 2000 vs. 2004, except for a decline in trade with the northeast states, which would have a much greater impact on the Niagara and St. Lawrence crossings than at the Detroit or St. Clair Rivers.

Similarly, Exhibits 5.13, 5.14 and 5.15, showing flows of forestry, agricultural, and "other" freight shipped by commercial vehicle, respectively, do not indicate changes in freight flows that would significantly change cross-border commercial vehicle patterns across the Detroit River between 2000 and 2004.

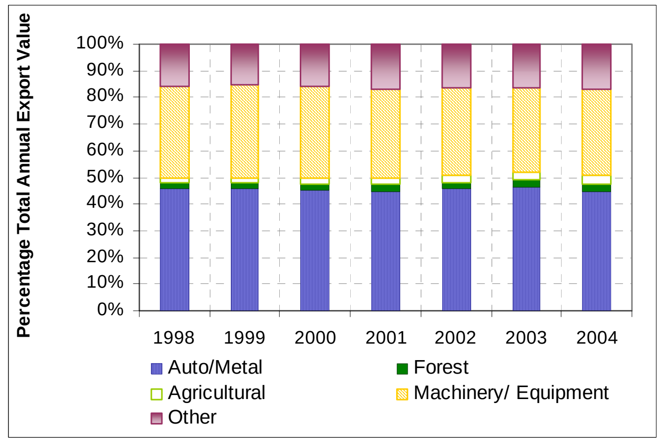
Exhibit 5.9: Commodity Percentage Trade Shipped by Truck by Value, 1998-2004

A. Between Ontario and Central States

ON to MI/OH/IN/IL/WI



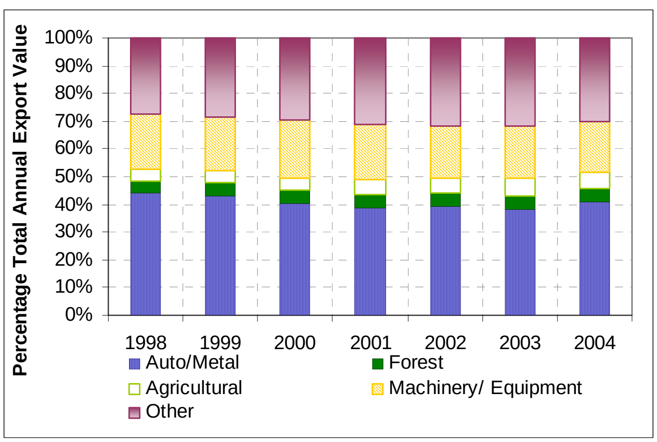
MI/OH/IN/IL/WI to ON



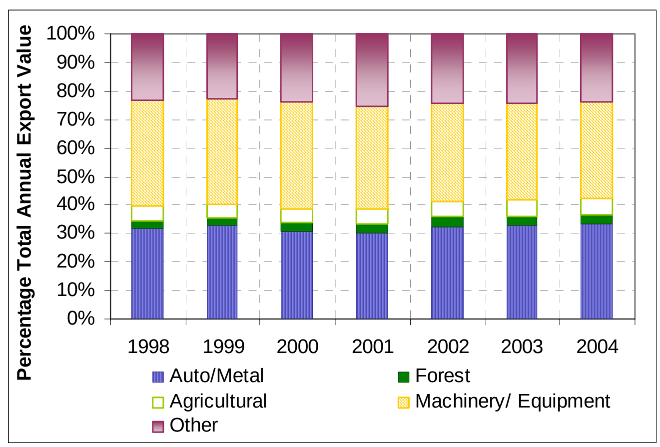
Source: US Bureau of Transportation Statistics Transborder Freight Data

B. Between ON and US

ON to US



US to ON

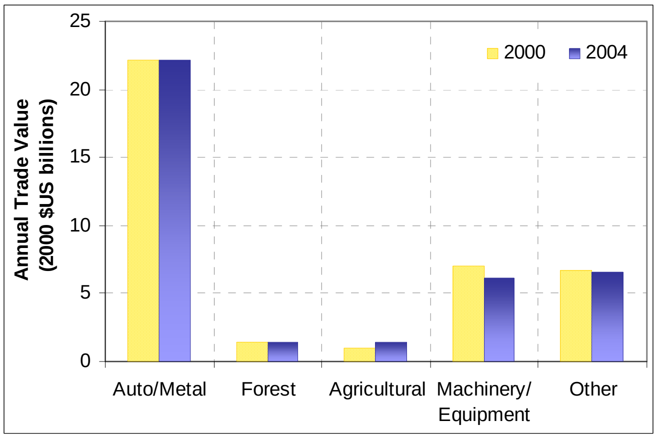


Source: US Bureau of Transportation Statistics Transborder Freight Data

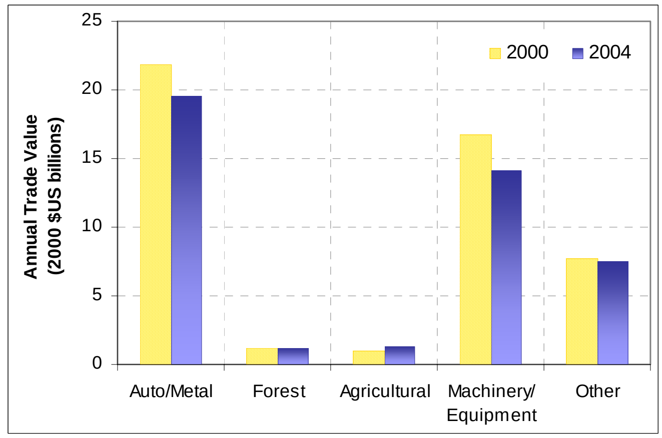
Exhibit 5.10: Value of Commodity Trade Shipped by Truck, 2000 & 2004

A. Between Ontario and Central States

ON to MI/OH/IN/IL/WI



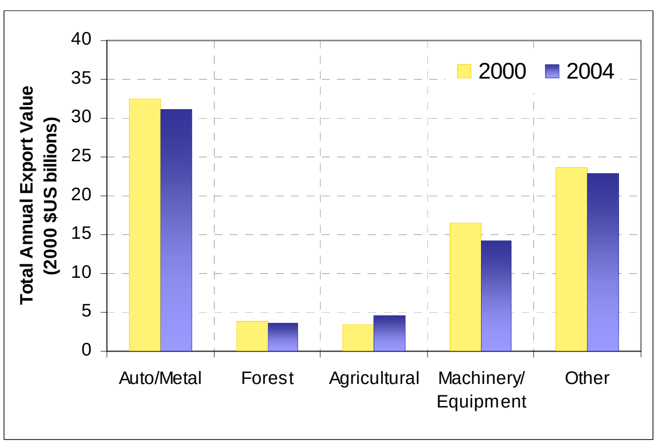
MI/OH/IN/IL/WI to ON



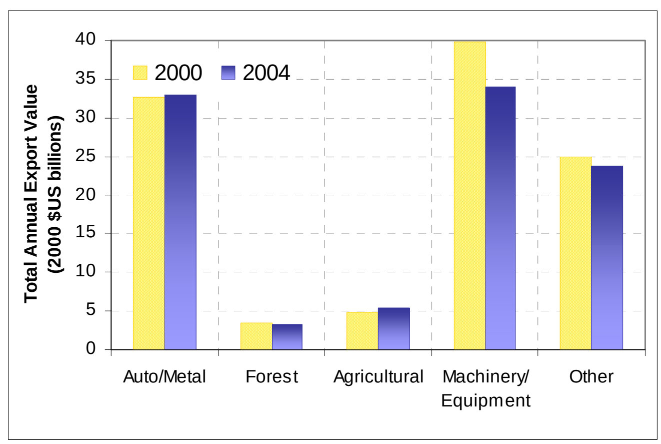
Source: US Bureau of Transportation Statistics Transborder Freight Data

B. Between ON and US

ON to US



US to ON



Source: US Bureau of Transportation Statistics Transborder Freight Data

Exhibit 5.11: Flows of Auto/Metal Freight Shipped by Truck, 2000 & 2004

A. US to Canada

	DESTINATION				DESTINATION			
ORIGIN	ONTARIO	QUEBEC	Other	TOTAL	ONTARIO	QUEBEC	Other	TOTAL
2000	**Value ($US millions)**				**Percentage**			
MICHIGAN	9,562	12	69	9,643	25.0	0.0	0.2	25.2
IL, IN, OH, WI	12,338	99	805	13,242	32.2	0.3	2.1	34.6
West North Central	1,585	16	635	2,236	4.1	0.0	1.7	5.8
Mountain	317	17	218	551	0.8	0.0	0.6	1.4
Pacific	663	57	942	1,662	1.7	0.1	2.5	4.3
West South Central	874	28	505	1,407	2.3	0.1	1.3	3.7
East South Central	1,777	31	120	1,927	4.6	0.1	0.3	5.0
South Atlantic	2,370	213	358	2,941	6.2	0.6	0.9	7.7
Northeast	3,091	485	1,114	4,690	8.1	1.3	2.9	12.2
2000 TOTAL	32,576	957	4,766	38,299	85.1	2.5	12.4	100.0
2004	**Value ($US millions)**				**Percentage**			
MICHIGAN	10,025	7	50	10,083	24.9	0.0	0.1	25.0
IL, IN, OH, WI	10,233	88	946	11,268	25.4	0.2	2.3	28.0
West North Central	2,850	12	786	3,647	7.1	0.0	2.0	9.1
Mountain	255	5	204	463	0.6	0.0	0.5	1.2
Pacific	727	67	1,248	2,042	1.8	0.2	3.1	5.1
West South Central	1,000	33	610	1,644	2.5	0.1	1.5	4.1
East South Central	2,862	31	155	3,049	7.1	0.1	0.4	7.6
South Atlantic	3,215	307	496	4,019	8.0	0.8	1.2	10.0
Northeast	3,338	462	263	4,063	8.3	1.1	0.7	10.1
2004 TOTAL	34,506	1,012	4,759	40,277	85.7	2.5	11.8	100.0

B. Canada to US

	ORIGIN				ORIGIN			
DESTINATION	ONTARIO	QUEBEC	Other	TOTAL	ONTARIO	QUEBEC	Other	TOTAL
2000	**Value ($US millions)**				**Percentage**			
MICHIGAN	16,923	287	38	17,249	43.2	0.7	0.1	44.0
IL, IN, OH, WI	5,192	957	245	6,394	13.2	2.4	0.6	16.3
West North Central	910	138	504	1,552	2.3	0.4	1.3	4.0
Mountain	212	45	180	437	0.5	0.1	0.5	1.1
Pacific	1,456	193	593	2,241	3.7	0.5	1.5	5.7
West South Central	829	265	119	1,213	2.1	0.7	0.3	3.1
East South Central	1,156	156	85	1,396	2.9	0.4	0.2	3.6
South Atlantic	1,406	513	142	2,061	3.6	1.3	0.4	5.3
Northeast	4,281	2,151	226	6,658	10.9	5.5	0.6	17.0
2000 TOTAL	32,365	4,705	2,131	39,202	82.6	12.0	5.4	100.0
2004	**Value ($US millions)**				**Percentage**			
MICHIGAN	19,095	312	41	19,447	44.2	0.7	0.1	45.1
IL, IN, OH, WI	5,918	1,232	356	7,505	13.7	2.9	0.8	17.4
West North Central	1,385	222	475	2,082	3.2	0.5	1.1	4.8
Mountain	267	68	199	534	0.6	0.2	0.5	1.2
Pacific	1,447	186	611	2,244	3.4	0.4	1.4	5.2
West South Central	933	208	116	1,257	2.2	0.5	0.3	2.9
East South Central	1,787	295	147	2,229	4.1	0.7	0.3	5.2
South Atlantic	1,570	592	130	2,292	3.6	1.4	0.3	5.3
Northeast	2,792	2,586	184	5,563	6.5	6.0	0.4	12.9
2004 TOTAL	35,193	5,702	2,258	43,153	81.6	13.2	5.2	100.0

US Regions/Divisions:
West North Central: IA, KS, ND, NE, MN, MO, SD
Mountain: AZ, CO, ID, MT, NM, NV, UT, WY
Pacific: AK, CA, HI, OR, WA
West South Central: AR, LA, OK, TX
East South Central: AL, KY, MS, TN
South Atlantic: DC, DE, FL, GA, MD, NC, SC, WV
Northeast: CT, MA, ME, NH, NJ, NY, PA, RI, VT

Source: US Bureau of Transportation Statistics Transborder Surface Freight Database

Exhibit 5.12: Flows of Machinery/Equipment Freight Shipped by Truck, 2000 & 2004

A. US to Canada

	DESTINATION				DESTINATION			
ORIGIN	ONTARIO	QUEBEC	Other	TOTAL	ONTARIO	QUEBEC	Other	TOTAL
2000	**Value ($US millions)**				**Percentage**			
MICHIGAN	6,144	43	127	6,314	11.5	0.1	0.2	11.8
IL, IN, OH, WI	10,641	417	1,556	12,614	19.9	0.8	2.9	23.6
West North Central	1,690	81	771	2,542	3.2	0.2	1.4	4.8
Mountain	615	57	361	1,032	1.2	0.1	0.7	1.9
Pacific	3,914	271	1,780	5,965	7.3	0.5	3.3	11.2
West South Central	4,329	110	1,325	5,764	8.1	0.2	2.5	10.8
East South Central	2,351	101	297	2,748	4.4	0.2	0.6	5.1
South Atlantic	3,773	425	941	5,139	7.1	0.8	1.8	9.6
Northeast	6,379	4,104	771	11,254	12.0	7.7	1.4	21.1
2000 TOTAL	39,836	5,606	7,928	53,371	74.6	10.5	14.9	100.0
2004	**Value ($US millions)**				**Percentage**			
MICHIGAN	4,666	23	110	4,799	10.0	0.0	0.2	10.3
IL, IN, OH, WI	9,928	581	1,641	12,151	21.2	1.2	3.5	26.0
West North Central	1,736	68	927	2,731	3.7	0.1	2.0	5.8
Mountain	1,199	39	441	1,679	2.6	0.1	0.9	3.6
Pacific	2,733	141	1,573	4,447	5.8	0.3	3.4	9.5
West South Central	3,770	72	1,273	5,114	8.1	0.2	2.7	10.9
East South Central	3,043	62	469	3,575	6.5	0.1	1.0	7.6
South Atlantic	3,452	362	665	4,479	7.4	0.8	1.4	9.6
Northeast	4,682	2,505	623	7,810	10.0	5.4	1.3	16.7
2004 TOTAL	35,209	3,854	7,723	46,787	75.3	8.2	16.5	100.0

B. Canada to US

	ORIGIN				ORIGIN			
DESTINATION	ONTARIO	QUEBEC	Other	TOTAL	ONTARIO	QUEBEC	Other	TOTAL
2000	**Value ($US millions)**				**Percentage**			
MICHIGAN	3,606	82	76	3,764	11.9	0.3	0.3	12.4
IL, IN, OH, WI	3,420	734	424	4,578	11.2	2.4	1.4	15.1
West North Central	786	432	535	1,753	2.6	1.4	1.8	5.8
Mountain	299	240	345	884	1.0	0.8	1.1	2.9
Pacific	1,160	442	1,102	2,705	3.8	1.5	3.6	8.9
West South Central	923	907	567	2,397	3.0	3.0	1.9	7.9
East South Central	1,034	259	238	1,530	3.4	0.9	0.8	5.0
South Atlantic	1,725	1,844	396	3,965	5.7	6.1	1.3	13.0
Northeast	3,563	4,164	1,114	8,841	11.7	13.7	3.7	29.1
2000 TOTAL	16,517	9,104	4,797	30,418	54.3	29.9	15.8	100.0
2004	**Value ($US millions)**				**Percentage**			
MICHIGAN	3,385	118	53	3,556	13.4	0.5	0.2	14.1
IL, IN, OH, WI	3,491	719	349	4,559	13.8	2.8	1.4	18.0
West North Central	748	493	637	1,878	3.0	2.0	2.5	7.4
Mountain	362	179	359	900	1.4	0.7	1.4	3.6
Pacific	1,292	335	847	2,474	5.1	1.3	3.4	9.8
West South Central	1,197	422	508	2,128	4.7	1.7	2.0	8.4
East South Central	1,100	251	234	1,584	4.4	1.0	0.9	6.3
South Atlantic	1,672	677	411	2,760	6.6	2.7	1.6	10.9
Northeast	2,703	2,427	287	5,417	10.7	9.6	1.1	21.4
2004 TOTAL	15,951	5,620	3,685	25,256	63.2	22.3	14.6	100.0

US Regions/Divisions:
West North Central: IA, KS, ND, NE, MN, MO, SD
Mountain: AZ, CO, ID, MT, NM, NV, UT, WY
Pacific: AK, CA, HI, OR, WA
West South Central: AR, LA, OK, TX
East South Central: AL, KY, MS, TN
South Atlantic: DC, DE, FL, GA, MD, NC, SC, WV
Northeast: CT, MA, ME, NH, NJ, NY, PA, RI, VT

Source: US Bureau of Transportation Statistics Transborder Surface Freight Database

Exhibit 5.13: Flows of Forestry Freight Shipped by Truck, 2000 & 2004

A. US to Canada

	DESTINATION				DESTINATION			
ORIGIN	ONTARIO	QUEBEC	Other	TOTAL	ONTARIO	QUEBEC	Other	TOTAL
2000	**Value ($US millions)**				**Percentage**			
MICHIGAN	184	3	19	206	3.4	0.1	0.3	3.8
IL, IN, OH, WI	1,035	24	179	1,238	19.1	0.4	3.3	22.9
West North Central	127	4	52	183	2.4	0.1	1.0	3.4
Mountain	14	1	98	112	0.3	0.0	1.8	2.1
Pacific	108	9	487	604	2.0	0.2	9.0	11.2
West South Central	103	5	28	136	1.9	0.1	0.5	2.5
East South Central	266	18	45	329	4.9	0.3	0.8	6.1
South Atlantic	502	78	56	636	9.3	1.4	1.0	11.8
Northeast	1,061	710	193	1,965	19.6	13.1	3.6	36.3
2000 TOTAL	3,401	852	1,156	5,409	62.9	15.8	21.4	100.0
2004	**Value ($US millions)**				**Percentage**			
MICHIGAN	193	3	25	221	3.6	0.1	0.5	4.1
IL, IN, OH, WI	1,015	16	161	1,192	18.8	0.3	3.0	22.1
West North Central	156	2	41	199	2.9	0.0	0.8	3.7
Mountain	22	1	91	114	0.4	0.0	1.7	2.1
Pacific	81	7	574	661	1.5	0.1	10.6	12.2
West South Central	132	5	33	171	2.4	0.1	0.6	3.2
East South Central	269	12	42	324	5.0	0.2	0.8	6.0
South Atlantic	524	93	67	684	9.7	1.7	1.2	12.6
Northeast	988	708	145	1,841	18.3	13.1	2.7	34.1
2004 TOTAL	3,380	847	1,179	5,407	62.5	15.7	21.8	100.0

B. Canada to US

	ORIGIN				ORIGIN			
DESTINATION	ONTARIO	QUEBEC	Other	TOTAL	ONTARIO	QUEBEC	Other	TOTAL
2000	**Value ($US millions)**				**Percentage**			
MICHIGAN	489	285	114	888	4.0	2.3	0.9	7.2
IL, IN, OH, WI	934	632	438	2,005	7.6	5.1	3.6	16.3
West North Central	349	151	300	800	2.8	1.2	2.4	6.5
Mountain	33	38	419	490	0.3	0.3	3.4	4.0
Pacific	122	134	1,578	1,833	1.0	1.1	12.8	14.9
West South Central	90	82	148	319	0.7	0.7	1.2	2.6
East South Central	178	196	75	449	1.4	1.6	0.6	3.7
South Atlantic	420	592	265	1,277	3.4	4.8	2.2	10.4
Northeast	1,130	2,124	966	4,219	9.2	17.3	7.9	34.4
2000 TOTAL	3,744	4,234	4,304	12,282	30.5	34.5	35.0	100.0
2004	**Value ($US millions)**				**Percentage**			
MICHIGAN	593	237	62	893	4.7	1.9	0.5	7.1
IL, IN, OH, WI	1,003	709	288	2,000	8.0	5.6	2.3	15.9
West North Central	425	151	261	837	3.4	1.2	2.1	6.6
Mountain	60	47	430	538	0.5	0.4	3.4	4.3
Pacific	146	138	1,606	1,890	1.2	1.1	12.8	15.0
West South Central	117	118	120	355	0.9	0.9	1.0	2.8
East South Central	165	214	77	456	1.3	1.7	0.6	3.6
South Atlantic	432	684	206	1,321	3.4	5.4	1.6	10.5
Northeast	1,178	2,263	860	4,301	9.4	18.0	6.8	34.2
2004 TOTAL	4,120	4,561	3,910	12,590	32.7	36.2	31.1	100.0

US Regions/Divisions:
West North Central: IA, KS, ND, NE, MN, MO, SD
Mountain: AZ, CO, ID, MT, NM, NV, UT, WY
Pacific: AK, CA, HI, OR, WA
West South Central: AR, LA, OK, TX
East South Central: AL, KY, MS, TN
South Atlantic: DC, DE, FL, GA, MD, NC, SC, WV
Northeast: CT, MA, ME, NH, NJ, NY, PA, RI, VT

Source: US Bureau of Transportation Statistics Transborder Surface Freight Database

Exhibit 5.14: Flows of Agricultural Freight Shipped by Truck, 2000 & 2004

A. US to Canada

	DESTINATION				DESTINATION			
ORIGIN	ONTARIO	QUEBEC	Other	TOTAL	ONTARIO	QUEBEC	Other	TOTAL
2000	**Value ($US millions)**				**Percentage**			
MICHIGAN	247	7	18	272	3.1	0.1	0.2	3.4
IL, IN, OH, WI	741	25	146	912	9.3	0.3	1.8	11.5
West North Central	576	8	338	922	7.2	0.1	4.2	11.6
Mountain	239	8	248	495	3.0	0.1	3.1	6.2
Pacific	960	25	1,222	2,207	12.1	0.3	15.3	27.7
West South Central	223	10	80	313	2.8	0.1	1.0	3.9
East South Central	173	17	27	217	2.2	0.2	0.3	2.7
South Atlantic	618	192	134	944	7.8	2.4	1.7	11.8
Northeast	1,072	252	359	1,684	13.5	3.2	4.5	21.1
2000 TOTAL	4,849	543	2,573	7,965	60.9	6.8	32.3	100.0
2004	**Value ($US millions)**				**Percentage**			
MICHIGAN	311	2	16	329	3.4	0.0	0.2	3.6
IL, IN, OH, WI	1,057	16	207	1,280	11.6	0.2	2.3	14.0
West North Central	583	7	351	940	6.4	0.1	3.8	10.3
Mountain	250	5	167	422	2.7	0.1	1.8	4.6
Pacific	1,098	35	1,479	2,612	12.0	0.4	16.2	28.7
West South Central	237	7	96	339	2.6	0.1	1.0	3.7
East South Central	209	15	36	260	2.3	0.2	0.4	2.9
South Atlantic	821	249	159	1,230	9.0	2.7	1.7	13.5
Northeast	1,064	321	317	1,702	11.7	3.5	3.5	18.7
2004 TOTAL	5,630	657	2,827	9,114	61.8	7.2	31.0	100.0

B. Canada to US

	ORIGIN				ORIGIN			
DESTINATION	ONTARIO	QUEBEC	Other	TOTAL	ONTARIO	QUEBEC	Other	TOTAL
2000	**Value ($US millions)**				**Percentage**			
MICHIGAN	284	20	72	376	2.9	0.2	0.7	3.8
IL, IN, OH, WI	751	126	417	1,293	7.6	1.3	4.2	13.0
West North Central	194	47	550	791	1.9	0.5	5.5	8.0
Mountain	54	11	377	442	0.5	0.1	3.8	4.5
Pacific	192	76	1,488	1,755	1.9	0.8	15.0	17.7
West South Central	162	23	118	303	1.6	0.2	1.2	3.1
East South Central	128	35	44	207	1.3	0.4	0.4	2.1
South Atlantic	394	109	331	835	4.0	1.1	3.3	8.4
Northeast	1,371	876	1,689	3,937	13.8	8.8	17.0	39.6
2000 TOTAL	3,530	1,323	5,087	9,940	35.5	13.3	51.2	100.0
2004	**Value ($US millions)**				**Percentage**			
MICHIGAN	333	73	70	475	2.7	0.6	0.6	3.8
IL, IN, OH, WI	1,312	187	394	1,894	10.5	1.5	3.2	15.2
West North Central	292	48	622	963	2.3	0.4	5.0	7.7
Mountain	76	23	221	320	0.6	0.2	1.8	2.6
Pacific	295	141	1,474	1,911	2.4	1.1	11.8	15.3
West South Central	235	32	152	419	1.9	0.3	1.2	3.4
East South Central	235	48	59	342	1.9	0.4	0.5	2.7
South Atlantic	652	141	431	1,224	5.2	1.1	3.5	9.8
Northeast	1,768	1,171	1,993	4,932	14.2	9.4	16.0	39.5
2004 TOTAL	5,198	1,865	5,417	12,480	41.7	14.9	43.4	100.0

US Regions/Divisions:
West North Central: IA, KS, ND, NE, MN, MO, SD
Mountain: AZ, CO, ID, MT, NM, NV, UT, WY
Pacific: AK, CA, HI, OR, WA
West South Central: AR, LA, OK, TX
East South Central: AL, KY, MS, TN
South Atlantic: DC, DE, FL, GA, MD, NC, SC, WV
Northeast: CT, MA, ME, NH, NJ, NY, PA, RI, VT

Source: US Bureau of Transportation Statistics Transborder Surface Freight Database

Exhibit 5.15: Flows of "Other" Freight Shipped by Truck, 2000 & 2004

A. US to Canada

	DESTINATION				DESTINATION			
ORIGIN	ONTARIO	QUEBEC	Other	TOTAL	ONTARIO	QUEBEC	Other	TOTAL
2000	**Value ($US millions)**				**Percentage**			
MICHIGAN	2,531	18	92	2,642	7.7	0.1	0.3	8.1
IL, IN, OH, WI	5,213	120	717	6,050	15.9	0.4	2.2	18.5
West North Central	1,061	50	498	1,609	3.2	0.2	1.5	4.9
Mountain	300	31	319	650	0.9	0.1	1.0	2.0
Pacific	872	97	1,207	2,176	2.7	0.3	3.7	6.7
West South Central	1,768	110	535	2,413	5.4	0.3	1.6	7.4
East South Central	2,065	118	264	2,447	6.3	0.4	0.8	7.5
South Atlantic	4,008	742	744	5,494	12.3	2.3	2.3	16.8
Northeast	6,677	1,778	763	9,219	20.4	5.4	2.3	28.2
2000 TOTAL	24,495	3,065	5,141	32,700	74.9	9.4	15.7	100.0
2004	**Value ($US millions)**				**Percentage**			
MICHIGAN	1,970	9	130	2,109	6.1	0.0	0.4	6.5
IL, IN, OH, WI	5,746	108	710	6,564	17.7	0.3	2.2	20.2
West North Central	1,221	19	544	1,784	3.8	0.1	1.7	5.5
Mountain	322	27	492	841	1.0	0.1	1.5	2.6
Pacific	963	146	1,365	2,474	3.0	0.5	4.2	7.6
West South Central	2,000	89	609	2,698	6.1	0.3	1.9	8.3
East South Central	2,205	70	246	2,521	6.8	0.2	0.8	7.8
South Atlantic	3,942	569	645	5,156	12.1	1.7	2.0	15.9
Northeast	6,094	1,585	698	8,376	18.7	4.9	2.1	25.8
2004 TOTAL	24,462	2,623	5,438	32,523	75.2	8.1	16.7	100.0

B. Canada to US

	ORIGIN				ORIGIN			
DESTINATION	ONTARIO	QUEBEC	Other	TOTAL	ONTARIO	QUEBEC	Other	TOTAL
2000	**Value ($US millions)**				**Percentage**			
MICHIGAN	2,782	224	71	3,077	7.8	0.6	0.2	8.6
IL, IN, OH, WI	3,916	771	436	5,122	10.9	2.2	1.2	14.3
West North Central	1,246	308	602	2,157	3.5	0.9	1.7	6.0
Mountain	826	165	715	1,707	2.3	0.5	2.0	4.8
Pacific	2,105	402	993	3,500	5.9	1.1	2.8	9.8
West South Central	1,276	326	345	1,947	3.6	0.9	1.0	5.4
East South Central	904	390	86	1,379	2.5	1.1	0.2	3.9
South Atlantic	3,029	990	862	4,880	8.5	2.8	2.4	13.6
Northeast	7,576	3,606	838	12,021	21.2	10.1	2.3	33.6
2000 TOTAL	23,661	7,181	4,947	35,790	66.1	20.1	13.8	100.0
2004	**Value ($US millions)**				**Percentage**			
MICHIGAN	2,652	277	136	3,065	6.8	0.7	0.3	7.8
IL, IN, OH, WI	4,750	1,050	527	6,327	12.1	2.7	1.3	16.1
West North Central	1,312	263	671	2,246	3.3	0.7	1.7	5.7
Mountain	755	200	546	1,502	1.9	0.5	1.4	3.8
Pacific	1,791	516	1,229	3,536	4.6	1.3	3.1	9.0
West South Central	1,538	460	281	2,279	3.9	1.2	0.7	5.8
East South Central	1,311	421	161	1,893	3.3	1.1	0.4	4.8
South Atlantic	3,354	1,170	771	5,295	8.6	3.0	2.0	13.5
Northeast	8,327	3,971	755	13,053	21.2	10.1	1.9	33.3
2004 TOTAL	25,789	8,328	5,079	39,195	65.8	21.2	13.0	100.0

US Regions/Divisions:
West North Central: IA, KS, ND, NE, MN, MO, SD
Mountain: AZ, CO, ID, MT, NM, NV, UT, WY
Pacific: AK, CA, HI, OR, WA
West South Central: AR, LA, OK, TX
East South Central: AL, KY, MS, TN
South Atlantic: DC, DE, FL, GA, MD, NC, SC, WV
Northeast: CT, MA, ME, NH, NJ, NY, PA, RI, VT

Source: US Bureau of Transportation Statistics Transborder Surface Freight Database

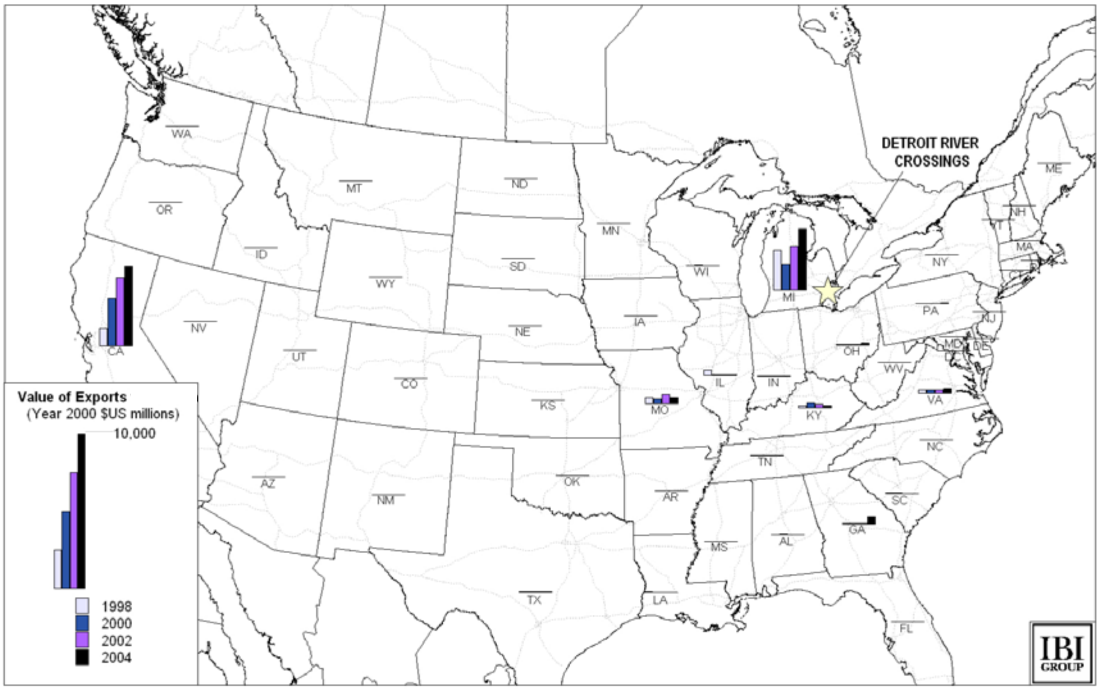
5.1.5 DIVERSION TO INTERMODAL/RAIL

Intermodal rail trends were previously discussed in Section 5.1.1. Building on this, Exhibit 5.16 graphically shows the distribution of Canada-US trade via the Detroit River by rail from 1998 to 2004. Exhibits 5.17 and 5.18 summarise numerically the flows of freight shipped by rail across the Detroit River and the St. Clair River, respectively. Most rail shipments across the Detroit River are to/from Ontario. Most rail shipments from Canada are to California and to Michigan; these are mostly auto/metal goods. Rail Shipments to California have seen tremendous growth since 1998. Shipments from the US to Canada have been increasing from Michigan, Ohio, Indiana, Kentucky and Georgia. Comparison of these plots and travel matrices with Exhibits 5.6 through 5.8 shows that where there have been increases in rail shipments, corresponding decreases are not evident in the commercial vehicle mode. Therefore, much of the increase in rail shipments is seen to be capturing new markets, as in newly-developing auto industry locations in the US, rather than diverting from existing commercial vehicle movements, as well as diversion from the St. Clair Tunnel as noted above.

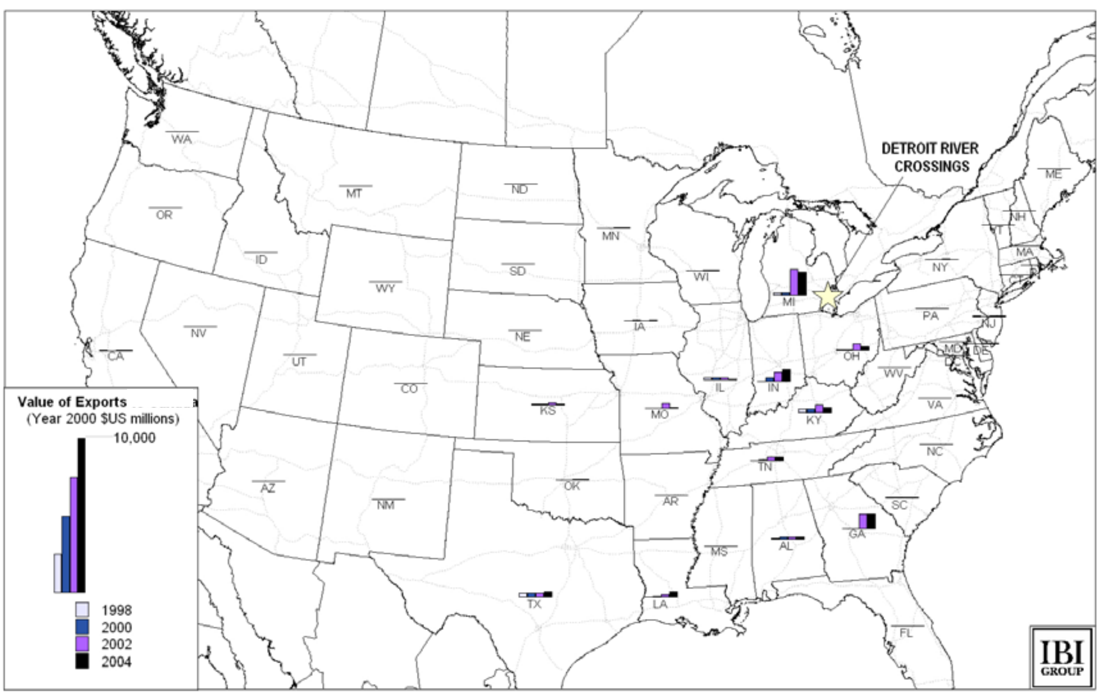
The above suggests that there have not been significant structural changes/modal shifts in movement of freight for the commercial vehicle mode at Detroit River and St. Clair River crossing between 2000 and 2004 and that the update of commercial vehicle trip matrices to 2004 can be performed using 2000 trip matrices as a representative base of current spatial patterns by commodity group.

Exhibit 5.16: Rail Freight Trade by State of Origin/Destination

A. Canada to US



B. US To Canada



Source: US BTS Transborder Surface Freight database

Exhibit 5.17: Flows of Freight Shipped by Rail via Detroit River by Value, 2000 & 2004

A. US to Canada

	DESTINATION				DESTINATION			
ORIGIN	ONTARIO	QUEBEC	Other	TOTAL	ONTARIO	QUEBEC	Other	TOTAL
2000	**Value ($US millions)**				**Percentage**			
MICHIGAN	195	7	4	206	9.5	0.3	0.2	10.0
IL, IN, OH, WI	446	51	18	515	21.7	2.5	0.9	25.0
West North Central	157	19	1	178	7.6	0.9	0.1	8.7
Mountain	13	15	0	29	0.7	0.7	0.0	1.4
Pacific	31	19	1	52	1.5	0.9	0.1	2.5
West South Central	253	105	8	366	12.3	5.1	0.4	17.8
East South Central	286	108	71	465	13.9	5.3	3.4	22.6
South Atlantic	129	22	6	157	6.3	1.1	0.3	7.6
Northeast	51	29	10	89	2.5	1.4	0.5	4.3
2000 TOTAL	1,562	375	118	2,055	76.0	18.2	5.7	100.0
2004	**Value ($US millions)**				**Percentage**			
MICHIGAN	1,558	6	0	1,564	24.3	0.1	0.0	24.4
IL, IN, OH, WI	1,255	73	31	1,359	19.6	1.1	0.5	21.2
West North Central	390	18	3	410	6.1	0.3	0.0	6.4
Mountain	11	2	0	14	0.2	0.0	0.0	0.2
Pacific	61	18	11	90	0.9	0.3	0.2	1.4
West South Central	741	62	7	810	11.6	1.0	0.1	12.6
East South Central	760	66	13	839	11.9	1.0	0.2	13.1
South Atlantic	1,180	40	13	1,232	18.4	0.6	0.2	19.2
Northeast	66	11	6	84	1.0	0.2	0.1	1.3
2004 TOTAL	6,023	296	85	6,403	94.1	4.6	1.3	100.0

B. Canada to US

	ORIGIN				ORIGIN			
DESTINATION	ONTARIO	QUEBEC	Other	TOTAL	ONTARIO	QUEBEC	Other	TOTAL
2000	**Value ($US millions)**				**Percentage**			
MICHIGAN	706	938	3	1,647	10.8	14.3	0.0	25.2
IL, IN, OH, WI	231	111	8	351	3.5	1.7	0.1	5.4
West North Central	405	26	1	432	6.2	0.4	0.0	6.6
Mountain	8	24	0	32	0.1	0.4	0.0	0.5
Pacific	3,005	15	1	3,021	45.9	0.2	0.0	46.2
West South Central	64	16	0	81	1.0	0.3	0.0	1.2
East South Central	391	79	10	481	6.0	1.2	0.2	7.3
South Atlantic	401	31	17	450	6.1	0.5	0.3	6.9
Northeast	43	4	1	48	0.7	0.1	0.0	0.7
2000 TOTAL	5,254	1,246	43	6,542	80.3	19.0	0.7	100.0
2004	**Value ($US millions)**				**Percentage**			
MICHIGAN	4,394	43	1	4,439	34.3	0.3	0.0	34.7
IL, IN, OH, WI	296	98	3	398	2.3	0.8	0.0	3.1
West North Central	477	20	2	498	3.7	0.2	0.0	3.9
Mountain	9	10	0	19	0.1	0.1	0.0	0.1
Pacific	5,714	43	1	5,759	44.7	0.3	0.0	45.0
West South Central	70	9	6	85	0.5	0.1	0.0	0.7
East South Central	278	71	4	353	2.2	0.6	0.0	2.8
South Atlantic	1,131	23	5	1,159	8.8	0.2	0.0	9.1
Northeast	79	6	2	88	0.6	0.1	0.0	0.7
2004 TOTAL	12,447	325	25	12,797	97.3	2.5	0.2	100.0

US Regions/Divisions:
West North Central: IA, KS, ND, NE, MN, MO, SD
Mountain: AZ, CO, ID, MT, NM, NV, UT, WY
Pacific: AK, CA, HI, OR, WA
West South Central: AR, LA, OK, TX
East South Central: AL, KY, MS, TN
South Atlantic: DC, DE, FL, GA, MD, NC, SC, WV
Northeast: CT, MA, ME, NH, NJ, NY, PA, RI, VT

Source: US Bureau of Transportation Statistics Transborder Surface Freight Database

Exhibit 5.18: Flows of Freight Shipped by Rail via St. Clair River by Value, 2000 & 2004

A. US to Canada

	DESTINATION				DESTINATION			
ORIGIN	ONTARIO	QUEBEC	Other	TOTAL	ONTARIO	QUEBEC	Other	TOTAL
2000	**Value ($US millions)**				**Percentage**			
MICHIGAN	268	13	8	289	10.8	0.5	0.3	11.6
IL, IN, OH, WI	254	42	33	330	10.2	1.7	1.3	13.2
West North Central	103	43	22	168	4.1	1.7	0.9	6.8
Mountain	35	8	5	48	1.4	0.3	0.2	1.9
Pacific	103	37	7	148	4.2	1.5	0.3	5.9
West South Central	631	113	47	792	25.4	4.6	1.9	31.8
East South Central	247	75	22	344	9.9	3.0	0.9	13.8
South Atlantic	130	39	19	187	5.2	1.6	0.8	7.5
Northeast	141	26	14	181	5.7	1.0	0.6	7.3
2000 TOTAL	1,913	397	178	2,488	76.9	15.9	7.2	100.0
2004	**Value ($US millions)**				**Percentage**			
MICHIGAN	227	4	3	234	5.1	0.1	0.1	5.3
IL, IN, OH, WI	284	39	28	352	6.4	0.9	0.6	8.0
West North Central	679	11	6	696	15.4	0.3	0.1	15.8
Mountain	60	6	2	68	1.4	0.1	0.0	1.5
Pacific	554	67	15	636	12.6	1.5	0.3	14.4
West South Central	991	149	62	1,203	22.5	3.4	1.4	27.2
East South Central	751	45	32	827	17.0	1.0	0.7	18.7
South Atlantic	206	15	17	238	4.7	0.3	0.4	5.4
Northeast	140	15	6	161	3.2	0.3	0.1	3.6
2004 TOTAL	3,893	351	171	4,415	88.2	8.0	3.9	100.0

B. Canada to US

	ORIGIN				ORIGIN			
DESTINATION	ONTARIO	QUEBEC	Other	TOTAL	ONTARIO	QUEBEC	Other	TOTAL
2000	**Value ($US millions)**				**Percentage**			
MICHIGAN	16,380	274	96	16,750	73.9	1.2	0.4	75.6
IL, IN, OH, WI	909	806	176	1,891	4.1	3.6	0.8	8.5
West North Central	116	129	50	295	0.5	0.6	0.2	1.3
Mountain	62	83	21	166	0.3	0.4	0.1	0.7
Pacific	304	218	22	544	1.4	1.0	0.1	2.5
West South Central	495	356	55	906	2.2	1.6	0.2	4.1
East South Central	323	464	147	934	1.5	2.1	0.7	4.2
South Atlantic	231	103	61	396	1.0	0.5	0.3	1.8
Northeast	174	43	58	275	0.8	0.2	0.3	1.2
2000 TOTAL	18,994	2,477	686	22,157	85.7	11.2	3.1	100.0
2004	**Value ($US millions)**				**Percentage**			
MICHIGAN	11,897	209	95	12,201	61.0	1.1	0.5	62.6
IL, IN, OH, WI	1,125	1,016	238	2,379	5.8	5.2	1.2	12.2
West North Central	326	308	32	665	1.7	1.6	0.2	3.4
Mountain	107	166	24	297	0.6	0.9	0.1	1.5
Pacific	314	295	26	635	1.6	1.5	0.1	3.3
West South Central	411	333	177	921	2.1	1.7	0.9	4.7
East South Central	326	839	130	1,295	1.7	4.3	0.7	6.6
South Atlantic	406	323	36	766	2.1	1.7	0.2	3.9
Northeast	254	66	23	343	1.3	0.3	0.1	1.8
2004 TOTAL	15,167	3,556	779	19,502	77.8	18.2	4.0	100.0

US Regions/Divisions:
West North Central: IA, KS, ND, NE, MN, MO, SD
Mountain: AZ, CO, ID, MT, NM, NV, UT, WY
Pacific: AK, CA, HI, OR, WA
West South Central: AR, LA, OK, TX
East South Central: AL, KY, MS, TN
South Atlantic: DC, DE, FL, GA, MD, NC, SC, WV
Northeast: CT, MA, ME, NH, NJ, NY, PA, RI, VT

Source: US Bureau of Transportation Statistics Transborder Surface Freight Database

5.2 Development of 2004 Commercial Vehicle Trip Tables

The primary source of data for developing cross-border commercial vehicle trip matrices for 2000 was the Commercial Vehicle Survey database provided by the MTO. This data set is based on the 1999 National Roadside Survey (NRS), combined with results from the 2000/2001 MTO Commercial Vehicle Survey (CVS), which provides an rich sample of more than 13,500 actual records collected for commercial vehicle trips crossing between Ontario and Michigan.

As described more fully in the ***Travel Demand Analysis Process Working Paper*** for the P/N&F study, the records for trips using the Detroit and St. Clair crossings required the following treatment before they could be used for the study:

- **Additional local geographic detail** – The geographic information in the NRS/MTO data set was coded to the nearest city or town, including Windsor, Detroit and nearby townships such as Dearborn as single zones. While this level of detail is suitable for assigning trip origins and destinations to many of the regional and external traffic zones, and for strategic modelling purposes, a more refined level of geographic detail for the many origins and destinations in the Detroit or Windsor areas was required to allow for the required trip assignment precision for trips with at least one end in these areas. Other sources, such as an MDOT/SEMCOG survey of commercial vehicles at six locations for external travel including the Ambassador Bridge and Blue Water Bridge, and other sources were used to attribute more detailed local geographic detail to these records; and

- **Correction of long-distance trip bias** – Review of initial commercial vehicle origin-destination travel matrices resulted in the identification of a bias in the expansion of the NRS/MTO data as provided by MTO, with the expanded NRS/MTO database significantly under-representing local trips. To correct for this, the proportions of long-distance and local trips for each crossing derived by using all expanded records were adjusted to reflect proportions derived by using those records representing surveys undertaken at the respective border crossings only.

The final database developed for the P/N&F study was used as the basis for development of the 2004 commercial vehicle trip tables.

As determined above, the origin-destination patterns for individual commodity groups have not fundamentally changed between 2000 and 2004, although there are changes in the relative growth of each commodity group, which would result in changes in overall commercial vehicle origin-destination patterns between 2000 and 2004. The update of the 5 commercial vehicle trip matrices corresponding to the 5 commodity groups to 2004 was therefore performed by calculating 2000 to 2004 growth factors determined for each commodity group from the BTS trade data and applying them to the respective 2000 matrices. The growth factors were developed by direction (US to Canada and Canada to US) using BTS trade data, expressed in constant dollars (weight/tonnage trade data is not available for both directions).

Because detailed trade information on commodity shipments for 2000 and 2004 are not available at the port level, changes in trade values between Ontario and the East North Central states were considered to provide a good indication of changes in trade at the Detroit River and St. Clair crossings. Shipments between Ontario and the East North Central states (Michigan, Ohio, Illinois, Indiana, and Wisconsin) accounted for more than half of commercial vehicle trade by value at the Detroit River and St. Clair River crossings in 2004. Exhibit 5.19 shows the growth factors used to update the 2000 trade values to 2004. The resulting 2004 trip tables by commodity group were then summed to provide total commercial vehicle trips crossing the border and compared to border BTOA commercial vehicle counts for a 2004 Fall weekday (as derived in Chapter 3) and for a.m. peak hour, p.m. peak hour and mid-day peak hour time periods. The BTOA traffic counts served as the control total volumes for the 2004 update. Some factoring of the trip matrices was necessary to match the 2004 Fall weekday traffic counts.

Exhibit 5.19: Growth Factors to Update Commercial Vehicle Matrices from 2000 to 2004

Commodity Type	Growth Factor	
	Canada to US	US to Canada
Auto	0.97	0.88
Forest	0.99	0.96
Agricultural	1.38	1.35
Metal[1]	1.17	0.96
Machinery/Equipment	0.87	0.84
Other	0.98	0.96
Empty	1.03	0.97

[1] Although separate growth factors are used for Auto and Metal categories to update the matrices from 2000 to 2004, these categories are combined for future-year forecasts.

The result of the above process was 2004 trip matrices by commodity group for each of the three time periods of analysis – a.m. peak hour, p.m. peak hour and mid-day peak hour time periods – and daily trip matrices corresponding to a 2004 Fall weekday.

5.2.1 SPATIAL TRAVEL PATTERNS

Exhibit 5.20 presents an overview of the aggregate trip pattern characteristics for commercial vehicle traffic at the Detroit River and St. Clair River crossings for August 2000, while Exhibit 5.21 shows trip patterns for the September 2004 time frame that resulted from the above update process. In 2004, there were approximately 13,000 Fall weekday commercial vehicle trips at Detroit River crossings, with over 95% of the commercial vehicle traffic using the Ambassador Bridge.

Based on the 2004 update of the trip matrices, it is estimated that there has been a slight increase in the proportion of entirely long-distance trips (not to/from Essex County in Canada or SEMCOG in Michigan) from 45% in August 2000 to 50% in September 2004, with a corresponding slight decrease in local trips. Of the total commercial vehicle traffic crossing at the Detroit River, However, approximately 30% of the commercial vehicle travel involves long-distance to local trips.

Exhibit 5.20: Weekday Commercial Vehicle Trip Patterns at Detroit River & St. Clair River Crossings, August 2000

Trip Type	Crossing							
	Ambassador Bridge		Detroit-Windsor Tunnel		Detroit River Crossings		Blue Water Bridge[1]	
	Volume	%	Volume	%	Volume	%	Volume	%
LOCAL to LOCAL	2,350	21	450	68	2,800	23	70	1.3
LOCAL (Southeast Michigan) to/from LONG-DISTANCE (beyond Windsor-Essex)	1,850	16	100	16	2,000	16	1,450	28
LOCAL (Windsor-Essex) to/from LONG-DISTANCE (beyond Southeastern)	1,700	15	100	11	1,750	15	150	3
LONG-DISTANCE to LONG-DISTANCE	5,400	47	30	4	5,400	45	3,500	67
OTHER[2]	100	1.0	5	0.6	100	1.0	50	0.9
TOTAL TRIPS	11,400	100	700	100	12,100	100	5,200	100

[1] The local trip area for Blue Water Bridge crossings is Sarnia and area (Lambton County) in Canada.
[2] This includes unexpected/atypical trips where the shortest route is not taken.

Exhibit 5.21: Weekday Commercial Vehicle Trip Patterns at Detroit River & St. Clair River Crossings, September 2004

Trip Type	Crossing							
	Ambassador Bridge		Detroit-Windsor Tunnel		Detroit River Crossings		Blue Water Bridge[1]	
	Volume	%	Volume	%	Volume	%	Volume	%
LOCAL to LOCAL	2,100	17	350	59	2,450	19	50	1.1
LOCAL (Southeast Michigan) to/from LONG-DISTANCE (beyond Windsor-Essex)	1,950	16	100	19	2,100	16	1,500	27
LOCAL (Windsor-Essex) to/from LONG-DISTANCE (beyond Southeast Michigan)	1,750	14	100	15	1,850	14	150	3
LONG-DISTANCE to LONG-DISTANCE	6,450	52	50	6	6,500	50	3,850	68
OTHER[2]	130	1.0	5	0.8	130	1.0	50	0.9
TOTAL TRIPS	12,400	100	600	100	13,000	100	5,650	100

[1] The local trip area for Blue Water Bridge crossings is Sarnia and area (Lambton County) in Canada.
[2] This includes unexpected/atypical trips where the shortest route is not taken.

There were approximately 5,650 commercial vehicle trips using the Blue Water Bridge or St. Clair River crossing on a 2004 Fall weekday. These trips are longer distance than the Detroit River crossings with almost 70% of the traffic representing long distance to long distance trips that travel through the Sarnia-Port Huron area, largely destined to other parts of Michigan and central US states.

5.2.2 DOMESTIC COMMERCIAL VEHICLES

It is necessary to estimate and assign domestic commercial vehicles to determine total commercial vehicles volumes on road facilities in the vicinity of border crossings and the domestic/international proportions of this traffic. Canadian domestic commercial vehicle flows are not modelled in the EWRTMP Model, requiring the synthesis of a 2004 base year domestic commercial vehicle trip table for the DRIC Model Update. However, domestic commercial vehicle trips are derived within the SEMCOG Model.

For Canadian domestic travel, a simplified approach was taken, given that commercial vehicle travel and count data are not available for internal Windsor-Essex. Commercial vehicle trips were assumed to have the same distribution as the non-home-based domestic car trips and then factored so they represented approximately 2% of the total vehicle trips. Trips to and from other areas of Canada were factored in a similar manner assuming commercial vehicles represented 2% of traffic. Many origin-destination pairs are not feasible for commercial traffic since commercial are prohibited on numerous streets in residential areas of Windsor. The domestic commercial vehicles traffic was therefore distributed between permitted origins and destinations.

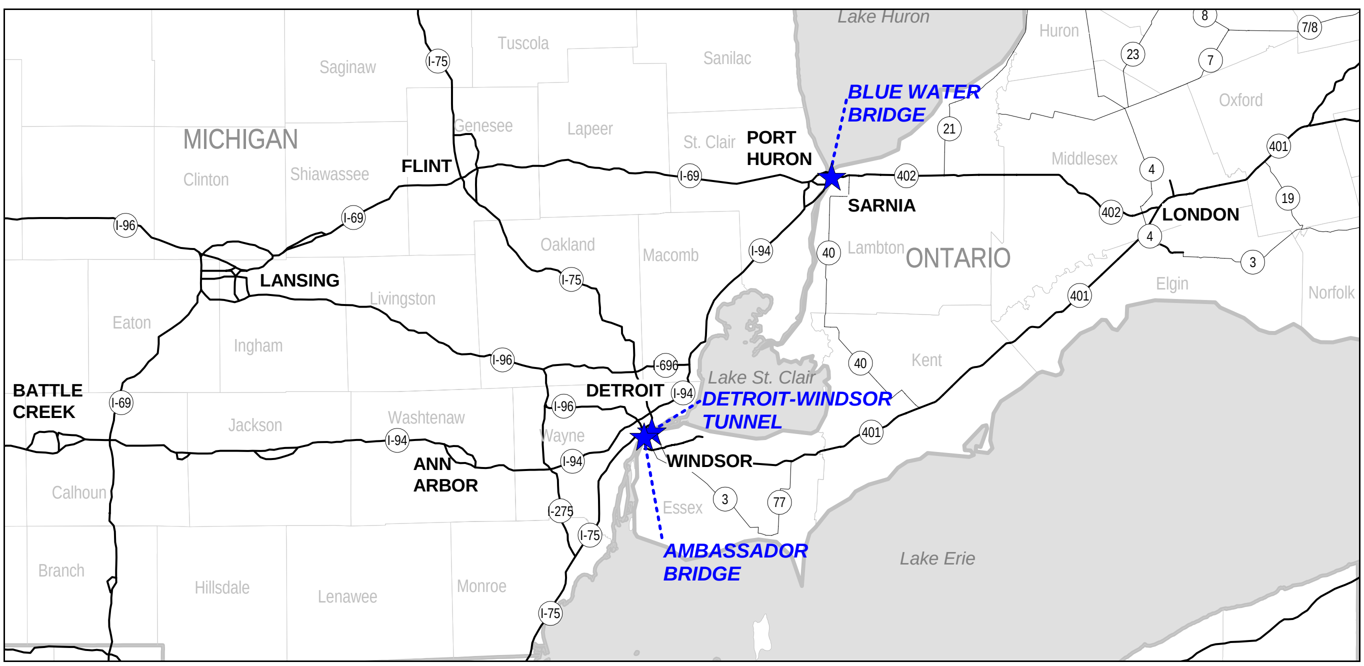
6. UPDATE OF TRANSPORTATION NETWORKS

This chapter describes the development and update of the TransCAD road and highway network for the DRIC Model Update. The focus of the update is the Canadian-side road network. The update of the network on the US side of the border is being prepared by the US-based DRIC Consultant.

6.1 Network Update

Trips from the cross-border origin-destination (O-D) matrices, as derived above, are assigned to road networks for the study area that include the three Southeast Michigan/Southwestern Ontario border crossing facilities. The modelled area must be sufficiently large to capture common points and points in the road network where the decision to cross the border at the Detroit River or at Blue Water Bridge are made: the Highway 401/Highway 402 interchange west of London, Ontario, and the Interstate-69/Interstate-94 interchange near Battle Creek, Michigan. Networks have therefore been developed approximately from London to Battle Creek, as shown in the map of the modelled area in Exhibit 6.1.

Exhibit 6.1: Modelled Area



6.1.1 ZONE SYSTEM

The model zone system is largely based on the PN/F system. Zone aggregation increases with distance from the crossings, as the finest level of detail is required only in the vicinity of the crossings. The distribution of Canadian zones in the updated model is as follows:

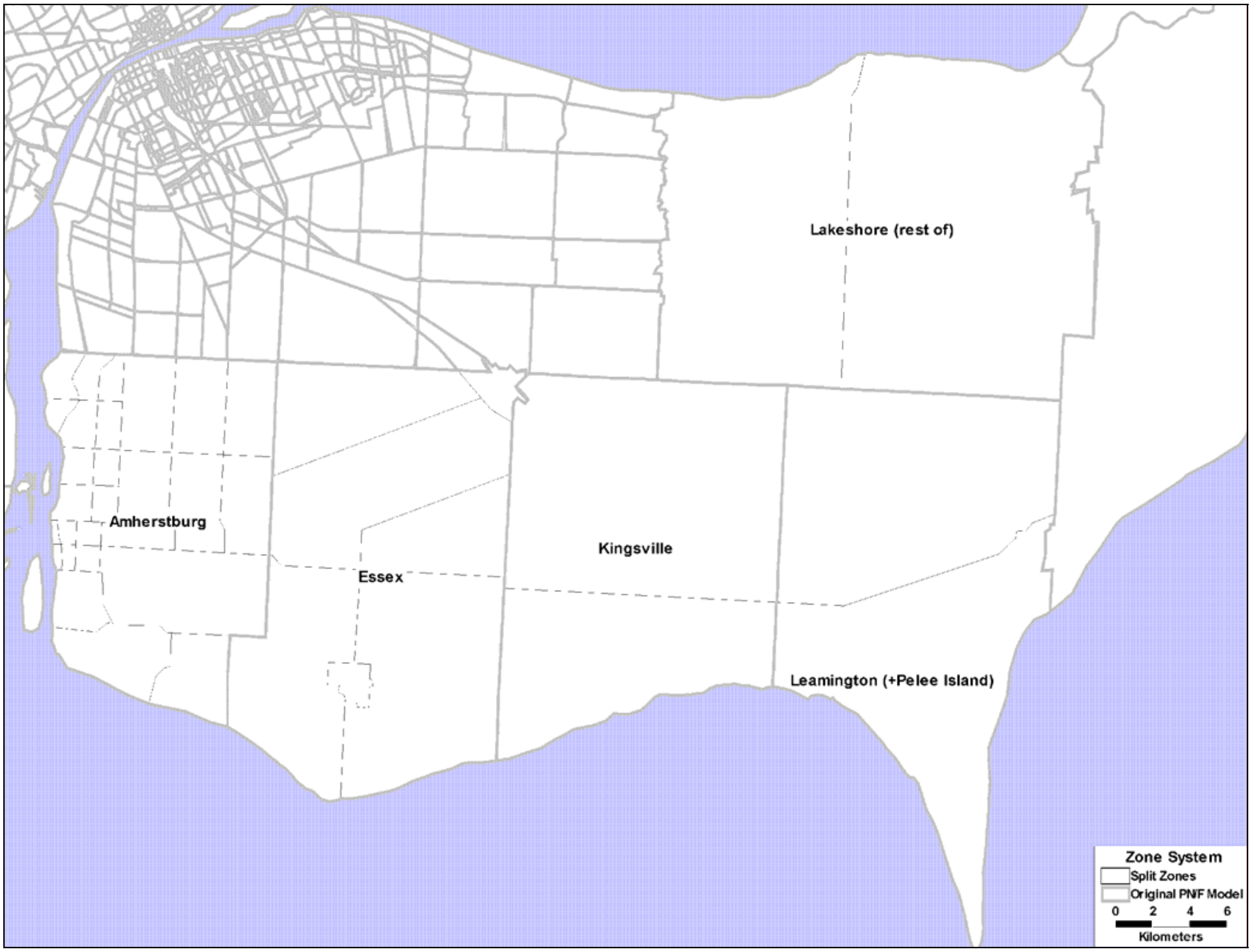
- 464 zones represent the municipalities closest to the Detroit River Crossings: the City of Windsor, the Towns of Tecumseh and Lasalle, and the former municipality of Maidstone;
- 26 zones represent Amherstburg;
- 7 zones represent the municipality of Essex;
- 2 zones are used for each of Kingsville, Leamington and rest of Lakeshore;
- 31 zones represent the rest of Southwestern Ontario (Kent, Lambton, Middlesex and Elgin counties); these zones are based on current or former Census subdivisions or municipalities; and
- 7 zones represent the rest of Ontario and Canada.

A higher level of detail than was provided in the P/N&F Model is considered pertinent to allow a south crossing to be tested as a crossing alternative. Therefore, zones in southern Essex County – Amherstburg, Essex, Kingsville, Leamington and rest of Lakeshore – that were previously coded as one zone each, have been disaggregated for the model update. The completion of the EWRTMP Study provided a basis for updating the zone system, although this is substantially more disaggregated than is required for the cross-border model. Exhibit 6.2 shows the updates made to the zone system in the Essex area.

The expansion of the fully modelled area (i.e. includes all domestic traffic) to encompass all of Essex County enabled the original Canadian domestic cordon zones to be removed. Zones 5001 to 5013 from the P/N/&F model represented trips to and from the Greater Windsor area with trips added at a cordon north of County Road 8 and west of the Belle River. Trips to or from other areas in Essex are now included in the Essex internal trip matrix, while trips to and from other parts of Canada have been allocated to the relevant geographic zone.

On the US side, the P/N&F study zoning system has been adopted with only change being the addition of Mexico as a separate zone.

Exhibit 6.2: DRIC Model Zone System Update



6.1.2 ROAD NETWORK

The TransCAD model network is derived from the model developed for the P/N&F Study, with some refinements in the Essex area. Two sources were used to develop the network on the Canadian side:

- ***Essex-Windsor Regional Transportation Master Plan*** *(EWRTMP)* – The EWALTS network was developed in TransCAD and covers the County of Essex. Networks are available for 2001 and 2021; and

- **Ministry of Transportation of Ontario Highway Networks** – The road/highway network developed by MTO for Southwestern Ontario provides coverage for the rest of Southwestern Ontario. This basic network is available in TransCAD and has been developed for the current year.

The 2001 original networks have been updated to the base year of 2004, enabling validation to current counts. Networks from the two sources above were merged to provide a single comprehensive and coherent network within TransCAD, as described below for four geographic areas:

- **Windsor Area –** The EWRTMP model provides the high level of detail that is required for the urban area of Windsor and the surrounding communities of Lasalle and Tecumseh. This includes almost all roads, from local collectors to freeways. Explicit truck routes have been defined with trucks prohibited from particular roads;

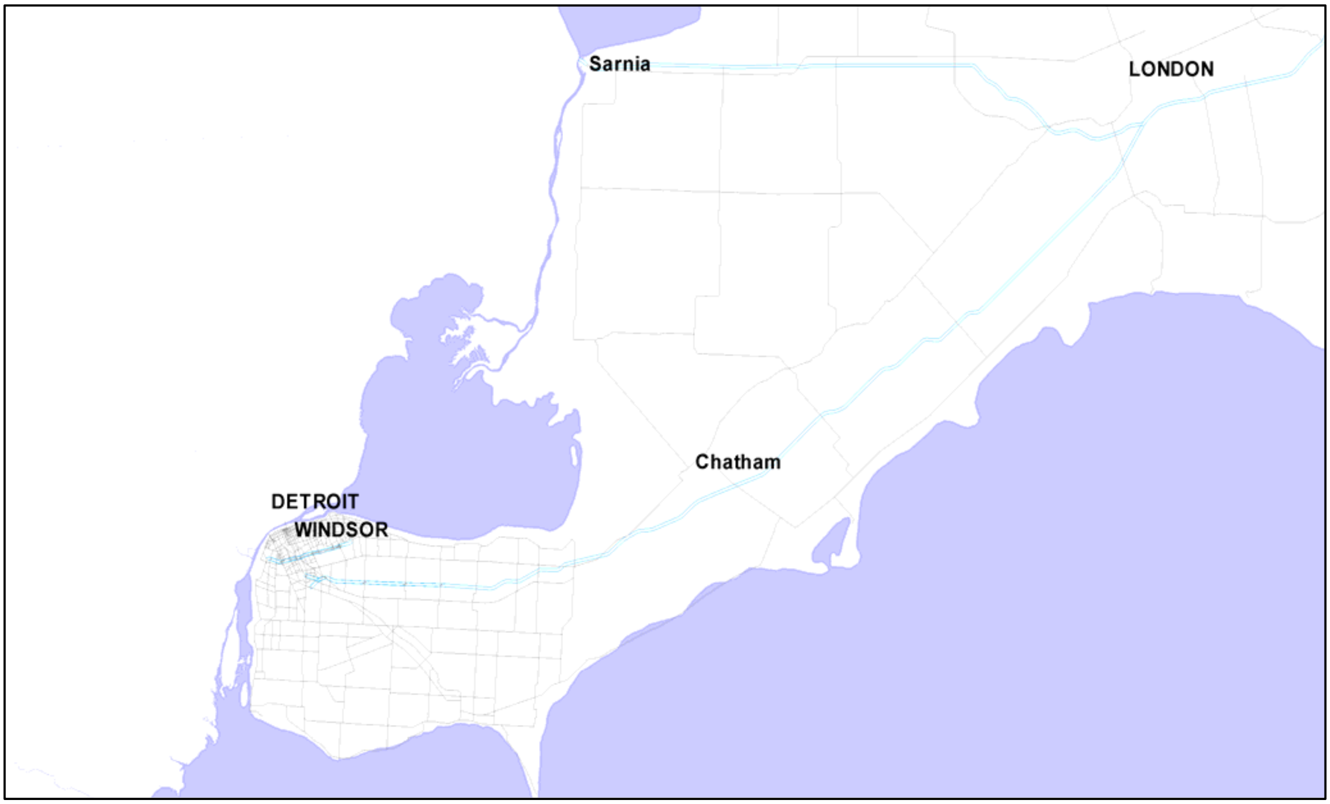
- **Rest of Essex –** A more moderate level of detail was required for this area. The EWRTMP model provides the source network, but considering the more aggregate zone system outside Windsor, the network has been simplified with only County roads upwards represented. This is a refinement from the P/N&F Study, which included only major routes. The refinement was necessitated by the disaggregation of zones in this area compared to the P/N&F Study;

- **Southwestern Ontario –** The level of network detail required decreases with distance from the border crossings. The MTO model provides network coverage for the rest of Southwestern Ontario, but outside Essex County only major routes have been adopted. These links provide routes to the Blue Water Bridge as well as to Eastern Canada and Northeastern US; and

- **Rest of Ontario/Canada –** East of London, a simple network of only major freeways is sufficient to connect the external area zones to the rest of the network.

Exhibit 6.3 shows the final Canadian network.

Exhibit 6.3: DRIC Model Update Canadian Road Network



6.2 Road Speed & Capacity Assumptions

6.2.1 CROSSING ATTRIBUTES

Crossing capacity refers to the physical capacity of the bridge or tunnel structure. Standardised approaches have been developed in the Highway Capacity Manual (HCM 2000) for freeways, multi-lane highways, two lane highways, signalised intersections, and other standard roadway elements. However, there are no standard capacity procedures for border crossing facilities. While border crossings, may resemble multi-lane or two-lane highways, they also may have unique physical characteristics (lengths, grades, etc.), non- typical traffic characteristics (non-regular drivers) and non-typical vehicle mix characteristics, specifically high truck percentages. Provide these unique characteristics are acknowledged, and the limitations of standard approaches are recognised, it is appropriate to use the HCM 2000 methods as a starting point for estimating crossing capacities.

In previous studies, HCM 2000 methods have been adapted to estimate crossing capacity for international bridge facilities, notably the previous P/N&F Study and the St. Clair and Detroit Rivers International Crossings Study undertaken for MTO, MDOT and Transport Canada. These studies provided crossing capacity estimates for the Ambassador Bridge, Detroit-Windsor Tunnel and Blue Water Bridge. It was recognised in these previous studies that HCM 2000 methods are not intended for use in bridge/tunnel crossings, but were used because it reflects the most appropriate traffic engineering technique available, given that there are no standardised methods to estimate crossing capacity. As such, professional judgement and on-site observation of traffic flows at the Ambassador Bridge were also used to confirm the reasonableness of the crossing capacity estimates.

While there are several potential definitions for capacity, HCM 2000 defines capacity as “the maximum hourly sustained flow rate at which vehicles can reasonably be expected to traverse a uniform segment under prevailing roadway and traffic conditions.” Persons per hour, passenger cars per hour, and vehicles per hour are measures that can define capacity. Capacity is also impacted by lane configuration (e.g. width, lateral clearance, gradient, etc.) and the mix of vehicles.

Due to the large proportion of heavy vehicles at the border crossings, special consideration of the impacts of heavy vehicles on capacity is required. When applying HCM 2000 methods, heavy vehicles are factored into the level-of-service analysis by expressing heavy vehicles as PCEs. The HCM 2000 provides methods for estimating truck equivalent factors based on length of grade and steepness of grade. For a 400- to 800-metre (1,300- to 2,600-foot), 4.5% grade (typical of the Ambassador Bridge), the recommended passenger car equivalent for commercial vehicles is 2.0.

A limitation of the HCM 2000 approach is that it does not explicitly account for the mix of straight commercial vehicles (single unit) and heavy tractor-trailers (multi-unit). Unlike typical road facilities, border crossings tend to have a much higher proportion of multi-unit commercial vehicles, with the NRS/MTO commercial vehicle survey indicating that nearly 90% of commercial vehicles crossing the Ambassador and Blue Water Bridges are tractor-trailer combinations. The Canadian Capacity Guide for Signalised Intersections provided a secondary source and it suggests a PCE factor of 2.5 for multi-unit trucks and 3.5 for heavily loaded multi-unit trucks. A PCE factor of 3.0 was adopted to reflect the predominance of multi-unit vehicles using the Ambassador and Blue Water Bridges and impact of grade.

For the DRIC Study, a review of the P/N&F capacity methodology and input assumptions was undertaken to ensure up-to-date physical and traffic vehicle mix characteristics of the respective crossings were used to determine the capacity. The review found that the P/N&F methodology and input assumptions are still valid. In addition, an independent review of the Ambassador Bridge crossing capacity was performed by the US-based DRIC consultant. To verify the crossing capacities derived above, field observations were performed at the Ambassador Bridge to observe truck flow rates on the bridge and the average headway or time separation between trucks. Observed headways suggested that the HCM 2000 capacity estimates are slightly lower than observed capacities, but very reasonable. As such, the P/N&F capacity estimates have been re-adopted.

Based on the above approach and on-site observations, the crossing capacities (shown in Exhibit 6.4) are estimated to be 1,750 PCE/h/lane for the Ambassador Bridge and 1,500 for the Detroit-Windsor Tunnel. These represent flow rates at the level-of-service E/F boundary. For the purposes of the DRIC study, capacities at the D/E boundary have also been established at 1,450 and 1,250, respectively, based on the same methodology.

Exhibit 6.4: Crossing Speeds & Capacities

Facility	No of Lanes One-Way	Capacity Per Lane (PCEs/h)	Total One-Way (PCEs/h)	Speed (km/h)
Ambassador Bridge	2	1,750	3,500	60
Detroit-Windsor Tunnel	1	1,500	1,500	40

6.2.2 LINK ATTRIBUTES

Model link speed and capacity values used in the DRIC Model are derived from the EWRTMP model network with some modifications to account for the modelling of commercial vehicles. Further modifications were made to improve assignment. Links from the MTO Model network have speeds and capacities that are compatible with the EWRTMP model classifications.

Exhibit 6.5 summarises the network attributes by link type. A PCE value of 2.5 is assumed for commercial vehicles on network links.

The model's traffic assignment was improved after the free flow speed on the urban freeway of the E.C. Row Expressway was reduced to 90 km/h, given the operational characteristics of this facility with short distances between interchanges and a high degree of weaving traffic.

Exhibit 6.5: Network Speeds & Capacities

Functional Class	Capacity Per Lane (PCEs/h)	Speed (km/h)
Rural Freeway	2,200	100
Urban freeway	2,000	90
Rural Arterial	1,100–1,250	50–80
Urban Major arterial	900	50–70
Minor arterial	800	35–80
Collector	650	35–60
Local street	500	30–50
Freeway ramp	1,300	50–100
Local non-through	350	35–50
Centroid connector	n/a	50–80

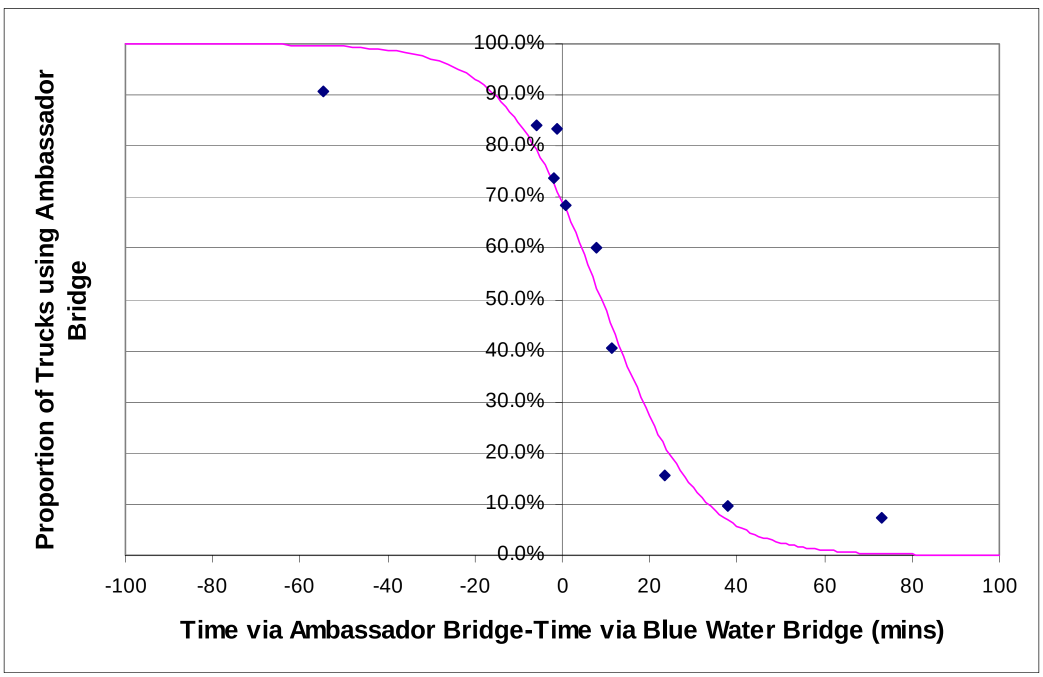
7. UPDATE OF CROSSING CHOICE/ASSIGNMENT PROCESS

7.1 Crossing Choice Logit Model

A large proportion of long-distance traffic has the option of using either the Detroit River or the St. Clair River crossings with little difference in travel time. In these instances, there is a preference or bias towards the Detroit River crossings. This is evidenced by Exhibit 7.1, which plots the proportion of total Ambassador/Blue Water Bridge commercial vehicle crossings using the Ambassador Bridge, against the corresponding travel time difference between an Ambassador Bridge route and a Blue Water Bridge route. A negative time difference indicates the Ambassador Bridge route is faster, while a positive difference indicates the Blue Water Bridge route is faster.

With no bias, half of trucks would use either crossing with travel time and cost equal. Instead, more than half of trucks (70%) use the Ambassador Bridge with equal travel time. This bias represents factors other than travel time that influence the choice between Ambassador Bridge and Blue Water Bridge. A similar relationship exists for passenger cars, but there is a substantially smaller proportion of trips that are long enough for the crossing choice to be realistic. (In this analysis and in the development of the crossing choice model, the Detroit-Windsor tunnel is excluded from commercial vehicle crossing choice model, as size limitations render it unavailable to most commercial vehicles.)

Exhibit 7.1: Impact of Travel Time on Crossing Choice



Source: 2000 Commercial Vehicle Survey; travel times from TransCAD cross-border model

A basic model assignment of cross-border trips is not capable of capturing non-travel time factors that influence crossing choice and can lead to large changes in assignment from one bridge to another with small changes in travel time. A crossing choice logit model was developed to more accurately predict the border crossing used for trips where drivers have a choice of crossing. This involves determining the magnitude of the bias to the Detroit River crossings, and identifying the trade-offs made by drivers among the various costs of the journey. The crossing choice model estimates the non-modelled (random) element that results in some trips using the apparently "more costly" route.

The shape of the diversion curve in Exhibit 7.1 suggests the logit formulation to determine crossing choice. With a binary choice between Detroit River crossings and the St. Clair River crossing, the logit equation is as follows. For trucks the Detroit-Windsor tunnel is excluded from the Detroit River crossings.

$$P_{ijD} = \frac{\exp(V_{ijD})}{\exp(V_{ijD}) + \exp(V_{ijC})}$$

where:

P_{ijD} = probability of using Detroit River crossings for a trip from zone *i* to zone *j*

V_{ijD} = utility of using Detroit River crossings for a trip from zone *i* to zone *j*

V_{ijC} = utility of using the St. Clair River crossing for a trip from zone *i* to zone *j*

The aim of the calibration exercise is to develop equations that determine the utility of each route. These equations include a constant term representing the magnitude of random or unobservable influences on choice.

7.1.1 CALIBRATION DATA

The following variables were considered likely to influence the crossing choice for cross-border traffic:

- In-vehicle travel time;
- Border crossing time;
- Tolls; and
- Other operating costs (including fuel and maintenance, but excluding driver wages)

Two models were to be estimated. The commercial vehicle model was calibrated using the 2000 Commercial Vehicle Survey data. This rich dataset includes detail on commercial vehicle origins and destinations, commodities carried, and commercial vehicle characteristics. The passenger car crossing choice model was calibrated using the Ontario-Michigan Border Crossing Traffic Study, which includes detail on trip purpose and frequency, in addition to the origins and destinations. Both models were thus calibrated using 2000 conditions, and other data collated for the calibration also relate to this year.

Travel time by origin and destination was determined using the TransCAD Model developed for the P/N&F Study. Models had been developed for both a.m. and p.m. peak hours; hence, travel times for routes using either crossing were extracted for both time periods. Since times vary during the day survey records outside the modelled peak periods were not used.

Commercial vehicle border crossing times were taken from a 2001 FWHA study[5], and are considered a good representation of the border times during 2000. Presented in Exhibit 7.2, the crossing times represent the time from the initial queue point in the exporting country to the point of exit from the first inspection station in the importing country. The initial point varies in location depending on the queue length.

Exhibit 7.2: 2000 Commercial Vehicle Border Crossing Times (Minutes)

Crossing & Direction	Baseline (shortest) Time	Average Time	95th Percentile Time	Delay Time (Average – Baseline)
Ambassador Bridge – to Canada	5.7	8.8	13.7	3.1
Ambassador Bridge – to US	12.9	20.4	33.9	7.5
Blue Water Bridge – to Canada	5.0	6.2	9.1	1.2
Blue Water Bridge – to US	11.1	34.2	80.3	23.1

Note: Detroit-Windsor tunnel not included in commercial vehicle crossing choice.
Source: Measurement of Commercial Motor Vehicle Travel Time and Delay at US International Border Stations, FHWA, 2001

For the purposes of the crossing choice model, average crossing times were used, although it is acknowledged that an element of border crossing delay variability may also affect crossing choice. It is worth noting at this stage that for commercial vehicles entering the US from Canada, crossing times via the Blue Water Bridge are almost 15 minutes longer than via Ambassador Bridge, on average. Conversely, crossing times entering Canada are marginally lower via Blue Water Bridge.

Prior to the events of 9/11, no surveys were taken for passenger car border crossing times. These are known to be less than commercial vehicle border crossing times, and similarly they are believed to have increased following the events of 9/11. The 2000 border crossing times shown in Exhibit 7.3 were estimated based on border-crossing times for 2003 and anecdotal information.

[5] Measurement of Commercial Motor Vehicle Travel Time and Delay at US International Border Stations, FHWA, 2001

Exhibit 7.3: 2000 Estimated Passenger Car Border Crossing Times

Facility / Direction	Estimated Time (Minutes)
Ambassador Bridge – to Canada	1
Ambassador Bridge – to US	2
Detroit-Windsor Tunnel – to Canada	4
Detroit-Windsor Tunnel – to US	4
Blue Water Bridge – to Canada	5
Blue Water Bridge – to US	5

Source: Estimated based on anecdotal information, 2003 data.

Tolls may also influence crossing choice, particularly for commercial vehicles due to the toll structuring. Blue Water Bridge commercial vehicle tolls are based solely on the number of axles, while tolls at Ambassador Bridge depend on both the number of axles and the gross weight. The commercial vehicle tolls included in the crossing choice model for 2000 are as follows (all costs in Canadian dollars at year 2000 prices):

Ambassador Bridge: $0.03335 per 100 lbs gross weight for 2 to 7 axles

$0.03698 per 100 lbs for 8 axles or more

Minimum toll ranges from $4.25 for 2 axles to $26.50 for 12 axles

Blue Water Bridge: $2.75 per axle

Toll rates are substantially higher for heavy commercial vehicles using the Ambassador Bridge rather than Blue Water Bridge. The 2000 Commercial Vehicle Survey includes data on gross weight and number of axles and thus a toll for each crossing could be calculated for each record in the dataset.

For cars, the difference in tolls between crossings is much less. Tolls per passenger car are as follows:

Ambassador Bridge: $4.00

Detroit-Windsor Tunnel: $3.50 to US; $4.75 to Canada

Blue Water Bridge: $2.50

The final cost to be included in the crossing choice model relates to the cost of the vehicle operation and maintenance, and is usually related to journey distance. Distances for routes using either crossing were determined from the TransCAD Regional Model, and a simple $CAN 0.34/km operating cost was used for commercial vehicles and $CAN 0.08/km for cars. Driver wages are not included in the commercial vehicle cost as they are already captured by travel time.

7.1.2 MODEL FORMULATION

The logit model was estimated initially with total costs and times for each crossing. The fit was substantially improved when the time and cost differences between the two crossings were used, rather than the absolute numbers. For passenger car trips a separate cost coefficient was not significant so cost was incorporated into generalised time. A route bias was confirmed with the Detroit River crossings preferred over Blue Water Bridge, all else being equal. For commercial vehicle trips, the choice set includes only the Ambassador and Blue Water Bridges, while both Detroit River crossings are included for the passenger car model.

For commercial vehicles, the final model is as follows:

$$\mathbf{V_{ijD} = 0.704 - 0.0486*(T_{ijD}-T_{ij0}) - 0.0323*(C_{ijD}-C_{ij0})}$$

$$\mathbf{V_{ijC} = -0.0486*(T_{ijC}-T_{ij0}) - 0.0323*(C_{ijC}-C_{ij0})}$$

For passenger cars:

$$\mathbf{V_{ijD} = 0.9234 - 0.0625 *(G_{ijD}-G_{ij0})}$$

$$\mathbf{V_{ijC} = -0.0625 *(G_{ijC}-G_{ij0})}$$

where:

T_{ij0} = total travel time via the shortest route from zone *i* to zone *j* (including border crossing)

T_{ijD} = total travel time via the Detroit River crossings from zone *i* to zone *j* (including border crossing)

T_{ijC} = total travel time via the St. Clair crossing from zone *i* to zone *j* (including border crossing)

C_{ij0} = total cost via the cheapest route from zone *i* to zone *j* (including tolls)

C_{ijD} = total cost via the Detroit River crossings from zone *i* to zone *j* (including tolls)

C_{ijC} = total cost via the St. Clair crossing from zone *i* to zone *j* (including tolls)

G_{ij0} = total generalised time via the shortest route from zone *i* to zone *j* (Value of time=$25/veh/h)

G_{ijD} **=** total generalised time via the Detroit River crossings from zone *i* to zone *j* (Value of time=$25/veh/h)

G_{ijC} total generalised time via the St. Clair crossing from zone *i* to zone *j* (Value of time=$25/veh/h)

The explicit value-of-time used to combine cost and time is based on a value of time of $10/person/h and an average vehicle occupancy of 2.5 for long-distance car trips.

The commercial vehicle model has a good ρ^2 statistic of 0.42, while the passenger car ρ^2 statistic is 0.81. The much higher value for the car model reflects a greater proportion of short-distance trips that are much easier to predict. The t-statistics are listed below, showing all parameters are significant.

Detroit River-specific constant (commercial vehicles): 14.9

Detroit River-specific constant (cars): 23.2

$(T_{ijA}–T_{ij0})$: -27.2

$(C_{ijA}–C_{ij0})$: -5.7

$(G_{ijA}–G_{ij0})$: -35.1

The coefficients imply the following:

- Truck value of time of $CAN 90/h; and
- Route bias in favour of the Detroit River crossings equivalent to 14 minutes or $CAN 21 for commercial vehicles, and 15 generalised minutes for passenger vehicles.

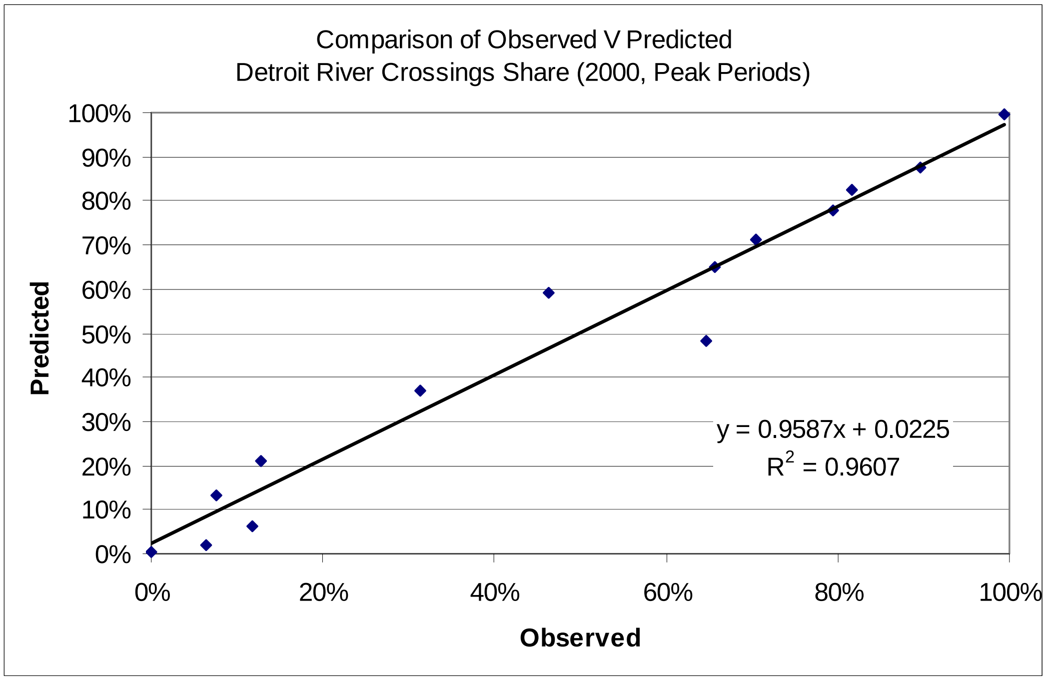
The value-of-time of $90/h CDN for commercial vehicles is marginally higher than often reported, but it is a reasonable result for a calibrated logit model. The bias towards the Detroit River crossings also seems reasonable. It may stem from less public awareness of Blue Water Bridge, and from the availability of more facilities in the Windsor-Detroit area; for commercial vehicles in particular there are more customs brokers and a number of truck stations.

7.1.3 2000 MODEL FIT

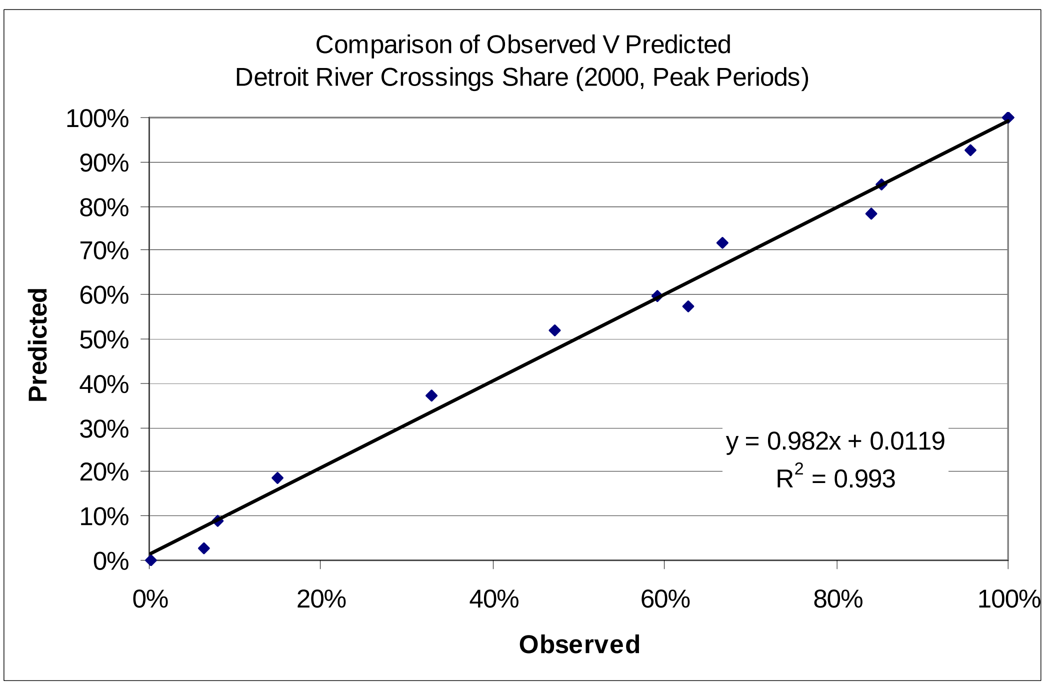
Exhibit 7.4 groups the observations by the utility difference and compares the observed and predicted commercial vehicle trips and passenger car trips, respectively, using the Detroit River route. The points at the bottom left represent those with a large negative difference (i.e. greater utility for a route via the St. Clair River crossing), while those in the top right indicate observations where there is substantially greater utility for the route via the Detroit River crossings. Observations in the centre indicate little difference in utility for either crossing choice, giving a more even split between crossings.

Exhibit 7.4: Crossing Choice Model Fit, 2000

A. Commercial Vehicles



B. Passenger Cars



With a small intercept and gradient close to one, the regression equation suggests no systematic error in either model. The high r-squared values also indicate a good fit between modelled and observed choice for a given utility difference.

Exhibits 7.5 and 7.6 group the observations by geographic superzone and compare the predicted and observed crossing choice for the 2000 a.m. and p.m. peak hours. The peak hours represents a subset of the time periods to which the model was calibrated. Trips are considered local if they have an origin or destination within the SEMCOG area in the US or the Windsor or Sarnia area in Canada.

Exhibit 7.5: Model Fit of 2000 Commercial Vehicle Crossing Choice Model

A. AM Peak Hour

Origin-Destination Pair	DETROIT RIVER				ST CLAIR RIVER			
	Obs	Model	Abs. Diff.	% Diff.	Obs	Model	Abs. Diff.	% Diff.
Long Distance – Local and Local – Long Distance	183	189	6	3%	57	51	-6	-10%
Long Distance – Long Distance	261	225	-36	-14%	112	148	36	32%
Local – Local and Other	61	61	0	0%	11	11	0	0%
TOTAL	506	476	-30	-6%	180	210	30	17%

B. PM Peak Hour

Origin-Destination Pair	DETROIT RIVER				ST CLAIR RIVER			
	Obs	Model	Abs. Diff.	% Diff.	Obs.	Model	Abs. Diff.	% Diff.
Long Distance – Local and Local – Long Distance	150	159	9	6%	68	59	-9	-13%
Long Distance – Long Distance	326	314	-12	-4%	174	186	12	7%
Local – Local and Other	89	95	6	6%	18	12	-6	-30%
TOTAL	565	568	3	0%	260	258	-3	-1%

Overall, the models fit the observed data well. For commercial vehicles, the fit is less successful at an origin-destination level, and in particular it was found that the model appears to under-predict Detroit River commercial vehicle traffic entering Canada where both the origins and destinations are distant from the crossings. The Detroit River crossings may attract more commercial vehicle traffic than modelled as the reasons suggested above are particularly relevant to longer distance commercial vehicle trips entering from the U.S, and there may be less awareness of Windsor afternoon congestion. Commercial vehicles entering the US via Detroit River crossings in the afternoon are over-predicted by the model.

For cars, the model accurately predicts crossing choice for most origin-destinations, but it is acknowledged that the proportion of trips where a true choice is made is substantially smaller than for commercial vehicles. Almost two-thirds of a.m. and p.m. peak hour car trips are local to local, where genuine crossing choice is unlikely, compared to approximately 12% of peak hour commercial vehicle trips.

Exhibit 7.6: Model Fit of 2000 Passenger Car Crossing Choice Model

A. AM Peak Hour

Origin-Destination Pair	DETROIT RIVER				ST CLAIR RIVER			
	Obs.	Model	Abs. Diff.	% Diff.	Obs.	Model	Abs. Diff.	% Diff.
Long Distance – Local and Local – Long Distance	516	524	8	2%	127	118	-9	-6%
Long Distance – Long Distance	110	110	0	0%	91	92	1	1%
Local – Local and Other	1,701	1,697	-4	0%	101	105	4	3%
TOTAL	2,327	2,331	4	0%	319	315	-4	0

B. PM Peak Hour

Origin-Destination Pair	DETROIT RIVER				ST CLAIR RIVER			
	Obs.	Model	Abs. Diff.	% Diff.	Obs.	Model	Abs. Diff.	% Diff.
Long Distance – Local and Local – Long Distance	908	915	7	1%	232	225	-7	-3%
Long Distance – Long Distance	235	257	22	9%	215	193	-22	-10%
Local – Local and Other	2,434	2,407	-27	-1%	275	302	27	10%
TOTAL	3,577	3,579	2	0%	722	720	-2	0%

7.1.4 2004 VALIDATION

Future year splits between crossings are developed incrementally. 2004 crossing choice splits are developed, and the change in modelled crossing choice between 2000 and 2004 is applied to the observed choice of 2000. 2004 crossing choice was estimated with the same assumptions as used for 2000, with the exception of border crossing times. These times reflect conditions post 9/11, but prior to the July 2004 Ambassador Bridge customs booth expansion. Transport Canada[6] and the Ministry of Transportation, Ontario[7] border delay data were used to estimate the 2004 crossing times shown in Exhibit 7.7. Truck crossing time to the United States via Ambassador Bridge is now longer than via Blue Water Bridge.

Observed 2004 origin-destination data are not available, and hence validation for 2004 must use the split between crossings from counts alone. Exhibit 7.8 compares the change in crossing choice between 2000 and 2004 for the modelled a.m. and p.m. peak hours, and applies this to daily splits from the BTOA dataset. A more accurate validation would compare changes in observed peak hour travel, but this is currently unavailable for the Blue Water Bridge. Daily traffic volumes are a reasonable proxy as the daily profile for commercial vehicle traffic is fairly flat throughout the day, and there is effectively only one trip purpose. Recognising these limitations, with the assumptions described above the model correctly predicts a 4% reduction in the Ambassador Bridge commercial vehicle share compared to 2000 conditions.

[6] Using GPS-Encoded Tractor Logs to Estimate Travel Times at Borders in Southern Ontario, Transport Canada, June 2002
[7] Ministry of Transportation, Ontario Analysis of Borders Delays, March 2003-June 2004

Exhibit 7.7: Comparison of 2000 & 2004 Border Crossing Times

Crossing	Border Crossing Times (Minutes)	
	2000	2004
Ambassador Bridge – to Canada	8.8	10.8
Ambassador Bridge – to US	20.4	28.9
Detroit-Windsor Tunnel – to Canada	n/a	n/a
Detroit-Windsor Tunnel – to US	n/a	n/a
Blue Water Bridge – to Canada	6.2	11.3
Blue Water Bridge – to US	34.2	26.3

Note: 2004 times are averages of crossing times between 2002 and early 2004.

Exhibit 7.8: Validation of 2004 Commercial Vehicle Crossing Choice Model

Time Period	Proportion of Trucks using Ambassador Bridge		
	2000	2004	Change
AM Peak Hour	74%	69%	-5%
PM Peak Hour	68%	65%	-3%
Peak Hour Average	71%	67%	-4%
Daily Observed Jan-June*	69%	65%	-4%

Source: BTOA

7.2 Assignment

A traffic assignment model was run to provide estimates of travel times and delays incurred by passenger cars and commercial vehicles crossing the international border. Most of the car traffic in the Windsor area does not cross the border but this local traffic is the source of most of the congestion in the region. The assignment model must therefore capture not only international trips, but local trips as well.

Observations of travel patterns have revealed two important peak periods for passenger vehicles and an additional peak period for commercial vehicles. Private car traffic, including international trips, peaks during the morning and afternoon rush hours. Most commercial vehicle trips are cross-border and these tend to peak around noon. In order to simulate all the peak conditions, three one-hour models were run: 7 to 8 a.m., 12 to 1 p.m. and 4 to 5 p.m.

Assignment is a conventional user equilibrium, but with the trip matrices segmented by commercial vehicles, cars, and crossing choice. The logit models described above estimate the crossing share in commercial vehicle and passenger car traffic between the Detroit River and St. Clair River crossings, with the remainder of the assignment process carried out as a multi-modal multi-class procedure. This procedure allows each segment to access a specific subset of the network with commercial vehicles constrained to truck-only routes and traffic allocated to a particular crossing by the logit model. Within the sub-network permitted for each class, trip assignment is based on travel time. Each commercial vehicle is equivalent to 2.5 passenger cars in the assignment model, with a PCE of 3.0 assumed for bridge/tunnel crossing facilities.

Volume delay functions are used within the TransCAD model to define the relationships between link travel time and volume to capacity ratios, with travel times increasing as links become more congested. The widely used BPR volume-delay function developed by the Bureau of Public Roads was adopted having been used in the source networks. Link travel times are defined according to the following equation:

$$T_n = T_o \left[1 + \alpha \left(\frac{V}{C} \right)^{\beta} \right]$$

where:

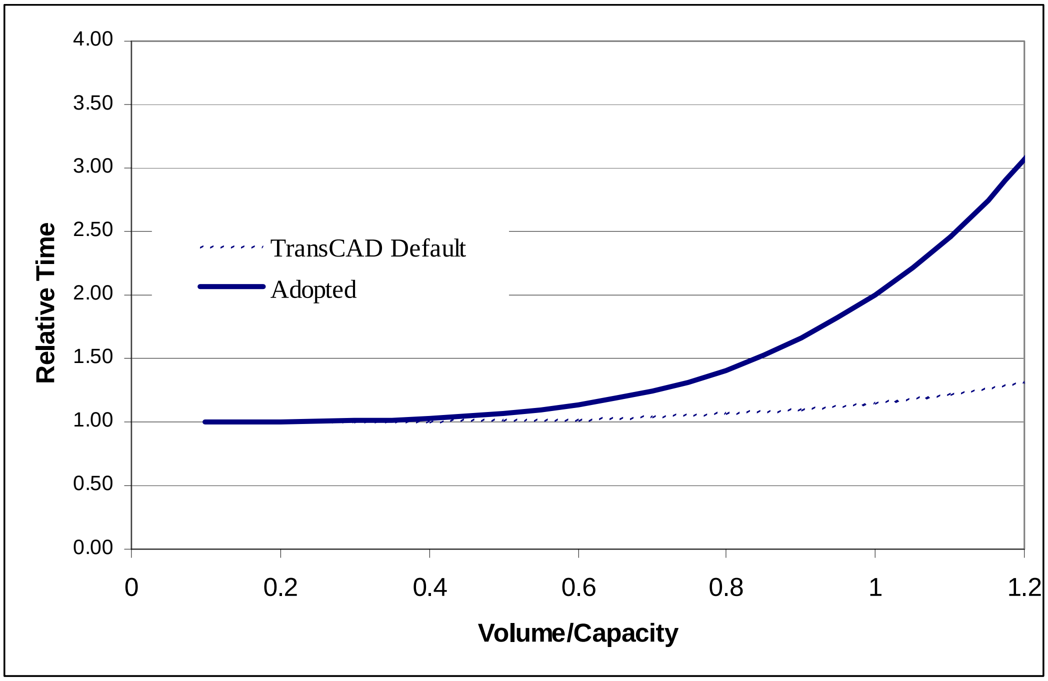
T_0 is free-flow travel time
V is volume, and
C is link capacity.
α and β are calibrated.

The parameters used in the cross-border model are as follows:

	α	β
Freeways	1	6
Non-freeways	1	4
TransCAD Default	0.15	4

The β parameters are similar to the standard TransCAD parameters, but the α parameter is substantially greater. Exhibit 7.9 compares the two volume delay curves. The more aggressive parameters are thought to better replicate the congestion levels experienced in the modelled area. When volume equals capacity, link travel time is only 15% longer than free flow conditions with the default parameters, compared to double with the parameters that have been adopted.

Exhibit 7.9: Volume/Delay Relationship



8. VALIDATION OF 2004 MODEL UPDATE

8.1 Observed & Modelled Volumes at Screenlines - Canada

Screenlines are series of observation posts set up across important traffic corridors to compare total modelled traffic flows with actual flows. Based on available traffic count data, eleven screenlines were defined within the Windsor area, as shown in Exhibit 8.1, with Exhibit 8.2 presenting a comparison of 2004 observed and modelled traffic volumes at these screenlines. Commercial vehicle and car traffic has been combined such that volumes are measured in passenger car equivalent units (PCE). Each commercial vehicle is assumed to be equivalent to 2.5 passenger cars.

A comparison of observed traffic flows with flows predicted by the model reveals that the size of the error is usually less than 15% for the afternoon peak hour and within 20% during the morning peak hour. The p.m. peak hour model performs better than the a.m. peak hour model because travel survey data for local trips in the Windsor area were available for the afternoon rush hour while travel demand during the morning peak hour was derived by factoring and transposing available p.m. origin-destination survey data for Windsor. The mid-day peak hour period was estimated based upon a factored combination of the a.m. and p.m. peak hours, reflecting directionality of travel (to/from home) and estimated trip purpose breakdown for this time period (based on City of London relationships).

The areas of primary interest are Screenlines 7 and 8 that cross Huron Church Road, the main arterial connecting Highway 401 to the Ambassador Bridge. These screenlines report total errors of 10% or less during the p.m. peak hour. The error on screenline 8 is somewhat larger during the a.m. period, which was modelled using less precise travel data. The peak directions for both the morning and afternoon were well represented by the model. The forecast southbound flows across Screenlines 7 and 8 are 9% and 6% below observations, respectively, during the p.m. peak hour. During the a.m. peak hour, the forecast northbound flows were 10% below observations at both screenlines. The screenline reporting the largest error is screenline 1 but it lies well to the west of Huron Church Road and measures traffic flowing east-west while the majority of international traffic travels across Windsor along the north-south axis. The mid-day period generates a larger total error although Screenlines 7 and 8 perform quite well with errors less than 10% at most locations.

The performance of the model can also be evaluated based on the fit between observed flows and modelled flows measured in passenger car equivalent (PCE) units at forty observation points in the Windsor area. In fitting a best-fit line to these data points, the goodness-of-fit should be high for a line should with slope of one (i.e. 45 degrees). This is shown in Exhibit 8.3. During the p.m. peak hour, for which survey-based travel demand data were available, the line has a R^2 of 0.89 and the slope of the linear function is 0.88. The a.m. and mid-day hours perform less well due to the absence of survey data for these hours. During the a.m. peak, the model has a R^2 of 0.78 and a slope of 0.70. During the mid-day peak, the R^2 falls to 0.73 but the slope increases to 0.75. Overall, the modelled results provide a reasonable fit against observed traffic count data at screenlines.

Exhibit 8.1: Windsor-Essex Screenlines

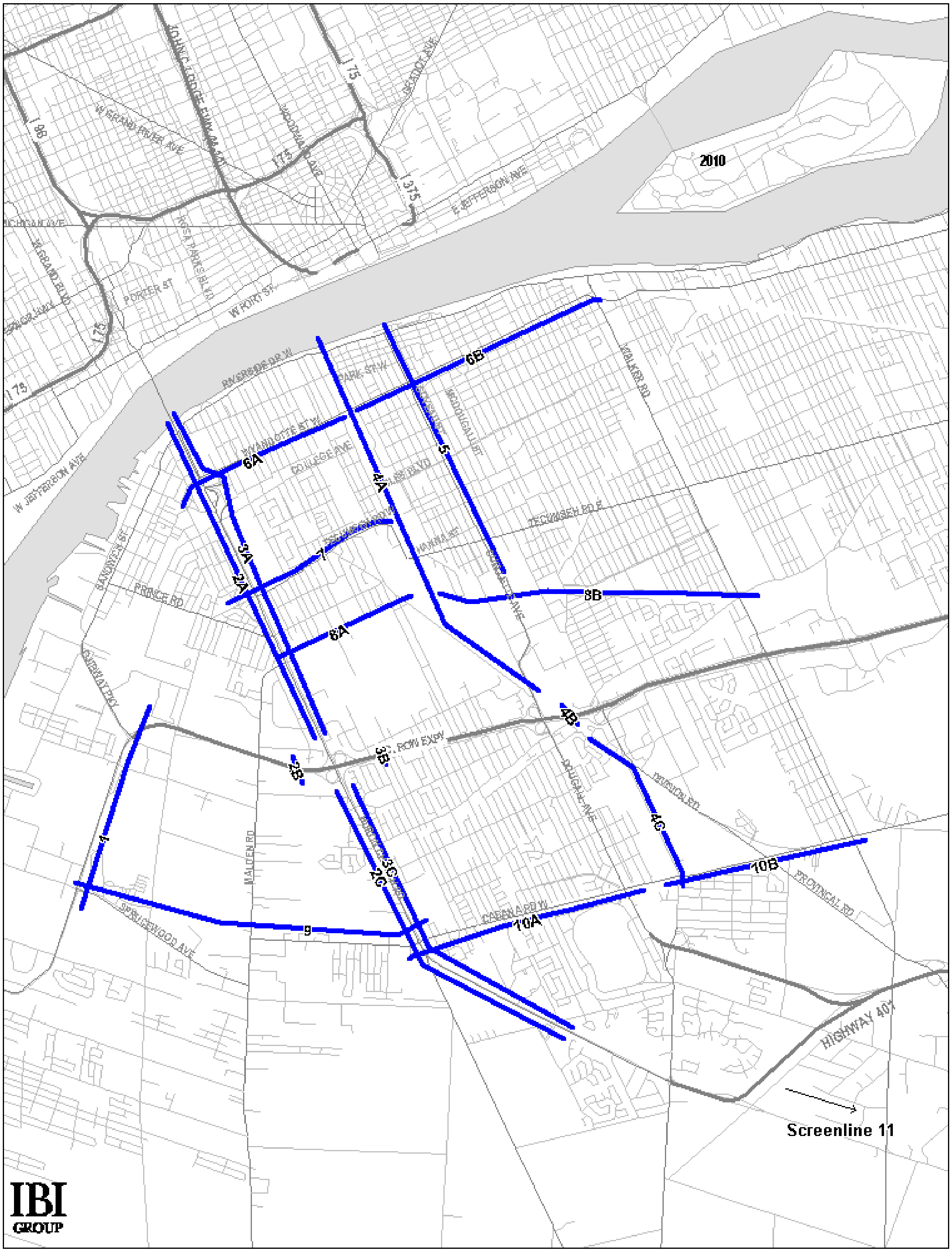


Exhibit 8.2: 2004 Screenline Validation

A. PM Peak Period (Windsor)

Screenline	PCE Observed		PCEs Modelled		Mod/Obs	
	NB/EB	SB/WB	NB/EB	SB/WB	NB/EB	SB/WB
1-East of Ojibway (Sprucewood-ECR)	742	1,313	1,476	1,353	1.99	1.03
2A West of Huron Church Road (Wyandotte-Industrial)	2,344	2,636	1,873	2,371	0.80	0.90
2B West of Huron Church Road (ECR)	976	1,653	1,735	1,653	1.78	1.00
2C West of Huron Church Road (Bethlehem-Cousineau)	1,099	1,323	938	979	0.85	0.74
TOTAL	4,419	5,612	4,545	5,003	1.03	0.89
3A East of Huron Church Road (Wyandotte-Northwood)	2,757	3,119	1,948	2,458	0.71	0.79
3B East of Huron Church Road (ECR)	2,212	2,320	2,536	2,428	1.15	1.05
3C West of Huron Church Road (Labelle-Cousineau)	1,207	1,309	783	526	0.65	0.40
TOTAL	6,175	6,748	5,267	5,412	0.85	0.80
4A CASO Railway (Riverside-Ouellette)	4,471	5,554	4,024	4,355	0.90	0.78
4B CASO Railway (ECR)	3,191	3,309	3,257	3,631	1.02	1.10
4C CASO Railway (Howard-Cabana)	1,034	1,284	898	1,299	0.87	1.01
TOTAL	8,695	10,147	8,179	9,284	0.94	0.91
5 East of Ouellette (Wyandotte-Giles)	4,151	3,975	3,925	3,688	0.95	0.93
6A South of Wyandotte (Mill-Crawford)	2,000	1,860	2,011	1,929	1.01	1.04
6B South of Wyandotte (Janette-Walker)	3,008	3,126	2,563	2,965	0.85	0.95
TOTAL	5,008	4,986	4,575	4,894	0.91	0.98
7 North of Tecumseh (Prince-Crawford)	2,350	3,511	2,347	3,208	1.00	0.91
8A South of Totten (South Cameron-HCR)	2,166	3,356	2,546	3,145	1.18	0.94
8B SL&H Railway (Dougall-Walker)	4,464	5,546	4,892	5,215	1.10	0.94
TOTAL	6,630	8,902	7,438	8,360	1.12	0.94
9 North of Todd Lane (Ojibway-HCR)	2,876	4,454	3,134	4,011	1.09	0.90
10A South of Cabana (HCR-Dougall Parkway)	2,353	3,138	2,587	3,257	1.10	1.04
10B South of Cabana (Howard-Walker)	2,282	2,835	2,024	2,553	0.89	0.90
TOTAL	4,635	5,974	4,611	5,811	0.99	0.97
11 East of Manning	3,181	2,426	3,368	2,155	1.06	0.89
ALL SCREENLINES	48,862	58,048	48,866	53,180	1.00	0.92

Exhibit 8.2 (Cont.): 2004 Screenline Validation

B. AM Peak Period (Windsor)

Screenline	PCE Observed		PCEs Modelled		Mod/Obs	
	NB/EB	SB/WB	NB/EB	SB/WB	NB/EB	SB/WB
1-East of Ojibway (Sprucewood-ECR)	1,143	689	1,124	1,233	0.98	1.79
2A West of Huron Church Road (Wyandotte-Industrial)	1,705	1,659	1,818	1,336	1.07	0.81
2B West of Huron Church Road (ECR)	1,387	698	1,394	1,346	1.01	1.93
2C West of Huron Church Road (Bethlehem-Cousineau)	1,000	590	783	665	0.78	1.13
TOTAL	4,091	2,946	3,995	3,347	0.98	1.14
3A East of Huron Church Road (Wyandotte-Northwood)	1,968	1,716	1,725	1,312	0.88	0.76
3B East of Huron Church Road (ECR)	2,225	1,375	2,012	2,173	0.90	1.58
3C West of Huron Church Road (Labelle-Cousineau)	595	887	301	645	0.51	0.73
TOTAL	4,788	3,978	4,038	4,130	0.84	1.04
4A CASO Railway (Riverside-Ouellette)	4,989	3,852	3,661	2,431	0.73	0.63
4B CASO Railway (ECR)	2,849	1,945	3,235	2,870	1.14	1.48
4C CASO Railway (Howard-Cabana)	1,211	605	1,124	494	0.93	0.82
TOTAL	9,049	6,402	8,020	5,794	0.89	0.91
5 East of Ouellette (Wyandotte-Giles)	2,391	3,792	2,675	2,546	1.12	0.67
6A South of Wyandotte (Mill-Crawford)	852	986	1,493	1,334	1.75	1.35
6B South of Wyandotte (Janette-Walker)	2,226	1,692	2,239	1,800	1.01	1.06
TOTAL	3,078	2,677	3,731	3,134	1.21	1.17
7 North of Tecumseh (Prince-Crawford)	3,156	1,562	2,838	1,742	0.90	1.11
8A South of Totten (South Cameron-HCR)	3,109	1,827	2,794	2,001	0.90	1.10
8B SL&H Railway (Dougall-Walker)	5,402	2,701	4,302	3,680	0.80	1.36
TOTAL	8,511	4,528	7,095	5,682	0.83	1.25
9 North of Todd Lane (Ojibway-HCR)	3,951	2,071	3,484	2,375	0.88	1.15
10A South of Cabana (HCR-Dougall Parkway)	2,894	1,615	2,380	1,921	0.82	1.19
10B South of Cabana (Howard-Walker)	2,766	1,383	2,109	1,603	0.76	1.16
TOTAL	5,660	2,998	4,489	3,524	0.79	1.18
11 East of Manning	1,624	2,846	1,609	2,567	0.99	0.90
ALL SCREENLINES	47,442	34,489	43,097	36,074	0.91	1.05

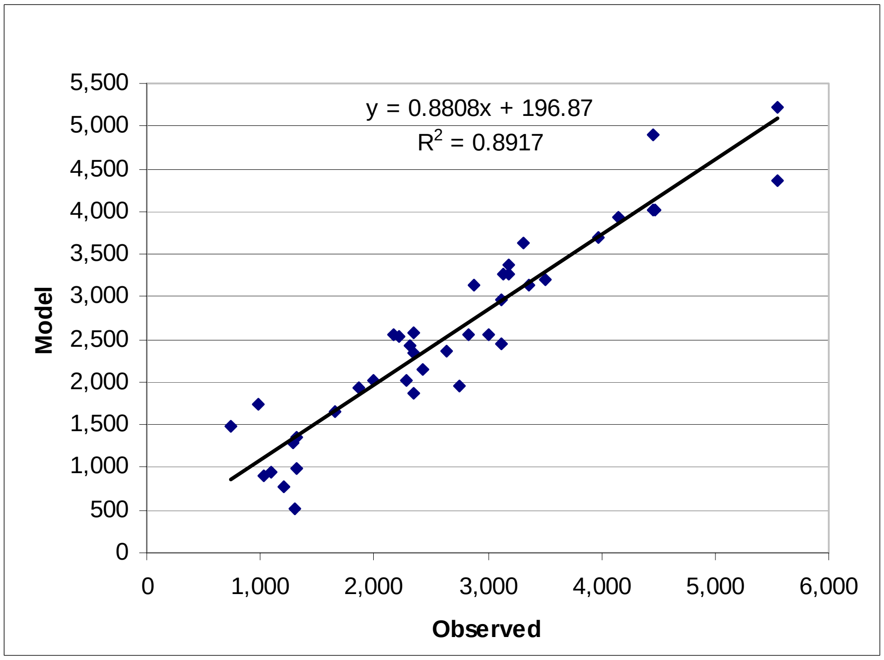
Exhibit 8.2 (Cont.): 2004 Screenline Validation

C. Midday Peak Period (Windsor)

Screenline	PCE Observed		PCEs Modelled		Mod/Obs	
	NB/EB	SB/WB	NB/EB	SB/WB	NB/EB	SB/WB
1-East of Ojibway (Sprucewood-ECR)	623	626	992	990	1.593	1.583
2A West of Huron Church Road (Wyandotte-Industrial)	1,983	2,132	1,389	1,274	0.700	0.598
2B West of Huron Church Road (ECR)	605	610	1,152	1071	1.904	1.758
2C West of Huron Church Road (Bethlehem-Cousineau)	959	944	632	570	0.660	0.605
TOTAL	3,547	3,685	3,174	2,916	0.895	0.791
3A East of Huron Church Road (Wyandotte-Northwood)	2,216	2,521	1,586	1,228	0.716	0.487
3B East of Huron Church Road (ECR)	1,497	1,126	1,749	1,732	1.168	1.538
3C West of Huron Church Road (Labelle-Cousineau)	871	1,030	389	398	0.447	0.386
TOTAL	4,584	4,676	3,725	3,358	0.813	0.718
4A CASO Railway (Riverside-Ouellette)	3,361	3,361	3,252	2,605	0.968	0.775
4B CASO Railway (ECR)	2,314	1,878	2,545	2,393	1.100	1.274
4C CASO Railway (Howard-Cabana)	757	757	774	585	1.023	0.773
TOTAL	6,432	5,995	6,572	5,583	1.022	0.931
5 East of Ouellette (Wyandotte-Giles)	3,088	3,300	2,702	2,560	0.875	0.776
6A South of Wyandotte (Mill-Crawford)	1,449	1,355	1,375	1,433	0.949	1.058
6B South of Wyandotte (Janette-Walker)	3,212	2,955	2,062	1,935	0.642	0.655
TOTAL	4,661	4,310	3,437	3,368	0.737	0.782
7 North of Tecumseh (Prince-Crawford)	1,450	2,385	1,750	2,257	1.207	0.946
8A South of Totten (South Cameron-HCR)	2,037	2,409	1,875	2,150	0.920	0.893
8B SL&H Railway (Dougall-Walker)	3,376	3,376	3,434	3,400	1.017	1.007
TOTAL	5,413	5,785	5,309	5,551	0.981	0.959
9 North of Todd Lane (Ojibway-HCR)	2,593	2,530	2,386	2,374	0.920	0.938
10A South of Cabana (HCR-Dougall Parkway)	2,054	2,060	1,774	2,194	0.864	1.065
10B South of Cabana (Howard-Walker)	1,729	1,729	1,748	1,520	1.011	0.879
TOTAL	3,783	3,789	3,522	3,714	0.931	0.980
11 East of Manning	1,785	1,785	2,069	1,889	1.159	1.058
ALL SCREENLINES	37,958	38,866	35,637	34,558	0.94	0.89

Exhibit 8.3: 2004 Observed & Model-Predicted Link Volumes

A. PM Peak



B. AM Peak

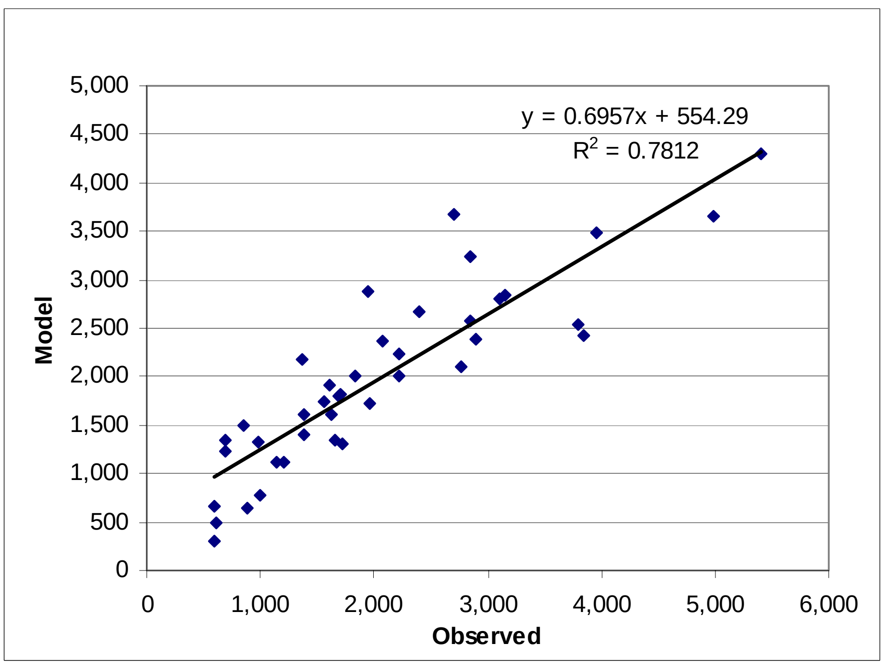
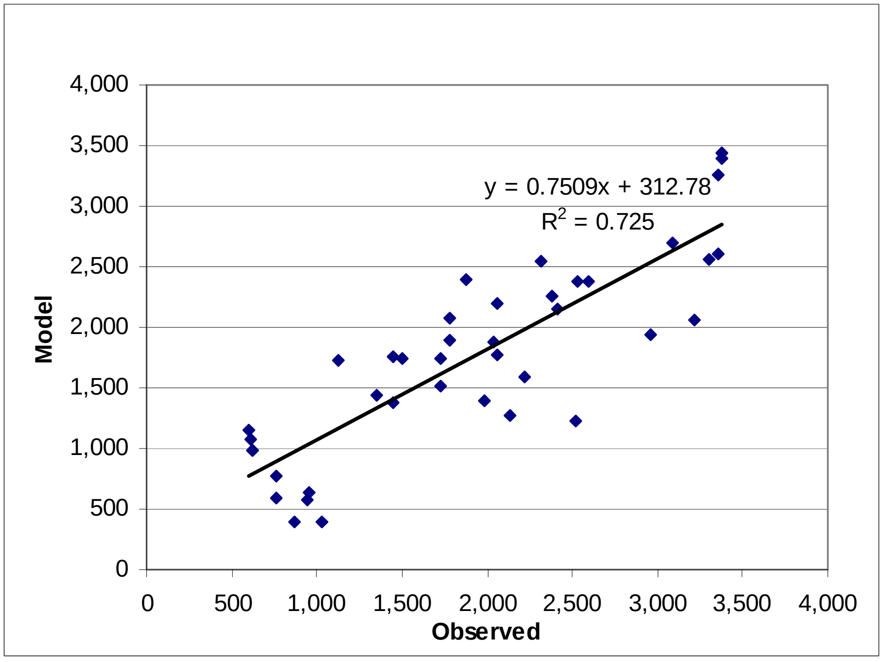


Exhibit 8.3 (Cont.): 2004 Observed & Model-Predicted Link Volumes

C. Mid-Day Peak



8.2 Canadian Network Traffic Assignments

Exhibit 8.4 shows traffic volumes along routes used by cars crossing the international border during the p.m., a.m. and mid-day peak hours. During the p.m. peak hour, traffic flows predominantly from the US into Canada as commuters who live in Windsor but work in Michigan return home. As expected, the reverse trend is observable during the morning peak hour. Most cross-border passenger car traffic is generated within the Windsor area, with only a small proportion of trips destined to or originating from other places. Most of these long-distance trips use the Ambassador Bridge to cross the border, while local travellers primarily use the tunnel. At mid-day, there is less traffic overall and Canada-bound flows are slightly greater than the U.S.-bound flows.

Cross-border commercial vehicle volumes are displayed in Exhibit 8.5 for the p.m., a.m. and mid-day peak hours. The flow maps show the majority of commercial vehicle traffic being generated at sources outside of Windsor along Highway 401. The traffic flows predominantly from the US into Canada during the afternoon while the volumes for both directions are almost even during the a.m. peak hours, with the Canada-to-US volumes being slightly greater. Truck traffic peaks during the mid-day, with the majority of traffic entering Canada.

Exhibit 8.4: 2004 Volumes of Cross-Border Passenger Cars

A. PM Peak Hour

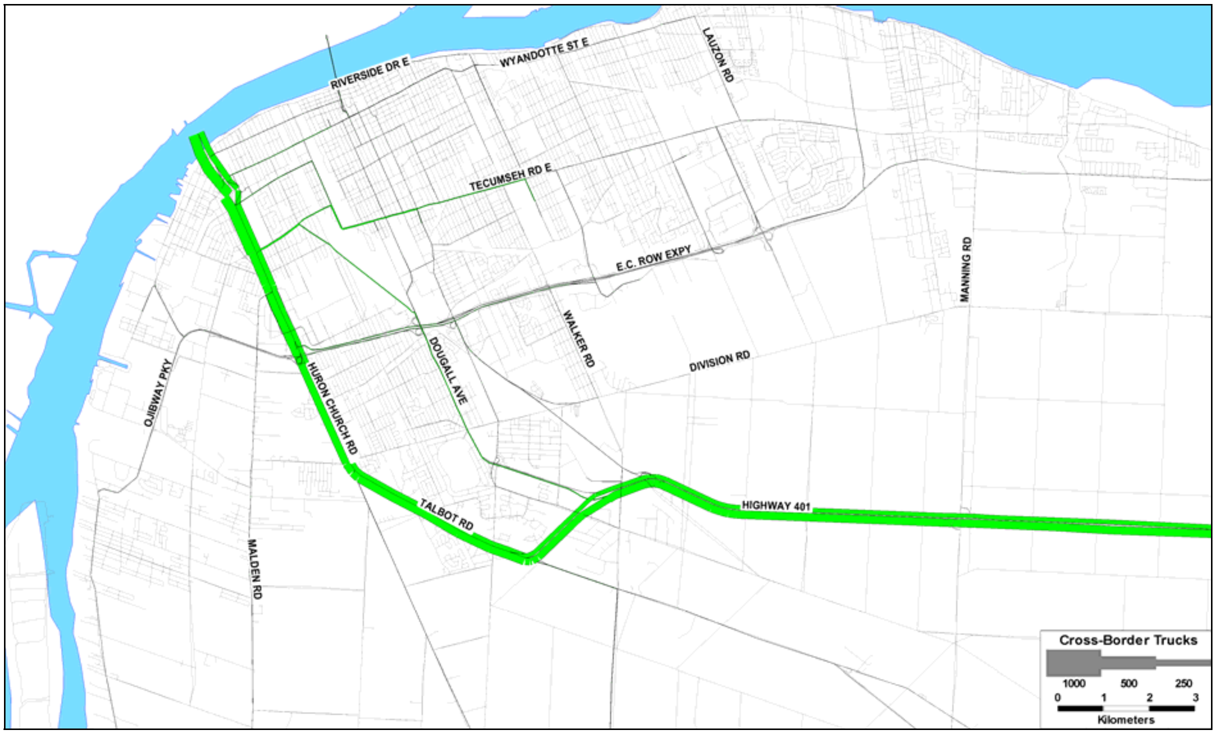
B. AM Peak Hour

Exhibit 8.4 (Cont.): Volumes of Cross-Border Passenger Cars

C. Mid-Day Peak Hour

Exhibit 8.5: 2004 Volumes of Cross-Border Commercial Vehicles

A. PM Peak Hour



B. AM Peak Hour

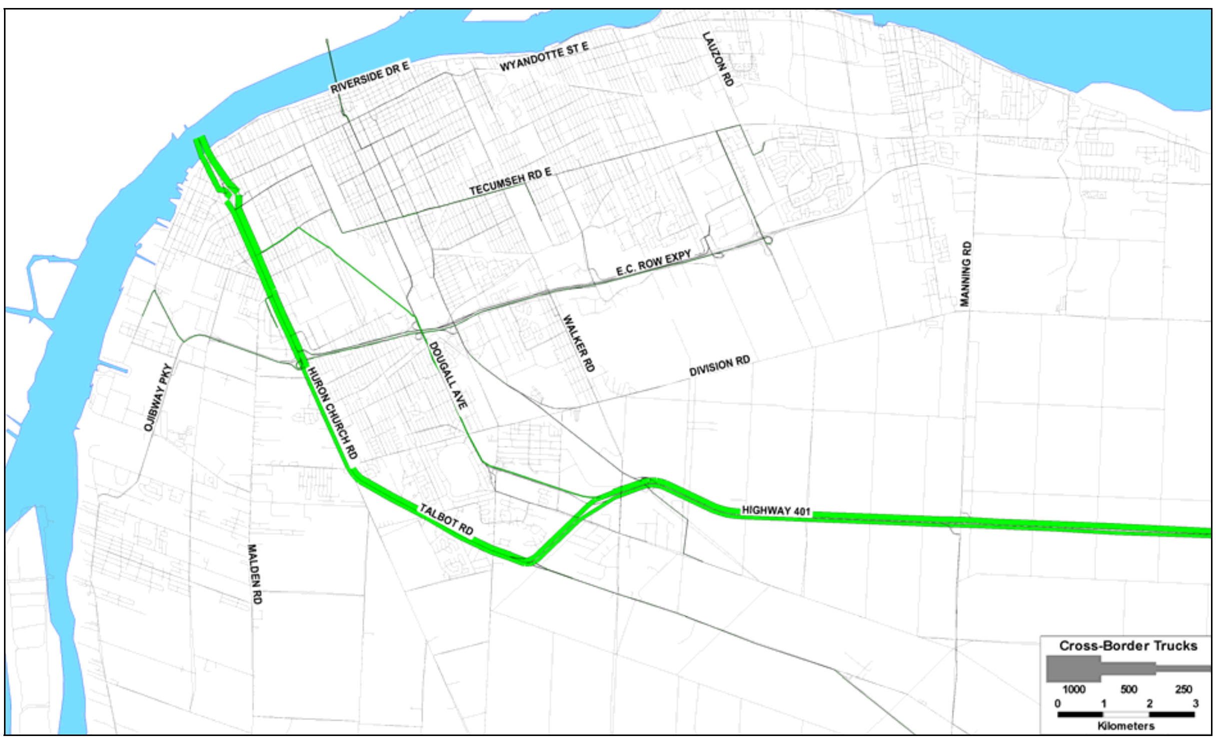


Exhibit 8.5 (Cont.): Volumes of Cross-Border Passenger Trucks

C. Mid-Day Peak Hour

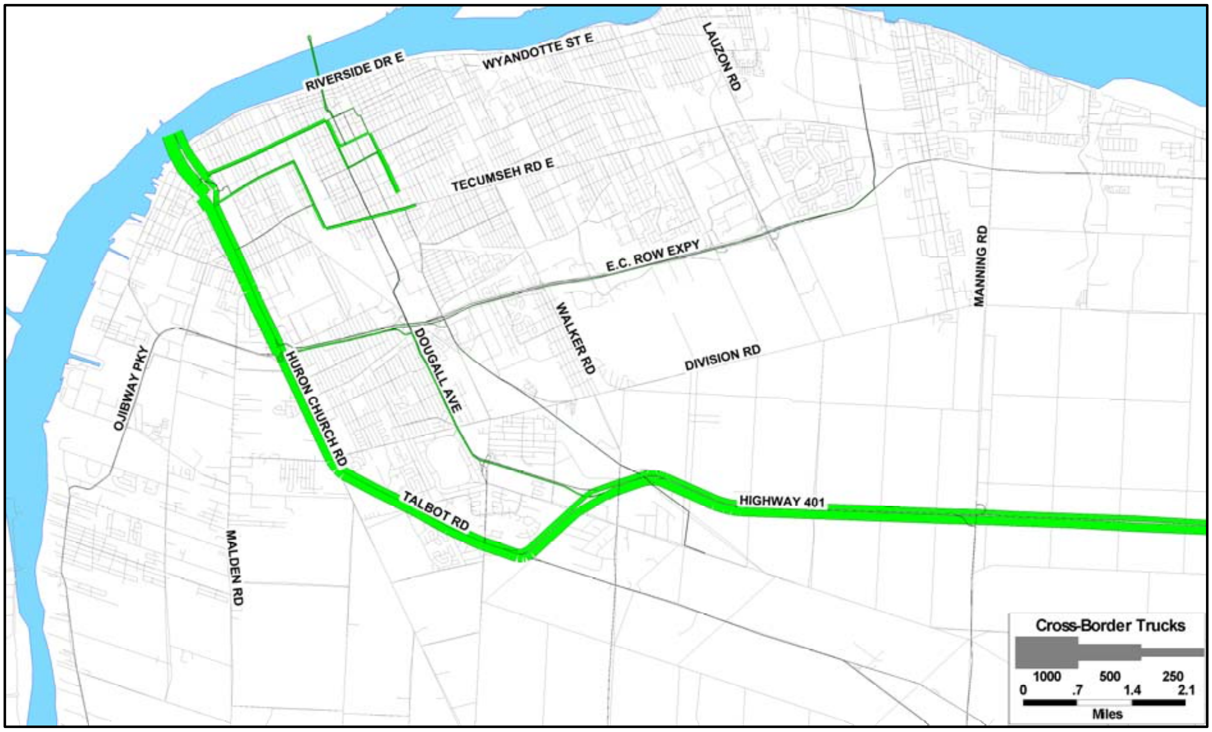


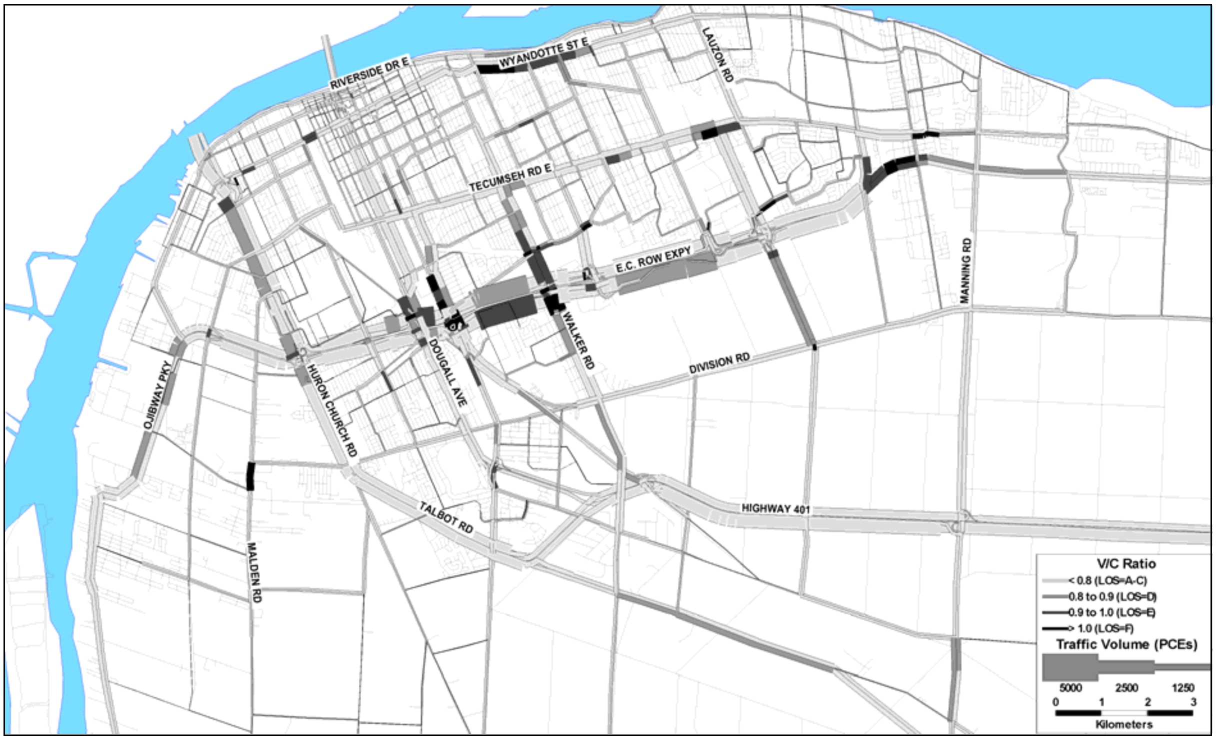
Exhibit 8.6 shows the volume-capacity ratios of major roads in the Windsor-Essex area during the afternoon, morning and mid-day peak hours. The model predicts that traffic congestion is more severe during the p.m. peak hour than during the a.m. peak hour and tends to be centred along the axis of the E.C. Row Expressway. The Ambassador Bridge corridor from Highway 401 along Huron Church Road operates mostly at volume-capacity ratios in the approximate 0.8 to 0.9 range and the streets in the vicinity of the Detroit-Windsor tunnel operate at volume-to-capacity ratios of approximately 0.8 or better. Two streets that feed into the tunnel – Dougall Avenue and Walker Road – experience serious congestion near the E.C. Row Expressway and at the intersection with Tecumseh Road.

Exhibits 8.7 illustrates p.m. peak hour traffic patterns over a broad geographic region encompassing both the Windsor-Detroit and Sarnia-Port Huron border crossings and extending eastward to the city of London for both international passenger car traffic and commercial vehicle traffic. The crossing choice model predicts car traffic splitting fairly evenly between the St. Clair River and Detroit River crossings, while commercial vehicle traffic tends to favour the Detroit River crossings. Much of the car traffic crossing the border is generated in the Sarnia-Port Huron or Windsor-Detroit area while majority of commercial vehicle traffic is long-distance, as discussed above. These results are reasonable given that a significant proportion of cross-border passenger car trips are made by commuters who live in Canada and work in the US. Commercial vehicles typical transport goods over long distances. Local freight movements are low compared to the through-traffic.

In summary, the assignment model provides a good representation of observed traffic behaviour. While the flows and travel times are not exact at all locations, the routing of vehicles and the locations of congested areas are generally correct. The model provides a good foundation for forecasting and analysing the impacts of new/expanded crossing alternatives.

Exhibit 8.6: 2004 Volume-to-Capacity Ratios

A. PM Peak Hour



B. AM Peak Hour

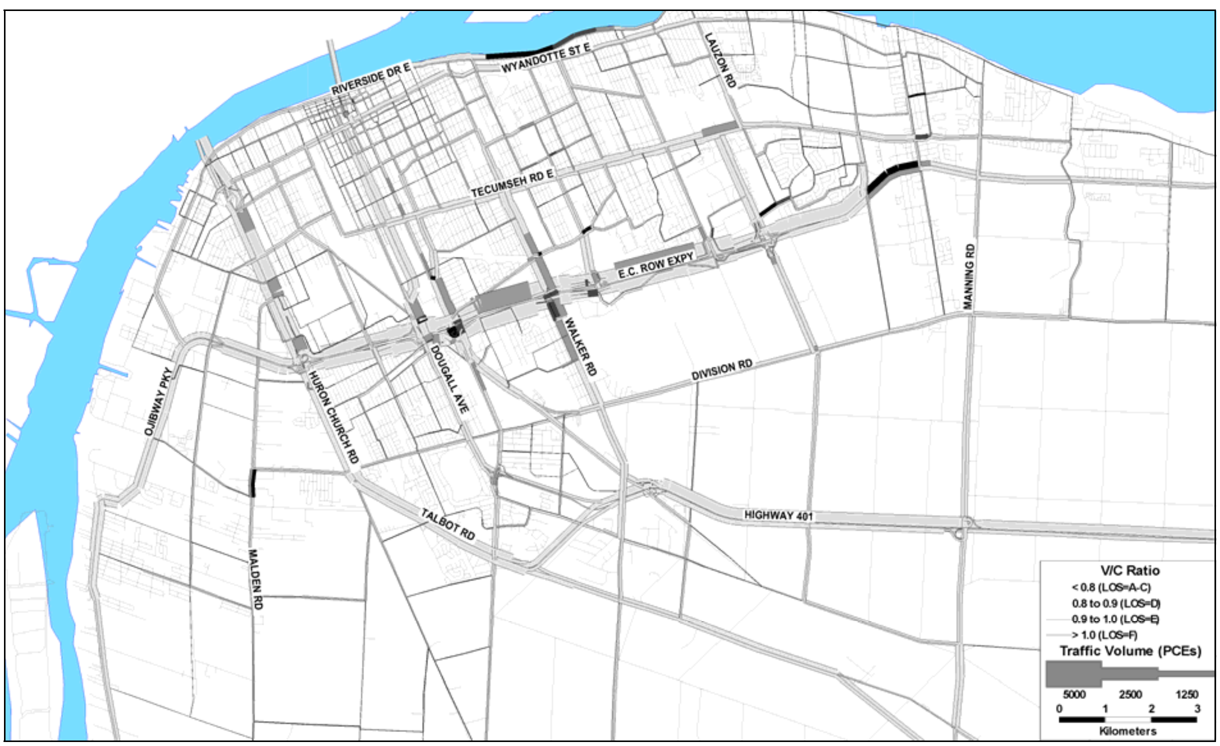


Exhibit 8.6 (Cont.): 2004 Volume-to-Capacity Ratios

C. Mid-Day Peak Hour

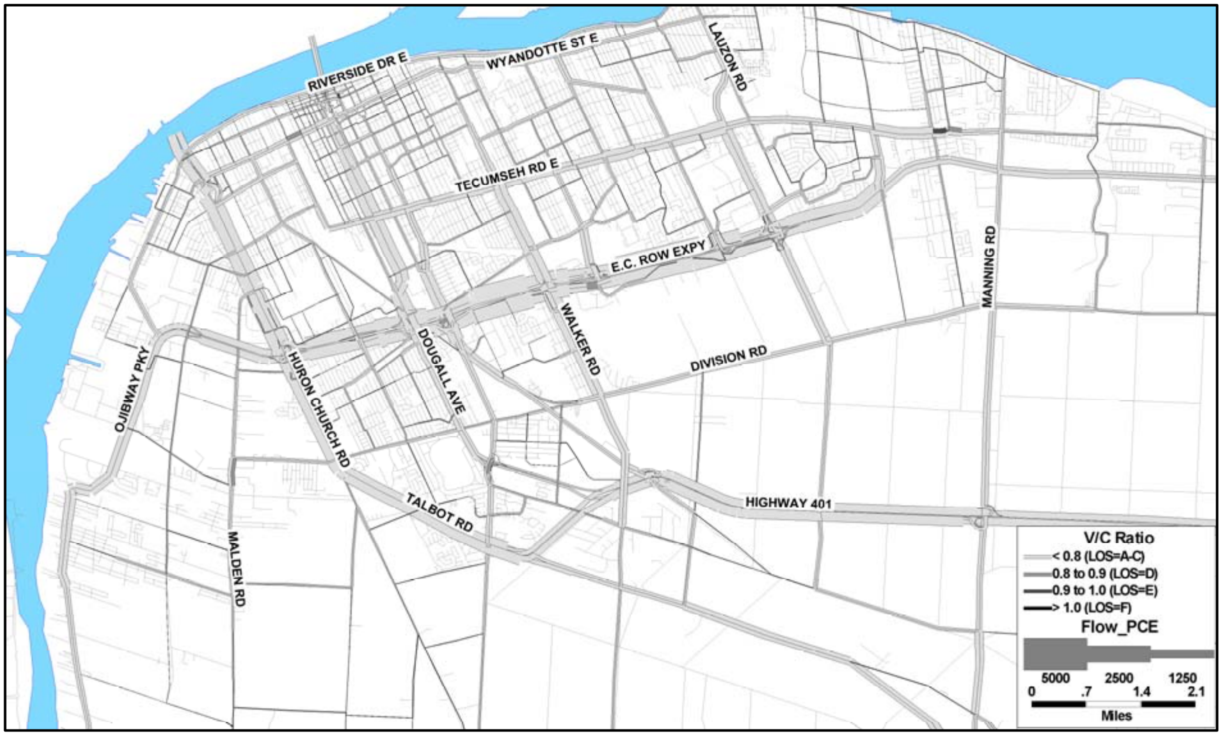
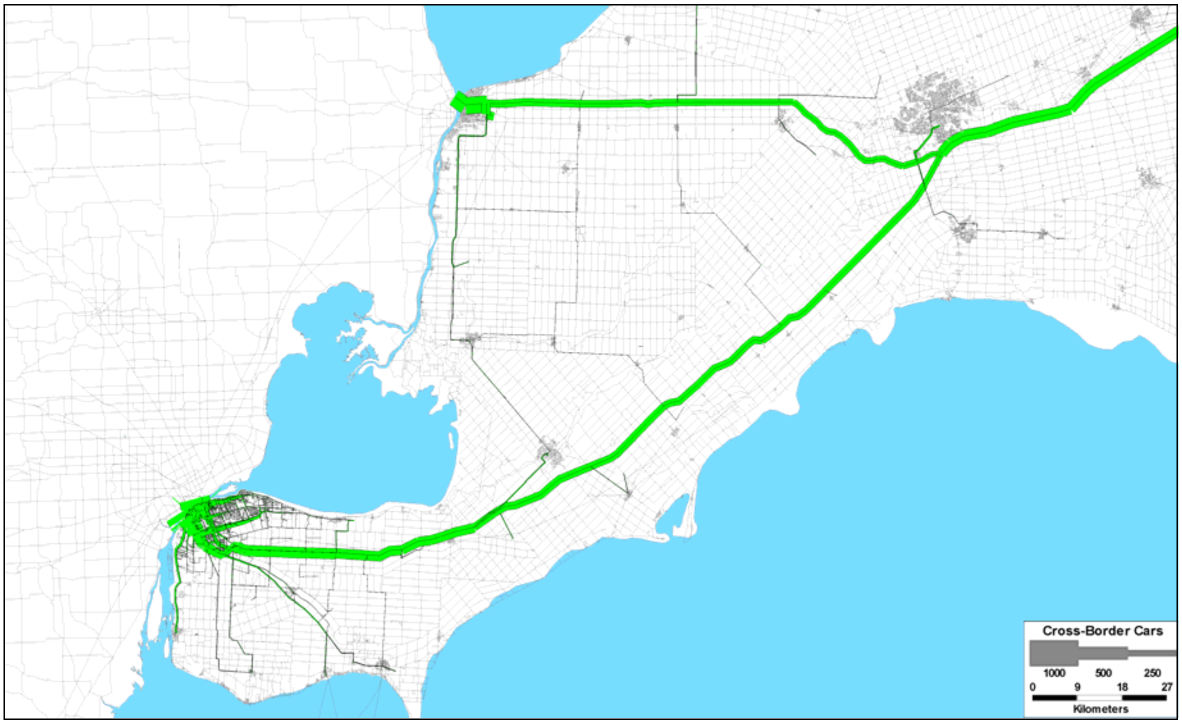
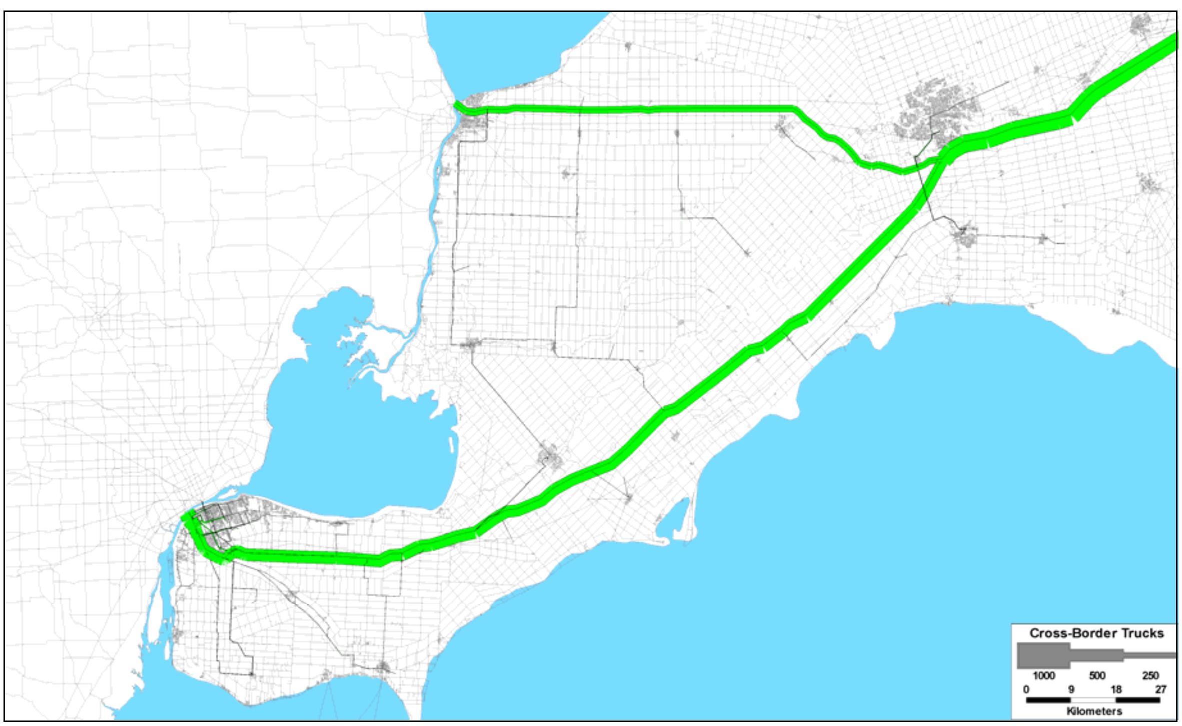


Exhibit 8.7: 2004 PM Peak Hour Cross-Border Traffic Volumes on Broad Canadian Road Network

A. Passenger Car Traffic



B. Commercial Vehicle Traffic



8.3 US Network Traffic Assignments

The Corradino Group of Michigan performed the validation of the US portion of the DRIC travel demand model. The validation was performed in a three-step process. First, the international trips, including both passenger cars and trucks, were validated based on observed data at the crossings. Second, the model was validated inside the Southeast Michigan Council of Governments (SEMCOG) area, based on count station data. Third, long-distance truck volumes were compared to data from Ontario's Commercial Vehicle Survey (CVS) and National (Canadian) Roadside Study.

8.3.1 VALIDATION OF INTERNATIONAL TRIPS

International trips were validated by comparing the model assigned volumes to traffic counts. Exhibit 8.8 illustrates the directional crossings by cars and trucks during the a.m., midday, and p.m. peak hours (labelled as Observed in Exhibit 8.8) as collected by IBI Group. The model produces good results for the a.m., p.m. and midday peak hours (labelled as Model in Exhibit 8.8) after applying a time penalty on the use of the Detroit-Windsor Tunnel. For example, cars using both the Tunnel and the Ambassador Bridge in both directions in the three time periods are within five percent of the observed numbers. A time penalty is applied to capture the restrictions of using the Tunnel by trucks and congestion in downtown Detroit not otherwise recognised by the model. The time penalties on the Detroit-Windsor Tunnel are shown in Exhibit 8.9.

Exhibit 8.8: 2004 Peak Hour Vehicle Trip Patterns at Detroit River Crossings

Time Period	Vehicle Type	Tunnel		AMB	
		US-Canada	Canada-US	US-Canada	Canada-US
AM Peak-Hour	Cars (Observed)	196	846	205	1,136
	Cars (Model)	198	813	200	1,152
	Difference	*1.00%*	*4.00%*	*2.40%*	*1.40%*
	Trucks (Observed)	15	19	210	265
	Trucks (Model)	5	5	228	228
	Difference	*66.70%*	*73.70%*	*8.60%*	*14.00%*
Midday	Cars (Observed)	410	316	434	353
	Cars (Model)	401	314	422	344
	Difference	2.20%	0.60%	2.80%	2.50%
	Trucks (Observed)	33	18	402	273
	Trucks (Model)	39	13	387	248
	Difference	*18.20%*	*27.80%*	*3.70%*	*9.20%*
PM Peak-Hour	Cars (Observed)	931	309	1,176	402
	Cars (Model)	902	301	1,171	380
	Difference	3.10%	2.60%	0.40%	5.50%
	Trucks (Observed)	14	5	390	237
	Trucks (Model)	24	4	372	203
	Difference	*71.40%*	*20.00%*	*4.60%*	*14.30%*

Source: The Corradino Group of Michigan, Inc.

Exhibit 8.9: Time Penalties Applied on Detroit-Windsor Tunnel (Minutes)

Time Period	Vehicle Type	US-Canada	Canada-US
AM Peak-Hour	Cars	2.25	2.50
	Trucks	5.25	5.50
Midday Peak Hour	Cars	2.75	2.00
	Trucks	4.50	8.00
PM Peak-Hour	Cars	3.50	2.50
	Trucks	5.50	7.50

Source: The Corradino Group of Michigan, Inc.

The next step in the process of validating international trips was to analyse the route used on the US-side to travel to and from the Ambassador Bridge. A license plate, origin-destination survey was conducted in November 2004 by the Detroit International Bridge Company. License plates were recorded at key points of ingress to and egress from the Bridge for three (one-hour) peak periods of traffic (A.M., midday, and P.M.) on each of the three days. Survey data indicate there are more passenger cars traveling from Canada to the US (egress from the Bridge) during the morning peak hour, while more passenger cars travel from the US to Canada (ingress to the Bridge) in the afternoon peak hour. The distribution of trucks in the morning peak hour is nearly balanced. However, like passenger cars, there are more trucks travelling from the US to Canada in the afternoon. It is worth mentioning that the percentage ingress/egress distribution to routes for the bridge by cars and trucks is well balanced. For example, most trucks (60 percent) are taking northbound I-75 as an ingress route, while most of them (56 percent) take southbound I-75 as an egress route, and the distribution on I-96 is balanced (25 percent).

Initial model runs for 2004 showed significant differences between model results and counts on the bridge ramps. There are many potential reasons why initial model results and ramp counts do not agree, but the most probable reason is that complex freeway system provides several possible paths to and from the bridge and the shortest time path may not be consistent with route marking and signs directing traffic to the bridge. Thus, adjustments were made to the model to produce better agreement with ramp counts.

In order to make the distribution of passenger cars and trucks match observed data, it was necessary to place time penalties on the on-ramps and off-ramps serving the Ambassador Bridge (see Exhibit 8.10). Penalties were added at three locations (illustrated in Exhibit 8.11):

1. The northbound I-75 off-ramp to the Ambassador Bridge;

2. The southbound I-75 off-ramp to the Ambassador Bridge; and

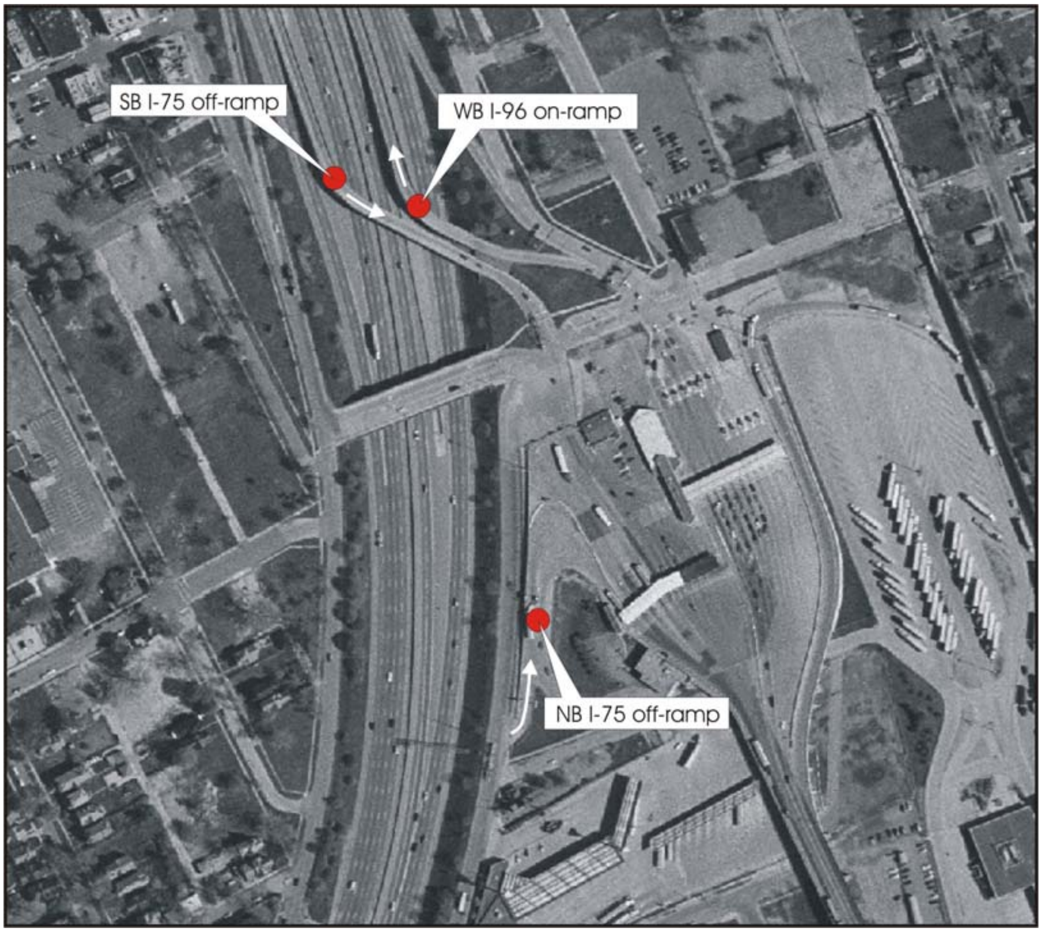
3. The on-ramp to westbound I-96 from the Ambassador Bridge.

Exhibit 8.10: Time Penalties Applied on Ambassador Bridge Ramps (Minutes)

Time Period	Vehicle Type	NB I–75 Off-Ramp	SB I-75 Off-Ramp	WB I-96 On-Ramp
AM Peak-Hour	Cars	2.75	0.25	0.85
	Trucks	0.00	0.50	0.25
Midday	Cars	2.75	1.00	0.90
	Trucks	0.00	1.00	0.35
PM Peak-Hour	Cars	3.00	1.50	0.90
	Trucks	0.00	1.00	0.10

Source: The Corradino Group of Michigan, Inc.

Exhibit 8.11: Location of Ramps Serving the Ambassador Bridge with Time Penalties for Passenger Cars and Trucks



Source: The Corradino Group of Michigan, Inc.

Exhibit 8.12 displays observed and modelled volumes at Ambassador bridge ramps. Modelled volumes are shown for both results with and without turn penalties applied. Modelled values with turn penalties generally match observed values well, particularly for the largest freeway movements of each time period. When judging the accuracy of a model, it is important to recognise the inherent limitations in reliability of the observed data to which model results are compared. One might expect a relatively large difference between the observed data, collected for a single day, and data collected over a period of several days or more (which are not available, but would provide more representative information). Thus, a larger percentage error is acceptable when comparing to data collected for just one day.

Exhibit 8.12: 2004 Peak Hour Ambassador Bridge Vehicle Distribution

A. AM Peak Hour

	Observed		Modelled Without Turn Penalties On Ramps		Moddelled With Turn Penalties on Ramps	
Cars Ingress (U.S. to Canada)	AM	Percent	AM	Percent	AM	Percent
I-96*	113	52.6%	67	30.2%	113	56.5%
NB I-75	36	16.7%	96	43.2%	37	18.5%
SB I-75	55	25.6%	57	25.7%	49	24.5%
Local**	11	5.1%	2	0.9%	1	0.5%
Total	215	100.0%	222	100.0%	200	100.0%
Cars Egress (Canada to U.S.)	AM	Percent	AM	Percent	AM	Percent
I-96	401	49.5%	824	68.4%	568	49.3%
NB I-75	236	29.1%	163	13.5%	300	26.1%
SB I-75	96	11.8%	177	14.7%	181	15.7%
Local	78	9.6%	40	3.3%	103	8.9%
Total	811	100.0%	1204	100.0%	1,152	100.0%
Truck Ingress (U.S. to Canada)	AM	Percent	AM	Percent	AM	Percent
I-96*	36	19.2%	64	27.9%	63	27.6%
NB I-75	107	56.9%	104	45.4%	106	46.5%
SB I-75	31	16.5%	46	20.1%	44	19.3%
Local**	14	7.4%	15	6.6%	15	6.6%
Total	188	100.0%	229	100.0%	228	100.0%
Truck Egress (Canada to U.S.)	AM	Percent	AM	Percent	AM	Percent
I-96	53	28.0%	89	39.2%	77	33.8%
NB I-75	25	13.2%	20	8.8%	24	10.5%
SB I-75	105	55.6%	118	52.0%	125	54.8%
Local	6	3.2%	0	0.0%	2	0.9%
Total	189	100.0%	227	100.0%	228	100.0%

* Ingress vehicles from I-96 includes traffic from southbound local streets, because vehicles from southbound local streets must travel through I-96 before getting on the Bridge.
** Local vehicles include only those from the northbound direction using NB I-75 service drive.

Source: The Corradino Group of Michigan, Inc.

Exhibit 8.12 (Cont.): 2004 Peak Hour Ambassador Bridge Vehicle Distribution

B. Mid-Day Peak Hour

	Observed		Modelled Without Turn Penalties On Ramps		Moddelled With Turn Penalties on Ramps	
Cars Ingress (U.S. to Canada)	MidDay	Percent	MidDay	Percent	MidDay	Percent
I-96*	255	55.4%	162	32.7%	238	56.4%
NB I-75	99	21.5%	205	41.4%	112	26.5%
SB I-75	85	18.5%	121	24.4%	70	16.6%
Local**	21	4.6%	7	1.4%	2	0.5%
Total	460	100.0%	495	100.0%	422	100.0%
Cars Egress (Canada to U.S.)	MidDay	Percent	MidDay	Percent	MidDay	Percent
I-96	128	46.4%	260	67.5%	180	52.3%
NB I-75	72	26.1%	44	11.4%	76	22.1%
SB I-75	50	18.1%	80	20.8%	82	23.9%
Local	26	9.4%	1	0.3%	6	1.7%
Total	276	100.0%	385	100.0%	344	100.0%
Truck Ingress (U.S. to Canada)	MidDay	Percent	MidDay	Percent	MidDay	Percent
I-96*	114	30.9%	148	36.5%	147	38.0%
NB I-75	207	57.2%	181	44.6%	206	53.2%
SB I-75	32	8.8%	77	19.0%	34	8.8%
Local**	11	3.1%	0	0.0%	0	0.0%
Total	362	100.0%	406	100.0%	387	100.0%
Truck Egress (Canada to U.S.)	MidDay	Percent	MidDay	Percent	MidDay	Percent
I-96	61	29.8%	128	50.8%	94	37.9%
NB I-75	36	17.5%	17	6.7%	47	19.0%
SB I-75	96	46.8%	107	42.5%	107	43.1%
Local	12	5.9%	0	0.0%	0	0.0%
Total	205	100.0%	252	100.0%	248	100.0%

* Ingress vehicles from I-96 includes traffic from southbound local streets, because vehicles from southbound local streets must travel through I-96 before getting on the Bridge.
** Local vehicles include only those from the northbound direction using NB I-75 service drive.
Source: The Corradino Group of Michigan, Inc.

Exhibit 8.12 (Cont.): 2004 Peak Hour Ambassador Bridge Vehicle Distribution

C. PM Peak Hour

	Observed		Modelled Without Turn Penalties On Ramps		Moddelled With Turn Penalties on Ramps	
Cars Ingress (U.S. to Canada)	PM	Percent	PM	Percent	PM	Percent
I-96*	613	56.3%	281	21.4%	577	49.3%
NB I-75	118	10.8%	469	35.7%	206	17.6%
SB I-75	292	26.8%	530	40.4%	378	32.3%
Local**	66	6.1%	33	2.5%	10	0.8%
Total	1,089	100.0%	1,313	100.0%	1,171	100.0%
Cars Egress (Canada to U.S.)	PM	Percent	PM	Percent	PM	Percent
I-96	143	48.1%	287	67.2%	196	51.6%
NB I-75	70	23.6%	37	8.7%	59	15.5%
SB I-75	59	19.9%	89	20.8%	93	24.5%
Local	25	8.4%	14	3.3%	32	8.4%
Total	297	100.0%	427	100.0%	380	100.0%
Truck Ingress (U.S. to Canada)	PM	Percent	PM	Percent	PM	Percent
I-96*	89	21.7%	67	17.6%	60	16.1%
NB I-75	260	64.4%	246	64.6%	261	70.2%
SB I-75	33	8.2%	62	16.3%	42	11.3%
Local**	23	5.7%	6	1.6%	9	2.4%
Total	404	100.0%	381	100.0%	372	10000.0%
Truck Egress (Canada to U.S.)	PM	Percent	PM	Percent	PM	Percent
I-96	50	23.7%	58	28.6%	55	27.1%
NB I-75	24	11.4%	18	8.9%	20	9.8%
SB I-75	120	56.9%	109	53.7%	110	54.2%
Local	17	8.0%	18	8.9%	18	8.9%
Total	211	100.0%	203	100.0%	203	100.0%

* Ingress vehicles from I-96 includes traffic from southbound local streets, because vehicles from southbound local streets must travel through I-96 before getting on the Bridge.
** Local vehicles include only those from the northbound direction using NB I-75 service drive.
Source: The Corradino Group of Michigan, Inc.

Exhibit 8.12 (Cont.): 2004 Peak Hour Ambassador Bridge Vehicle Distribution

D. Peak Hour Totals

	Observed		Modelled Without Turn Penalties On Ramps		Moddelled With Turn Penalties on Ramps	
Cars Ingress (U.S. to Canada)	Total	Percent	Total	Percent	Total	Percent
I-96*	981	55.6%	510	25.1%	928	51.8%
NB I-75	253	14.3%	770	37.9%	355	19.8%
SB I-75	432	24.5%	708	34.9%	497	27.7%
Local**	98	5.6%	42	2.1%	13	0.7%
Total	1,764	100.0%	2,030	100.0%	1,793	100.0%
Cars Egress (Canada to U.S.)	Total	Percent	Total	Percent	Total	Percent
I-96	672	48.6%	1,371	68.0%	944	50.3%
NB I-75	378	27.3%	244	12.1%	435	23.2%
SB I-75	205	14.8%	346	17.2%	356	19.0%
Local	129	9.3%	55	2.7%	141	7.5%
Total	1,384	100.0%	2,016	100.0%	1,876	100.0%
Truck Ingress (U.S. to Canada)	Total	Percent	Total	Percent	Total	Percent
I-96*	236	24.7%	279	27.5%	270	27.4%
NB I-75	574	60.2%	531	52.3%	573	58.0%
SB I-75	96	10.1%	185	18.2%	120	12.2%
Local**	48	5.0%	21	2.1%	24	2.4%
Total	954	100.0%	1,016	100.0%	987	100.0%
Truck Egress (Canada to U.S.)	Total	Percent	Total	Percent	Total	Percent
I-96	164	27.1%	275	41.0%	226	33.9%
NB I-75	85	14.0%	44	6.6%	78	11.7%
SB I-75	321	53.1%	334	49.8%	342	51.4%
Local	35	5.8%	18	2.7%	20	3.0%
Total	605	100.0%	671	100.0%	666	100.0%

* Ingress vehicles from I-96 includes traffic from southbound local streets, because vehicles from southbound local streets must travel through I-96 before getting on the Bridge.
** Local vehicles include only those from the northbound direction using NB I-75 service drive.
Source: The Corradino Group of Michigan, Inc.

8.3.2 SEMCOG AREA TRAFFIC VOLUMES

It is standard practice to validate the highway assignment process by comparing modelled traffic flow volumes with actual traffic counts on key links in the network. There are several other comparisons that are commonly performed, including comparisons of modelled and observed vehicle-miles of travel (VMT). DRIC background traffic on the US-side (the SEMCOG area) is based on trip tables coming from the “E3” version of the SEMCOG Model.

SEMCOG indicates in its original TransCAD model report that its model version “E1” was validated to the VMT produced by the earlier TRANPLAN model rather than observed counts due to a lack of reliable data at that time. In 2002, using the traffic counts from different sources including the Highway Performance Monitoring System (HPMS) database, SEMCOG revalidated its 2000 base year travel model version “E3”. SEMCOG’s assessment of the “E3” model, based on freeway counts, indicates that the model is overestimating freeway VMT by about 17 percent. SEMCOG’s description of this comparison is as follows:

“The majority of “HPMS database” counts are from arterial/regional streets SEMCOG compiled and submitted to MDOT as a base for the State HPMS estimation. Some freeway counts were also included in this data set. This data set is called the ‘HPMS set.’ Please note that the VMT derived from this data set does not necessarily reflect the State official HPMS estimation.”

Yet, for the sum of all links, the base year 2000 model is estimating the correct amount of traffic, and is within 2.9 percent of an official HPMS estimate of VMT. The year 2002 model is within 1.1% of the official 2002 HPMS VMT. It is important to note that SEMCOG has a program of improving the TransCAD model, and is making improvements to the model and validation process. The new validation results will be released along with SEMCOG travel model Version “E4” in late fall of 2005.

In the model developed for the DRIC Study, validation using available traffic count data was conducted by comparing observed VMT at count stations with modelled results. There are two traffic count sources: 1) the Michigan Intelligent Transportation Systems Center (MITSC) Freeway counts; and, 2) SEMCOG Surface Street counts. The MITSC freeway data are hourly traffic counts conducted at 86 locations by time-of-day, while SEMCOG data are daily counts. Estimates of VMT are based on freeway count data from MITSC because they represent the largest part of the traffic in the region that will influence international travel. VMT was estimated from the MITSC data by multiplying the model link length in miles by the MITSC count.

While it is acknowledged that it is preferable to validate the DRIC assignments using screenlines or count summaries tabulated by facility type, sufficient count data are not available for this level of analysis. A primary reason for the lack of more reliable counts is the disruption of the Detroit freeway system in recent years due to construction. MITSC data are the best available and were used to develop adjustment factors for the DRIC model. Exhibit 8.13 displays the observed data and the model results.

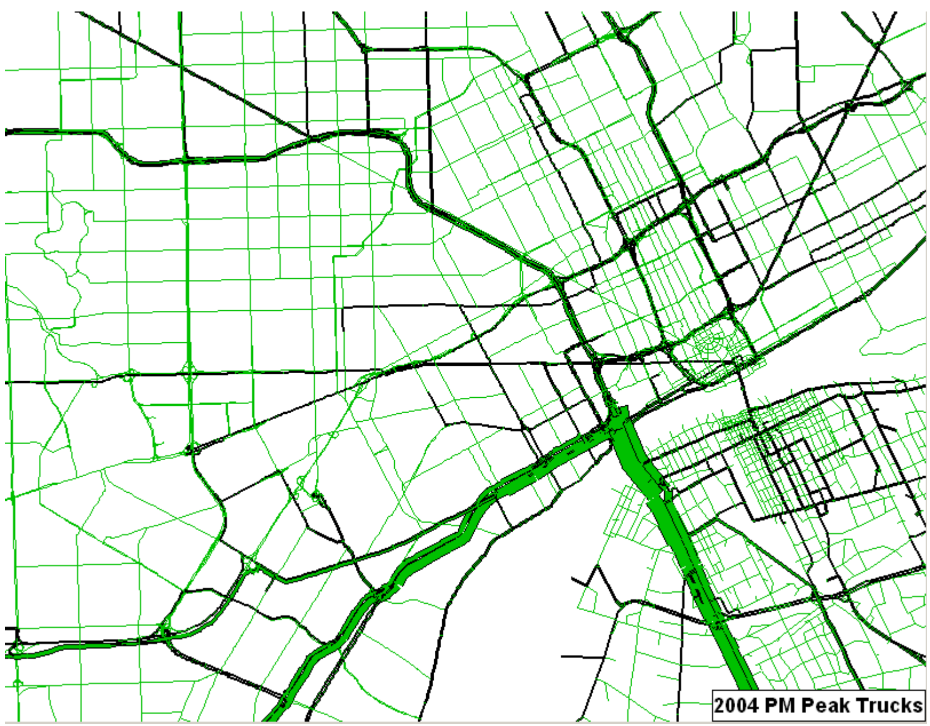
Exhibit 8.13: 2004 Observed & Model-Predicted Freeway VMT

Time Period	Observed VMT at Count Station	Modeled VMT	Ratio	Revised Modeled VMT	Revised Ratio
AM Peak Hour	112,383	129,457	0.87	122,025	0.92
Midday Hour	89,064	125,984	0.71	95,900	0.95
PM Peak Hour	124,909	141,828	0.88	132,159	0.95

Source: The Corradino Group of Michigan, Inc.

Exhibit 8.13 indicates that modeled results for the US were consistently higher than the observed VMT at the count stations. As a result, the SEMCOG trip tables were factored “down” by 10 percent for the AM peak-hour, 30 percent for the midday, and 10 percent for the PM peak-hour. As noted earlier, SEMCOG’s latest validation suggests that the model is overestimating freeway VMT by about 17.1 percent. As shown by the revised VMTs and ratios, the DRIC model is slightly overestimating freeway VMT, even after adjustment. However, because of SEMCOG’s finding that the model is closely matching overall HPMS VMT, it was thought to be unwise to decrease the trip tables further. A visual check of the model was performed to ensure that an unreasonable percentage of long distance truck trips was not assigned to the local street system. Based on this examination and the indication supported by Exhibit 8.12 that the model is slightly overestimating freeway VMT, it was concluded that the model was correctly assigning long distance truck traffic to freeways (Exhibit 8.14).

Exhibit 8.14: 2004 PM Peak-Hour Modelled International Truck Volume Bandwidth Plot



Source: The Corradino Group of Michigan, Inc.

It is important to note the international traffic volumes are not directly impacted by the SEMCOG Model volumes because international traffic is estimated by a process outside the SEMCOG Model. However, congestion on roadways in the Detroit region from domestic travel influences the paths chosen by international travellers. For example, overall congestion influences whether a traveller chooses to use the Detroit-Windsor Tunnel or the Ambassador Bridge.

8.3.3 COMMERCIAL VEHICLES

As part of the validation process, truck assignment results were compared to commercial vehicle traffic data from Ontario's Commercial Vehicle Survey (CVS) and National (Canadian) Roadside Study. Daily truck volumes for 2002 were obtained by examining summaries of the CVS results provided by MTO. Daily volumes are seven-day averages and thus would be expected to be somewhat lower than weekday volumes used in the DRIC Study. Traffic counts performed by the Detroit International Bridge Company were also considered as a potential source of validation data for commercial vehicle volume. However, these traffic volumes were based on single-day counts for each station. Counts of longer duration would generally be considered more reliable. The CVS provides a reliable and stable source of information, with data compiled from 1999 through 2001 and factored to 2002 counts. Thus, a comparison of model results to the CVS was performed as an additional check of model.

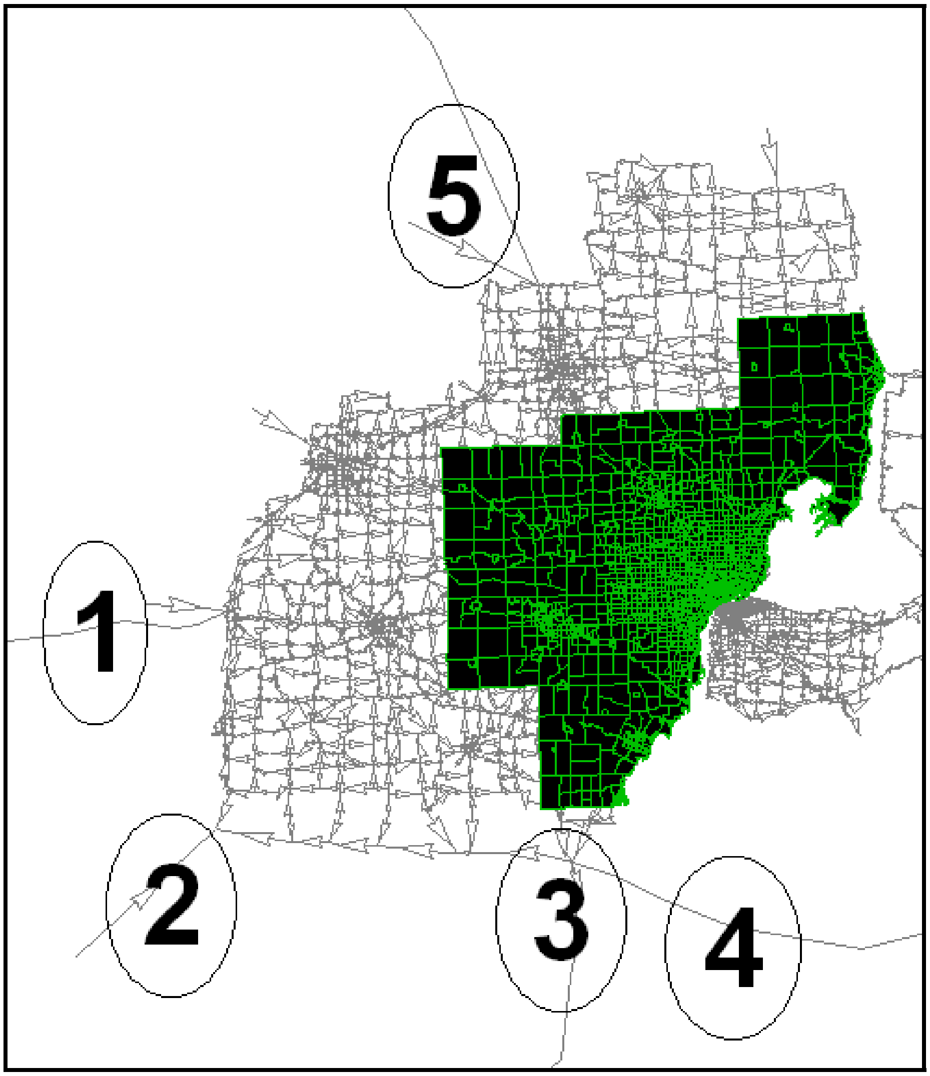
It is important to note that the international truck trip table developed and used in this study is based upon the CVS data. Thus, one would expect that the international truck trip table would show travel patterns similar to the CVS, although some differences would be expected because of different base years and factoring to specific peak hours.

Comparison of DRIC model results inside the SEMCOG region with the CVS data was considered, but was not performed because vehicle routings shown in the CVS data appeared unreasonable. A notable example of this is that all trucks between the Ambassador Bridge and I-94 in the area of the Detroit Metro Wayne County Airport travel across the Southfield Highway. While the disruption to the Detroit area freeways in recent years may have increased the use of the Southfield highway, this routing representation is believed to remain inaccurate. The unrealistic route choices would not provide an appropriate validation target. Thus, detailed comparisons of the DRIC model results to the CVS inside the SEMCOG region were not made.

DRIC model results were compared to CVS data in Southeastern Michigan, outside the SEMCOG region. Comparisons were made at five locations (Exhibit 8.15) on the periphery of the SEMCOG region:

- I-94 on the western edge of the region;
- I-69 at the southwestern edge of the region (2);
- I-75 at the southern edge of the region;
- I-80/90 at the southeastern edge of the region; and
- I-75 at the northern edge of the region.

Exhibit 8.15: CVS Comparison Locations



Source: The Corradino Group of Michigan, Inc.

The DRIC model estimates traffic for three peak hours: AM, midday, and PM. Based on the survey data from which the trip table data were derived, expansion factors were developed, by direction (U.S. to Canada, Canada to U.S.), to expand the model volumes to four time periods comprising an entire weekday (AM – 3 hours, midday – 6 hours, PM – 4 hours, and night – 11 hours). These data are shown in Exhibit 8.16.

Exhibit 8.16: 2004 Modelled Commercial Vehicle Traffic

Location	AM		MD		PM		Night	
	Vehicles	%	Vehicles	%	Vehicles	%	Vehicles	%
I-94	546	42.0%	1,326	40.8%	984	40.0%	1,793	40.6%
I-69	121	9.3%	322	9.9%	271	11.0%	440	10.0%
I-75S	426	32.8%	1,044	32.1%	901	36.7%	1,422	32.2%
I-80/90E	34	2.6%	178	5.5%	151	6.1%	237	5.4%
I-75N	172	13.3%	380	11.7%	150	6.1%	519	11.8%
TOTAL	1,299	100.0%	3,250	100.0%	2,457	100.0%	4,410	100.0%

Source: The Corradino Group of Michigan, Inc.

The DRIC Model reasonably replicates data from the CVS. Exhibit 8.17 demonstrates that the percentage distribution of daily international trucks as reported in the CVS and the DRIC Model are very similar. Here again, this was expected because the DRIC international truck trip tables were derived from the CVS. This analysis confirms that the derivation was correct.

For the p.m. peak hour, on which much of the evaluation of alternatives will be based, the model results are very similar to CVS data at the two highest volume locations (40% for the model and 42.1% for the CVS at I-94, and 36.7% for the model and 37.0% for the CVS at the I-75 south). Modelled international truck distribution is similar to the CVS for each time period as well as for the entire 24-hour period. Again, this indicates that the international trip table agrees with the CVS.

Exhibit 8.17: Daily Commercial Vehicle Traffic Comparison

Location	2004 DRIC Model		2002 CVS	
	Vehicles	%	Vehicles	%
I-94	4,648	40.7%	3,045	42.1%
I-69	1,153	10.1%	562	7.8%
I-75S	3,793	33.2%	2,679	37.0%
I-80/90E	600	5.3%	569	7.9%
I-75N	1,223	10.7%	378	5.2%
TOTAL	11,416	100.0%	7,233	100.0%

Source: The Corradino Group of Michigan, Inc.

The year 2002 total at the five stations is 7,233 daily (average of seven days, including Saturday and Sunday), while the 2004 model total, representing an average weekday, is 11,416. The differences in basis days (average day versus average weekday) and years (2002 versus 2004) are believed to account for this difference. The updated DRIC trip table estimates that the number of long distance trips between Canadian locations outside of Windsor and U.S. locations outside SEMCOG, plus trips from the Windsor area to U.S. locations outside SEMCOG, total about 12,350 truck trips per day, as compared to the 11,436 value reported by the model. This is thought to be a good level of agreement. Differences are due to slight variance in the definitions of the area. The larger number (12,350) is for the number of international truck trips ending outside

SEMCOG, which is the solid dark area in Exhibit 8.15, while the smaller number is the number of international truck trips ending outside the Southeast Michigan area, as indicated by the five circled numbers. The sum of international truck trips at the five stations is smaller than the sum at the SEMCOG boundary because some international truck trips will have found their destinations between the SEMCOG boundary and the five stations.

8.3.4 NEXT STEPS

In preparation for the analysis of Practical Alternatives, several additional model validation checks and refinements will be implemented by the Corradino Group of Michigan. They will include:

1. Comparisons of the Ambassador Bridge and Tunnel selected link volumes to survey data. The Ambassador Bridge ramp volumes, without time penalties, will be discussed to further substantiate the use of ramp penalties. This will be done as follows:

    - 1999 National Roadside Survey (NRS) data showing the trips ends in separate trip tables for the Ambassador Bridge and the Detroit Windsor Tunnel will be obtained;
    - Selected link assignments will be made for the bridge and tunnel;
    - Trip ends from the model selected link assignments will be compared to the NRS data; and
    - Any major differences will be explained, and the model will be adjusted, if necessary, to account for survey travel patterns.

2. A link-by-link comparison of model volumes on freeways, MITSC counts, and data from MDOT's 2004 daily counts for Trunklines and Sufficiency files will be prepared. Additional validation statistics will be developed from these comparisons.

3. Special model runs will be made that "preload" international trucks. These will be done for the existing, no-action, and other selected alternatives. These runs will point out the most attractive international truck crossing system, if no congestion were in evidence and/or all truckers had no familiarity with the travel system. In that modeling process international trucks would be assigned first by the all-or-nothing method.

4. After the alternatives are narrowed to a set of practical alternatives, the model's traffic analysis zone system and network will be refined or subdivided in the project area to provide more detail if the necessary detail is absent from the existing model.

9. SUMMARY

Changes in travel behaviour and trip patterns across the Southeast Michigan/ Southwestern Ontario border have occurred during the past five years. A decline in the US economy, 9/11, a SARS outbreak in Toronto, the Iraq war, a rising Canadian dollar and the opening of three casinos in Detroit and other events have all contributed to a large decline in cross-border passenger car traffic and has retarded commercial vehicle growth. None of these events were reflected in the previous 2000 base year data that provided the basis for the thirty-year passenger car and commercial vehicle forecasts prepared for the previous Bi-national Partnership P/N&F Study.

This Working Paper has outlined the update of the passenger car and commercial vehicle travel patterns and characteristics to 2004 and the update of the P/N&F Travel Demand Model for the current DRIC Study. This includes incorporating the changes in traffic levels, trip purpose, trade by commodity group, origin-destination patterns and modal share. The road network has been edited to incorporate new infrastructure as well as proposed additions to existing facilities. A crossing choice logit model has been added to better reflect the estimation of the split of flows between the Detroit River and St. Clair River crossings. The traffic assignment model has also been refined to simulate conditions during three peak hours: the a.m. peak hour (peak Canada to US flows), p.m. peak hour (peak US to Canada flows) and mid-day peak hour (peak commercial vehicle volumes). Finally, a detailed screenline validation of the assignment model has demonstrated that the model generates a reliable representation of traffic conditions along the main corridors used by international traffic in the Windsor area.

The resulting Travel Demand Model Update provides a comprehensive transportation analysis tool that is based on detailed travel origin-destination data for passenger cars and commercial vehicles, reflects local domestic background traffic in urbanised areas, with assignment to detailed representations of the road and highway network and international crossings. The model provides a current (2004) and sophisticated tool to assess and evaluate the impact of new/expanded crossings on local and international traffic and related transportation impacts.

This paper has documented updates made to the Ontario side of the international crossings. Refinements have also been made to the Michigan side. The next step is to integrate the modifications into a single model that will allow for a comprehensive analysis of cross-border Southeast Michigan/Southwestern Ontario vehicular flows.