Partnership of

Canada-United States-Ontario-Michigan
Border Transportation Partnership
Planning/Need and Feasibility Study

Existing and Future Travel Demand

Working Paper

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Prepared by IBI Group for URS Canada

Existing and Future Travel Demand Working Paper

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Preface

The Canadian, U.S., Ontario and Michigan governments are conducting a Needs and Feasibility Planning Study to provide a long-term strategy that will ensure the safe and efficient movement of people, goods and services between Southeast Michigan and Southwest Ontario. The study will assess the existing transportation network, including border crossings and will identify medium- and long-term transportation needs, alternatives and potential new crossings in the region of Southeast Michigan and Southwest Ontario.

The context under which this study was carried out, the justification for the project and the issues and opportunities to be addressed by the study is documented in the **Transportation Problems and Opportunities Report.** This Report incorporates the findings of four technical Working Papers:

- Strategic and Geographic Area Working Paper;
    - Will set the context of the study in terms of identifying jurisdictions involved and their respective legislation and policies which provide the framework for this study.
- Travel Demand Analysis Process Working Paper;
    - Determines the appropriate methodology to be used for travel demand forecasting.
- Existing and Future Travel Demand Working Paper;
    - The description, analysis and assessment of existing and future scenarios for road and rail to develop a quantitative and qualitative understanding of travel demand.
- Environmental Overview;
    - Inventory existing conditions to assist in the generation and evaluation of alternatives.

The Transportation Problems and Opportunities Report provided the basis for the identification, development and assessment of transportation alternatives.

1. Introduction

Canada and the United States are the largest bilateral trading partners in the world, and enjoy a high level of personal travel across their border. Much of this travel and trade are concentrated at a small number of Canada-US border crossings, especially the three road based crossings within the Southeast Michigan/Southwest Ontario corridor:

- Ambassador Bridge connecting Windsor and Detroit;
- Detroit-Windsor Tunnel connecting the downtown areas of Windsor and Detroit; and
- Blue-Water Bridge connecting Sarnia and Port Huron.

***Ranking** in total vehicle and passenger car traffic volume among all CAN-US border crossings, 2000*

Ambassador Br. ***1st***
D-W Tunnel ***2nd***
Blue Water Br. ***5th***

***Ranking** in commercial vehicle traffic volume among all CAN-US border crossings, 2000*

Ambassador Br. ***1st***
Blue Water Br. ***2nd***
D-W Tunnel ***13th***

The Ambassador Bridge and the Detroit-Windsor Tunnel are the two highest volume border crossings between Canada and the United States. In year 2000, these crossings carried 12.3 million vehicles and 8.6 million vehicles. The Blue Water Bridge ranked fifth in terms of vehicles carried, with 5.9 million annual vehicles. The year 2000 ranking in terms of passenger car volumes is the same as for total vehicles, with the crossings carrying 8.8 million, 8.4 million and 4.4 million passenger cars, respectively, as shown in Exhibit 1.1. Combined, the three crossings represent 29% of the total two-way car-based traffic volume between the United States and Canada. By comparison, the Niagara Region, consisting of the Peace, Whirlpool and Lewiston-Queenston Bridges, represents the second highest volume border region and served less than 11.0 million passenger cars in 2000. In terms of truck volumes, the Ambassador Bridge carried 26% of the 13.6 million total truck trips between the US and Canada in 2000, the Blue Water Bridge carried 11%, and the Detroit-Windsor Tunnel, 1.3%, for a total of 38% of truck volumes. These crossings ranked first, second, and thirteenth, respectively, in terms of truck volumes.

While car and truck traffic represent the predominant modes between Southeast Michigan and Southwest Ontario, rail and marine services also provide an important role in moving goods and people across the border. Rail tunnels are located at Detroit-Windsor and Sarnia/Port Huron to provide cross-border railway services. There is also a truck ferry operating at Detroit-Windsor, and commercial and passenger car ferries at Walpole Island, Ontario/Algonac, Michigan and Marine City, Michigan/Sombra, Ontario, crossing the St. Clair River.

The truck, rail and marine modes at Southeast Michigan/Southwest Ontario crossings combine to provide the dominant trade corridor between Canada and the United States. Measured in dollar value[1], the proportion of trade between Southeast Michigan and Southwest Ontario represents 42% of the value of all Canada-US trade ($154 US billion of $365 US billion) in 2000. This includes 46% of the total value of truck freight crossing the Canada-US border in 2000 ($118 US billion of $258 US billion), and 53% of the total value of rail freight ($33 US billion of $63 US billion).

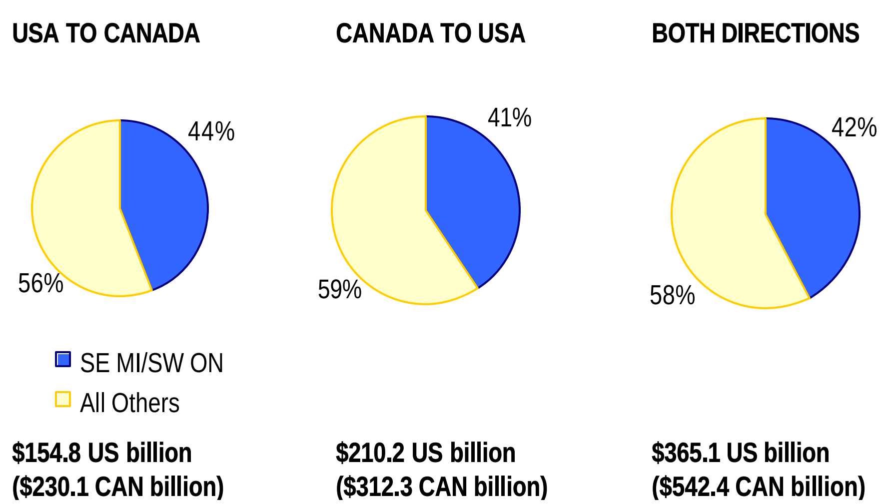
[1] US Bureau of Transportation Statistics transborder freight data; excludes in-transit trips.

EXHIBIT 1.1: HIGHEST-VOLUME CANADA-US BORDER CROSSINGS, 2000

Crossing	Province	Passenger Cars		Trucks	
		Volume (Millions)	Rank	Volume (Millions)	Rank
AMBASSADOR BRIDGE	**ONTARIO**	**8.8**	**1**	**3.49**	**1**
DETROIT-WINDSOR TUNNEL	**ONTARIO**	**8.4**	**2**	**0.18**	**13**
Peace Bridge	Ontario	6.8	3	1.45	3
Pacific Highway/Douglas	British Columbia	6.0	4	0.87	6
BLUE WATER BRIDGE	**ONTARIO**	**4.4**	**5**	**1.48**	**2**
Rainbow Bridge	Ontario	3.7	6	n/a	>20
Queenston-Lewiston Bridge	Ontario	3.5	7	1.04	4
Sault Ste. Marie	Ontario	2.4	8	0.13	17
Cornwall	Ontario	2.1	9	n/a	>20
Lacolle	Quebec	2.0	10	0.79	5
All Others		24.7		4.15	
TOTAL		**72.8**		**13.58**	
Percentage of Volume at 3 Study Crossings		**29%**		**38%**	

Source: based on Transport Canada, ***Transportation in Canada 2001 Annual Report,*** Tables 9-7 and 9-8

EXHIBIT 1.2: VALUE OF TRADE AT SOUTHEAST MICHIGAN/SOUTHWEST ONTARIO CROSSINGS, 2000



Source: BTS transborder freight database

1.1. Purpose

The purpose of this Working Paper is to describe existing and projected travel and traffic characteristics for international travel crossing between Southeast Michigan and Southwest Ontario, covering passenger car, commercial vehicle, rail and marine modes. This includes the following:

- An overview of the existing transportation system;
- A description of current travel trends, characteristics and patterns related to the movement of goods and people;
- The identification of traffic volumes and assessment of existing conditions; and
- Projections of future cross-border traffic volumes and the implications on existing transportation system.

The major focus of the report is vehicle traffic crossing the border at the three bridge and tunnel crossings between Southeast Michigan and Southwest Ontario, given the extensive crossing delays that are presently being experienced at these particular crossings.

1.2. Analysis Area

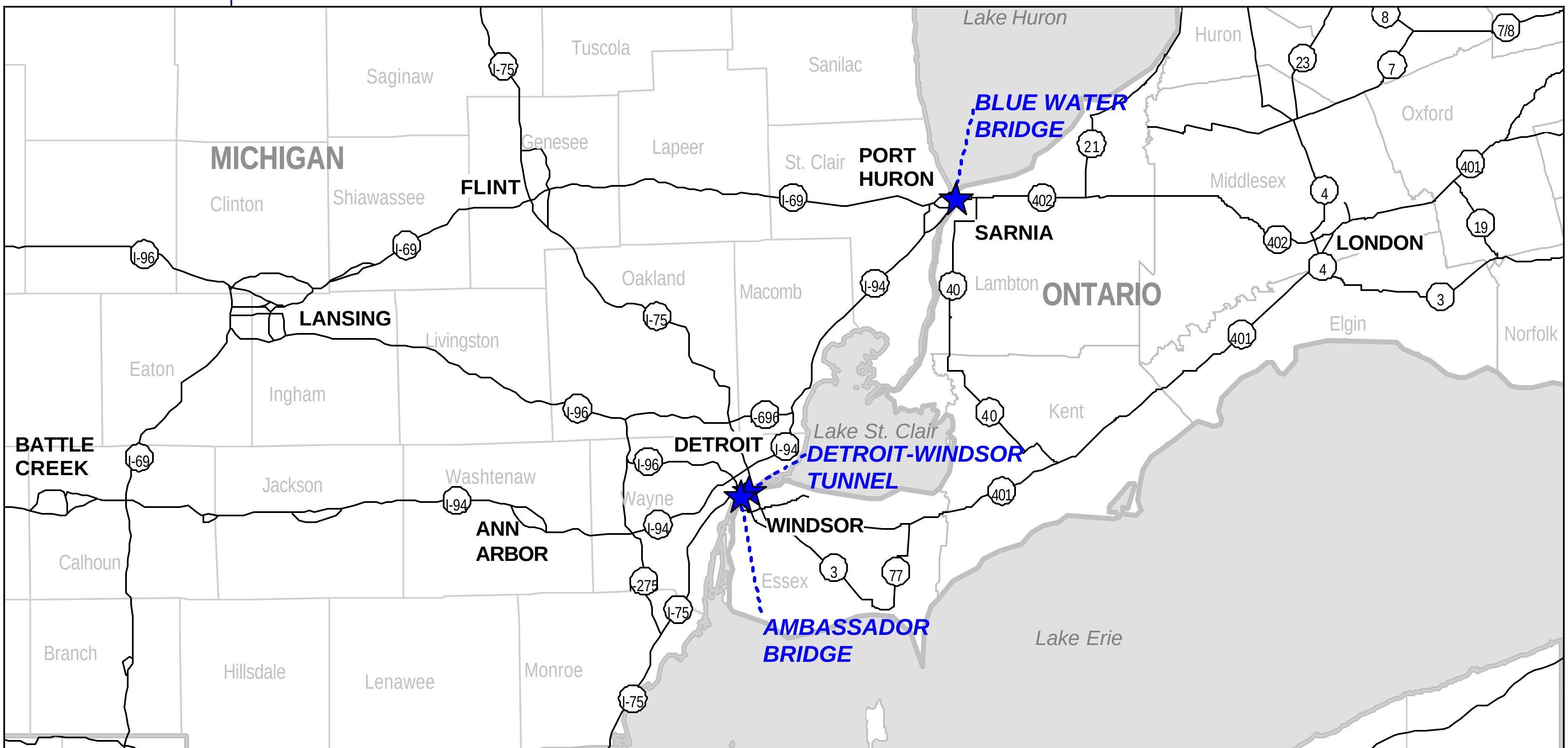
The analysis area corresponds with the study's Broad Geographic Area. The geographic coverage is shown in Exhibit 1.3. It includes Windsor-Detroit and Sarnia-Port Huron crossings and comprises Southwest Ontario and Southeast Michigan. The area is defined to be sufficiently large to capture key decision points on the road system where motorists must determine which crossing location they intend to use (i.e. Windsor/Detroit or Sarnia/Port Huron).

1.3. Report Organization

This Working Paper is organized in seven chapters. Following this introduction:

- Chapter 2 details existing travel demand and trends for each travel mode.
- Chapter 3 describes the transportation system profile.
- Chapter 4 describes macro-economic trends that have affected the use of the border crossing, and describes the future outlook for these trends.
- Chapter 5 presents cross-border travel demand forecasts for each mode.
- Chapter 6 summarizes and discusses the impacts of these future cross-border demand estimates with respect to crossing capacities and other transportation impacts.
- Finally, Chapter 7 presents a report summary and describes next steps.

EXHIBIT 1.3: BROAD GEOGRAPHIC AREA



2. Existing Travel Demand Profile and Trends

This chapter describes the existing traffic volumes, characteristics and spatial patterns for each cross-border mode between Southeast Michigan and Southwest Ontario, presented in the following order:

- Passenger Car
- Commercial Vehicle
- Local and Intercity Bus
- Passenger and Freight Rail
- Marine
- Air Passenger

For the purposes of this study, a base year of 2000 is used to describe existing conditions. This is consistent with the year of data collection for the main data sources describing current travel, most notably the **2000 Ontario-Michigan Border Crossing Traffic Study** and the **1999/2000 National Roadside Survey/MTO Commercial Vehicle Survey**, which provide very detailed and comprehensive origin-destination and travel characteristic information for passenger cars and commercial vehicles crossing between Southeast Michigan and Southwest Ontario. A 2000 base year also describes conditions before the events of September 11, 2001 (9/11), which dramatically affected cross-border traffic characteristics. Therefore, 2001 is not considered indicative of typical or normal conditions for the purposes of this study.

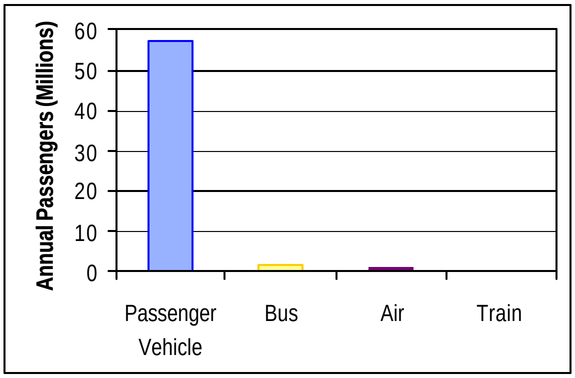
2.1. Overview

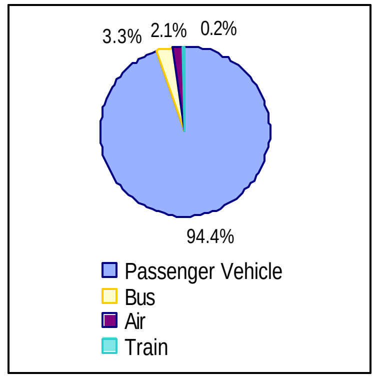
Mode Shares

Mode shares for the movement of people and goods through the Southeast Michigan/ Southwest Ontario corridor are shown in Exhibit 2.1. Passenger cars and commercial vehicles are the predominant travel modes in the corridor, with 94% of person-trips across the border being made by passenger car, and 76% of the value of goods being carried by commercial vehicle.

EXHIBIT 2.1: MODAL SHARE OF TOTAL PEOPLE AND GOODS

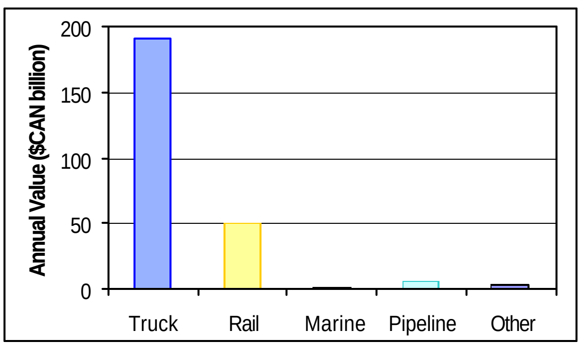
A. CROSS-BORDER PERSON TRIPS BY MODE (ANNUAL 2000)

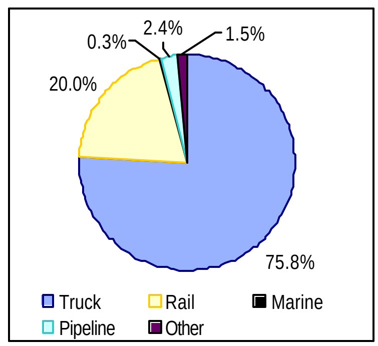




Source: Passenger Car, Bus Passenger, Train Passenger: US DOT, BTS, based on data from US Customs Service, Mission Support Services, Office of Field Operations, Operations Management Database – based on passengers incoming to US, multiplied by 2. Air: US DOT, based on flights between London/Toronto and Detroit/Lansing/Grand Rapids/Chicago.

B. CROSS-BORDER VALUE OF GOODS TRANSPORTED BY MODE (ANNUAL 2000)





Note: Other may include mail and/or air
Source: Canada Customs and Revenue Agency

Data Sources

Two recent major data collection efforts provided a rich source of cross-border passenger car and commercial vehicle travel, which were the basis of the road-based travel analyses and forecasts in this report:

- The **Ontario-Michigan Border Crossing Traffic Study** (August 2000). 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 volum es at each crossing.
- The **Ontario Commercial Vehicle Survey/National Roadside Study** (summer and fall of 1999). Commercial vehicle data were collected by roadside survey at 238 sites

across Canada. The completed dataset consists of about 65,000 observations. The MTO has supplemented this with a further 3,000 observations from an additional collection effort in 2000, and expanded all records to represent the estimated number of trucks operating on a given stretch of highway with the same characteristics.

The synthesis and application of these data for the purposes of this study are documented separately in the **Travel Demand Analysis Process Working Paper**, January 2004.

2.2. Cross-Border Passenger Car Travel

Historic Annual Trends

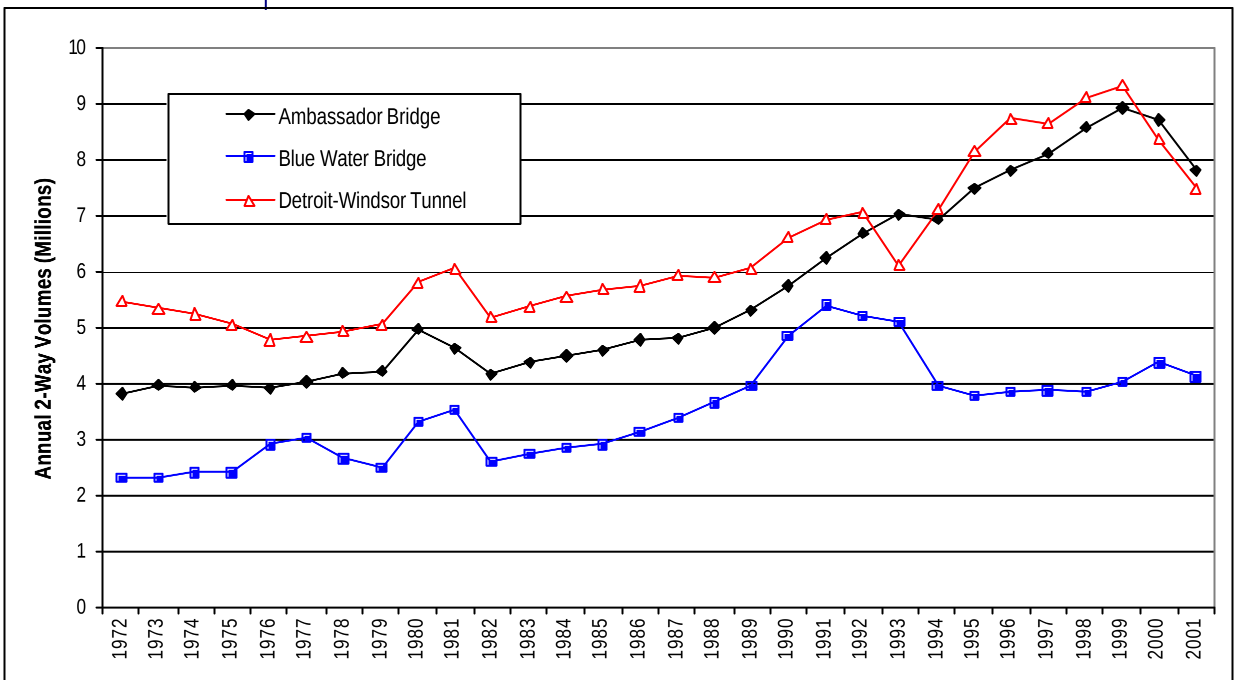
Since 1994, the growth in passenger car volumes at the SE Michigan/SW Ontario crossings has been more than 10 times greater than the next highest US-Canada border region.

Ontario-Michigan passenger car border crossing volumes have been rising fairly steadily, almost doubling from 11.6 million in total in 1972 to 21.3 million in total for 2000. Declines in traffic since 2000 have been experienced on all three crossings due to the events of 9/11 and the economic slowdown that was already occurring before 9/11.

The thirty-year historic trends for each crossing can be seen in Exhibit 2.2. Average annual growth rates by crossing over this time have been 3.0% for the Ambassador Bridge, 2.3% for the Detroit-Windsor Tunnel, and 1.5% for the Blue Water Bridge.

The three crossings exhibited steady growth from the 20-year period from 1972 to 1992, with short traffic peaks in the early 1980s and dramatic growth between 1988 and 1992. US-Canadian currency exchange rates have had a significant impact on cross-border traffic levels, and a particularly key factor since the early 1980s as the Canadian dollar had been roughly on par with the American dollar in the early 1970s. The Iran-Iraq war in the early 1980's 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, contributed to increased cross-border travel by Americans.

EXHIBIT 2.2: ANNUAL PASSENGER CAR CROSSINGS, 1972-2001



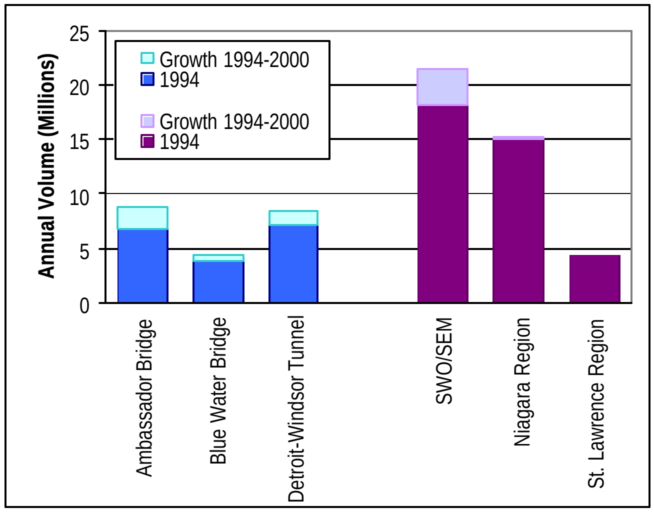
Source: Bridge and Tunnel Operators Association (BTOA)

Cross-border shopping, followed by Casino traffic fuelled the dramatic increase in trips during the 1990s.

During the late 1980s, an increase in Canada-US currency exchange rates, differences in prices on many goods and Sunday closing laws in Ontario led to the cross-border shopping phenomena, with Canadian residents shopping in the US to realize 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. The Blue Water Bridge saw a 26% decrease in traffic from 1993 to 1995, with current 2000 traffic levels still 20% lower than the peak in 1991.

Traffic on the Ambassador Bridge and the Detroit-Windsor Tunnel, while very negatively affected by the sudden drop in cross-border shopping, has 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. Since 1994, the growth in passenger car volumes exhibited at the three crossings has by far exceeded that exhibited in any other Canada-US border region (see Exhibit 2.3).

EXHIBIT 2.3: GROWTH IN ANNUAL PASSENGER CAR VOLUMES, 1994-2000



Source: Data Management and Analysis Office (MTO) with input from both US and Canadian Bridge Authorities

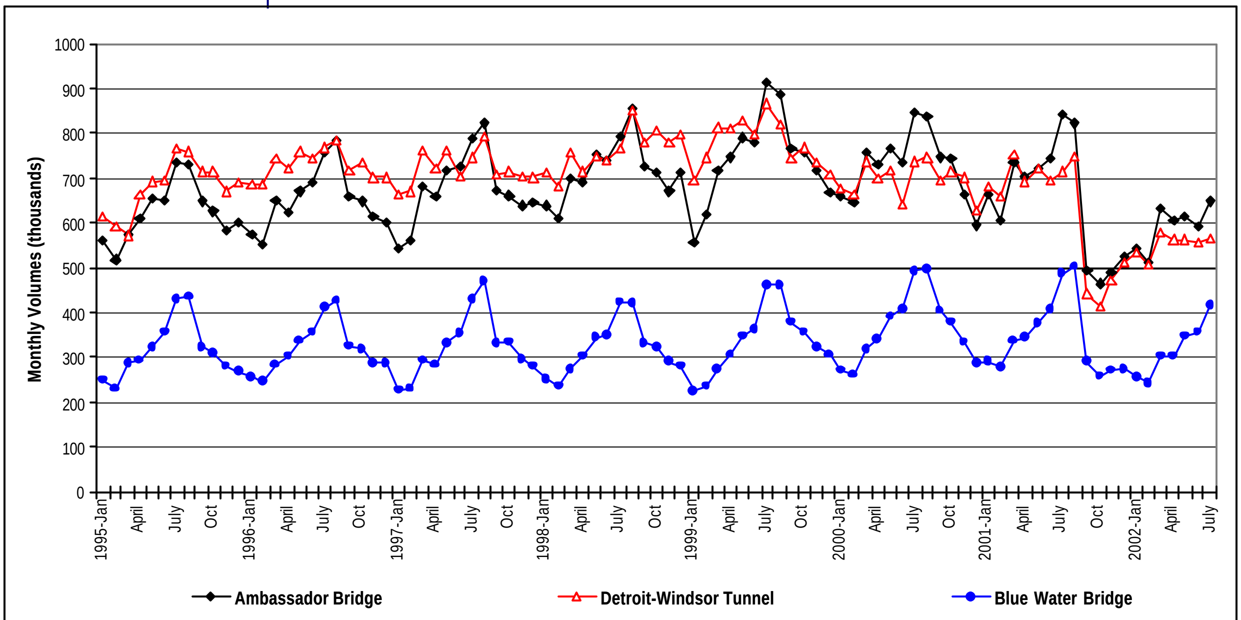
The tunnel has historically had the highest passenger car volumes of the three crossings until 1993, when Ambassador Bridge passenger volumes rose to levels close to or exceeding the tunnel volumes. Blue Water Bridge passenger car volumes peaked in the early 1990s and have dropped back to close to 1989 levels since then, or about half the volume of the Detroit-Windsor crossings. Total volumes for all crossings in 2001 are lower than in 2000 due to changes in border processing and travel patterns after the terrorist events of September 11, 2001, although 2001 traffic levels were already below 2000 due to a downturn in the economy after several years of very strong growth, with the Canadian dollar at historic lows compared to the US dollar. The opening of casinos in Detroit in late 1999/2000 also intercepted some cross-border traffic previously destined to the Windsor Casino, which also contributed to the observed declines.

Seasonal/ Monthly Trends

Summer is the peak traffic season for all three crossings, with the Blue Water Bridge showing the greatest seasonal peaking due to higher proportion of vacation/long-distance travel.

Exhibit 2.4 shows monthly passenger car volumes for each crossing since 1995. The Blue Water Bridge shows the greatest seasonal variation, followed by the Ambassador Bridge, then the Detroit-Windsor Tunnel. This variation reflects in large part the percentages of vacation-related traffic at these crossings. Passenger car volumes are generally highest in the summer months of July and August, and lowest in the winter months of January and February. July/August passenger car volumes are 30 to 40% higher than the annual average at the Blue Water Bridge, 15 to 20% higher than the annual average at the Ambassador Bridge, and 5 to 10% higher than the annual average at the Detroit-Windsor Tunnel. Until 2000, Ambassador Bridge passenger car volumes would approach or exceed the Detroit-Windsor Tunnel levels only during the summer peak. After that time, the Detroit Windsor Tunnel volumes dropped to less than the Ambassador Bridge volumes throughout the year.

EXHIBIT 2.4: SEASONAL TRENDS IN PASSENGER CAR TRAFFIC BY CROSSING, 1995-2002



Source: Bridge and Tunnel Operators Association as provided by MTO Data Management and Analysis Office.

A significant drop in volumes can be seen during and after September 2001, due to changing travel patterns and increased border security after the terrorist events of 9/11. This has affected passenger car volumes at the Detroit-Windsor crossings more than at Blue Water Bridge.

Daily Traffic Trends

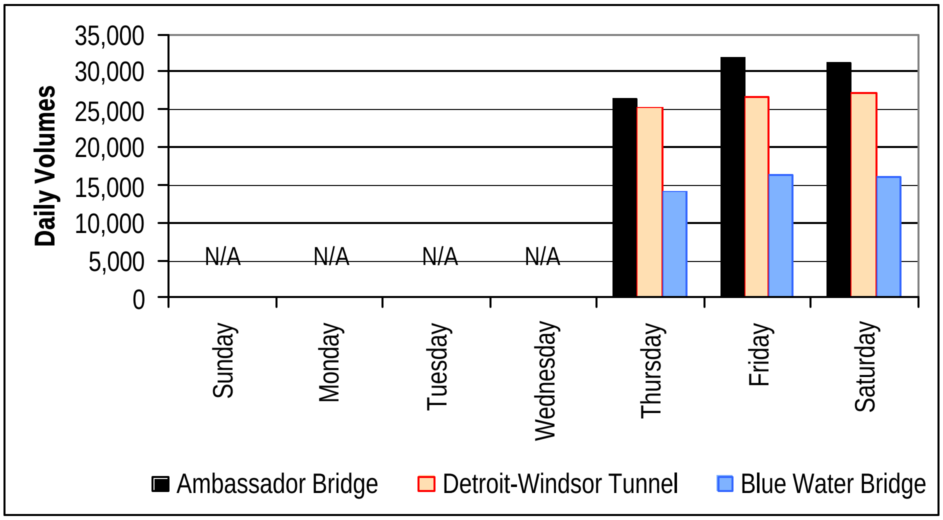
Highest travel days occur on summer weekend days, but the highest peak hour demands occur during weekday morning and afternoon peaks.

Trends by day of week for the three crossings are shown in Exhibit 2.5, for two seasons: summer and fall. Summer volumes, available from the **Ontario-Michigan Border Crossing Traffic Study**, covered the period between Wednesday afternoon and Saturday evening only. Traffic counts for the **1999/2000 Commercial Vehicle Survey**, supplied by MTO, provided a full week of counts for fall.

For the Ambassador Bridge and Detroit-Windsor Tunnel, the weekly profile shows that the number of cars is greatest on the weekend and Fridays, when the majority of drivers may be on leisure trips. The difference in car traffic between weekend days and weekdays is less pronounced for the tunnel than for the Ambassador Bridge. In the fall, average weekday volumes are 79% of weekend volumes for the Ambassador Bridge and 91% of weekend volumes for the Detroit-Windsor Tunnel. This may be due in part to high truck levels on the Ambassador Bridge diverting passenger car traffic to the tunnel during the week. Also, the tunnel provides convenient access between the Windsor and Detroit downtowns and therefore accommodates a significant volume of discretionary travel to restaurants, casinos and entertainment venues in addition to weekday business/commute travel. The Blue Water Bridge, with the highest proportion of vacation travellers, shows the highest variation of passenger car traffic by day, with the highest volumes on Fridays and weekends (weekday passenger car volumes are 75% of average weekend volumes).

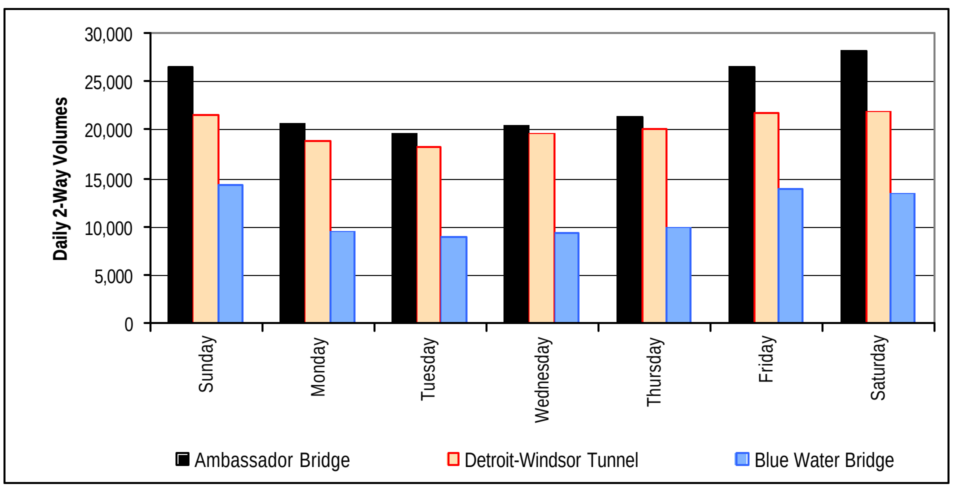
EXHIBIT 2.5: CROSS-BORDER PASSENGER CAR TRAFFIC BY DAY OF WEEK

A. SUMMER 2000



Source: ***Ontario-Michigan Border Crossing Traffic Study***, 2000

B. FALL 1999



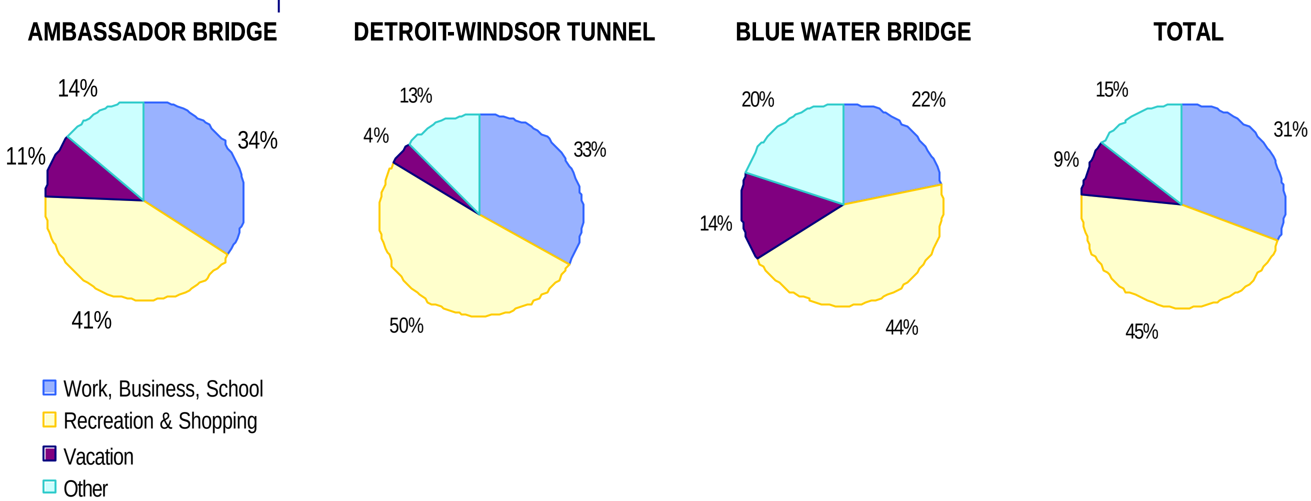
Source: ***1999/2000 NRS/MTO Commercial Vehicle Survey***

Trip Purpose

Trends by time of day and trip purpose by time of day are available based on **Ontario-Michigan Border Crossing Traffic Study** data for August 2000. A breakdown of cross-border passenger car trips by trip purpose by crossing is shown in Exhibit 2.6. The Ambassador Bridge and the Detroit Windsor Tunnel are similar in that they carry a higher proportion of commuting travel (work, business, school), but less recreation and shopping travel, compared to the Blue Water Bridge. Vacation travel is highly oriented to the Blue Water and Ambassador Bridges, with a small proportion of trips using the Detroit-Windsor Tunnel for this trip purpose.

The average auto occupancy (the number of people in the car including the driver) for cross-border trips at the three crossings combined is 1.26 for work trips, 2.09 for recreation trips, 2.44 for vacation trips, and 1.95 for other trip types, for an overall average of 1.84 persons per vehicle. Reflecting the distribution of tip purposes at each crossing, the tunnel has the lowest overall auto occupancy, 1.75, and the Blue Water Bridge has the highest, 2.01. The Ambassador Bridge has an average auto occupancy of 1.85.

EXHIBIT 2.6: WEEKDAY CROSS-BORDER PASSENGER CAR TRIPS BY TRIP PURPOSE, 2000



Source: Ontario-Michigan Border Crossing Traffic Study, 2000

Time of Day Patterns

Exhibit 2.7 presents weekday cross-border passenger car trip volumes in tabular form for average weekday conditions by time period for each crossing. A more detailed examination of travel by time period and trip purpose is illustrated in Exhibit 2.8 for each border crossing, with hourly distributions by trip purpose also shown for each of the three border crossings in Exhibits 2.9 to 2.11. The highest one-hour period or peak hour in terms of travel demand occurs during weekday peak periods, given commuting patterns. For travel into the US, the morning peak hour represents the highest volume period, while the

EXHIBIT 2.7: PASSENGER CAR TRAFFIC VOLUMES (AVERAGE HOURLY) BY TIME OF DAY AND TRIP PURPOSE , 2000

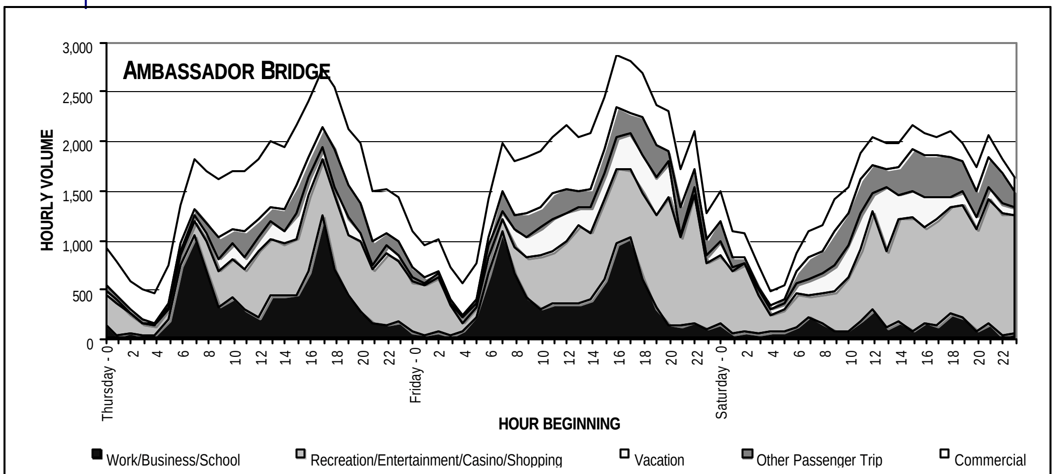
	INTO CANADA					INTO USA					TOTAL		TOTAL
	AM Pk	Mid-Day	PM Pk	Evening	Night	AM Pk	Mid-Day	PM Pk	Evening	Night	INTO	INTO	BOTH
TRIP PURPOSE	6-9 AM	9AM -3PM	3-7 PM	7-11 PM	11PM-6AM	6-9 AM	9AM -3PM	3-7 PM	7-11 PM	11PM-6AM	CANADA	USA	DIRECTIONS
VOLUMES (AVERAGE HOUR)											**TOTAL DAILY VOLUMES**		
AMBASSADOR BRIDGE													
Work, Business, School	125	154	604	178	44	677	184	144	45	43	4,737	4,184	8,921
Recreation & Shopping[1]	94	278	382	427	90	88	229	321	274	162	5,817	5,152	10,968
Vacation	30	112	125	82	18	51	66	75	54	14	1,716	1,163	2,879
Other	44	91	137	116	23	68	100	104	87	23	1,852	1,732	3,584
TOTAL	293	636	1,246	803	176	884	579	644	459	242	14,122	12,230	26,352
DETROIT-WINDSOR TUNNEL													
Work, Business, School	164	198	496	148	43	585	170	151	43	35	4,554	3,791	8,346
Recreation & Shopping[1]	76	289	381	538	103	84	221	312	430	263	6,360	6,392	12,752
Vacation	14	24	45	20	6	6	25	31	22	8	484	433	917
Other	35	81	100	77	12	65	116	124	86	16	1,383	1,842	3,224
TOTAL	288	592	1,021	783	164	739	531	618	581	322	12,781	12,458	25,239
BLUE WATER BRIDGE													
Work, Business, School	52	61	151	40	12	137	122	91	36	15	1,367	1,750	3,118
Recreation & Shopping[1]	36	189	262	171	22	31	139	207	211	62	3,129	3,037	6,166
Vacation	35	86	79	45	8	33	56	58	25	9	1,167	828	1,995
Other	41	81	100	65	14	44	98	126	41	9	1,364	1,454	2,818
TOTAL	164	417	590	321	56	246	415	482	313	95	7,028	7,069	14,097
TOTAL													
Work, Business, School	341	413	1,250	366	99	1,398	475	386	124	92	10,659	9,725	20,385
Recreation & Shopping[1]	206	757	1,024	1,136	215	204	590	840	915	487	15,306	14,580	29,886
Vacation	79	221	248	147	32	90	147	165	101	31	3,367	2,424	5,791
Other	120	253	336	258	49	178	314	353	213	49	4,599	5,028	9,627
TOTAL	745	1,645	2,858	1,907	395	1,870	1,525	1,744	1,353	659	33,931	31,757	65,688
PERCENTAGES													
AMBASSADOR BRIDGE													
Work, Business, School	43%	24%	48%	22%	25%	77%	32%	22%	10%	18%	34%	34%	34%
Recreation & Shopping[1]	32%	44%	31%	53%	51%	10%	40%	50%	60%	67%	41%	42%	42%
Vacation	10%	18%	10%	10%	10%	6%	11%	12%	12%	6%	12%	10%	11%
Other	15%	14%	11%	14%	13%	8%	17%	16%	19%	10%	13%	14%	14%
TOTAL	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
DETROIT-WINDSOR TUNNEL													
Work, Business, School	57%	33%	49%	19%	26%	79%	32%	24%	7%	11%	36%	30%	33%
Recreation & Shopping[1]	26%	49%	37%	69%	63%	11%	42%	50%	74%	82%	50%	51%	51%
Vacation	5%	4%	4%	3%	4%	1%	5%	5%	4%	2%	4%	3%	4%
Other	12%	14%	10%	10%	8%	9%	22%	20%	15%	5%	11%	15%	13%
TOTAL	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
BLUE WATER BRIDGE													
Work, Business, School	32%	15%	25%	13%	21%	56%	29%	19%	12%	15%	19%	25%	22%
Recreation & Shopping[1]	22%	45%	44%	53%	40%	13%	34%	43%	67%	65%	45%	43%	44%
Vacation	21%	21%	13%	14%	14%	14%	13%	12%	8%	9%	17%	12%	14%
Other	25%	19%	17%	20%	25%	18%	24%	26%	13%	10%	19%	21%	20%
TOTAL	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
TOTAL													
Work, Business, School	46%	25%	44%	19%	25%	75%	31%	22%	9%	14%	31%	31%	31%
Recreation & Shopping[1]	28%	46%	36%	60%	54%	11%	39%	48%	68%	74%	45%	46%	45%
Vacation	11%	13%	9%	8%	8%	5%	10%	9%	7%	5%	10%	8%	9%
Other	16%	15%	12%	14%	13%	10%	21%	20%	16%	7%	14%	16%	15%
TOTAL	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

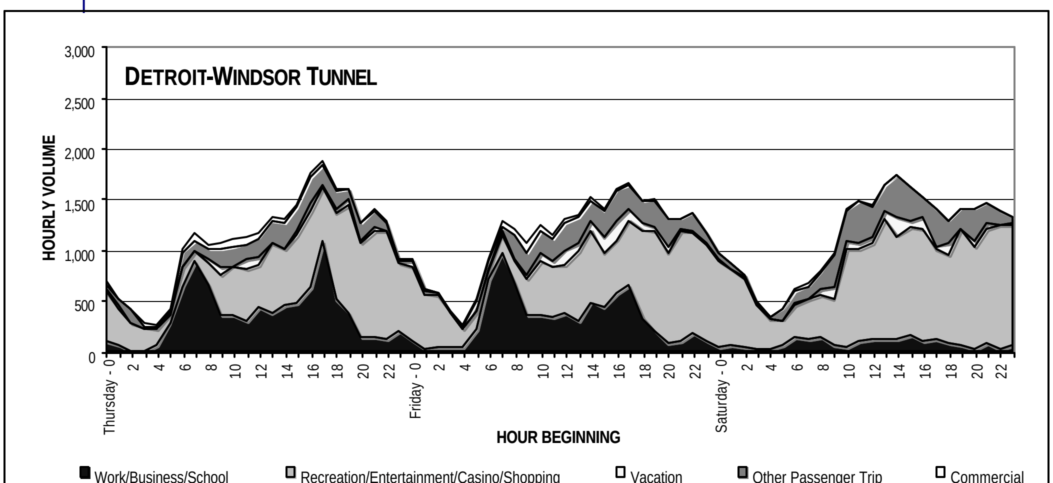
Note:

[1] Includes Entertainment and Casino trips

For trips where trip purpose was not reported, the distribution of trip purposes was assumed to be the same as for reported trip purposes.

EXHIBIT 2.8: TOTAL TRAFFIC VOLUMES BY TIME OF DAY AND TRIP PURPOSE, 2000





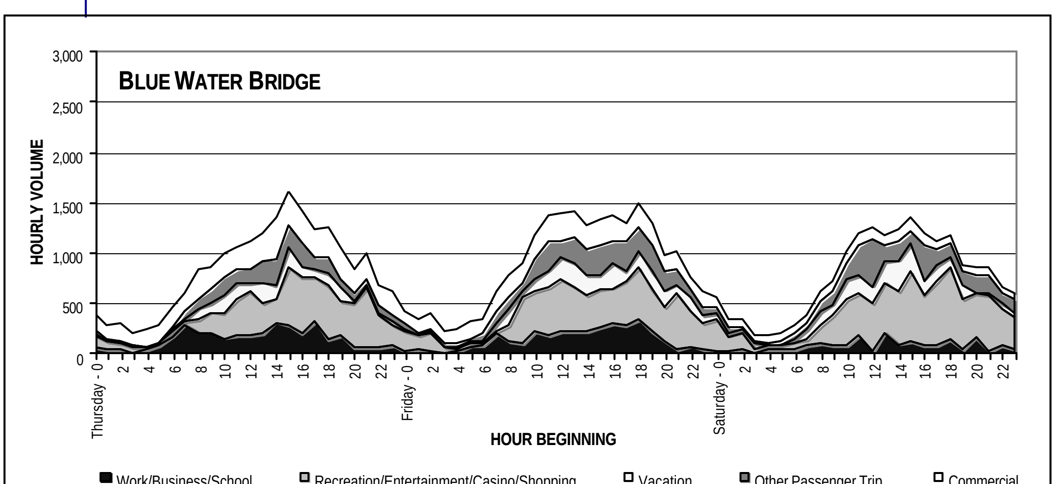
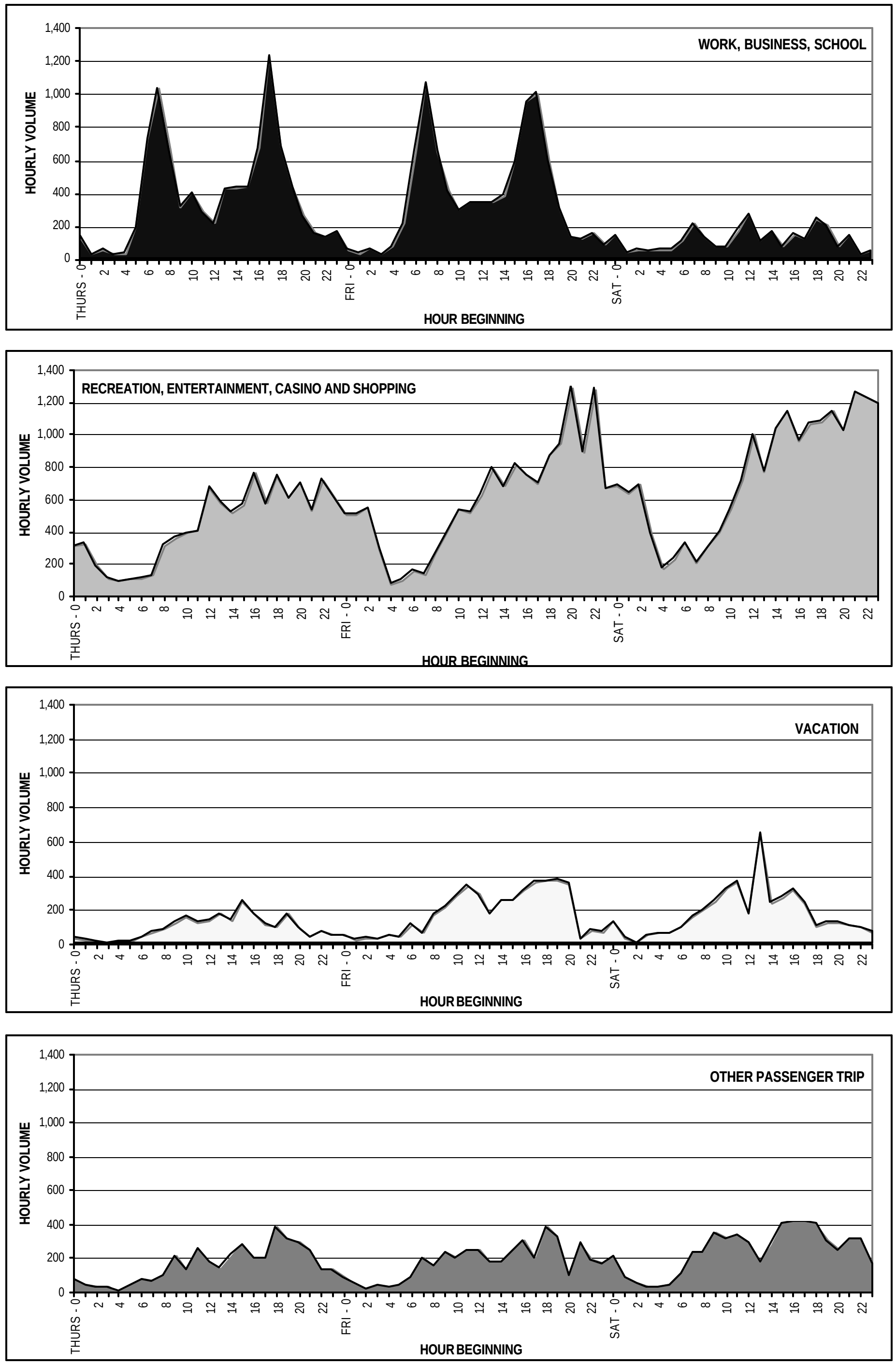
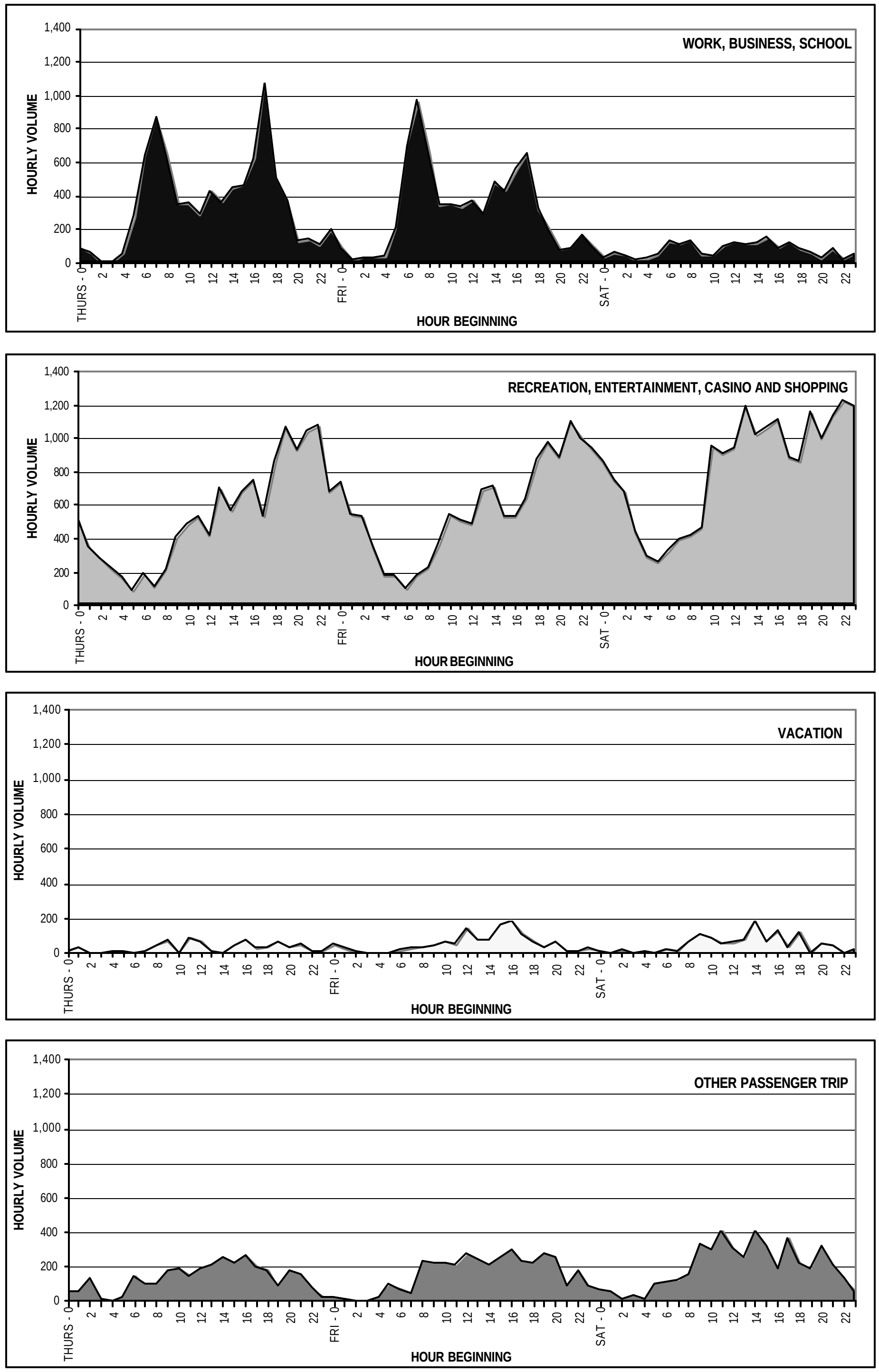


EXHIBIT 2.9: AMBASSADOR BRIDGE PASSENGER CAR TRENDS BY TIME OF DAY AND TRIP PURPOSE, 2000



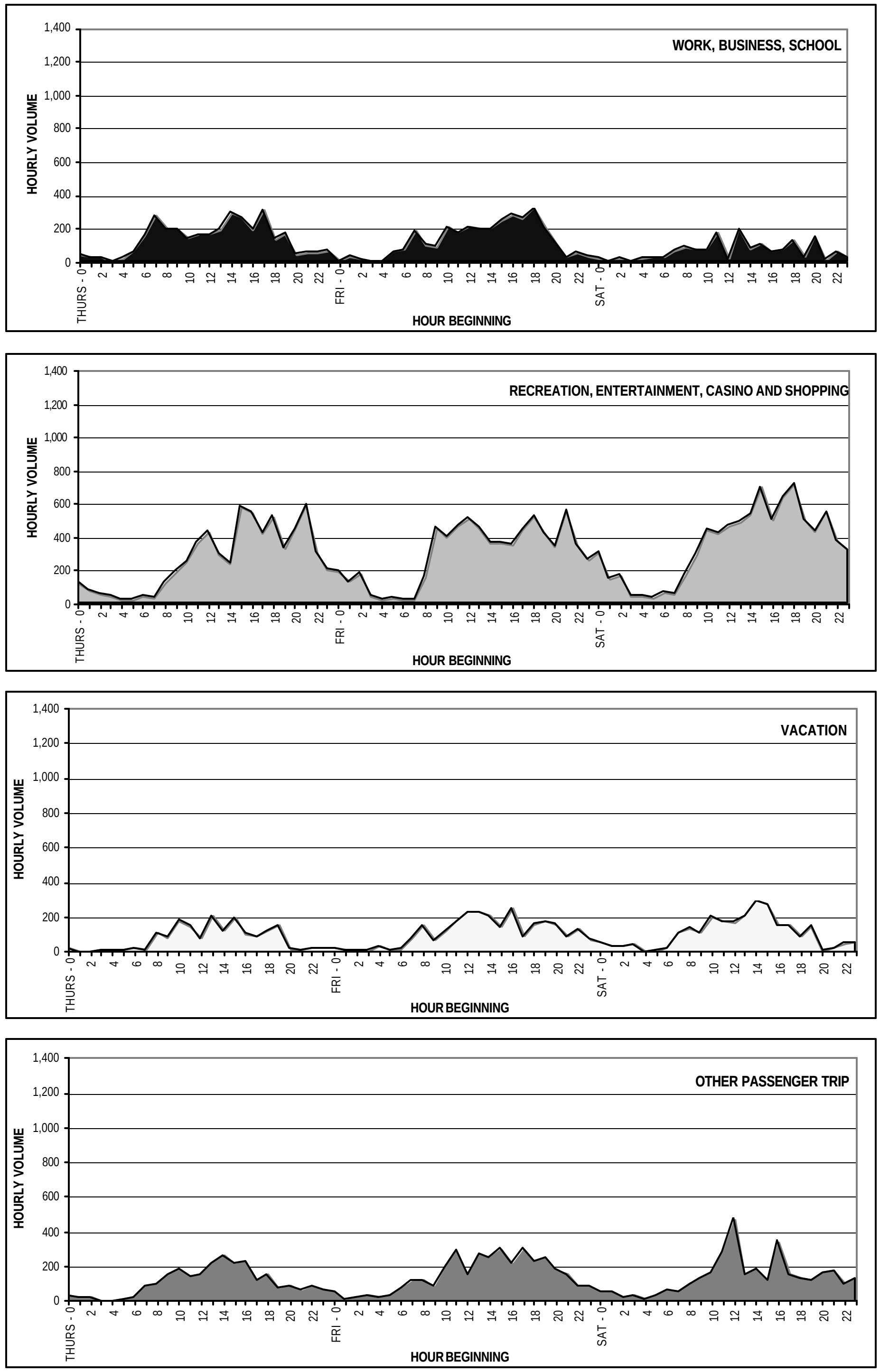
Source: Based on data in the **2000 Ontario-Michigan Border Crossing Traffic Study** database.

EXHIBIT 2.10: DETROIT-WINDSOR TUNNEL PASSENGER CAR TRENDS BY TIME OF DAY AND TRIP PURPOSE, 2000



Source: Based on data in the **2000 Ontario-Michigan Border Crossing Traffic Study** database.

EXHIBIT 2.11: BLUE WATER BRIDGE PASSENGER CAR TRENDS BY TIME OF DAY AND TRIP PURPOSE, 2000



Source: Based on data in the **2000 Ontario-Michigan Border Crossing Traffic Study** database.

afternoon peak hour is the highest for Canadian bound traffic. The afternoon peak hour is typically higher, given that it combines Canadian workers returning to Canada and US residents destined to Canada for evening recreation/entertainment purposes (e.g. restaurants/bars, casino, bingo, etc.). General observations from these findings for each crossing are described below.

The **Ambassador Bridge** carries the highest passenger car traffic levels of the three crossings throughout the day, except for evenings and at night, when the Detroit-Windsor Tunnel volumes are slightly greater. Weekday volumes total approximately 26,400 passenger cars. The morning and afternoon peaks at Ambassador Bridge and the tunnel are largely due to high peaks related to work trips, with the afternoon peak marginally higher in volume. The peak weekday period occurs on Friday evenings when commuter and recreational/casino traffic occur concurrently. This crossing has the highest number of weekday work trips (8,900), with the tunnel very close behind (8,300). Only about 1 in 6 work trips are for job/business locations in Canada; therefore work traffic is quite directional, with most morning peak work traffic destined to the US and most afternoon peak traffic returning to Canada. In the peak hours, the Ambassador Bridge serves 1,000 to 1,200 work trips. Over the course of an average weekday, recreation and shopping trips (recreation, entertainment, shopping, and casino) outnumber work trips (11,000 trips), and are even greater on Saturdays. Virtually all casino trips are to Windsor, and more than 60% of recreation and entertainment trips destinations are in Canada, while almost 60% of shopping trip destinations (a much smaller portion of discretionary trips) are in the US, and are mostly from Essex County. The Ambassador Bridge also serves the largest volume of vacation traffic (2,900 per day) compared to the other two crossings. Approximately 70% of vacation trip destinations are in Canada, mostly in Southwest Ontario as far as the Greater Toronto Area, and about 20% of vacation destinations are to points in the US other beyond Michigan. The remaining 3,600 trips per day include social, medical/financial, and personal business trips.

At the **Detroit-Windsor Tunnel**, discretionary trips (recreation, entertainment, shopping and casino) make up just over half of all weekday passenger car trips (12,800 trips of 25,200). Discretionary trip volumes are roughly the same as those at the Ambassador Bridge throughout the day, and but are higher in the evenings and night-time, given the large number of casinos, bingo establishments, restaurants, pubs, shops and nightclubs in the Windsor downtown, close to the tunnel. Despite the Windsor Casino's proximity to the Detroit-Windsor Tunnel, the Tunnel carries only 25% more trips to the Casino than does the Ambassador Bridge: choice of crossing used seems to be more dependent on which crossing is closer to where the trip originated. Among recreation and entertainment trip destinations, two-thirds are in Windsor, while 20% are in the SEMCOG area. The tunnel serves a high volume of work trips as well (8,300), only a little less than Ambassador Bridge (8,900). The tunnel, however, serves a higher volume of work trips destined for employment locations in Canada (630 of 3,180 work destinations) than the Ambassador Bridge (580 of 3,280 work destinations). Vacation trips make up only 4% (900 trips) of weekday travel at the tunnel, while the remainder of trips (13%, or 3,200 trips) include social, medical and personal business trips.

At the **Blue Water Bridge**, weekday passenger car volumes are just over half that of Ambassador Bridge (14,100 vs. 26,400 trips). Work trips make up only 3,100 trips, or just over one-fifth of all trips at the Blue Water Bridge, or just over one-third of the volume of work trips at either Detroit-Windsor crossing. Work trips are not as peaked as the travel patterns at the Detroit-Windsor crossings show, due to the lower proportion of work trips, longer distance travel that does not cross at typical peak periods or the nature of much of the employment may not be typical of 9 to 5 workdays. One in 8 work trips at the Blue Water Bridge are destined to employment locations in Michigan. Vacation trip volumes total almost 2,000 trips per day (14%), which is about 70% of the volume of vacation trips at the Ambassador Bridge. A total of 6,200 trips (44%) are for recreation, entertainment, shopping and casino purposes. Virtually all casino trips are to/from the Sarnia casino and comprise 1,600 trips on a typical weekday. Some 40% of recreation and entertainment trip destinations are in Sarnia, and a total of more than two-thirds are in Canada. Shopping trips at the Blue Water Bridge are the same in volume as at both Detroit-Windsor crossings combined (over 900 one-way trips); 70% of these are destined to Port Huron/St. Clair County, and another 15%, to other US destinations. The remaining trips (20%) include trip purposes such as social, personal business, and medical/financial.

Spatial Travel Patterns

Travel origin-destination patterns for passenger car trips crossing the border at Southeast Michigan/Southwest Ontario crossings were based on the comprehensive dataset prepared for the **Ontario-Michigan Border Crossing Traffic Study**. Based on these data, Exhibits 2.12 and 2.13 present graphics of overall flow patterns between Canada and the United States for border crossing trips at Detroit-Windsor and Sarnia-Port Huron, respectively.

Over 70% of passenger car trips are local between Windsor-Detroit or between Sarnia-Port Huron.

Exhibit 2.12 presents a summary of the major travel flows for passenger car trips between Canada and the US that cross at Detroit-Windsor. Shorter-distance local travel between the Detroit and Windsor areas dominate the travel flows based on typical weekday conditions. Longer-distance travel tends to follow the major highway corridors leading to and from the Detroit-Windsor area. The Highway 401 corridor is the single and dominant travel corridor on the Canadian side, while trip flows in the US are much more widely distributed to the south (I-75), east (I-94) and north/northeast (I-96, I-75 and I-94).

Passenger car flows between Canada and the US crossing at Sarnia-Port Huron are shown in Exhibit 2.13. Compared to the Detroit-Windsor crossings, the absolute number of trips is significantly lower, with a much lower proportion of local trips between Sarnia and Port Huron and higher proportion of long-distance trips. The long-distance travel flows strongly follow the Highway 402/401 corridors in Canada, with strong easterly flows through central Michigan and the US Midwest.

The spatial patterns for cross-border passenger car trips are also be examined in a more structured manner according to four trip types: local-to-local trips, local to/from long-distance trips separately for each side of the border, and long-distance to long-distance trips. The total volumes for each type of trip are summarized in Exhibit 2.14.

Exhibit 2.15 shows the travel origin and destination patterns for travel through each of the three border crossings, summarized for a ten-zone system. More detailed travel matrices using a 40-zone system are included in Appendix A. Graphics indicating flows of local, long distance travel between Canada and the US that use the three border crossings are shown in Exhibits 2.16 to 2.18.

The majority of weekday **Ambassador Bridge** passenger car trips (18,470, or 70%) are local to local. Approximately 58% (over 7,000) of trips to the US originate in Windsor itself, and some 60% of trips to Canada (approximately 8,500 trips) are destined for Windsor. (These volumes do not balanc e in part due to the many trips to Canada on Friday evening that do not return until early Saturday morning.)

The Ambassador Bridge carries approximately 2,770 long-distance to long-distance passenger car trips daily (10% of total trips), only just behind the Blue Water Bridge in volume (2,960 trips). Some 2,170 long-distance trips daily are to/from the local Detroit area. Of these, about one-third (710 trips) are to/from the Greater Toronto area, about 100 trips are in-transit trips between New York state or eastern United States, and the remainder are generally from throughout southern and eastern Ontario. Long-distance trips to/from the Windsor area total some 2,940 trips daily. Although these trip ends are diverse, the most common direction is toward Ohio (almost 40% of trips).

The **Detroit-Windsor Tunnel** is a border crossing option used more by local residents than for long-distance trips, especially for trips to/from the city of Windsor. Some 87% of trips (22,080) are entirely local, while just less than 1% are entirely long-distance. Approximately 19,310 trips (88%) of local-to-local trips are to/from the city of Windsor. This is about 45% higher than local Windsor trips via the Ambassador Bridge. However, total volumes of trips to/from Windsor with a long-distance trip end are 1,940 for the tunnel and 2,940 for Ambassador Bridge. This indicates that while the tunnel is readily used by local travelers for easier access to/from the city of Windsor, longer-distance or occasional travelers to/from Windsor may find the tunnel more difficult to find or intimidating to use and therefore use Ambassador Bridge instead. On the Michigan side, the tunnel is preferred to the bridge for local trips to/from Detroit, and Macomb and Livingston Counties, given its more northerly position compared to the Ambassador Bridge. Volumes are 1.6, 3.3 and 2.0 times greater for these trips crossing the tunnel than the same trips for Ambassador Bridge.

The **Blue Water Bridge** has the greatest volume of entirely long-distance trips of the three crossings (2,960 vehicles), slightly more than the Ambassador Bridge (2,770). These represent 20% of the weekday Blue Water Bridge passenger car volumes of 14,100 vehicles. The Blue Water Bridge has lower volumes of local travel compared to the Detroit-Windsor crossings, given the smaller size of the communities on either side of the border in this area.

EXHIBIT 2.12: WEEKDAY DETROIT-WINDSOR CROSS-BORDER PASSENGER CAR FLOWS, 2000
A. FLOWS TO US

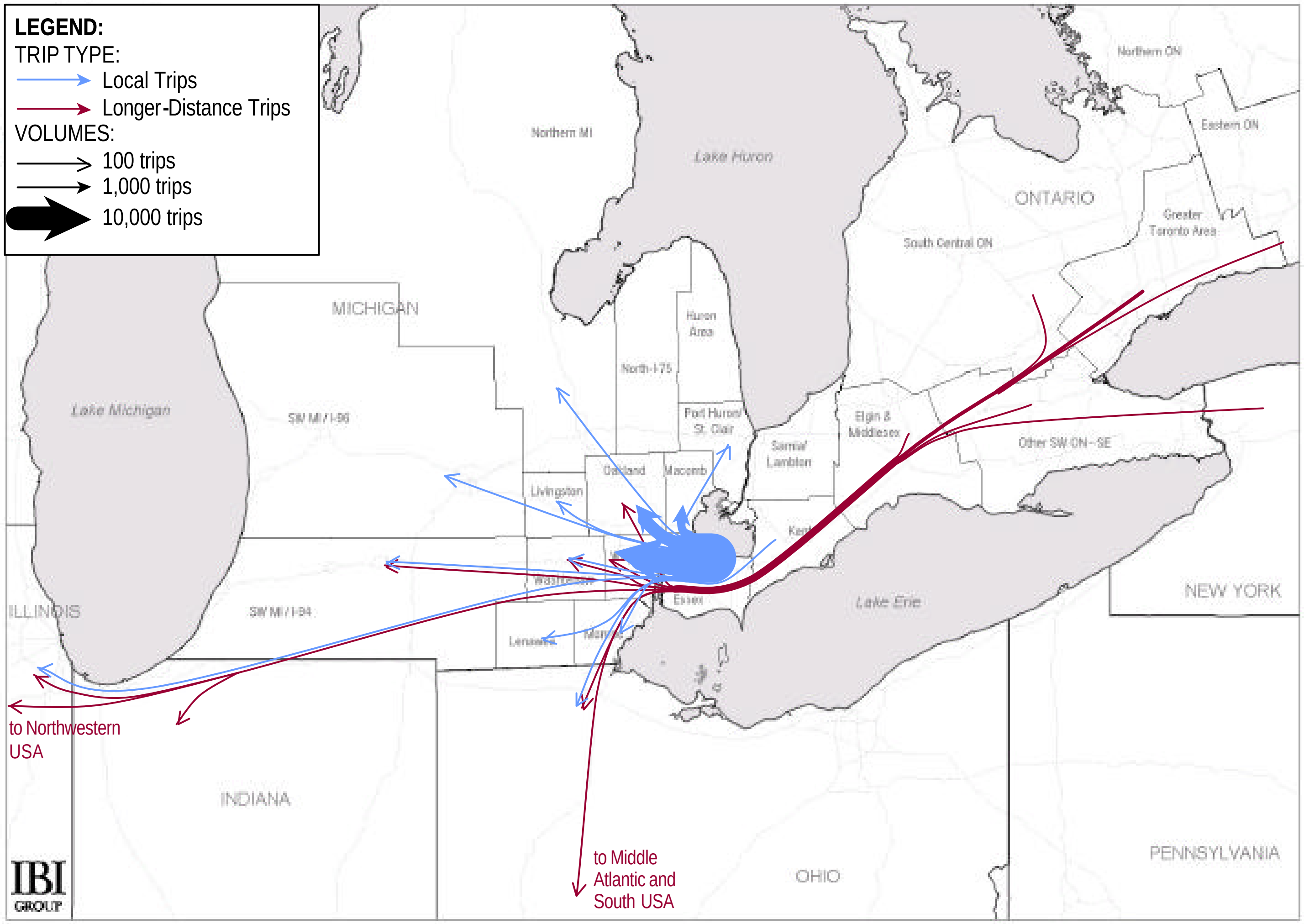


EXHIBIT 2.12 (CONT.): WEEKDAY DETROIT-WINDSOR CROSS-BORDER PASSENGER CAR FLOWS, 2000
B. FLOWS TO CANADA

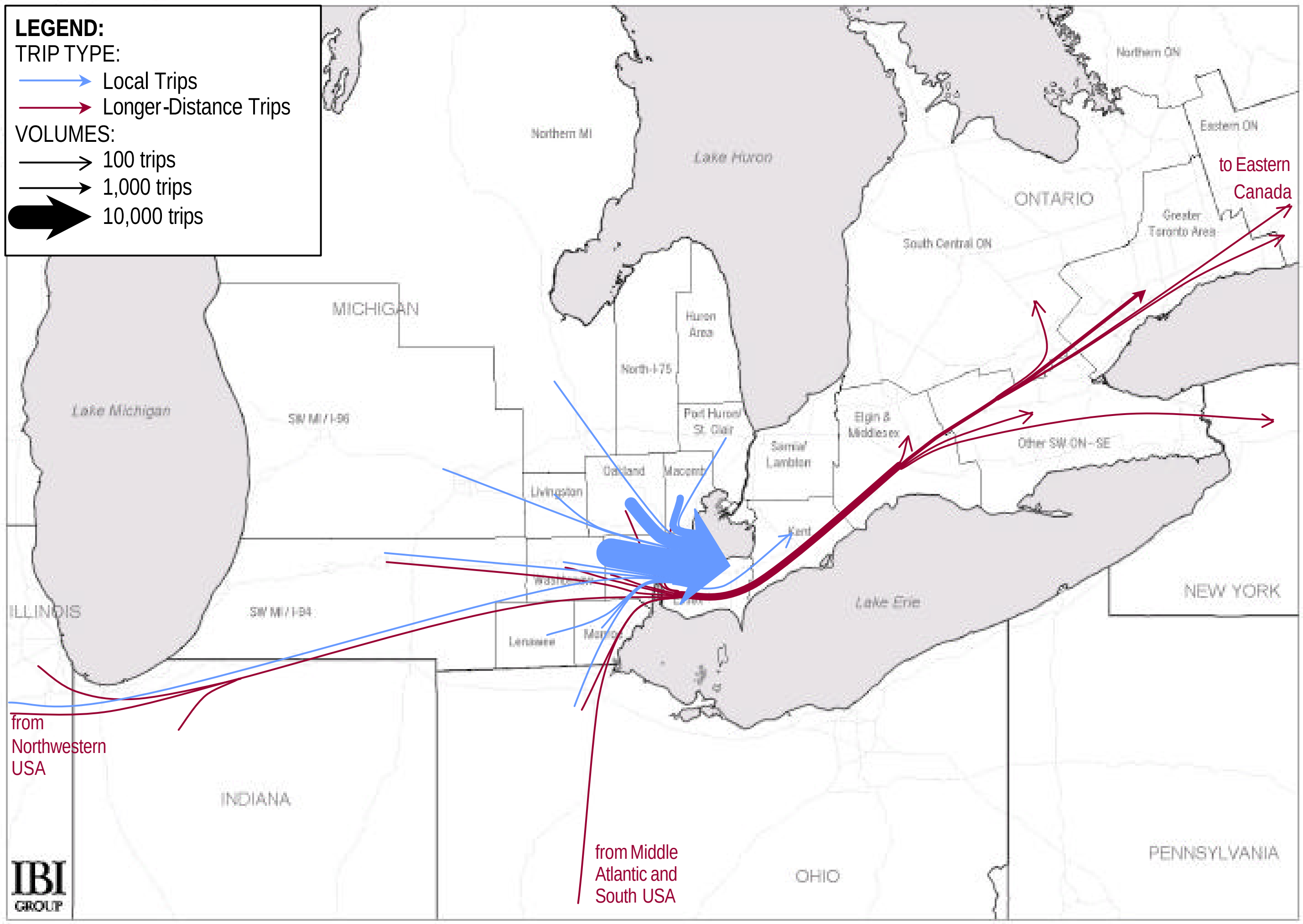


EXHIBIT 2.13: WEEKDAY SARNIA-PORT HURON CROSS-BORDER PASSENGER CAR FLOWS, 2000
A: FLOWS TO US

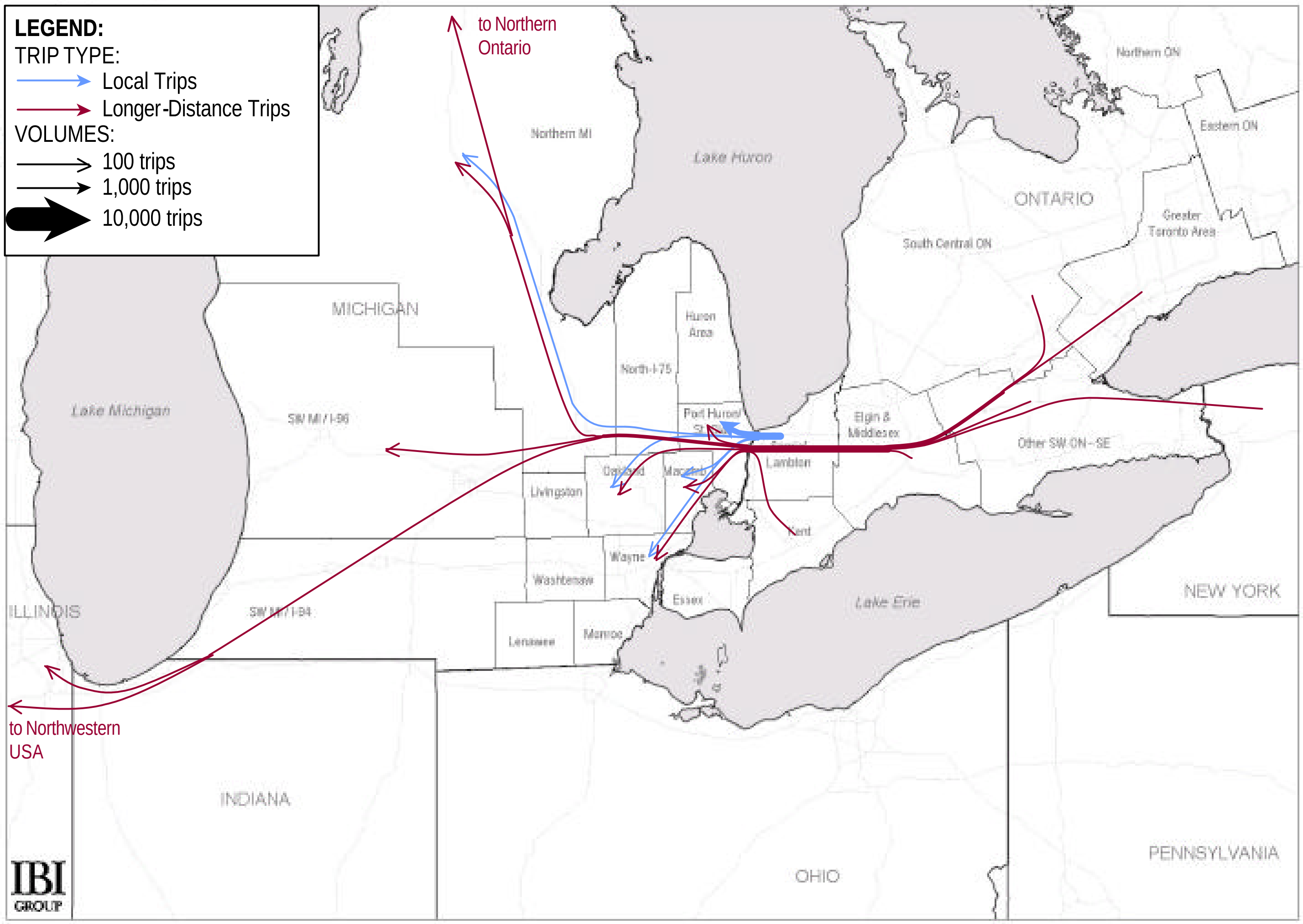


EXHIBIT 2.13: WEEKDAY SARNIA-PORT HURON CROSS-BORDER PASSENGER CAR FLOWS, 2000
B. FLOWS TO CANADA

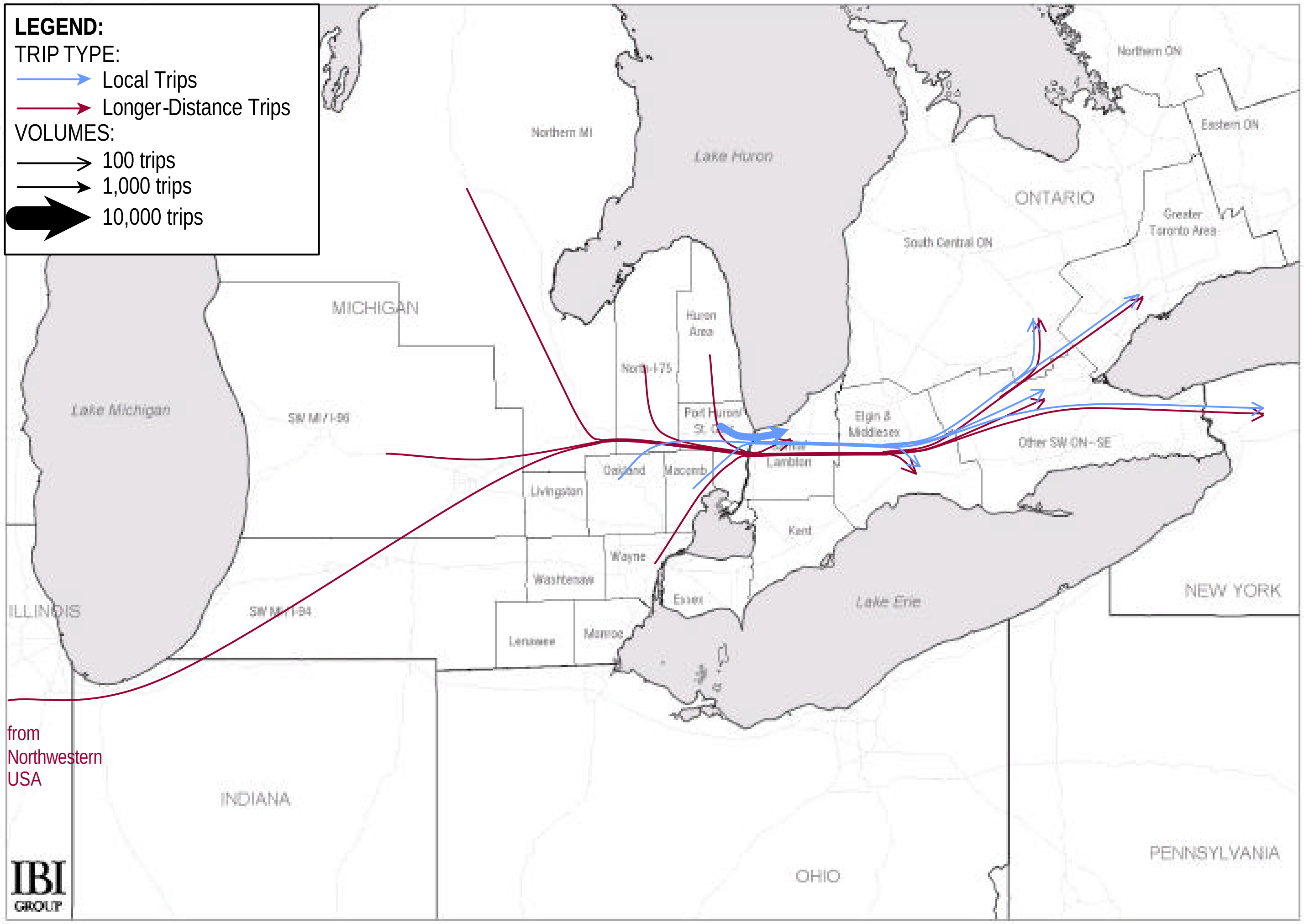


EXHIBIT 2.14: WEEKDAY CROSS-BORDER PASSENGER CAR TRIPS BY LOCAL/LONG-DISTANCE TRIP TYPE, 2000

	DAILY PASSENGER CAR TRIPS							
	Ambassador Bridge		Detroit-Windsor Tunnel		Blue Water Bridge		TOTAL	
TRIP TYPE[1]	**Volume**	**%**	**Volume**	**%**	**Volume**	**%**	**Volume**	**%**
Local to Local	18,470	70	22,080	87	6,390	45	46,950	71
Local (Detroit or Port Huron Area) to/from Long-Distance	2,170	8	970	4	2,850	20	5,990	9
Local (Windsor or Sarnia Area) to/from Long-Distance	2,940	11	1,940	8	1,900	12	6,780	10
Long-Distance to Long-Distance	2,770	10	240	0.9	2,960	21	5,970	9
TOTAL TRIPS	26,350	100	25,240	100	14,100	100	65,690	100

Notes:
[1] For Ambassador Bridge and the Detroit-Windsor Tunnel, a "local" trip end refers to Essex and Kent County in Ontario, and the SEMCOG area in Michigan, excluding St. Clair County in Michigan. For the Blue Water Bridge, a "local" trip end refers to Lambton County in Ontario, and St. Clair, Macomb, Oakland and Livingston Counties in Michigan.
Unexpected or nonsensical trips, such as where the shortest routing was not taken, were redistributed according to the same distributions as the remaining trips.

EXHIBIT 2.15: WEEKDAY PASSENGER CAR TRAVEL ORIGIN AND DESTINATION MATRIX, 2000

AMBASSADOR BRIDGE

ORIGIN	DESTINATION 1	2	3	4	5	6	7	8	9	10	TOTAL
1 Detroit + NE Wayne			5			19	1,959	605	5	353	2945
2 Rest of Wayne County	9			5		28	3,107	851	9	595	4605
3 Port Huron/St. Clair County							18	13			31
4 Rest of SEMCOG						49	2,149	887		652	3737
5 Rest of MI						19	307	78		138	542
6 Other USA/Mexico	10	49		69	93	30	862	154	5	1,105	2377
7 Windsor	1,685	2,610	50	1,789	305	578	10	9	12	11	7058
8 Rest of Essex County	581	713	6	750	119	128			12	13	2322
9 Sarnia/Lambton County					4	4	40	5			53
10 Other Ontario/Canada	204	419	4	382	438	1,158	25	8	4	42	2683
TOTAL	2489	3791	65	2995	958	2013	8477	2609	47	2909	**26352**

DETROIT-WINDSOR TUNNEL

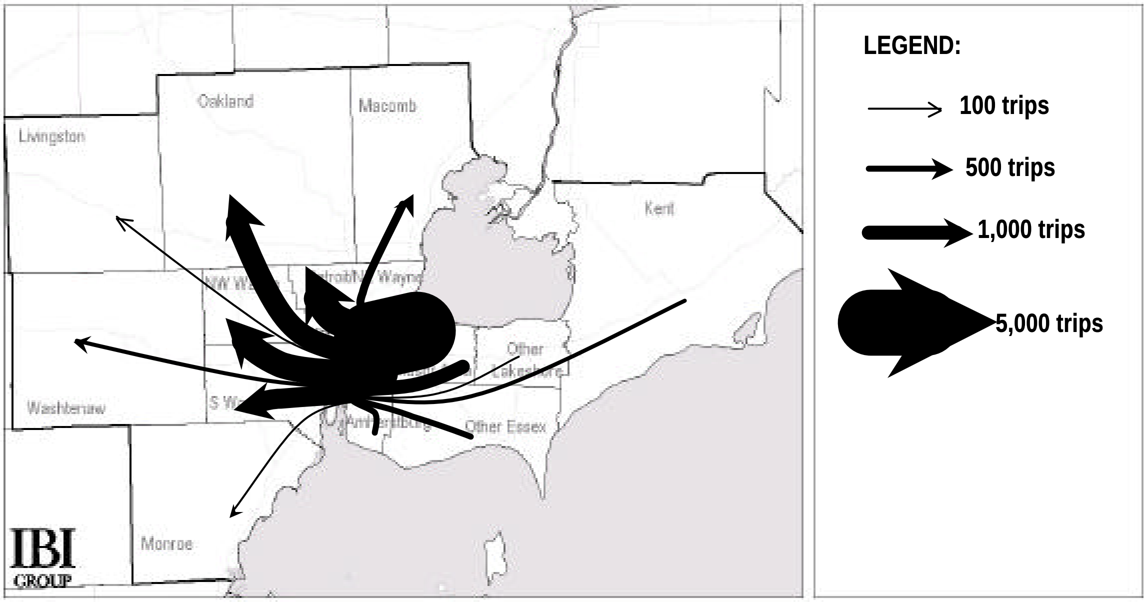
ORIGIN	DESTINATION 1	2	3	4	5	6	7	8	9	10	TOTAL
1 Detroit + NE Wayne	4					12	3,730	588		311	4646
2 Rest of Wayne County							1,041	78		98	1217
3 Port Huron/St. Clair County							127	19			145
4 Rest of SEMCOG				12		24	4,967	519	6	332	5860
5 Rest of MI							422	53		55	531
6 Other USA/Mexico	24	5		18		6	162	49		115	379
7 Windsor	3,206	1,214	89	5,154	499	317	9		28	28	10544
8 Rest of Essex County	416	69	5	588	35	25			5	14	1157
9 Sarnia/Lambton County							25		4		29
10 Other Ontario/Canada	198	84		270	72	68	11	6		21	730
TOTAL	3849	1371	94	6043	607	452	10495	1312	42	974	**25239**

BLUE WATER BRIDGE

ORIGIN	DESTINATION 1	2	3	4	5	6	7	8	9	10	TOTAL
1 Detroit + NE Wayne						22			68	123	212
2 Rest of Wayne County						12			94	124	230
3 Port Huron/St. Clair County						10		5	2,288	383	2686
4 Rest of SEMCOG						155	6		639	943	1743
5 Rest of MI						242	6		543	800	1590
6 Other USA/Mexico	20		3	143	190	54			101	264	775
7 Windsor					9				50	15	74
8 Rest of Essex County			5						19	6	30
9 Sarnia/Lambton County	67	89	2,474	655	506	82	52	44	3	14	3987
10 Other Ontario/Canada	122	63	481	660	739	368	11		31	292	2768
TOTAL	210	153	2963	1458	1445	945	75	49	3835	2964	**14097**

EXHIBIT 2.16: WEEKDAY 24-HOUR PASSENGER CAR TRIPS TO US VIA AMBASSADOR BRIDGE, 2000

LOCAL TRIPS



LONG-DISTANCE TRIPS

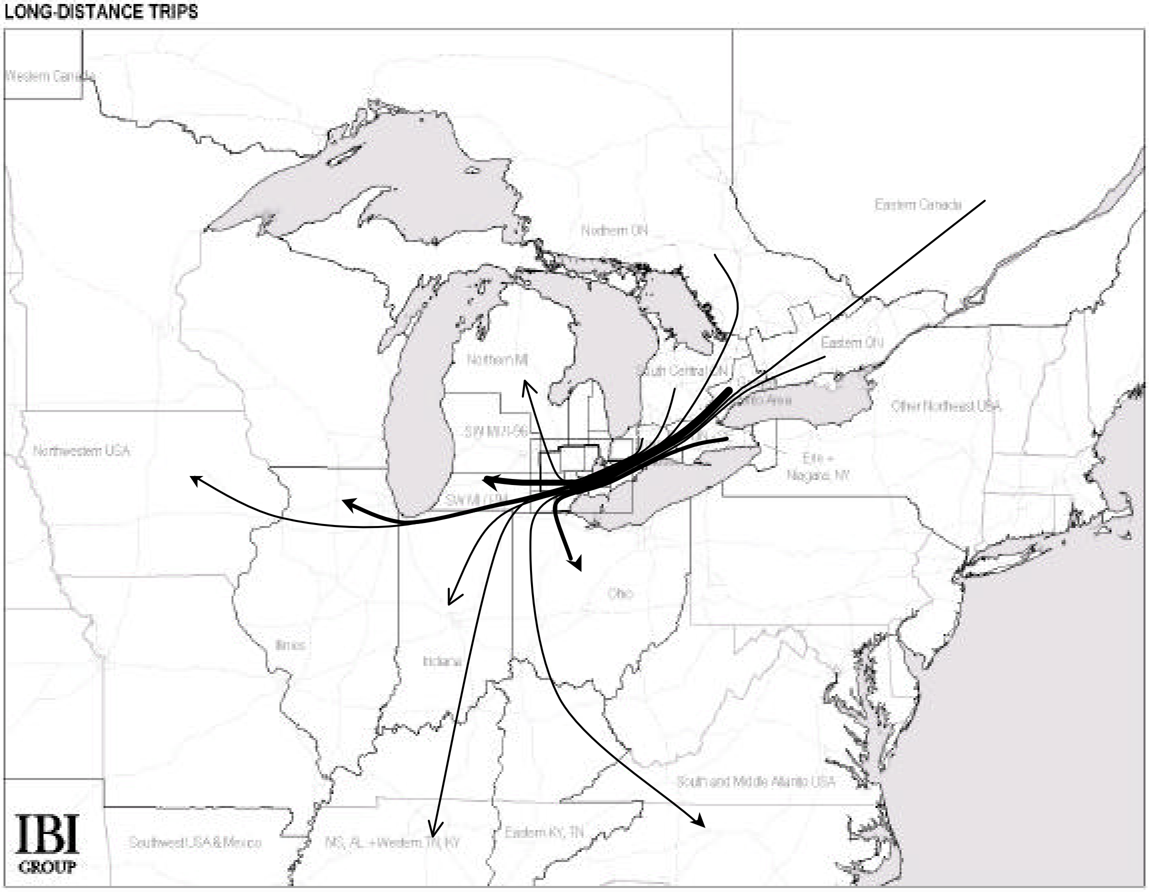
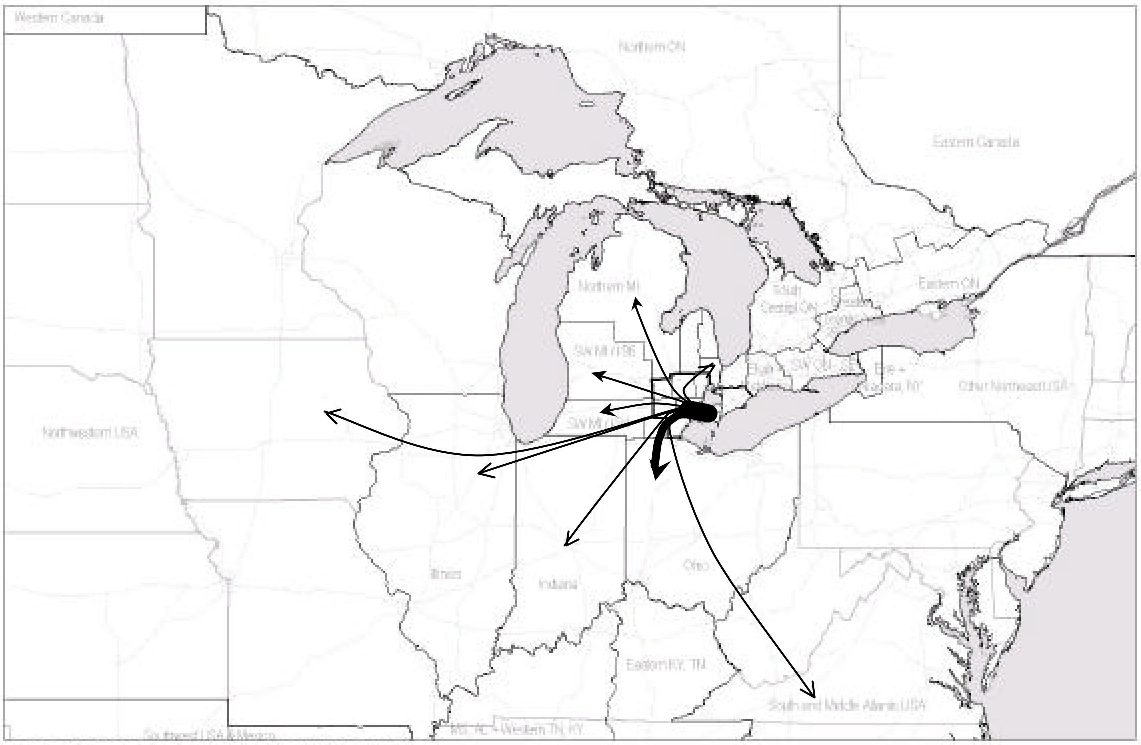


EXHIBIT 2.16 (CONT.): WEEKDAY 24-HOUR PASSENGER CAR TRIPS TO US VIA AMBASSADOR BRIDGE, 2000

LOCAL (WINDSOR AREA) TO LONG-DISTANCE TRIPS



LONG-DISTANCE TO LOCAL (DETROIT AREA) TRIPS

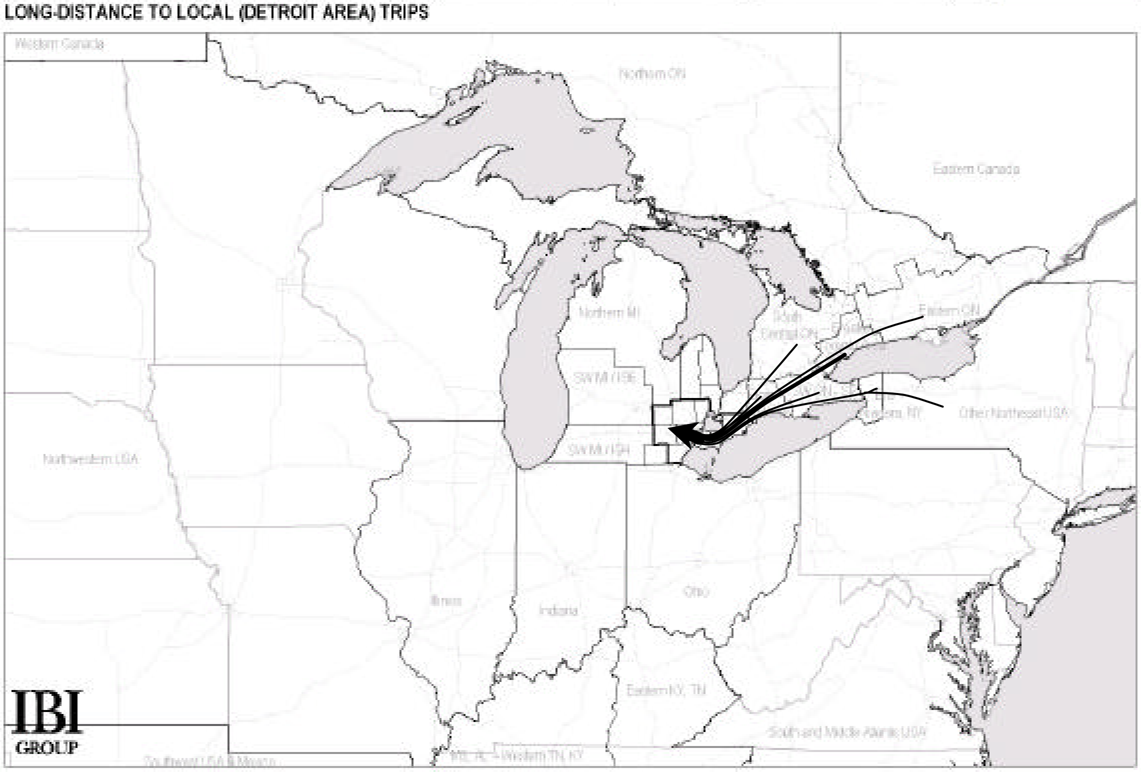
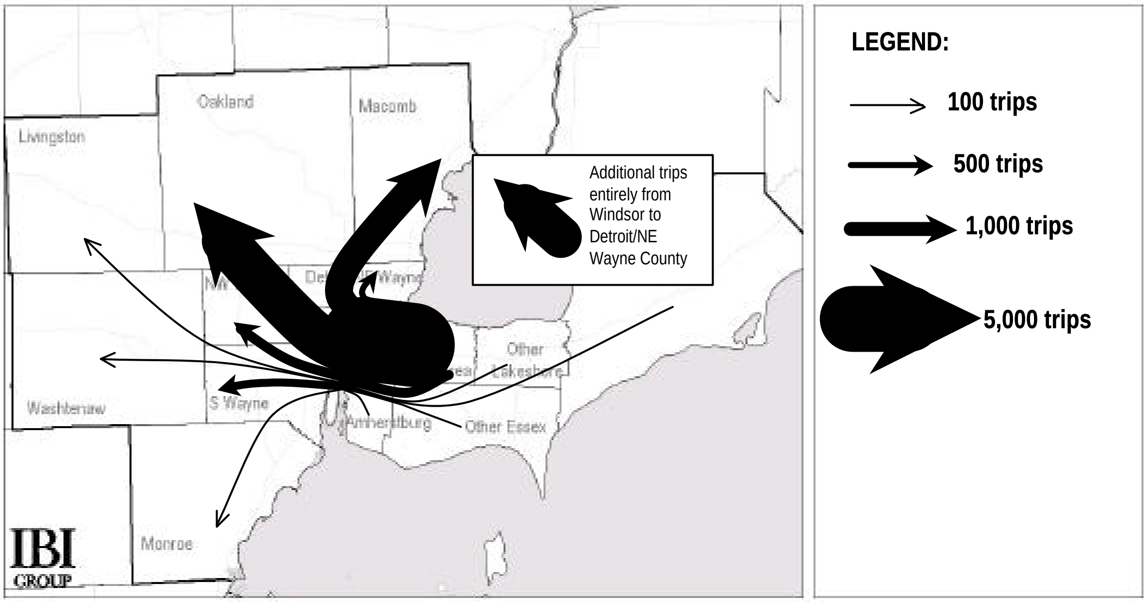


EXHIBIT 2.17: WEEKDAY 24-HOUR PASSENGER CAR TRIPS TO US VIA DETROIT-WINDSOR TUNNEL, 2000

LOCAL TRIPS



LONG-DISTANCE TRIPS

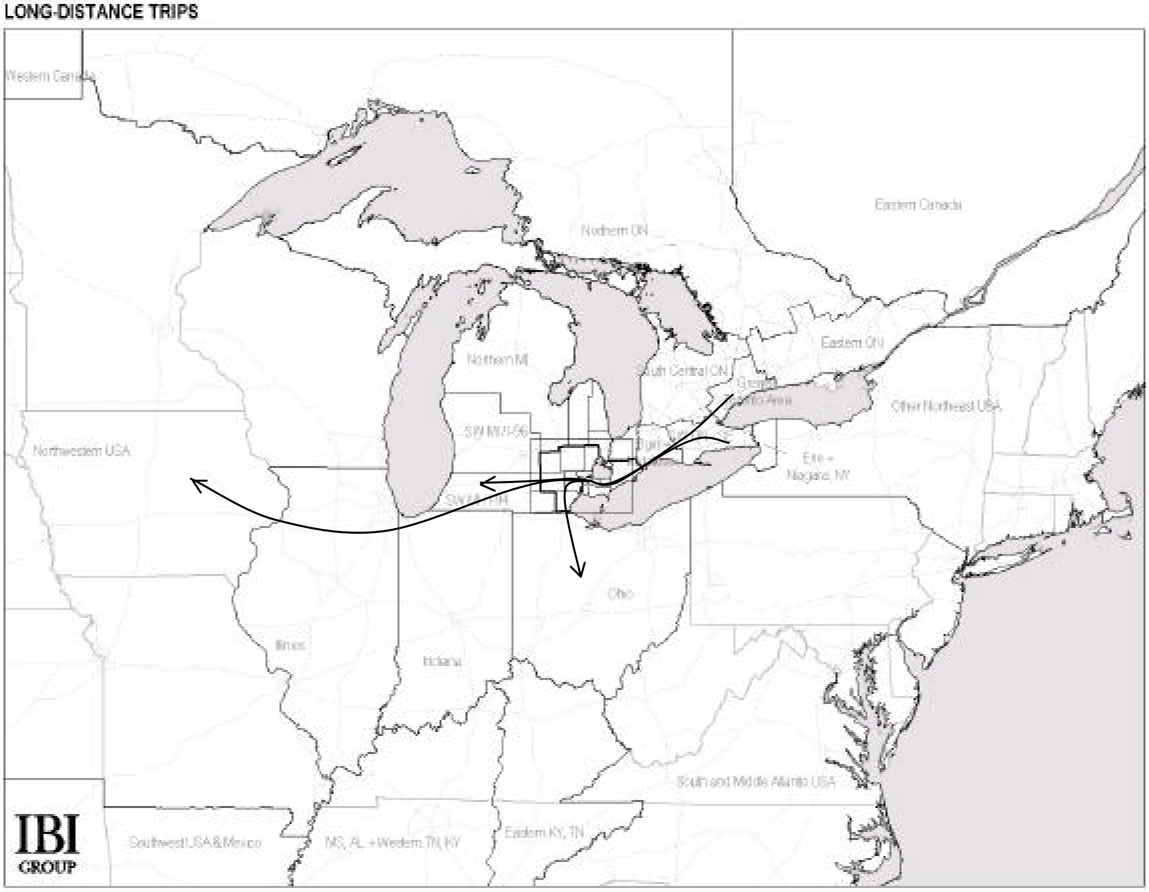
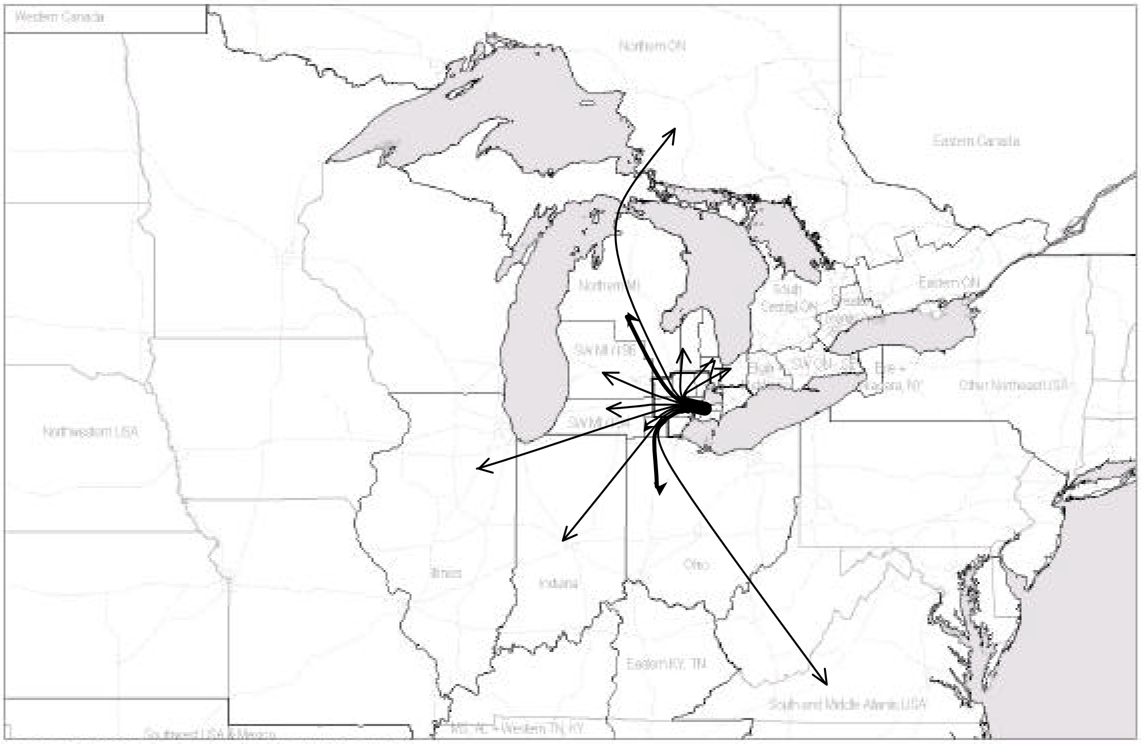


EXHIBIT 2.17 (CONT.): WEEKDAY 24-HOUR PASSENGER CAR TRIPS TO US VIA DETROIT-WINDSOR TUNNEL, 2000

LOCAL (WINDSOR AREA) TO LONG-DISTANCE TRIPS



LONG-DISTANCE TO LOCAL (DETROIT AREA) TRIPS

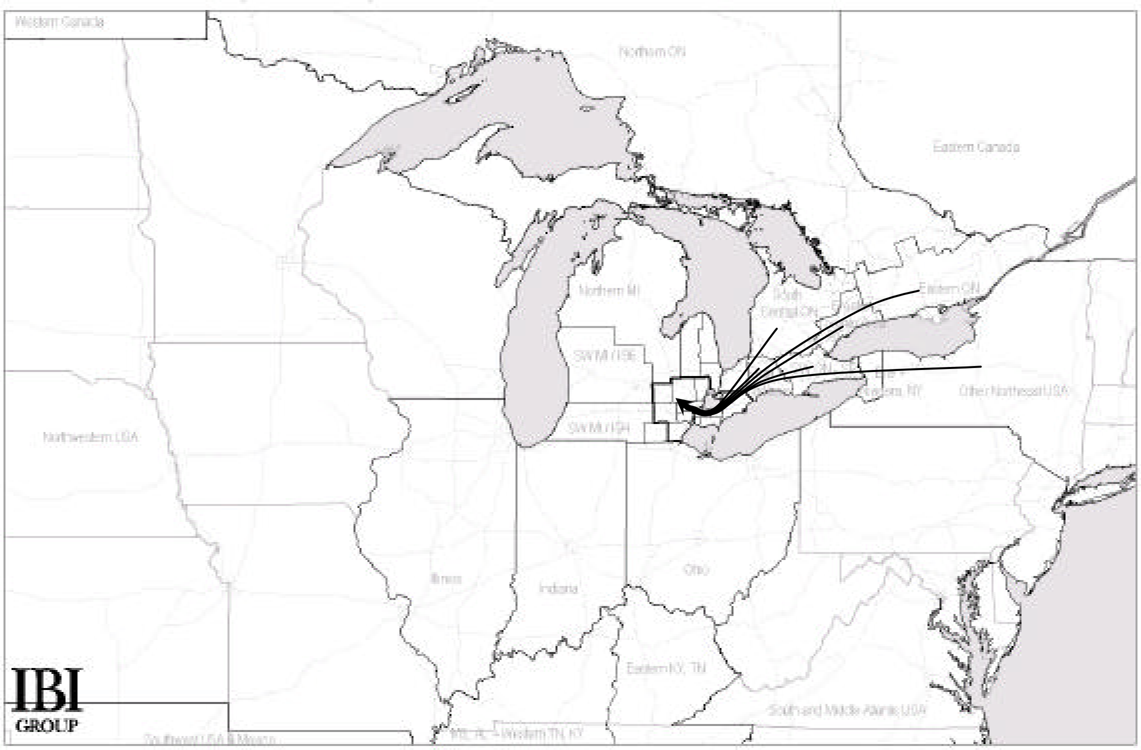
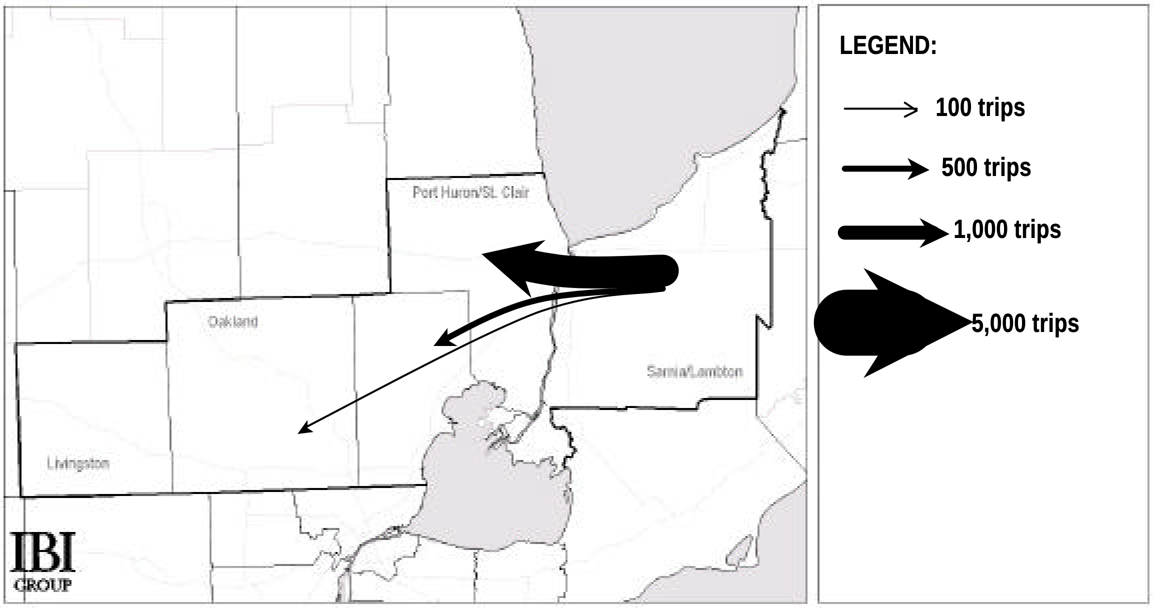


EXHIBIT 2.18: WEEKDAY 24-HOUR PASSENGER CAR TRIPS TO US VIA BLUE WATER BRIDGE, 2000

LOCAL TRIPS



LONG-DISTANCE TRIPS

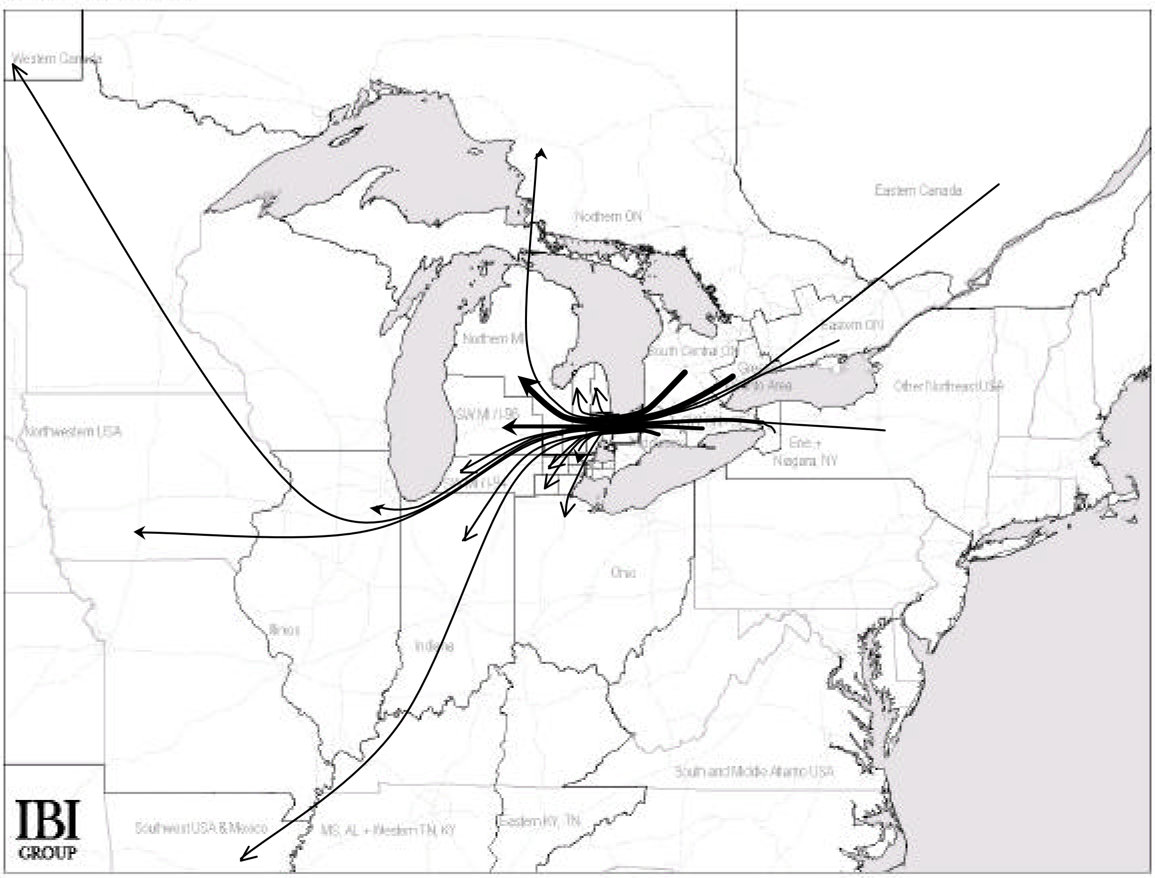
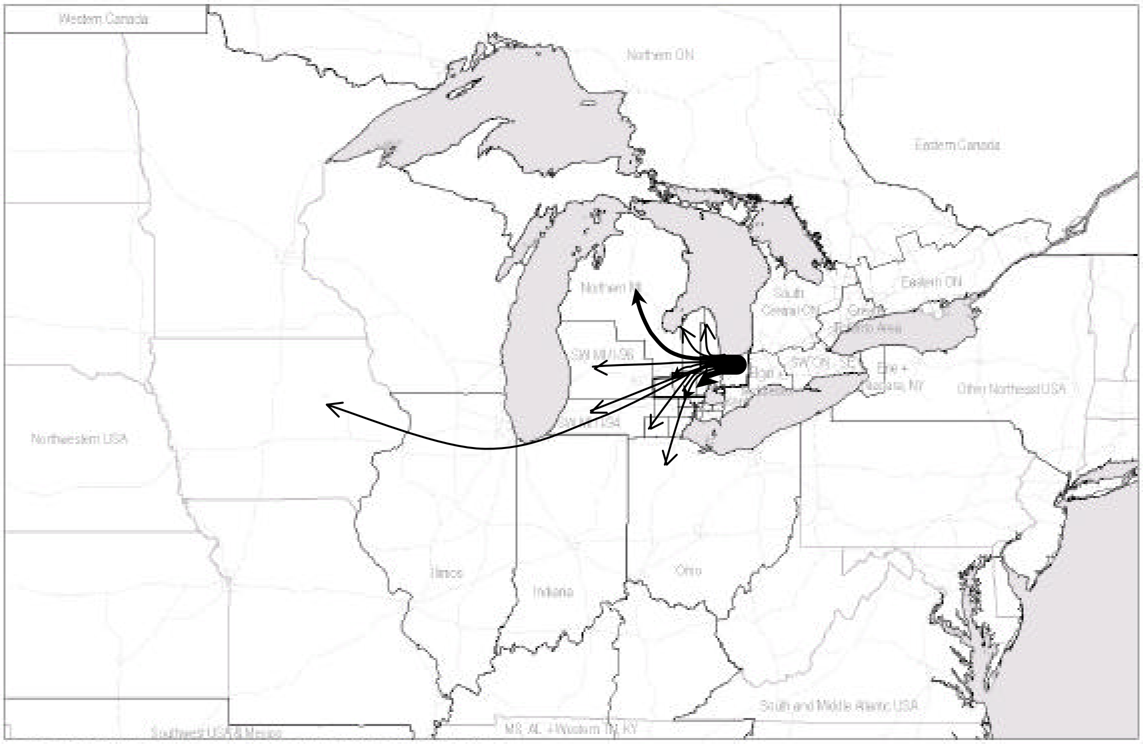
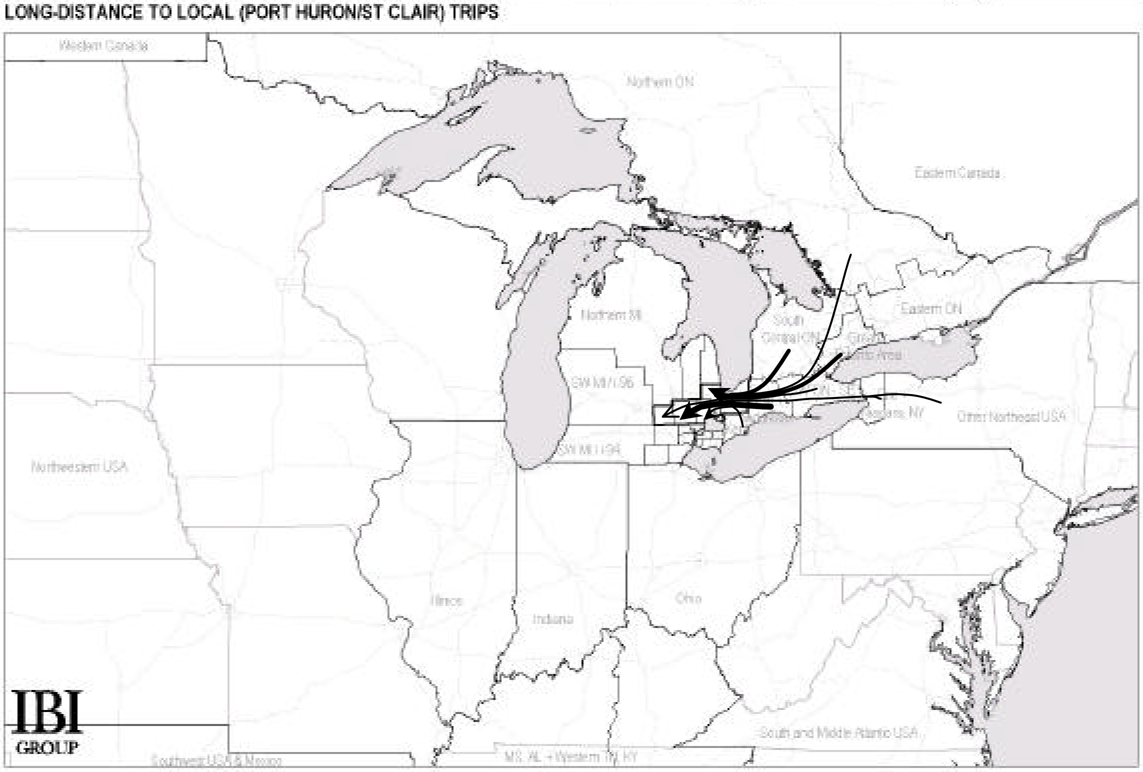


EXHIBIT 2.18 (CONT.): WEEKDAY 24-HOUR PASSENGER CAR TRIPS TO US VIA BLUE WATER BRIDGE, 2000

LOCAL (SARNIA/LAMBTON) TO LONG-DISTANCE TRIPS



LONG-DISTANCE TO LOCAL (PORT HURON/ST CLAIR) TRIPS



Exhibits 2.19 to 2.23 provide additional information regarding spatial distribution of trip ends for different trip purposes: vacation, work, casino, recreation/entertainment and shopping. Observations that can be made from these plots are described below.

Almost 70% of **vacation** trips are made by US citizens to Canadian vacation spots, which include the north shore of Lake Erie, the south shore of Lake Huron, and places throughout Southwest Ontario as far as the Greater Toronto Area. Approximately 4% of vacation trips using the Southwest Ontario/Southeast Michigan border crossings are in transit to location spots in New York State and Northeast US.

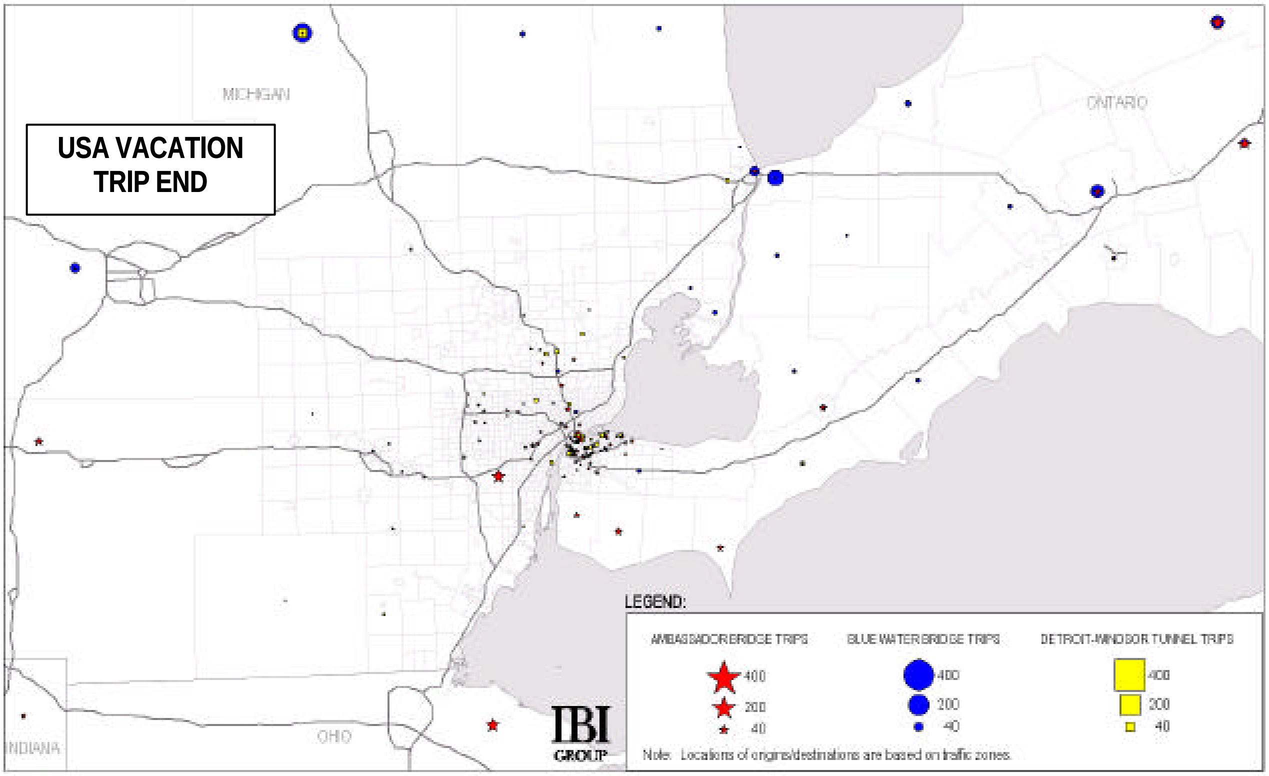
Approximately 77% of **work/business**/school destinations are in the United States. For these trips, the Detroit-Windsor Tunnel is generally used to access locations along the I-75 and I-95 north corridors, and also throughout the Windsor central area. The labour force living along the Huron-Church corridor in Windsor, as well as outside of Windsor, tends to use the Ambassador Bridge more. On the US side, although trip destinations for trips using the Ambassador Bridge are more scattered, there is a larger concentration of destinations along I-94 south and in downtown Detroit

Virtually all **casino** trips are to two locations: the Windsor Casino and the Sarnia Casino. Only 2.2% of casino trips are to US casinos, most notably MGM Grand Detroit. Northern Michigan residents tend to go to the Sarnia casino, whereas virtually all casino-goers from outside of St. Clair County and south of the I-69 corridor go the Windsor Casino. Among Windsor Casino-goers, the border crossing closest to the origin-destination on the US side is used.

More than 70% of **recreation/entertainment** trips are to Canadian attractions. Two-thirds of these Canadian attractions are in Essex County, mostly in the Windsor central area (e.g. restaurants, night clubs). Other destinations include Sarnia (12%) and throughout Southwest Ontario as far as the Greater Toronto Area. Of Canadians making recreation/entertainment trips to the US, 54% are from Essex County (mostly Windsor), and 11% are from Sarnia.

More than 70% of **shopping** trips are to US shopping locations, largely in Port Huron, as well as along the I-75 corridor north of Detroit, including Royal Oak, Birmingham and Pontiac areas. More than half of the cross-border shopping done in Canada is in the Windsor downtown and as far south as Devonshire Mall (E.C. Row and Howard Avenue), the rest of the shopping being done in Sarnia and throughout Southwest Ontario. The Blue Water Bridge has almost as many shopping trips as the Ambassador Bridge and the Detroit-Windsor Tunnel combined.

EXHIBIT 2.19: PASSENGER CAR ORIGINS/DESTINATIONS FOR WEEKDAY VACATION TRIPS, 2000



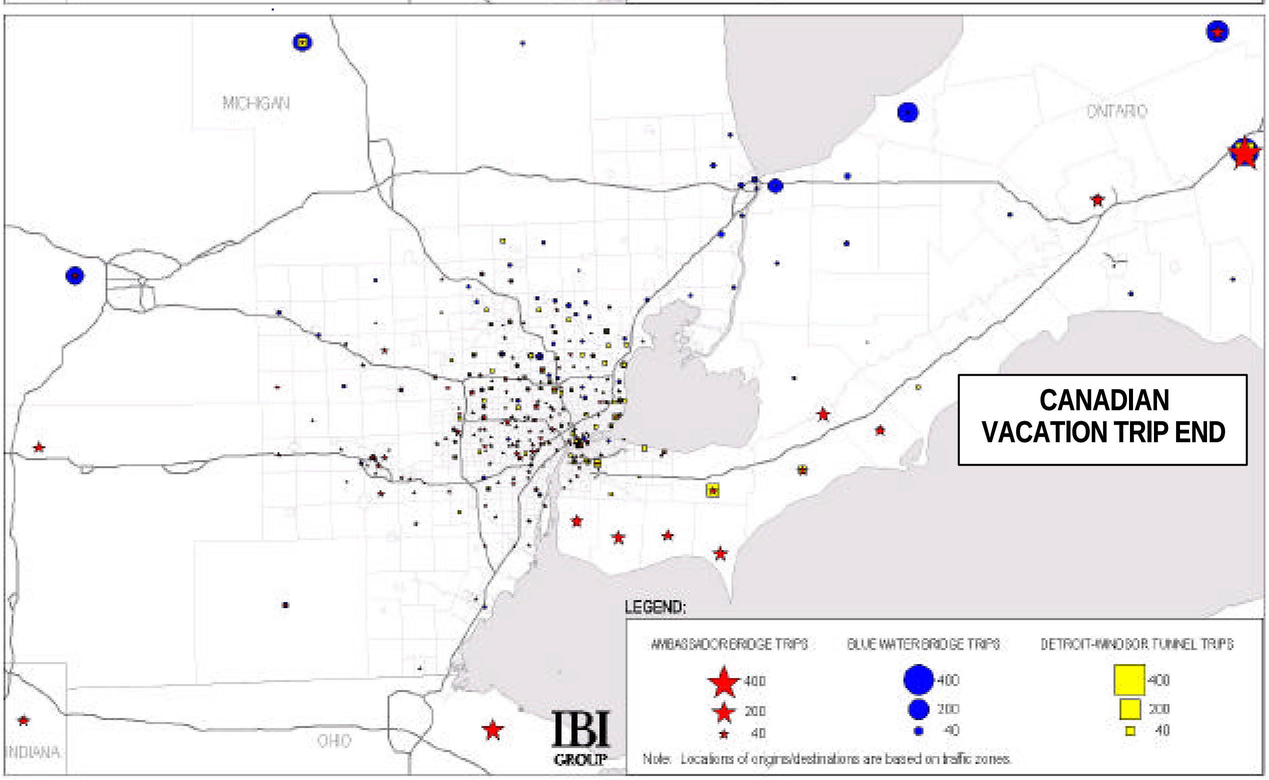
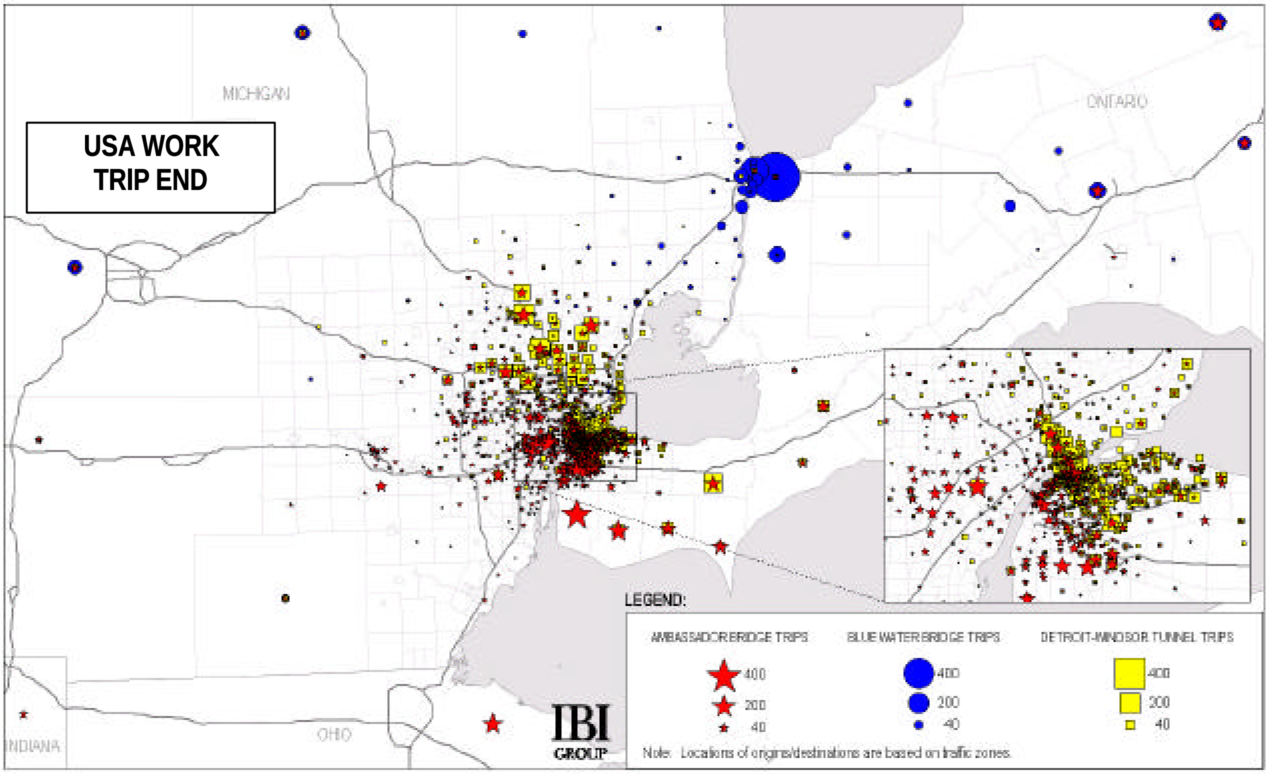


EXHIBIT 2.20: PASSENGER CAR ORIGINS/DESTINATIONS FOR WEEKDAY WORK/BUSINESS/SCHOOL TRIPS, 2000



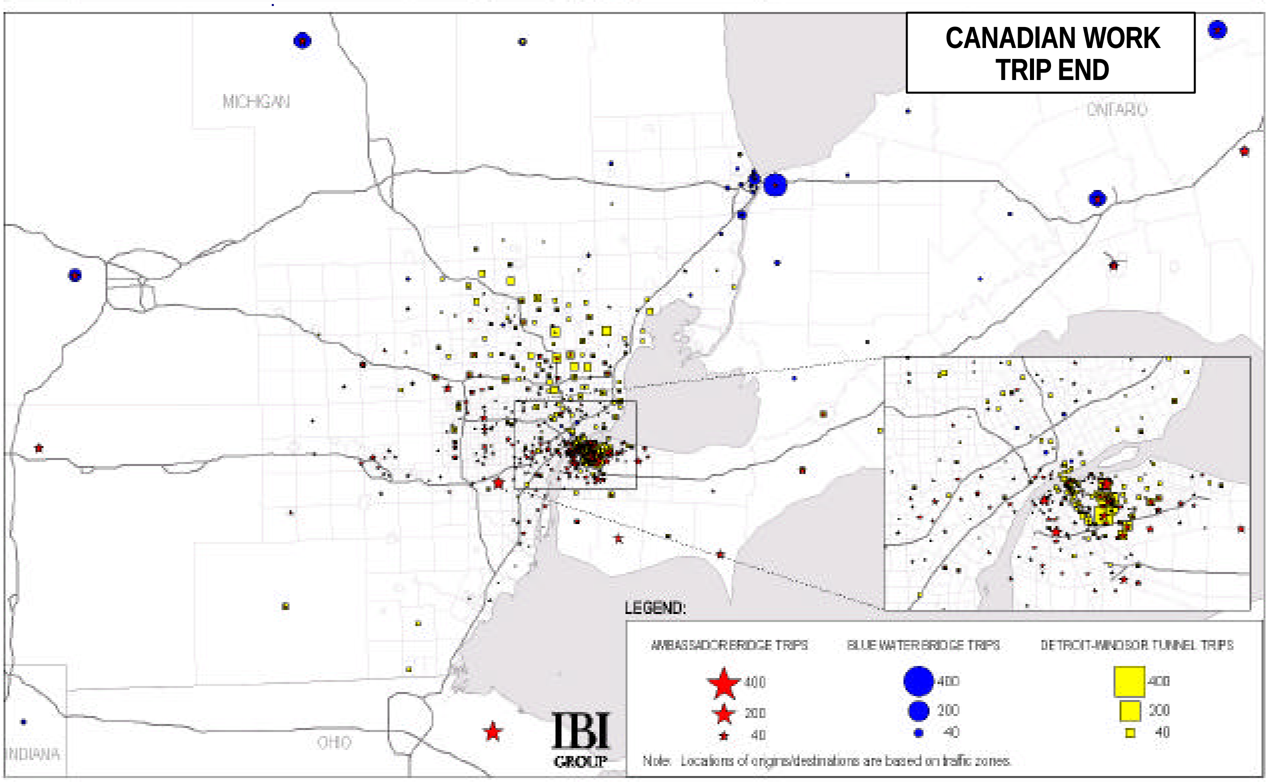
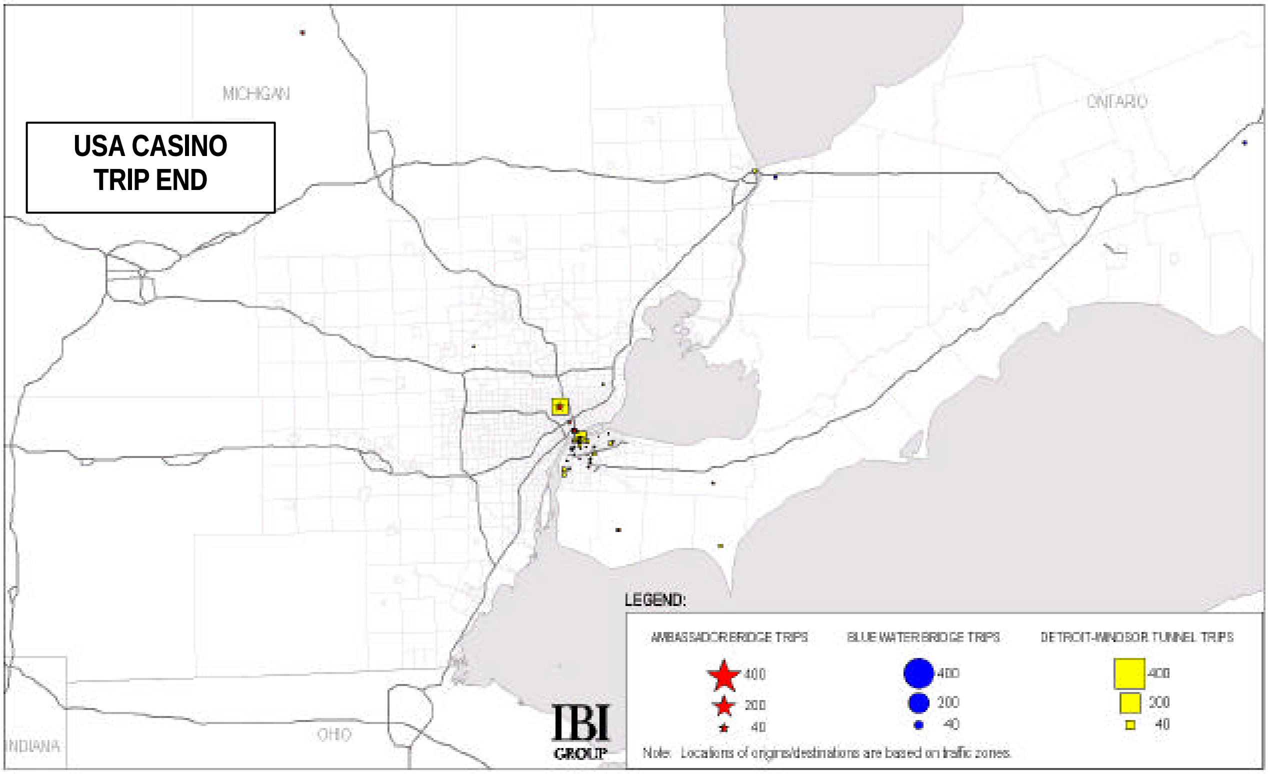


EXHIBIT 2.21: PASSENGER CAR ORIGINS/DESTINATIONS FOR WEEKDAY CASINO TRIPS, 2000



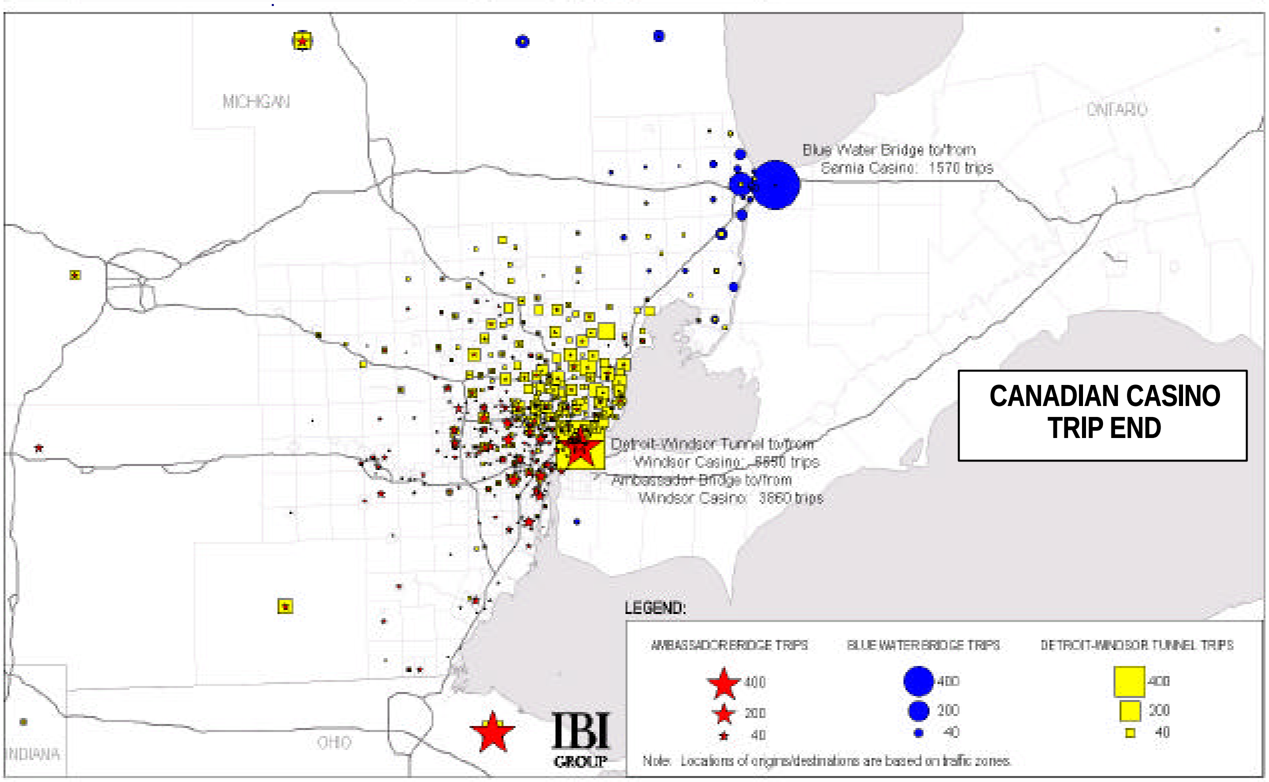
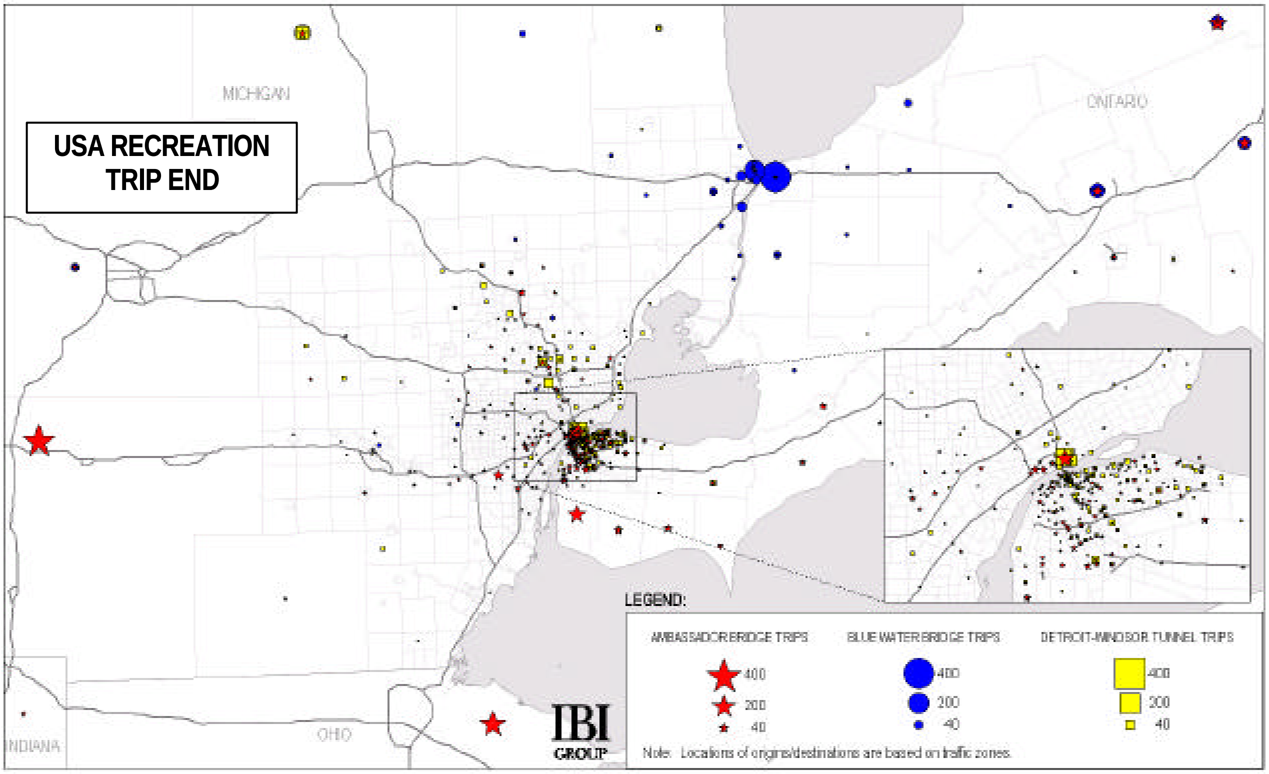


EXHIBIT 2.22: PASSENGER CAR ORIGINS/DESTINATIONS FOR WEEKDAY REC./ENT. TRIPS, 2000



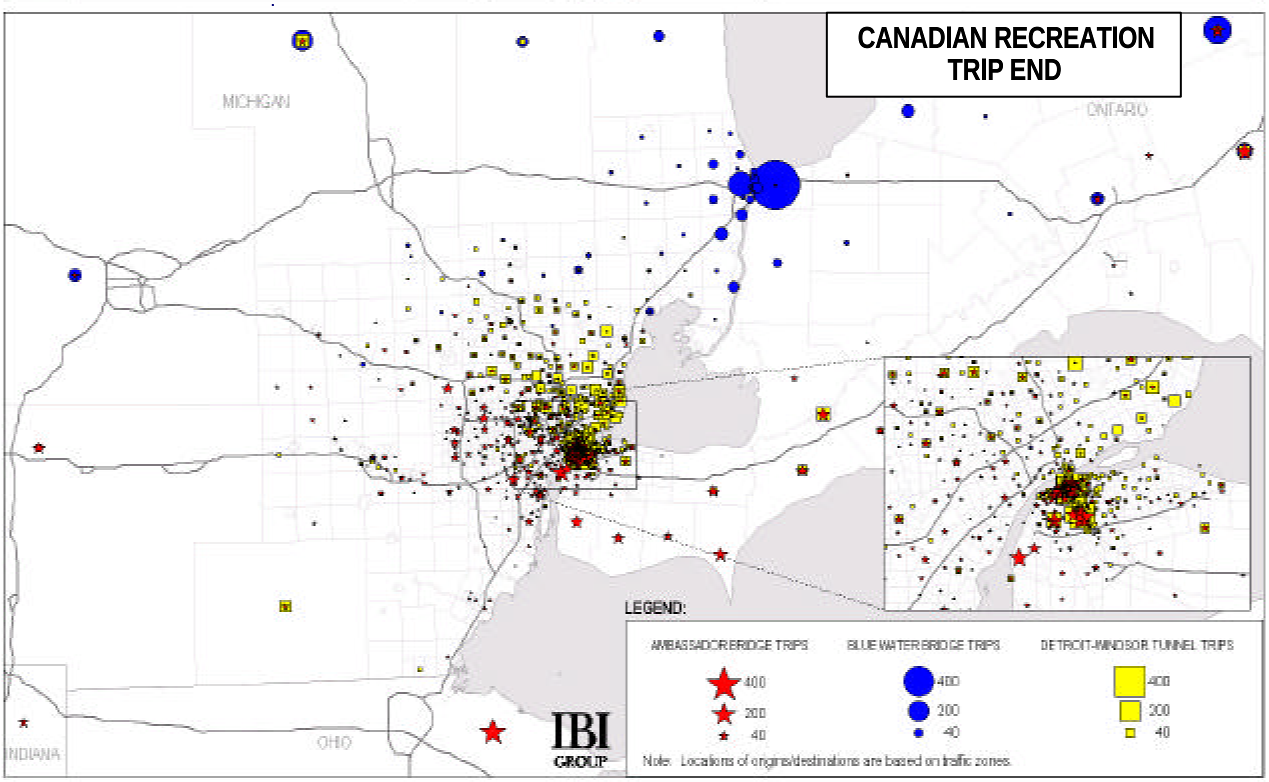
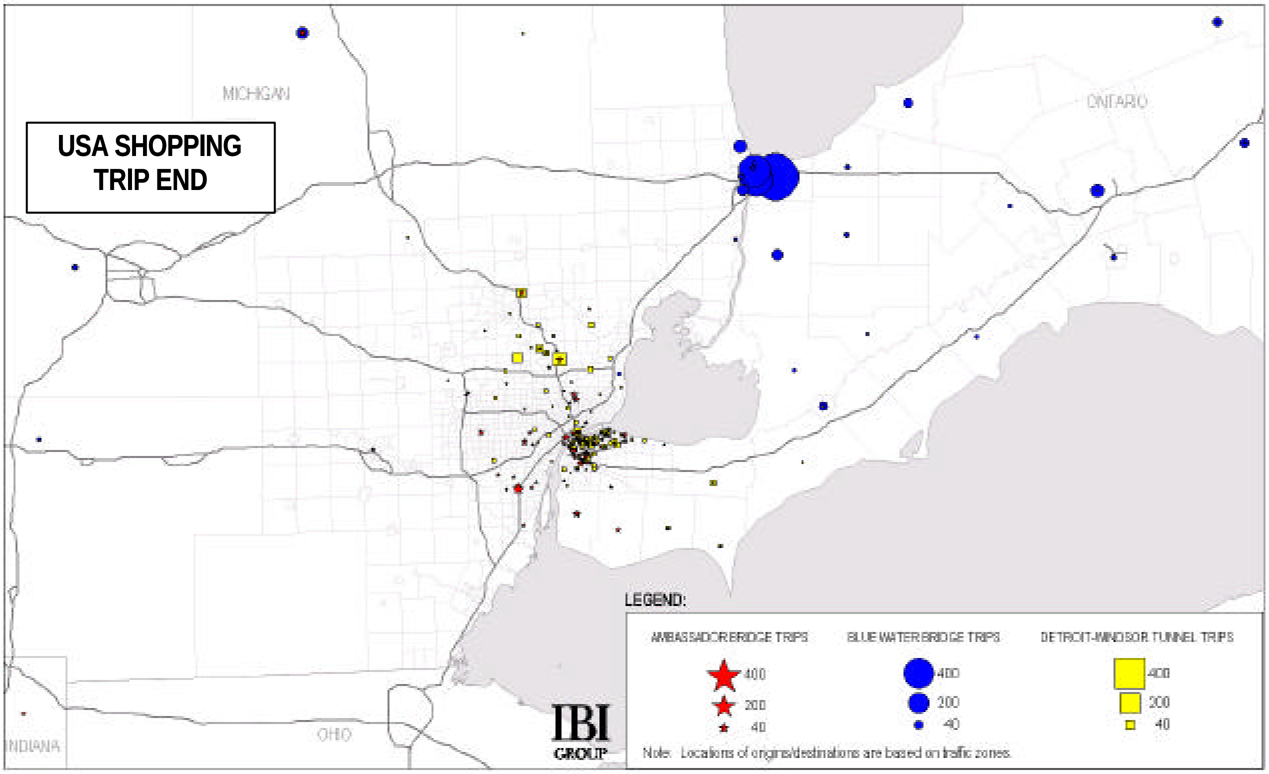
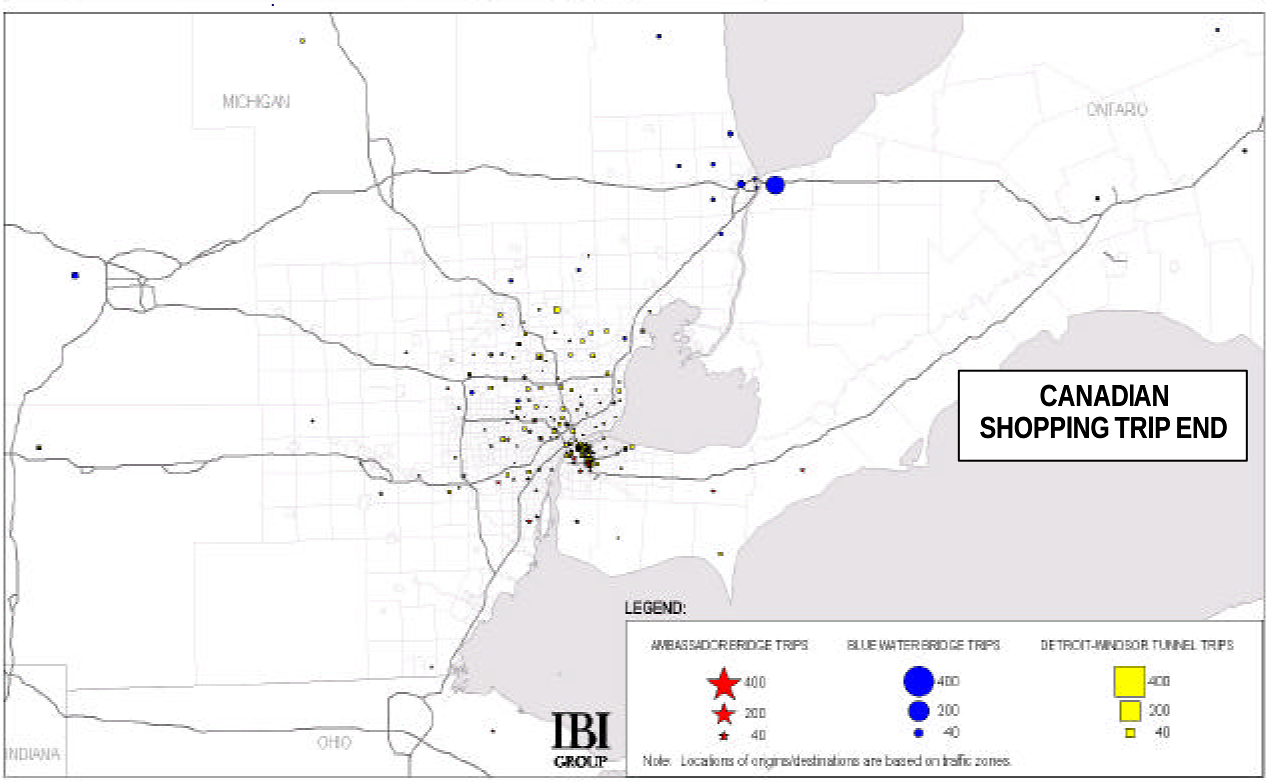


EXHIBIT 2.23: PASSENGER CAR ORIGINS/DESTINATIONS FOR WEEKDAY SHOPPING TRIPS, 2000





2.3. Cross-Border Commercial Vehicle Travel

Historic Trends

Exhibit 2.24 shows annual commercial vehicle volumes for the three crossings from 1972 to 2001. In the past ten years, commercial vehicle volumes have increased very rapidly and have 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, have 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. In total, since 1994, growth in commercial vehicle volumes exhibited at the three crossings has been much stronger than that of other Canada-US border region (see Exhibit 2.25).

Cross-border commercial vehicle traffic has increased by almost 5 times since 1972, and doubled in the last decade.

Since 1994, the growth in traffic between SE Michigan and SW Ontario is approximately triple Niagara Region, the next highest US-Canada border region.

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 Southwest 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).

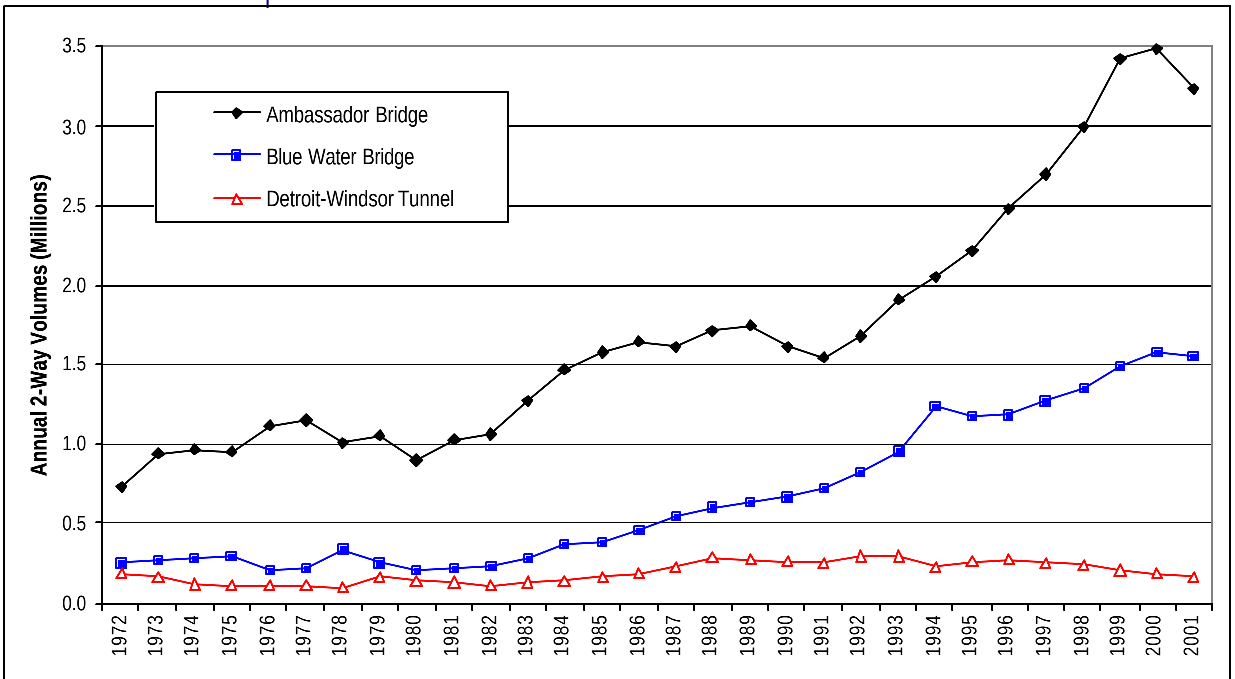
In terms of overall levels of commercial vehicle traffic, the movement to just-in-time inventories has resulted in significantly increased demand in the trucking industry in general, and increased competitiveness of the trucking mode relative to rail. This trend to just-in-time inventories is most prevalent in the auto industry, which is the dominant industry in the corridor. 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 three Southwest Michigan/Southwest Ontario border crossings.

Trade agreements have also positively influenced the rate of growth in commercial vehicles across the border, most notable 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 January 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.

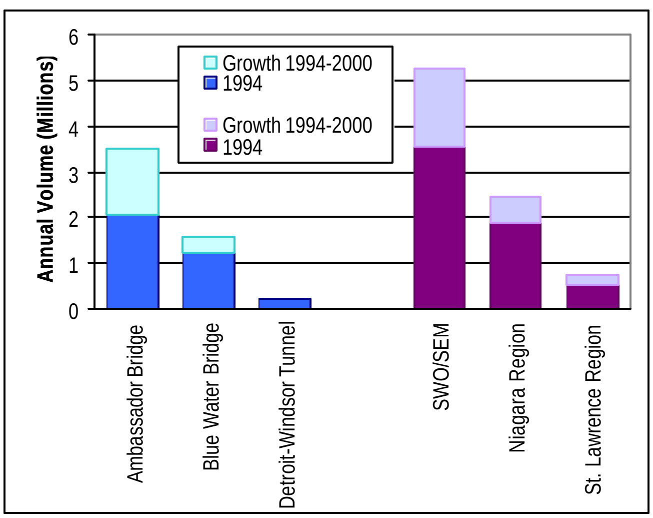
At present, it is estimated that over one-third of goods moving between US and Canada relate to automotive components or assembled vehicles, with trucking representing the dominant mode of transport between Canada and the US.

EXHIBIT 2.24: ANNUAL COMMERCIAL VEHICLE VOLUMES, 1972-2001



Source: Bridge and Tunnel Operators Association (BTOA)

EXHIBIT 2.25: GROWTH IN ANNUAL COMMERCIAL VEHICLE VOLUMES, 1994-2000



Source: Data Management and Analysis Office (MTO) with input from both US and Canadian Bridge Authorities

Seasonal Variation

Exhibit 2.26 shows monthly commercial vehicle volumes at each of the three crossings since 1995. Each crossing shows lower commercial vehicle volumes in July, and to a lesser extent, in December or January each year. July volumes are typically 70 to 90% lower than the annual average at each crossing, largely due to plant shutdowns during this month due plant shutdowns of the major automobile manufacturers.

The impacts of the events of 9/11 can be seen in an uncharacteristic drop in commercial vehicle volumes for that month. However, there was less of an impact on Blue Water Bridge volumes than on Ambassador Bridge volumes. Ambassador Bridge volumes for the last quarter of 2001 were 6% lower than the same quarter of 2000, whereas at the Blue Water Bridge they were 1% higher.

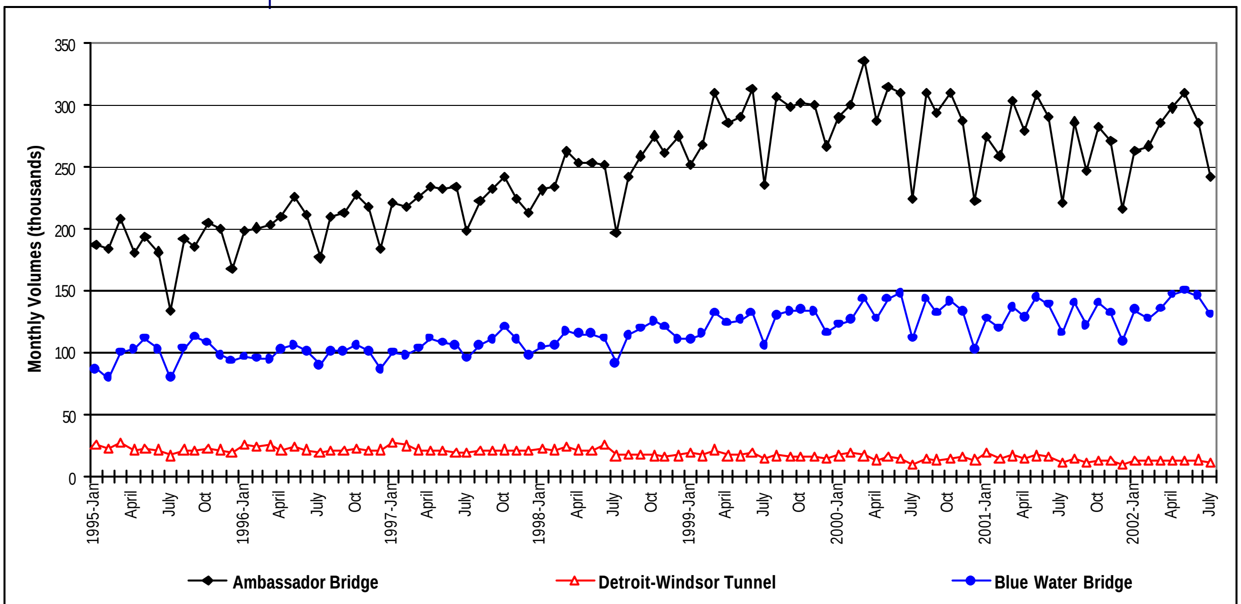
Exhibit 2.27 is a plot of historic seasonal trends for combined passenger vehicle and commercial vehicle border crossings for the three crossings. It can be seen that, given the greater seasonal variations of passenger car traffic, the highest volumes for total traffic have consistently occurred in the month of August. This remains the case even when a truck passenger-car equivalent factor of 3.0 is applied.

Daily Traffic Variation

The variation of commercial vehicle border crossing traffic volumes by day of week for each crossing can be seen in Exhibit 2.28. The highest traffic volumes are on weekdays, especially mid-week (Tuesday to Thursday). For the Ambassador and Blue Water Bridges, Saturday volumes are about half of mid-week volumes, while Sunday volumes are only 30% to 40% of mid-week volumes. The Detroit-Windsor Tunnel exhibits an even greater percentage decrease in commercial vehicle traffic on weekends.

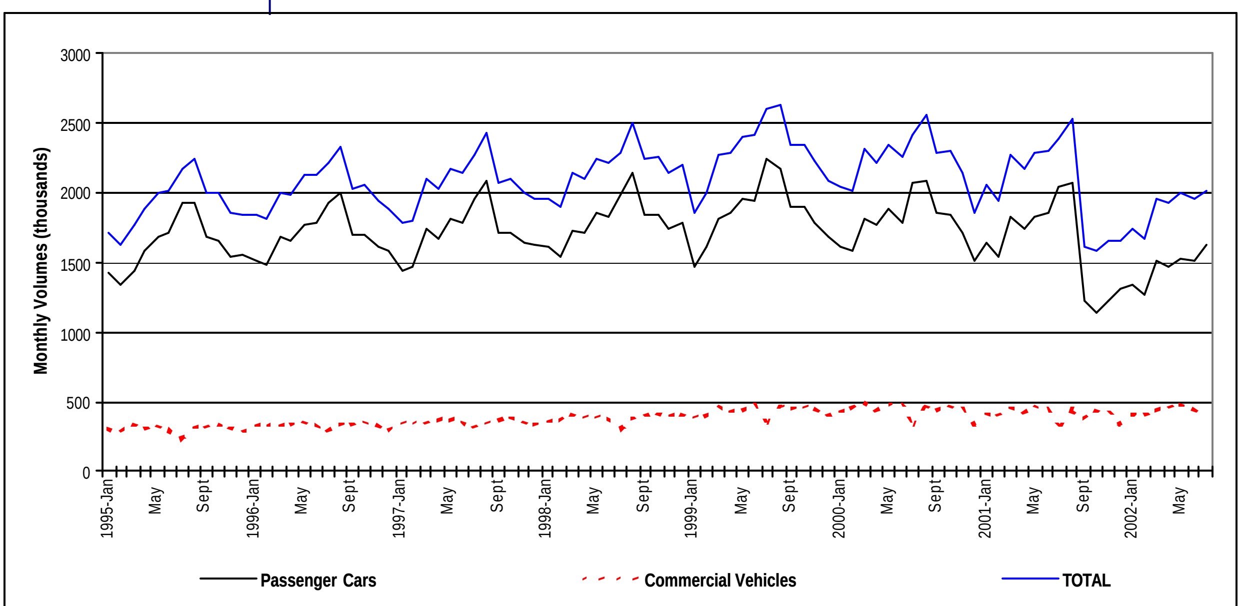
When commercial vehicles are considered together with passenger cars, as shown in Exhibit 2.29, Fridays have the highest total traffic, followed by Saturdays. However, when comparing volumes in terms of passenger car equivalents, given that commercial vehicles take up more space on the road, any weekday has higher total traffic than Saturdays or Sundays. The same is true of counts taken for the **Ontario-Michigan Border Crossing Traffic Study** (summer 2000).

EXHIBIT 2.26: SEASONAL TRENDS IN COMMERCIAL VEHICLE TRAFFIC BY CROSSING, 1995-2002



Source: Bridge and Tunnel Operators Association, as provided by MTO Data Management and Analysis Office.

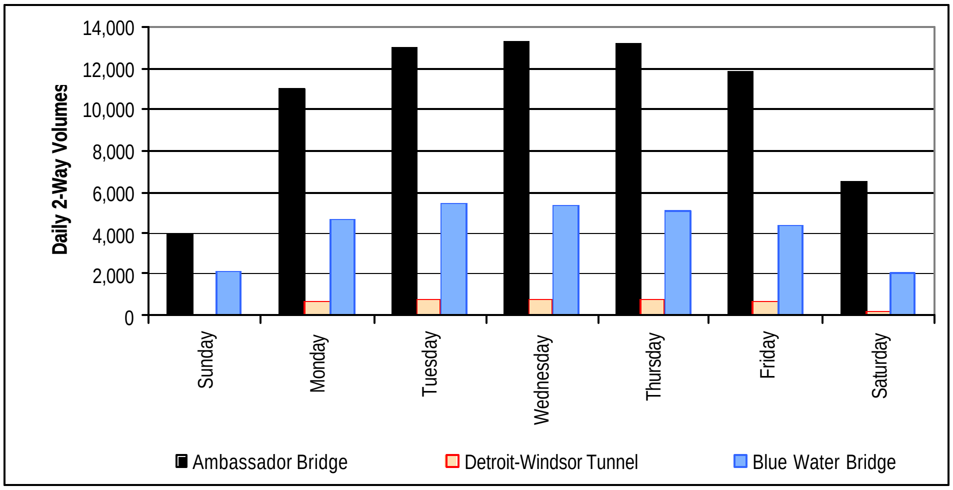
EXHIBIT 2.27: SEASONAL TRENDS IN COMMERCIAL AND PASSENGER VEHICLE TRAFFIC, 1995-2002, SOUTHEAST MICHIGAN – SOUTHWEST ONTARIO CROSSINGS



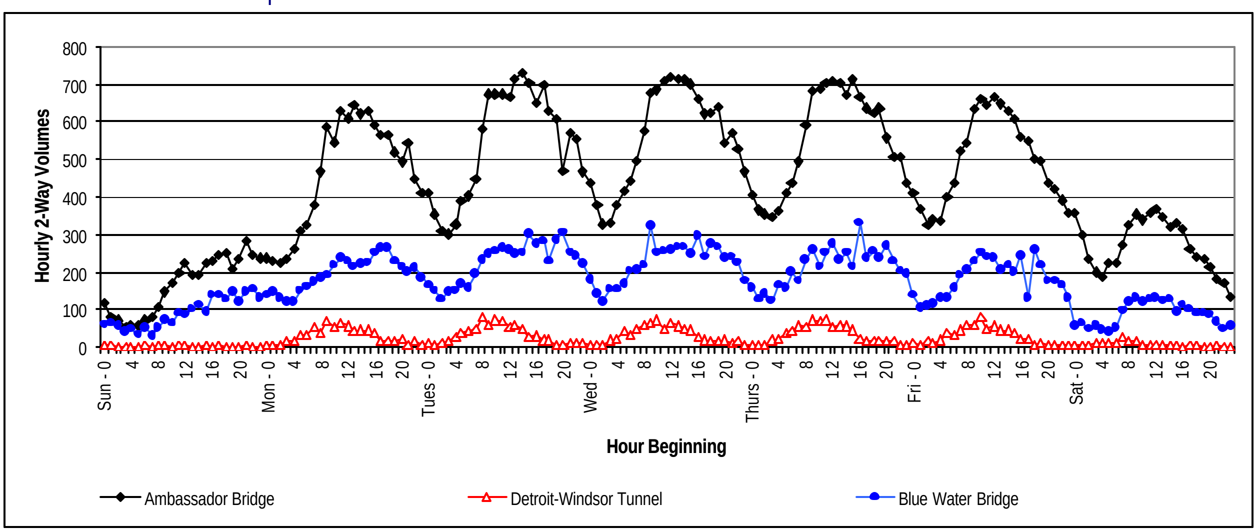
Source: Bridge and Tunnel Operators Association, as provided by MTO Data Management and Analysis Office.

EXHIBIT 2.28: DAILY VARIATION IN COMMERCIAL VEHICLE TRAFFIC, 2000

A. DAILY TOTALS



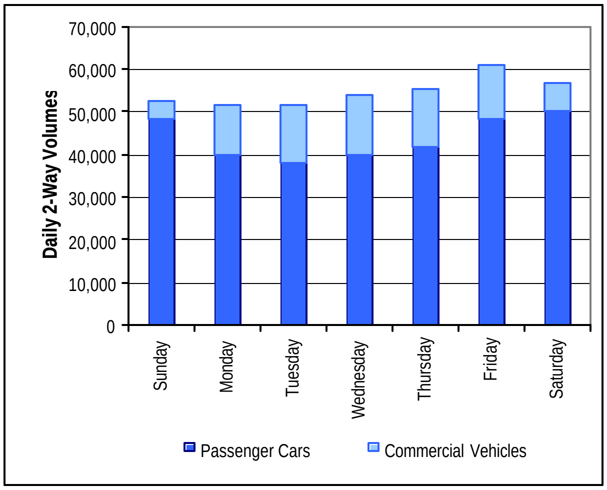
B. DAILY VARIATION WITH HOURLY DETAIL



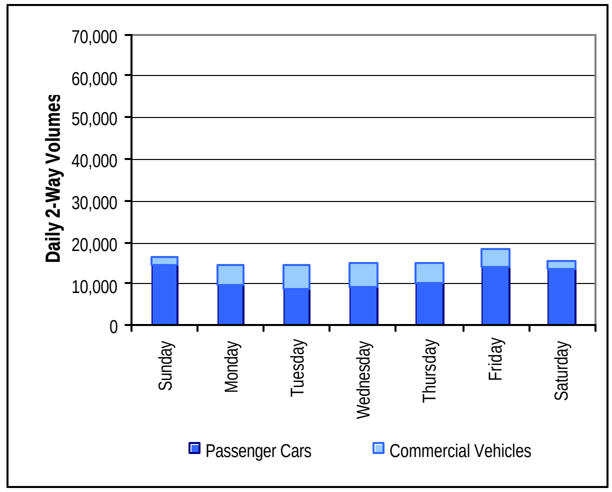
Source: **NRS/MTO Commercial Vehicle Survey** traffic counts (Ambassador Bridge and Detroit-Windsor Tunnel – September 2000, Blue Water Bridge – September 1999)

EXHIBIT 2.29: DAILY TOTALS FOR COMBINED PASSENGER CAR AND COMMERCIAL VEHICLE CROSS-BORDER TRAFFIC, 2000

DETROIT-WINDSOR



SARNIA-PORT HURON



Source: **NRS/MTO Commercial Vehicle Survey** traffic counts (Ambassador Bridge and Detroit-Windsor Tunnel – September 2000, Blue Water Bridge – September 1999)

Hourly Traffic Variation

Hourly commercial vehicle volumes by hour, day and direction can be seen for each crossing in Exhibit 2.30 (note different scales). Cross-border commercial vehicle traffic is highest during weekday mid-day periods, although the distribution is relative even throughout the day and do not include the characteristic morning and afternoon peaks associated with passenger car traffic.

At the Ambassador and Blue Water Bridges, commercial vehicle volumes remain relatively steady from approximately 9 AM, until gradually dropping off after about 6 PM at the Ambassador Bridge, and about 10 PM at the Blue Water Bridge. In the middle of the night, volumes drop only by about half compared to weekday peak hours. Saturday daytime peak volumes reach roughly only as high as weekday middle-of-the-night volumes. Sunday volumes are very low in the morning, but are close to weekday middle-of-the-night volumes by about mid-day.

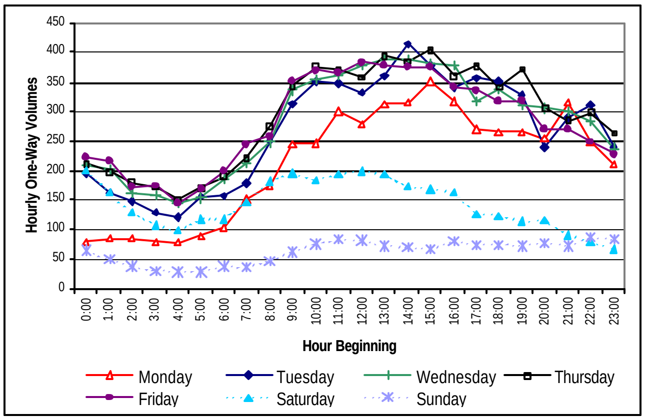
At the Detroit-Windsor Tunnel, traffic peak begins earlier in the morning (as early as 5 or 6 AM), and drops off significantly by mid-afternoon. Night-time and weekend volumes are only a small percentage of weekday volumes.

As could be seen previously in Exhibit 2.8 in Section 2.2, when passenger car and commercial vehicle volumes are combined, peak traffic times are during the weekday morning and afternoon peak periods, due largely to large volumes of commuter traffic, described in Section 2.2.

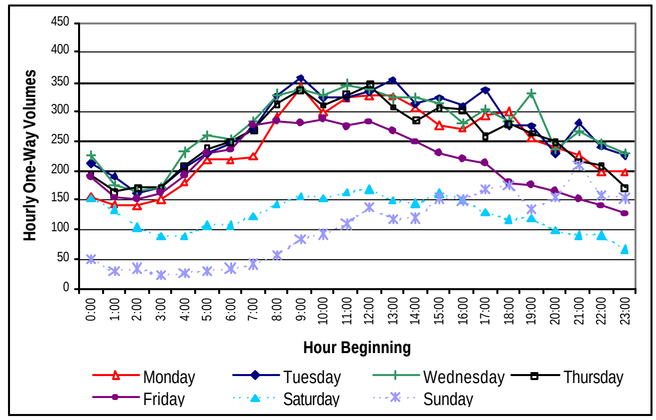
EXHIBIT 2.30: HOURLY COMMERCIAL VEHICLE VOLUMES BY DIRECTION, 2000

AMBASSADOR BRIDGE

INTO CANADA

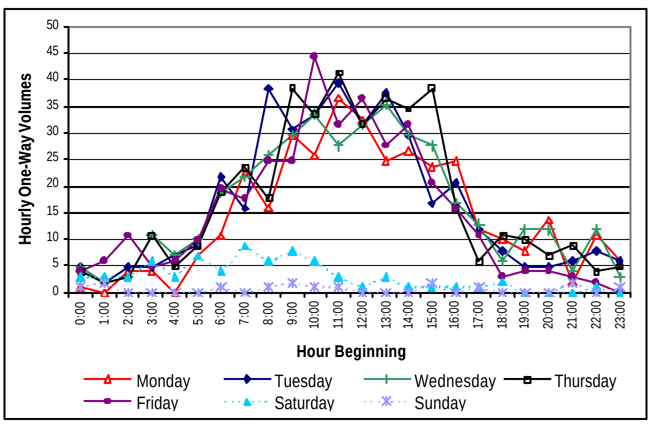


INTO US

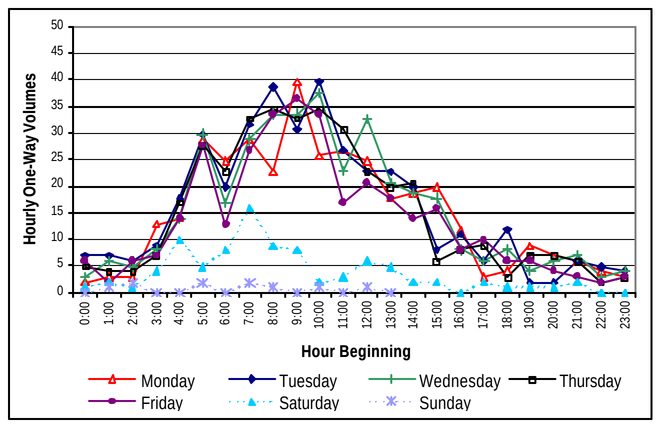


DETROIT-WINDSOR TUNNEL – *Note Change of Scale*

INTO CANADA

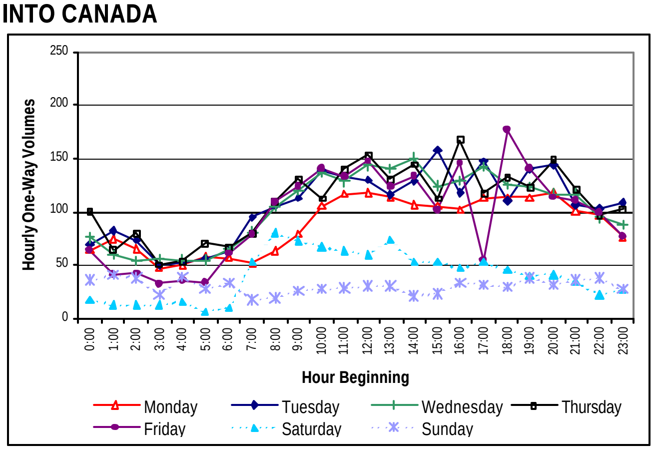


INTO US

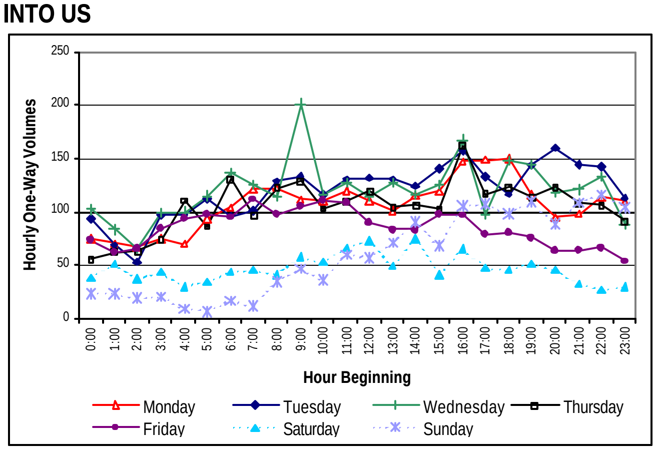


BLUE WATER BRIDGE – *Note Change of Scale*

INTO CANADA



INTO US



Source: ***NRS/MTO Commercial Vehicle Survey*** traffic counts (Ambassador Bridge and Detroit-Windsor Tunnel – September 2000, Blue Water Bridge – September 1999)

Over 90% of the commercial vehicles are multi-unit vehicles with tractor and trailer or tractor and two trailers.

Vehicle Configuration

Ontario-Michigan border crossings generally carry a higher proportion of larger trucks than would be seen on a typical highway. The distribution of weekday vehicle configurations at each of the three border crossings is shown in Exhibit 2.31. At the Ambassador and Blue Water Bridges, 89% of commercial vehicles are tractors with 1 trailer, while 92 to 94% of commercial vehicles have at least one trailer. Commercial vehicles are smaller at the Detroit-Windsor Tunnel, with 37% being straight trucks only. However, the percentage of trucks with two trailers is highest at this crossing, 10% of commercial vehicles, versus 5% at the Blue Water Bridge, and 2% at the Ambassador Bridge. Some of these trucks and trailers are specially designed to be low enough to clear the tunnel.

EXHIBIT 2.31: COMMERCIAL VEHICLE CONFIGURATIONS, 2000

Vehicle Type	Percentage Of Weekday Vehicles		
	Ambassador Bridge	Detroit-Windsor Tunnel	Blue Water Bridge
Tractor & 1 trailer	88.7%	46.4%	89.1%
Tractor & 2 trailers	2.2%	10.4%	5.2%
Straight truck	6.6%	37.0%	5.0%
Straight truck & trailer	0.7%	0.9%	0.2%
Tractor only	1.8%	5.2%	0.5%
Other	0.1%	0.0%	0.1%
TOTAL TRIPS	**100%**	**100%**	**100%**

Source: Based on NRS/MTO commercial vehicle dataset

Approximately 35% of the commercial vehicles are carrying goods directly related to the automobile industry.

Commodity Types

The distribution of weekday commercial vehicle volumes by commodity type and crossing is summarized in Exhibit 2.32, with more detail shown in tabular form in Exhibit 2.33. These are based on commodity information provided in the expanded NRS/MTO commercial vehicle database. (Trucks carrying only pallets or empty racks were designated as empty.) The most common commodity type by volume of commercial vehicles is related to the auto industry with over 6,200 vehicles daily, or 34% of all commercial vehicle trips. In addition to these, a percentage of the almost 1,600 vehicles carrying metal daily would be directly related to the auto industry. The Ambassador Bridge carries 68% of the auto industry-related commercial vehicle volumes among the three crossings. Forest and animal/plant products are also common, each at 1,600 trips daily, followed by machinery/electronics (880 vehicles). Approximately 13% of commercial vehicles are not carrying freight during their cross-border trip.

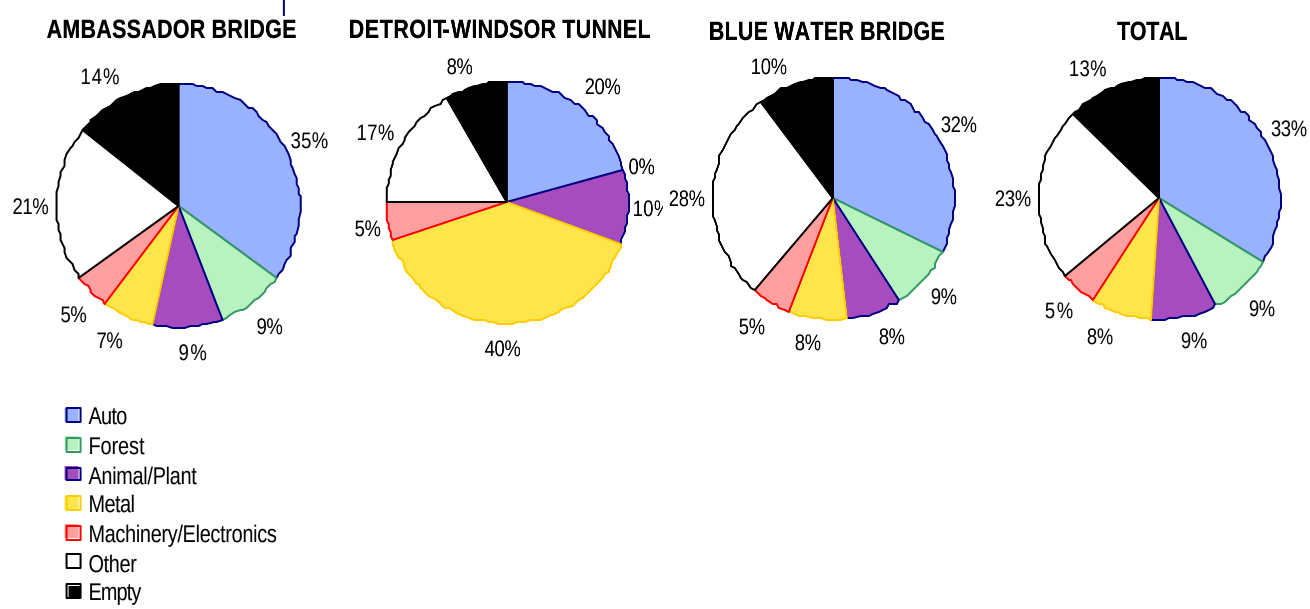
The estimate of 13% empty truck is based on the MTO/NRS Commercial Vehicle Survey used in this study, which compares to a much higher 27% level reported by the EBTC for the three crossings. A recent analysis by MTO estimated 17% empty movements. The wide range is due to the use of different datasets and possibly the definition used for an empty movement. Nevertheless, the proportion of empty movements is much higher than typical non-cross border movements given US Customs Service, US Immigration and

Naturalization Service and Citizenship and Immigration Canada laws on cabotage, which do not permit non-citizen truck drivers to pick up and haul goods. Hence a Canadian truck driver may cross the border and deliver in the US, but cannot carry back-haul cargos from the US to Canada.

Hazardous materials (HAZMAT) may be transported by the Detroit-Windsor Ferry and the Blue Water Bridge using designated HAZMAT corridors. There are HAZMAT restrictions on the Ambassador Bridge and Detroit-Windsor Tunnel, making the Ferry the only HAZMAT corridor in the Detroit-Windsor area. The Detroit-Windsor Ferry and Blue Water Bridge can also accommodate oversized and heavy loads. The ferry carries approximately 40 vehicles per day.

The origin-destination patterns of commercial vehicles vary by commodity, as can be seen in the lower part of Exhibit 2.33. Certain commodity types tend to be transported longer distances than others. For example, 76% of animal/plant product trips are long-distance to long-distance trips. Forest products, machinery/electronics and "other" commodities are also transported by a higher proportion of long-distance trips, at about two-thirds of trips for these commodities. Auto industry-related trips are unique in that some 30% of auto industry trips are between the SEMCOG area and locations beyond Essex County, whereas this makes up no more than 21% of trips by other commodity types. Commercial vehicles tend not to be driven empty for long distances: some 27% of local-to-local (between the SEMCOG area and Essex County) trips are empty trucks, whereas these make up only 8% of entirely long-distance trips (both ends outside of SEMCOG/Essex County).

EXHIBIT 2.32: DISTRIBUTION OF COMMERCIAL VEHICLE VOLUMES BY COMMODITY TYPE, 2000



Source: NRS/MTO Commercial Vehicle Survey, 1999/2000

EXHIBIT 2.33: COMMERCIAL VEHICLE VOLUMES BY COMMODITY TYPE, 2000

	Commodity Type							
Crossing	**Auto**	**Forest**	**Animal/ Plant**	**Metal**	**Machinery/ Electronics**	**Other**	**Empty**	**TOTAL**
Weekday Volumes								
Ambassador Bridge								
Into Canada	1,966	263	688	390	328	1,372	981	5,988
Into USA	2,258	819	441	446	219	1,138	735	6,056
TOTAL	4,224	1,082	1,129	836	547	2,510	1,716	12,044
Percent	35%	9%	9%	7%	5%	21%	14%	100%
Detroit-Windsor Tunnel								
Into Canada	77	0	32	153	16	61	33	373
Into USA	72	2	39	134	20	59	27	351
TOTAL	148	2	71	287	36	120	61	725
Percent	20%	0.2%	10%	40%	5%	17%	8%	100%
Blue Water Bridge								
Into Canada	877	104	217	173	161	783	274	2,588
Into USA	967	401	215	272	133	844	322	3,153
TOTAL	1,844	505	432	445	294	1,627	596	5,742
Percent	32%	9%	8%	8%	5%	28%	10%	100%
TOTAL								
Into Canada	2,919	367	937	716	506	2,216	1,289	8,949
Into USA	3,297	1,221	694	852	371	2,041	1,084	9,560
TOTAL	6,216	1,588	1,631	1,568	877	4,257	2,373	18,510
Percent	34%	9%	9%	8%	5%	23%	13%	100%
Origin-Destination Type								
Weekday Volumes								
SEMCOG/Essex	1,202	97	121	166	161	417	815	2,979
SEMCOG/Long-Dist.	1,898	250	166	304	97	595	454	3,764
Essex/Long-Distance	753	181	82	104	36	407	318	1,881
Long-Distance Only	2,578	1,059	1,196	897	583	2,788	785	9,886
TOTAL	6,431	1,586	1,564	1,471	878	4,206	2,373	18,510
Percentages By Commodity								
SEMCOG/Essex	19%	6%	8%	11%	18%	10%	34%	16%
SEMCOG/Long-Dist.	30%	16%	11%	21%	11%	14%	19%	20%
Essex/Long-Distance	12%	11%	5%	7%	4%	10%	13%	10%
Long-Distance Only	40%	67%	76%	61%	66%	66%	33%	53%
TOTAL	100%	100%	100%	100%	100%	100%	100%	100%
Percentages By Origin-Destination Type								
SEMCOG/Essex	40%	3%	4%	6%	5%	14%	27%	100%
SEMCOG/Long-Dist.	50%	7%	4%	8%	3%	16%	12%	100%
Essex/Long-Distance	40%	10%	4%	6%	2%	22%	17%	100%
Long-Distance Only	26%	11%	12%	9%	6%	28%	8%	100%

Source: Based on NRS/MTO commercial vehicle dataset, controlled to **Ontario-Michigan Border Crossing Traffic Study** traffic volumes

Of the some 18,500 daily commercial vehicle trips:

Approximately 50% represent long distance through travel.

Approximately 20% are local trips between Detroit-Windsor or Sarnia-Port Huron areas.

Spatial Travel Patterns

Travel origin-destination patterns for commercial vehicle trips crossing the border at Southeast Michigan/Southwest Ontario crossings were based on the NRS/MTO commercial vehicle survey database. Based on these data, Exhibits 2.34 and 2.35 present a graphic of overall flow patterns between Canada and the United States for border crossing trips at Detroit-Windsor and Sarnia-Port Huron, respectively.

At 12,040 weekday trips, the Ambassador Bridge carries the highest commercial vehicle volumes of the three crossings. The Blue Water Bridge carries some 5,740 weekday trips, or approximately 47% of the volumes of the Ambassador Bridge. In comparison, commercial vehicle volumes at the Detroit-Windsor Tunnel are very low, at only about 700 crossings per day. Exhibit 2.36 shows how these trips are distributed according to local trips, long-distance trips, and trips between local and long-distance locations. To provide a basis for understanding commercial vehicle flows, Exhibits 2.37 summarizes commercial vehicle trip movements in trip matrices for each crossing. More detailed travel matrices using a 40-zone system are included in Appendix A. Exhibits 2.38 to 2.40 plot commercial vehicle movements as flows for different trip distance types, while Exhibits 2.41 to 2.43 plot the origins and destinations of all trips, aggregated to the nearest town or city.

The Ambassador Bridge carries the highest commercial vehicle volumes for both local and long-distance trips. Thirty-one percent of trips have a trip end in Windsor, and 37% of trips have a trip end in the SEMCOG area (Detroit representing almost one-third of these). Entirely long-distance travel makes up approximately 5,600 trips, or 46% of weekday travel.

At the Detroit-Windsor Tunnel, more than two-thirds of commercial vehicle travel is entirely local, while entirely long-distance travel is only 4% of commercial vehicle volumes. However, commercial vehicle traffic using the tunnel is very low and it primarily serves passenger cars, given the geometric and height restrictions in the tunnel that preclude many truck types.

The Blue Water Bridge has very little entirely local travel, although more than 21% use the bridge to access northern SEMCOG counties to/from long-distance points. Some 4,090 trips, or 71% of travel is entirely long-distance.

Approximately 6% of the commercial vehicle trips crossing between Southeast Michigan and Southwest Ontario start and end the trip in the US and are referred to as in-transit trips. These trips largely involve travel between Michigan and Western New York where the travel distance to travel through Canada is significantly shorter than travelling entirely within the US by a routing south of Lake Erie. Approximately 14% of the commercial vehicle traffic at the Blue Water Bridge is in-transit, compared to 3% at the Ambassador Bridge.

EXHIBIT 2.34: WEEKDAY DETROIT-WINDSOR CROSS-BORDER COMMERCIAL VEHICLE FLOWS, 2000
A: FLOWS TO US

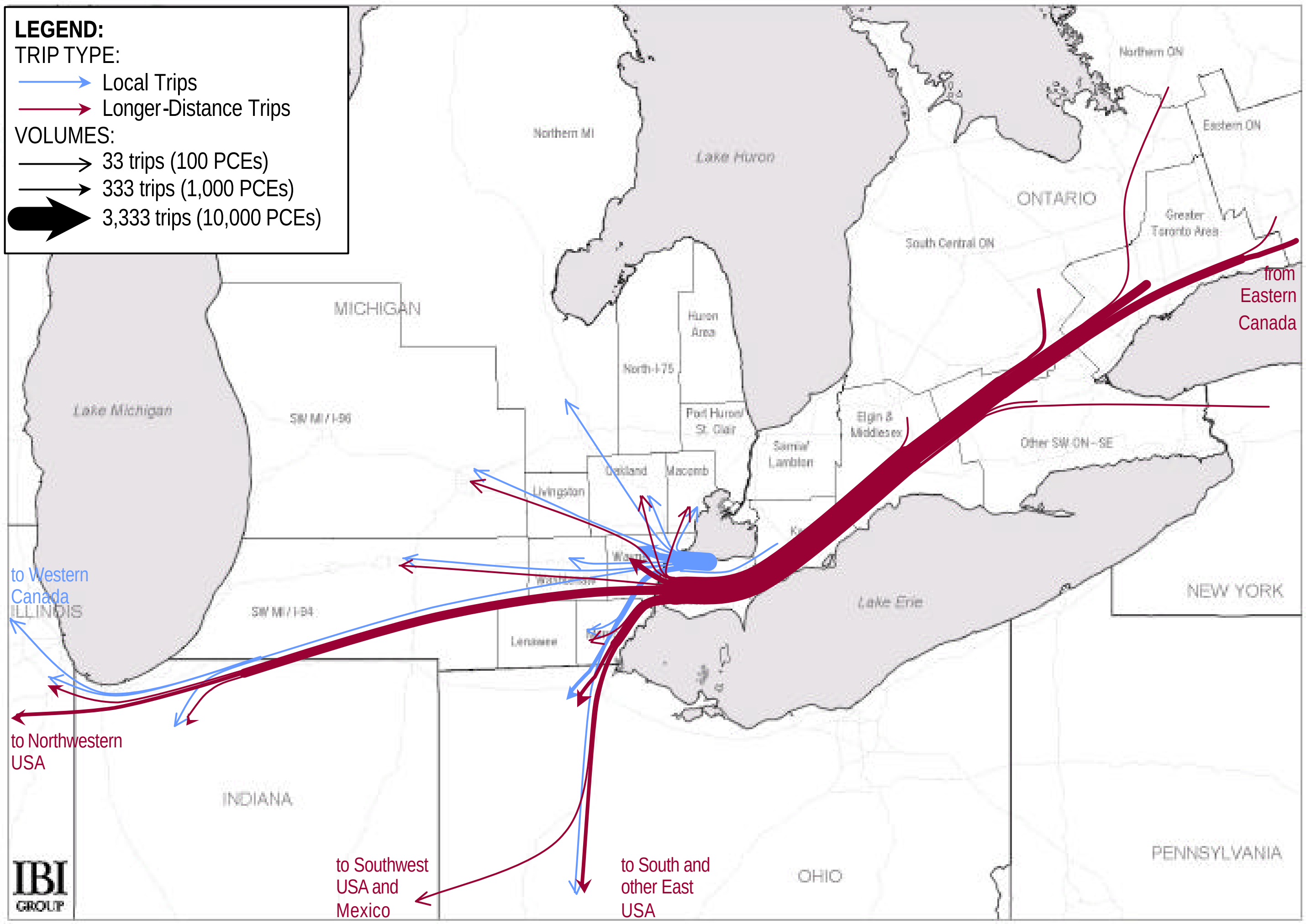


EXHIBIT 2.34 (CONTINUED): WEEKDAY DETROIT-WINDSOR CROSS-BORDER COMMERCIAL VEHICLE FLOWS, 2000
B. FLOWS TO CANADA

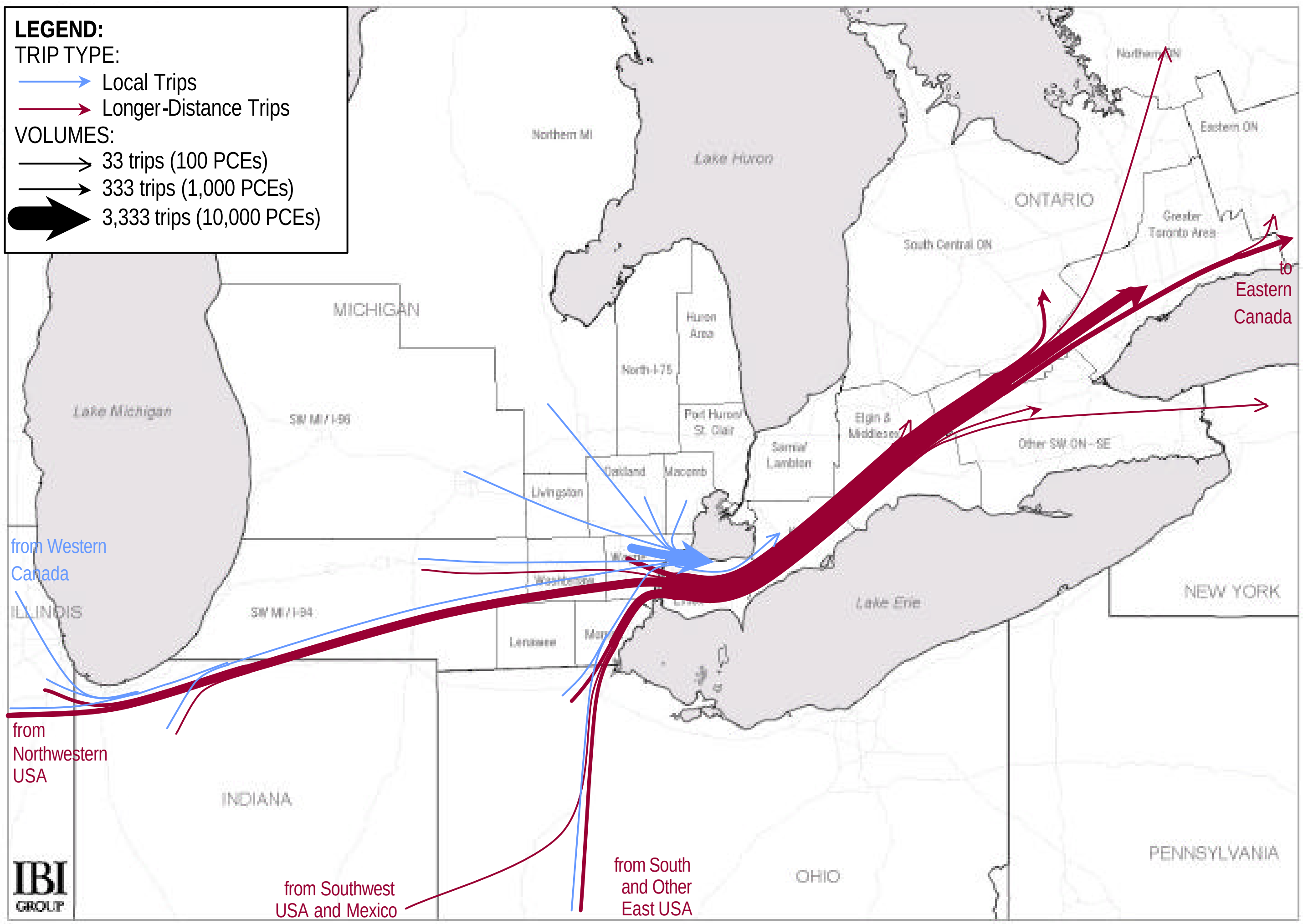


EXHIBIT 2.35: WEEKDAY SARNIA-PORT HURON CROSS-BORDER COMMERCIAL VEHICLE FLOWS, 2000
A: FLOWS TO US

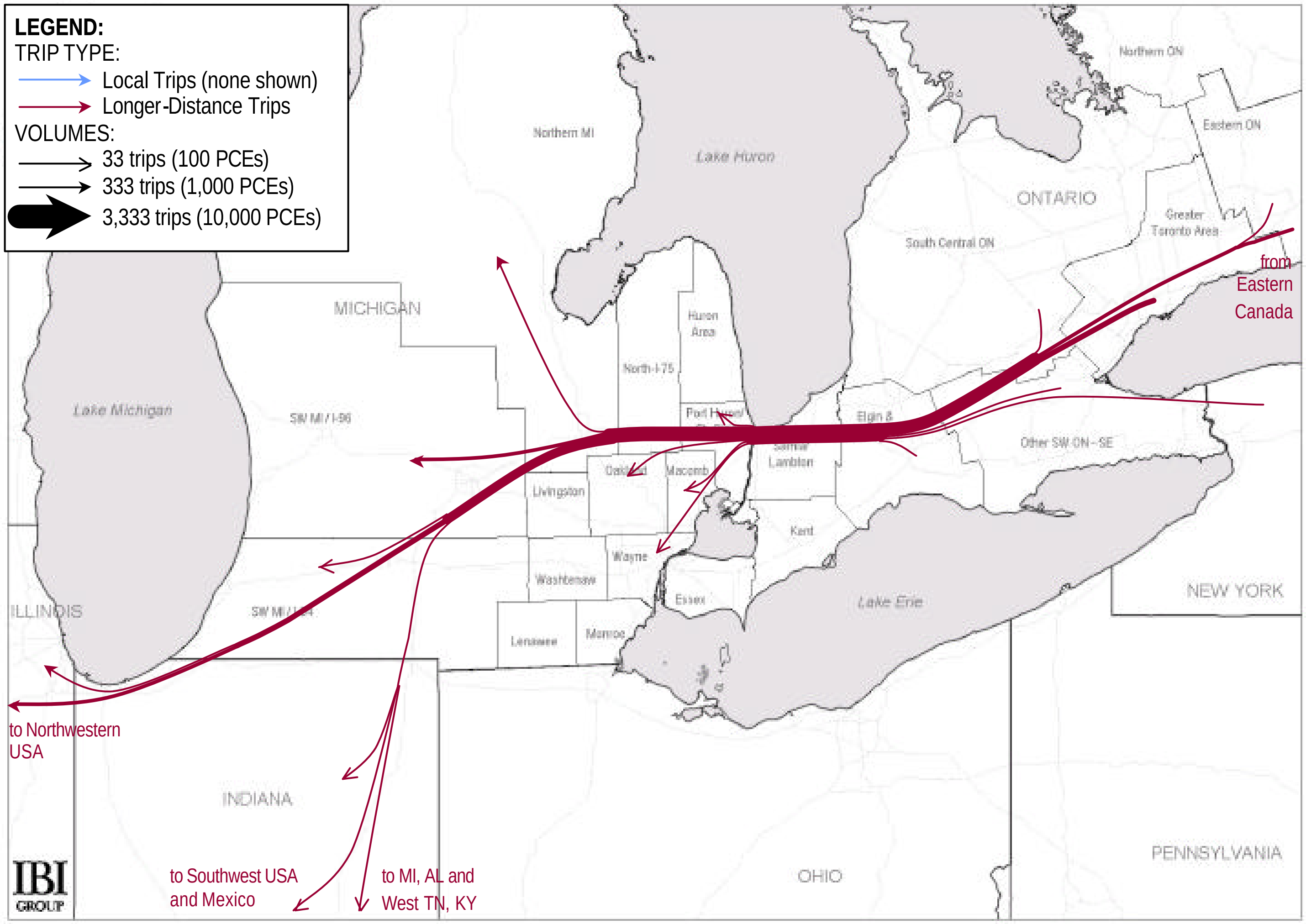


EXHIBIT 2.35 (CONTINUED): WEEKDAY SARNIA-PORT HURON CROSS-BORDER COMMERCIAL VEHICLE FLOWS, 2000
B. FLOWS TO CANADA

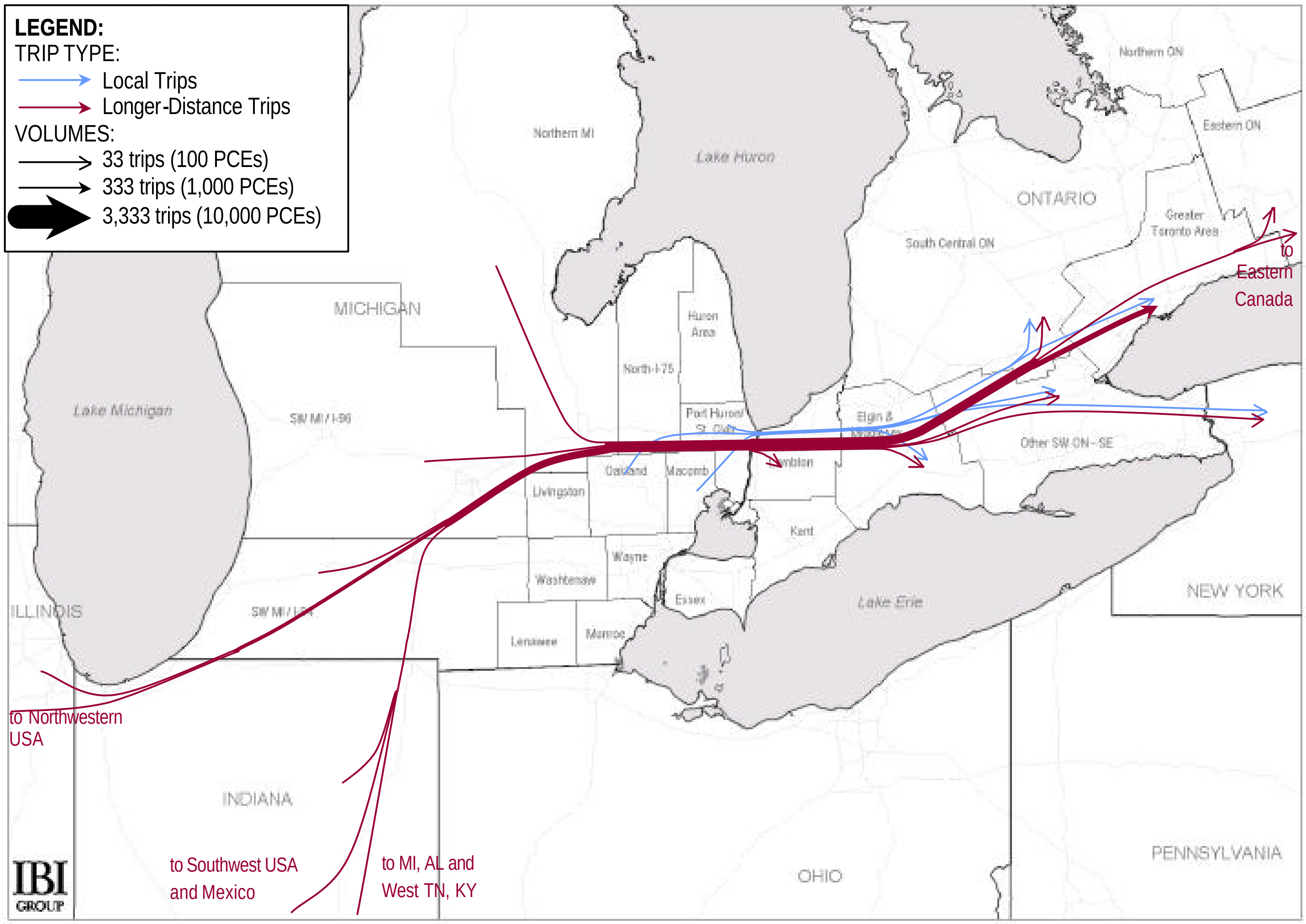


EXHIBIT 2.36: WEEKDAY CROSS-BORDER COMMERCIAL VEHICLE TRIPS BY LOCAL/LONG-DISTANCE TRIP TYPE, 2000

	DAILY COMMERCIAL VEHICLE TRIPS							
	Ambassador Bridge		Detroit-Windsor Tunnel		Blue Water Bridge		TOTAL	
TRIP TYPE[1]	Volume	%	Volume	%	Volume	%	Volume	%
Local to Local	2,580	21	500	69	50	0.9	3,130	17
Local (Detroit or Port Huron Area) to/from Long-Distance	1,870	16	110	15	1,370	24	3,350	18
Local (Windsor or Sarnia Area) to/from Long-Distance	2,030	17	90	12	240	4	2,350	13
Long-Distance to Long-Distance	5,560	46	30	4	4,090	71	9,680	52
TOTAL TRIPS	12,040	100	720	100	5,740	100	18,510	100

Notes:
[1] For Ambassador Bridge and the Detroit-Windsor Tunnel, a "local" trip end refers to Essex and Kent County in Ontario, and the SEMCOG area in Michigan, excluding St. Clair County in Michigan. For the Blue Water Bridge, a "local" trip end refers to Lambton County in Ontario, and St. Clair, Macomb, Oakland and Livingston Counties in Michigan.
Unexpected or nonsensical trips, such as where the shortest routing was not taken, were redistributed according to the same distributions as the remaining trips.

EXHIBIT 2.37: WEEKDAY 24-HOUR COMMERCIAL VEHICLE TRAVEL ORIGIN AND DESTINATION MATRIX, 2000

AMBASSADOR BRIDGE

ORIGIN	DESTINATION 1	2	3	4	5	6	7	8	9	10	TOTAL
1 Detroit + NE Wayne						23	279	15		310	627
2 Rest of Wayne County						65	613	46		355	1079
3 Port Huron/St. Clair County						2	31				33
4 Rest of SEMCOG						8	156	89		149	402
5 Rest of MI						10	129	35		172	346
6 Other USA/Mexico	59	56	2	33	26	56	499	28	6	2,879	3642
7 Windsor	531	296		344	145	538				84	1937
8 Rest of Essex County	26	30		26	29	221				17	350
9 Sarnia/Lambton County		0			6	2					9
10 Other Ontario/Canada	297	420		177	147	2,501	56	8		14	3621
TOTAL	912	803	2	580	353	3426	1763	221	6	3981	**12046**

DETROIT-WINDSOR TUNNEL

ORIGIN	DESTINATION 1	2	3	4	5	6	7	8	9	10	TOTAL
1 Detroit + NE Wayne						3	86	22		17	129
2 Rest of Wayne County						5	62	20		12	99
3 Port Huron/St. Clair County											0
4 Rest of SEMCOG						3	68	12		10	93
5 Rest of MI							16	15		5	36
6 Other USA/Mexico	2			6		1	4			12	24
7 Windsor	104	41	1	41	33	11					231
8 Rest of Essex County	13	6		12	4						35
9 Sarnia/Lambton County						0					0
10 Other Ontario/Canada	12	15	4	30	1	16					78
TOTAL	130	61	5	89	37	39	237	69	0	57	**725**

BLUE WATER BRIDGE

ORIGIN	DESTINATION 1	2	3	4	5	6	7	8	9	10	TOTAL
1 Detroit + NE Wayne						28			6	82	117
2 Rest of Wayne County						8			5	58	70
3 Port Huron/St. Clair County						39			9	88	136
4 Rest of SEMCOG				2		83			7	286	378
5 Rest of MI						176	4	1	25	605	811
6 Other USA/Mexico	41	27	41	139	183	67	2	2	66	969	1537
7 Windsor			8	1		1					11
8 Rest of Essex County											0
9 Sarnia/Lambton County	10	5	13	19	29	58					134
10 Other Ontario/Canada	92	52	101	446	663	1,149			2	41	2547
TOTAL	143	84	164	607	876	1610	6	3	120	2129	**5742**

EXHIBIT 2.38: WEEKDAY 24-HOUR COMMERCIAL VEHICLE TRIPS TO US VIA AMBASSADOR BRIDGE, 2000

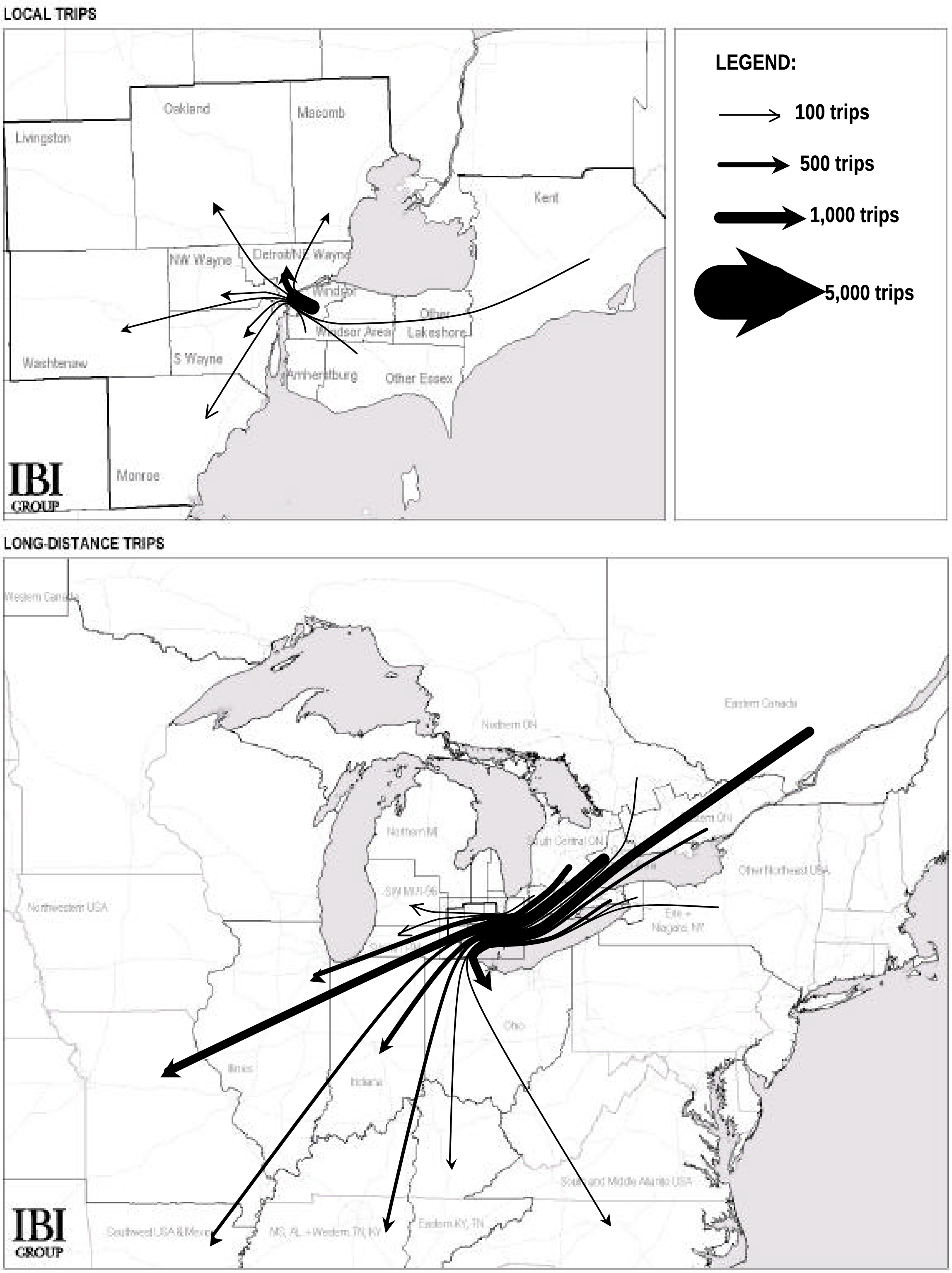
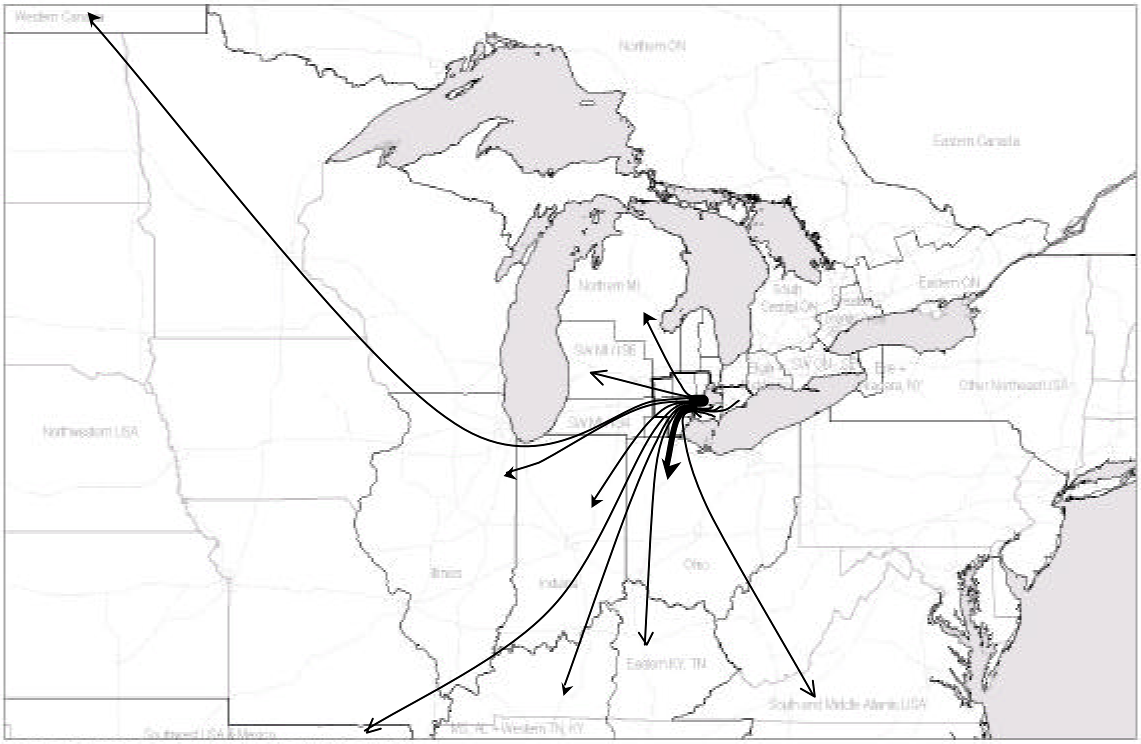


EXHIBIT 2.38 (CONT.): WEEKDAY 24-HOUR COMMERCIAL VEHICLE TRIPS TO US VIA AMBASSADOR BRIDGE, 2000

LOCAL (WINDSOR AREA) TO LONG-DISTANCE TRIPS



LONG-DISTANCE TO LOCAL (DETROIT AREA) TRIPS

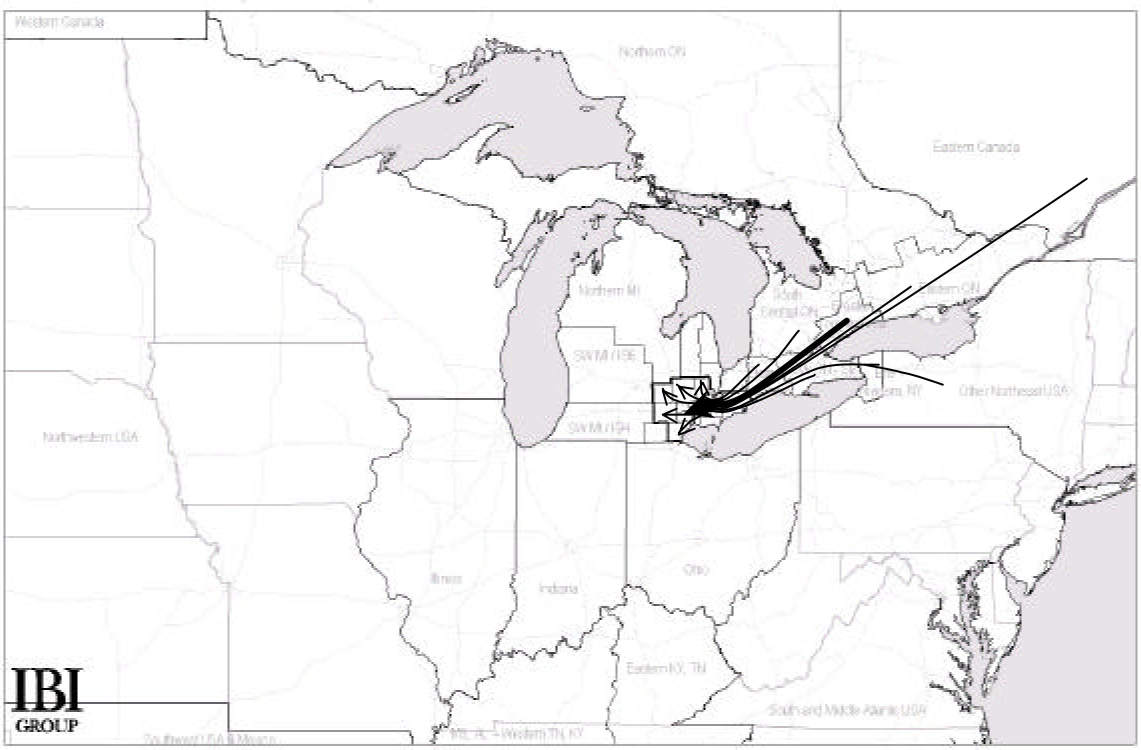
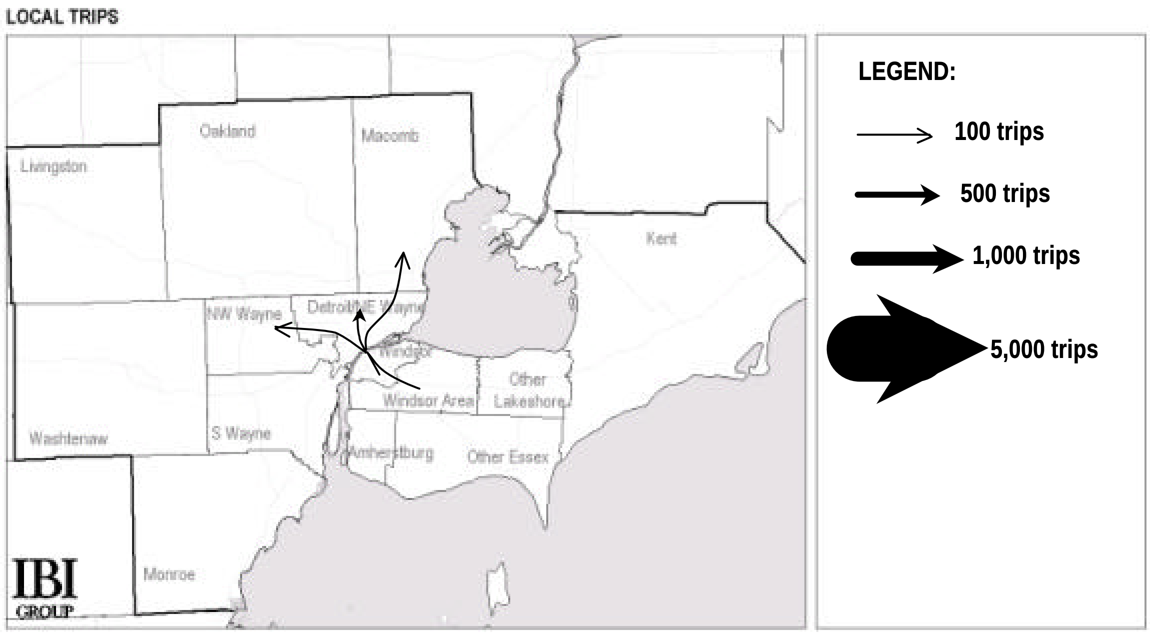


EXHIBIT 2.39: WEEKDAY 24-HOUR COMMERCIAL VEHICLE TRIPS TO US VIA DETROIT-WINDSOR TUNNEL, 2000



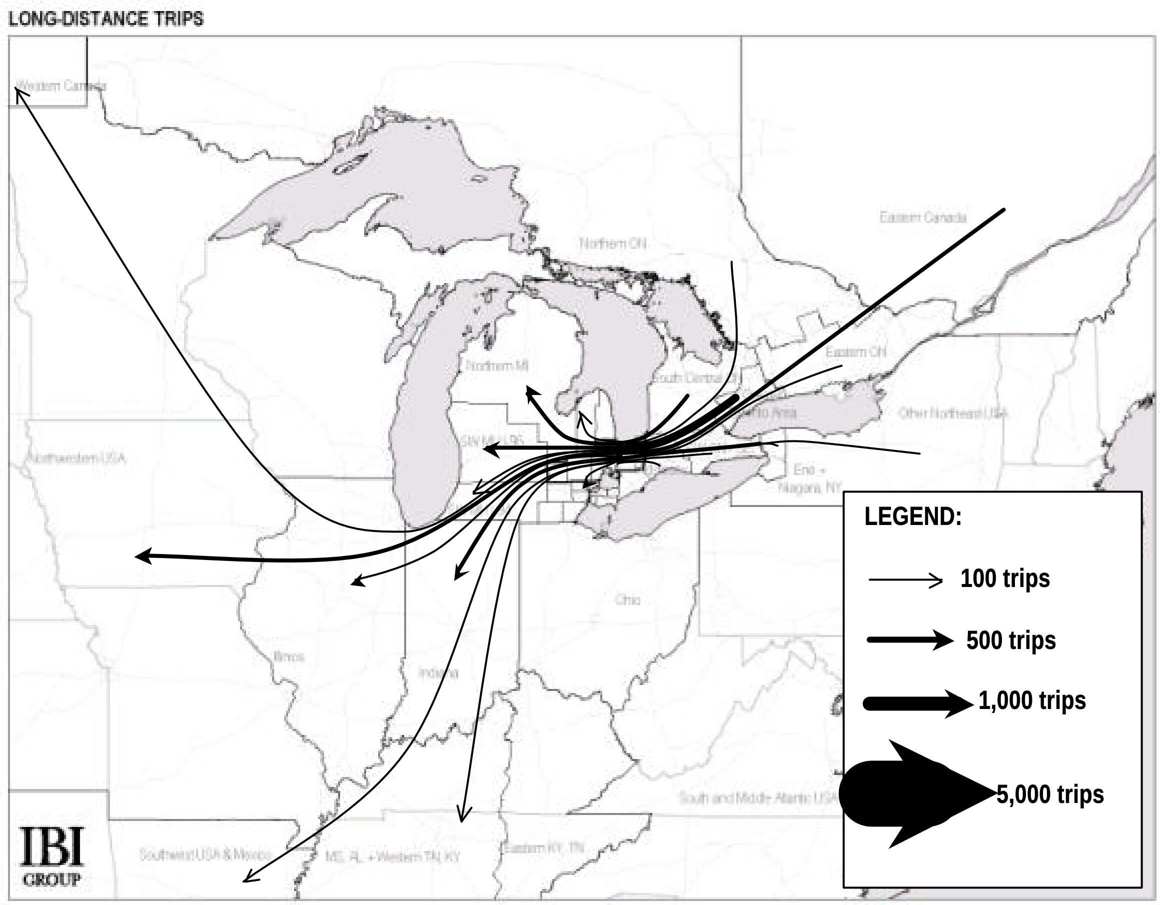
Not illustrated due to low volumes:

Long-Distance Trips (31 trips in total)

Local (Windsor Area) to Long-Distance Trips (41 trips in total)

Long-Distance to Local (Detroit Area) Trips (57 trips in total)

EXHIBIT 2.40: WEEKDAY 24-HOUR COMMERCIAL VEHICLE TRIPS TO US VIA BLUE WATER BRIDGE, 2000



Not illustrated due to low volumes:

Local Trips (25 trips total)

Local (Sarnia/Lambton) to Long-Distance Trips (95 trips in total, very diverse trip ends)

EXHIBIT 2.40 (CONT.): WEEKDAY 24-HOUR COMMERCIAL VEHICLE TRIPS TO US VIA BLUE WATER BRIDGE, 2000

LONG-DISTANCE TO LOCAL (PORT HURON/ST CLAIR) TRIPS

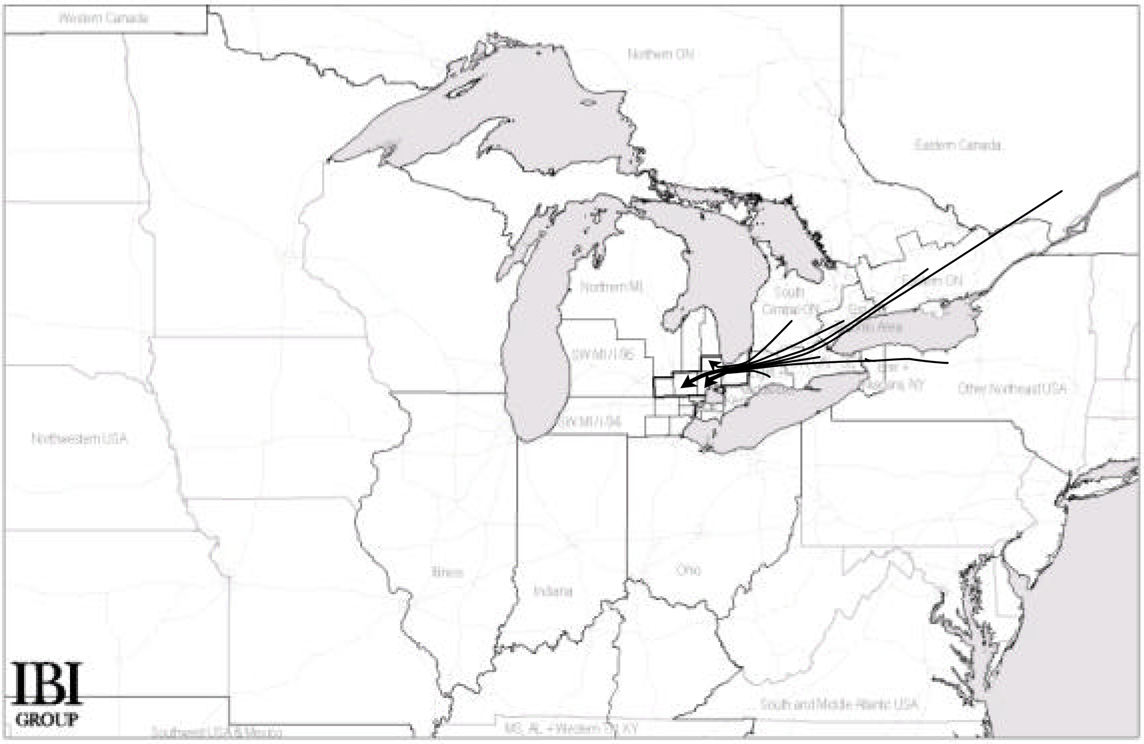


EXHIBIT 2.41: WEEKDAY ORIGINS AND DESTINATIONS OF COMMERCIAL VEHICLES AT AMBASSADOR BRIDGE, 2000
A. TO CANADA

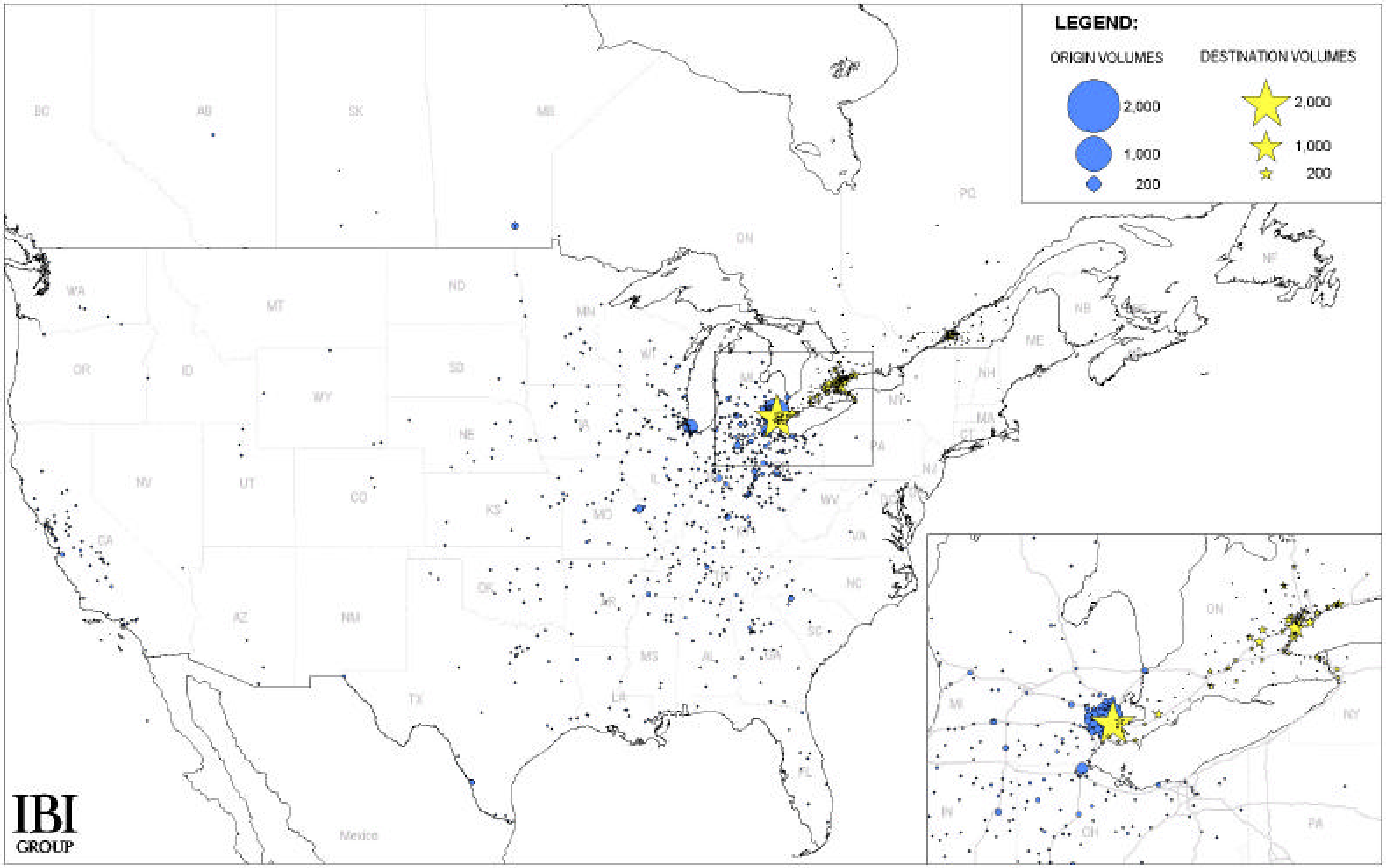


EXHIBIT 2.41 (CONT.): WEEKDAY ORIGINS AND DESTINATIONS OF COMMERCIAL VEHICLES AT AMBASSADOR BRIDGE, 2000
B. TO US

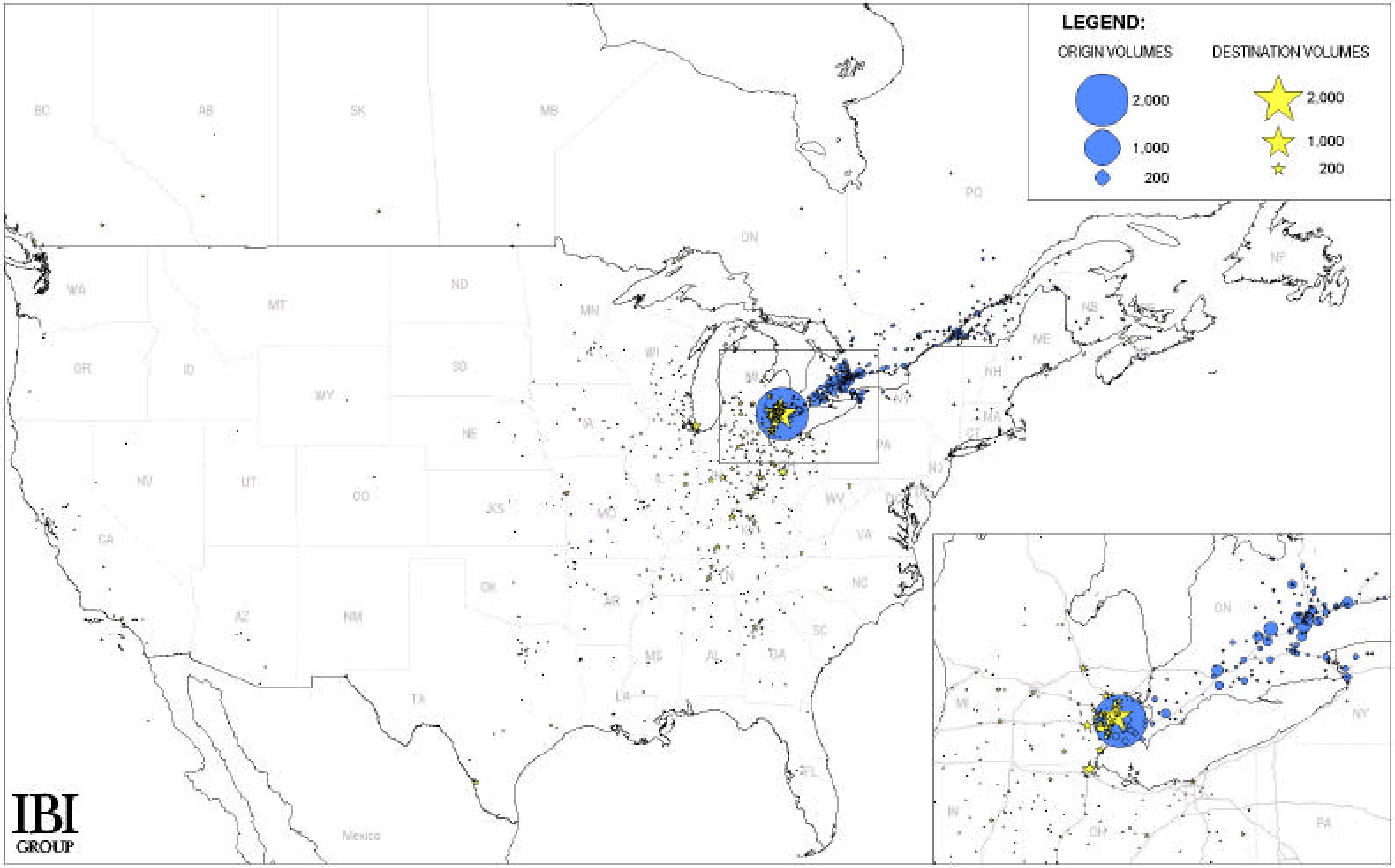


EXHIBIT 2.42: WEEKDAY ORIGINS AND DESTINATIONS OF COMMERCIAL VEHICLES AT DETROIT-WINDSOR TUNNEL, 2000
A. TO CANADA

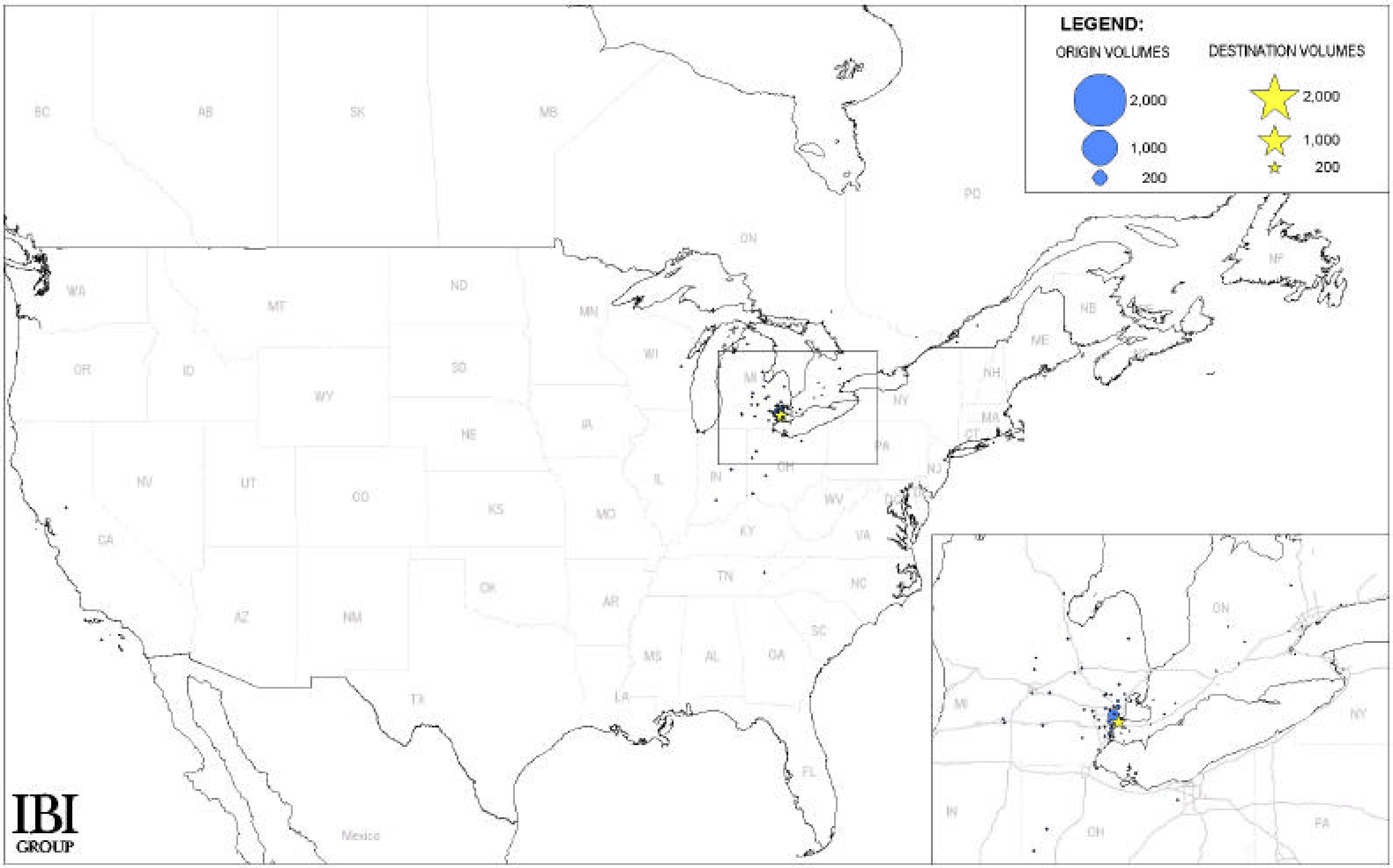


EXHIBIT 2.42 (CONT.): WEEKDAY ORIGINS AND DESTINATIONS OF COMMERCIAL VEHICLES AT DETROIT-WINDSOR TUNNEL, 2000
B. TO US

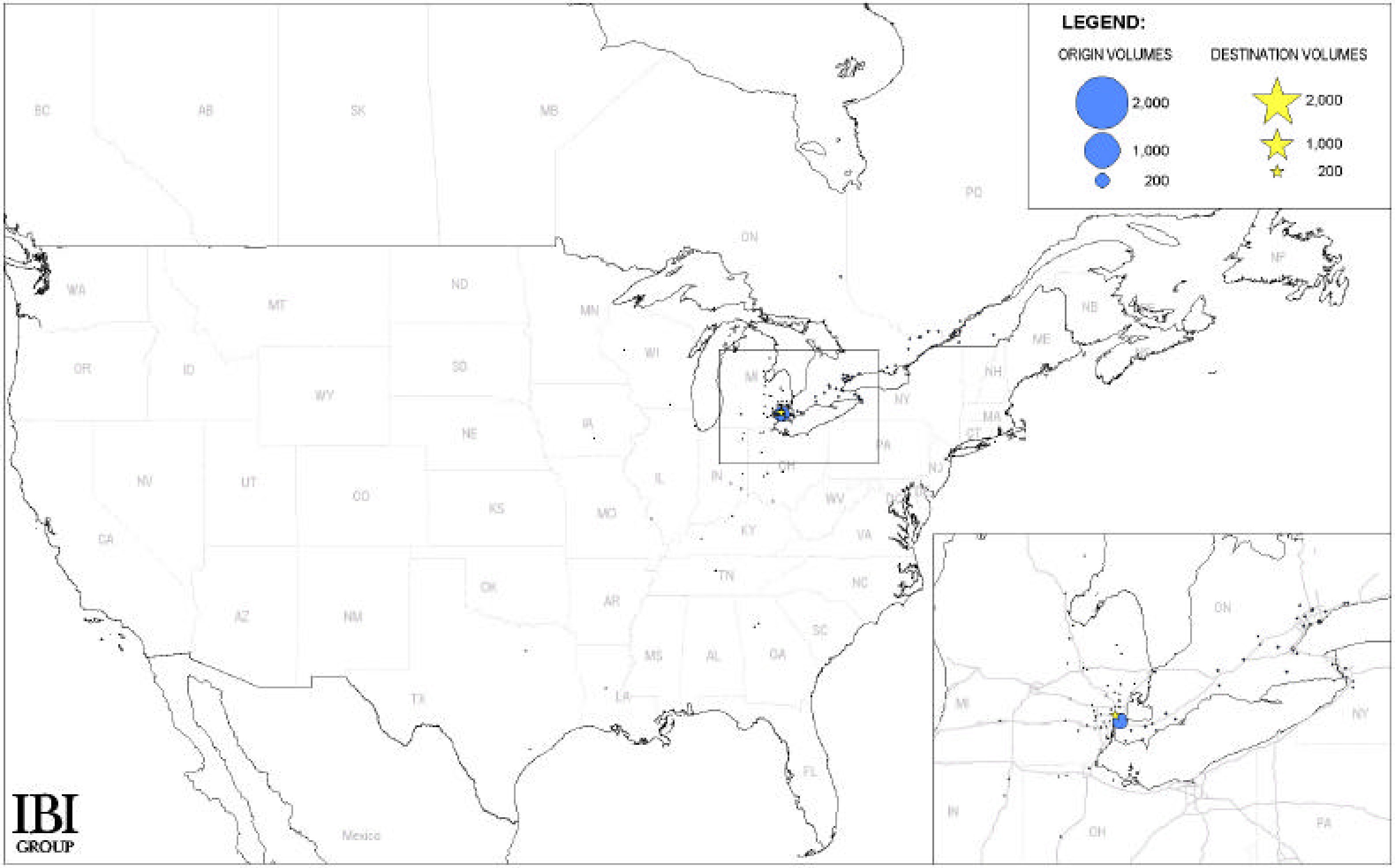


EXHIBIT 2.43: WEEKDAY ORIGINS AND DESTINATIONS OF COMMERCIAL VEHICLES AT BLUE WATER BRIDGE, 2000

A. TO CANADA

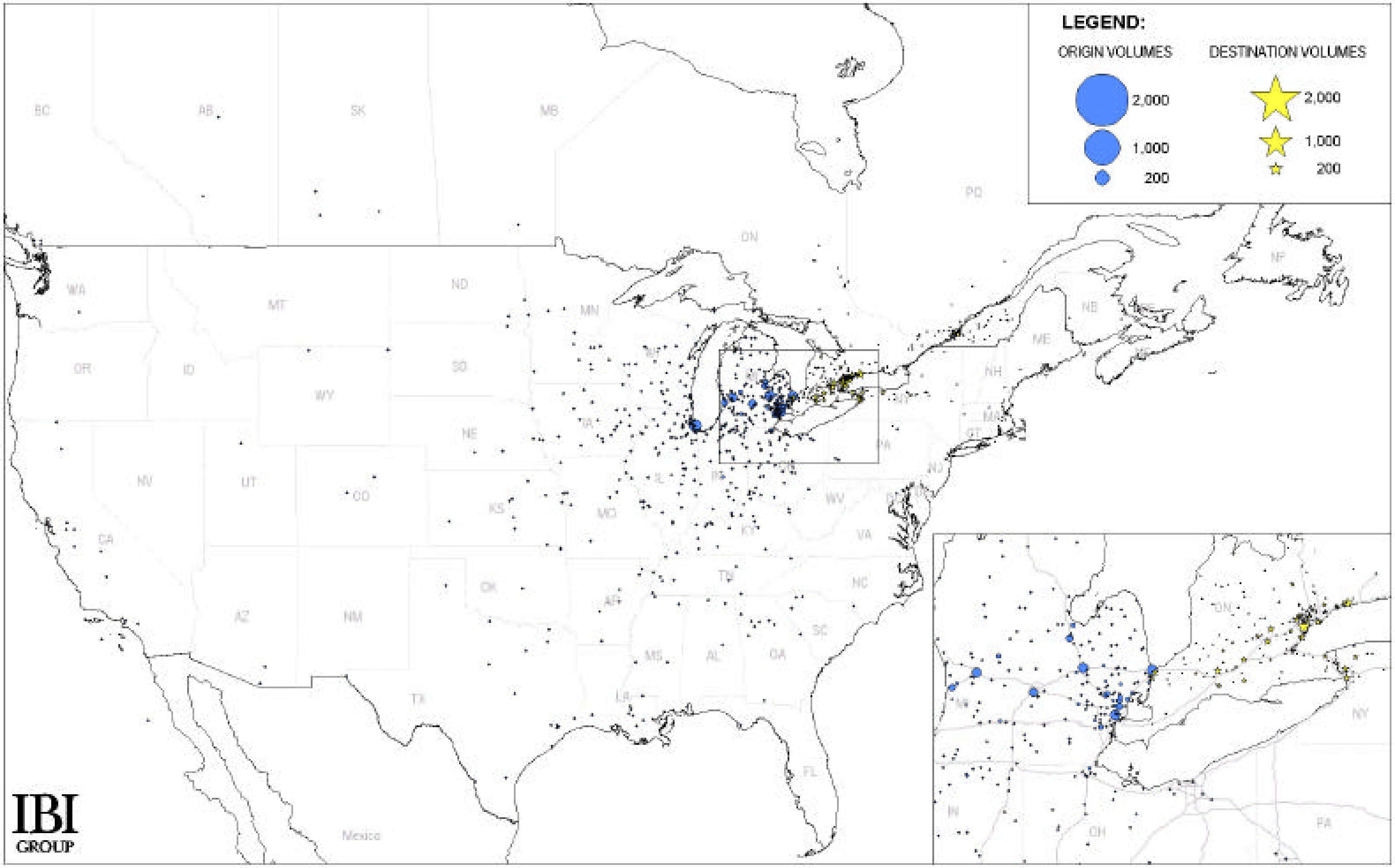
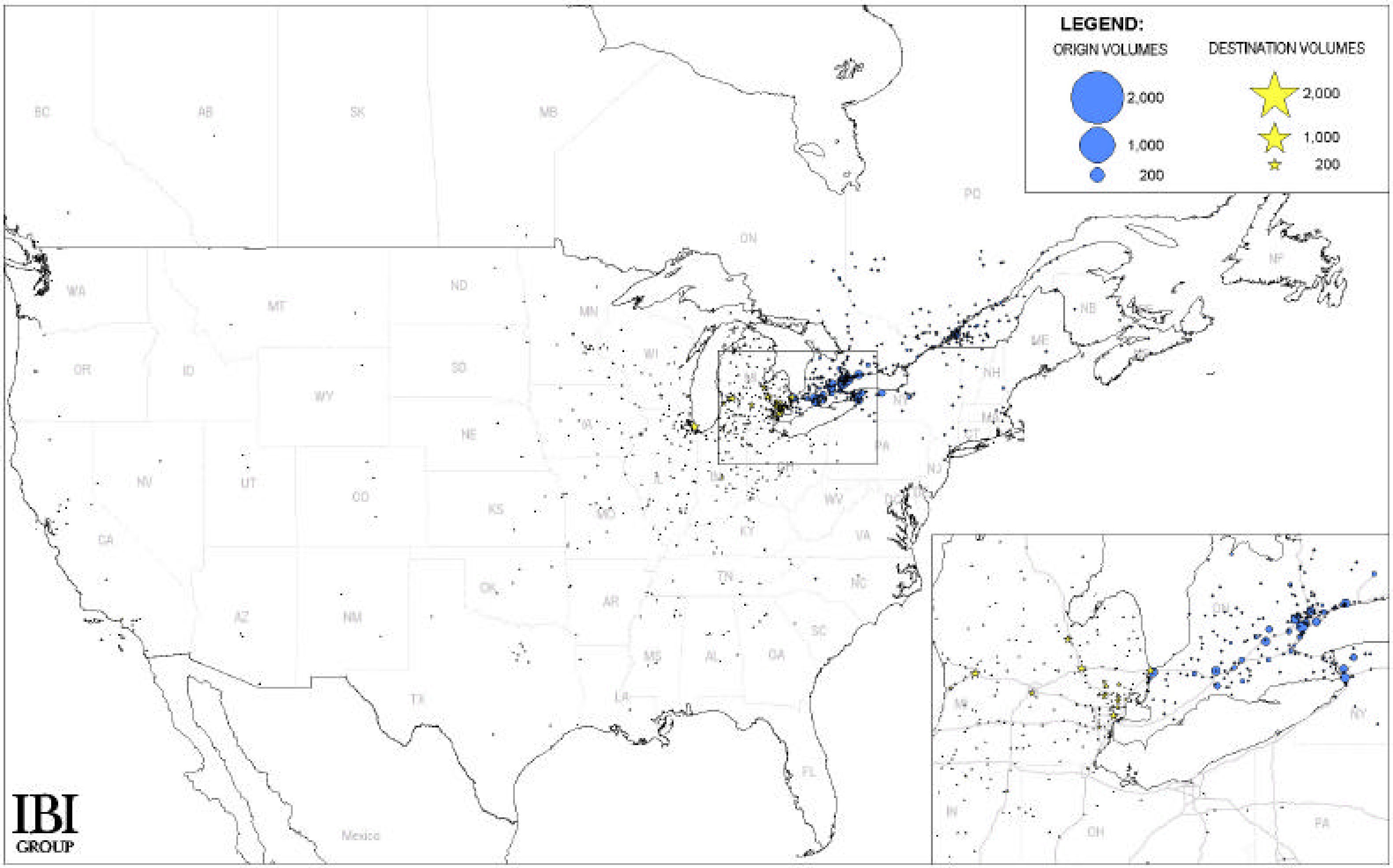


EXHIBIT 2.43 (CONT.): WEEKDAY ORIGINS AND DESTINATIONS OF COMMERCIAL VEHICLES AT BLUE WATER BRIDGE, 2000
B. TO US



Because of its large share of commercial vehicle traffic, the spatial distribution of auto industry commodity movement is shown in tabular form in Exhibit 2.44, and Exhibit 2.45 graphically shows trip origins and destinations for auto industry trips, aggregated to the level of the nearest town or city.

EXHIBIT 2.44: WEEKDAY 24-HOUR AUTO INDUSTRY ORIGINS AND DESTINATIONS (PERCENT OF TOTAL TRIPS), 2000

	DESTINATION										
ORIGIN	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**TOTAL**
1 Detroit + NE Wayne						0.5	1.0			2.8	4.4
2 Rest of Wayne County						0.7	1.1	0.0	0.0	3.4	5.3
3 Port Huron/St. Clair County						0.4	0.6			0.3	1.3
4 Rest of SEMCOG				0.0		1.1	1.7		0.0	3.4	6.3
5 Rest of MI						1.3	0.4	0.0	0.1	6.2	8.0
6 Other USA/Mexico	0.9	1.2	0.3	1.8	1.4	0.2	5.1		0.1	16.4	27.3
7 Windsor	4.7	1.3		3.6	1.3	3.4					14.4
8 Rest of Essex County					0.4	1.2					1.6
9 Sarnia/Lambton County		0.1	0.0	0.1	0.0						0.3
10 Other Ontario/Canada	3.4	4.0	0.3	5.1	4.3	14.0				0.0	31.2
TOTAL	9.0	6.6	0.7	10.7	7.4	23.0	10.0	0.1	0.2	32.4	**100.0**

Auto industry related commercial vehicle trips are generally dispersed in a wide corridor extending from the Greater Toronto Area, through Southeast Michigan and including nodes in Ohio, Illinois, Missouri, and Kentucky, among others. The locations are indicative of the large interactions between assembly plants/parts manufacturers situated in this "automotive corridor" that is focused in the Detroit area, with high auto related traffic to or from Windsor and Detroit, as well as flows travelling in the corridor and travelling through Windsor-Detroit. For trips crossing the three border crossings from Canada to the US, one-quarter of trips are from Windsor, about 8% are from western New York State, 9% from Quebec, and most of the remainder from the GTA and vicinity. Roughly one-third of these trips are destined to Wayne County, one-third to the rest of Michigan, and one-third to the rest of the US.

EXHIBIT 2.45: WEEKDAY AUTO INDUSTRY ORIGINS AND DESTINATIONS, 2000

A. CANADA TO US

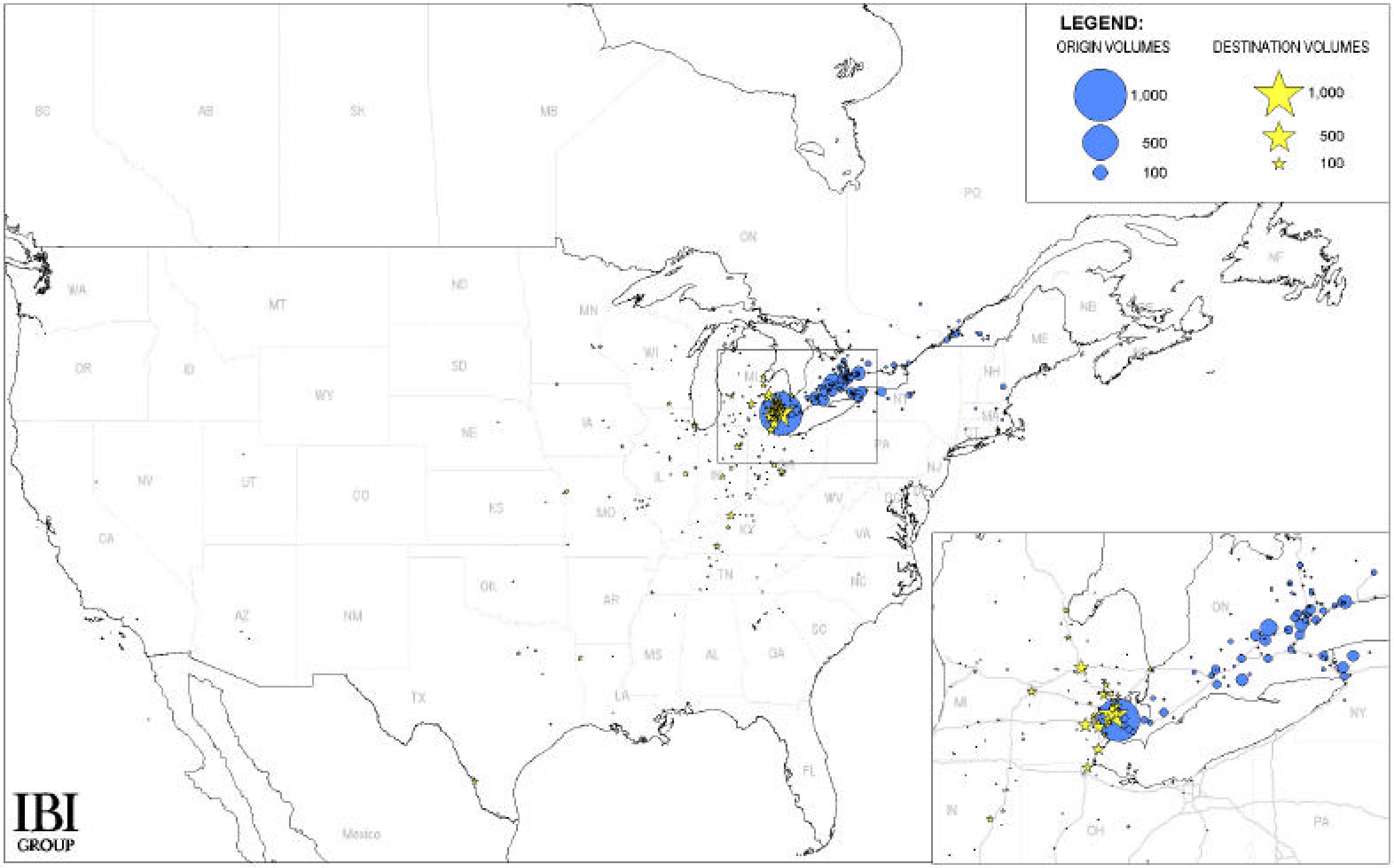
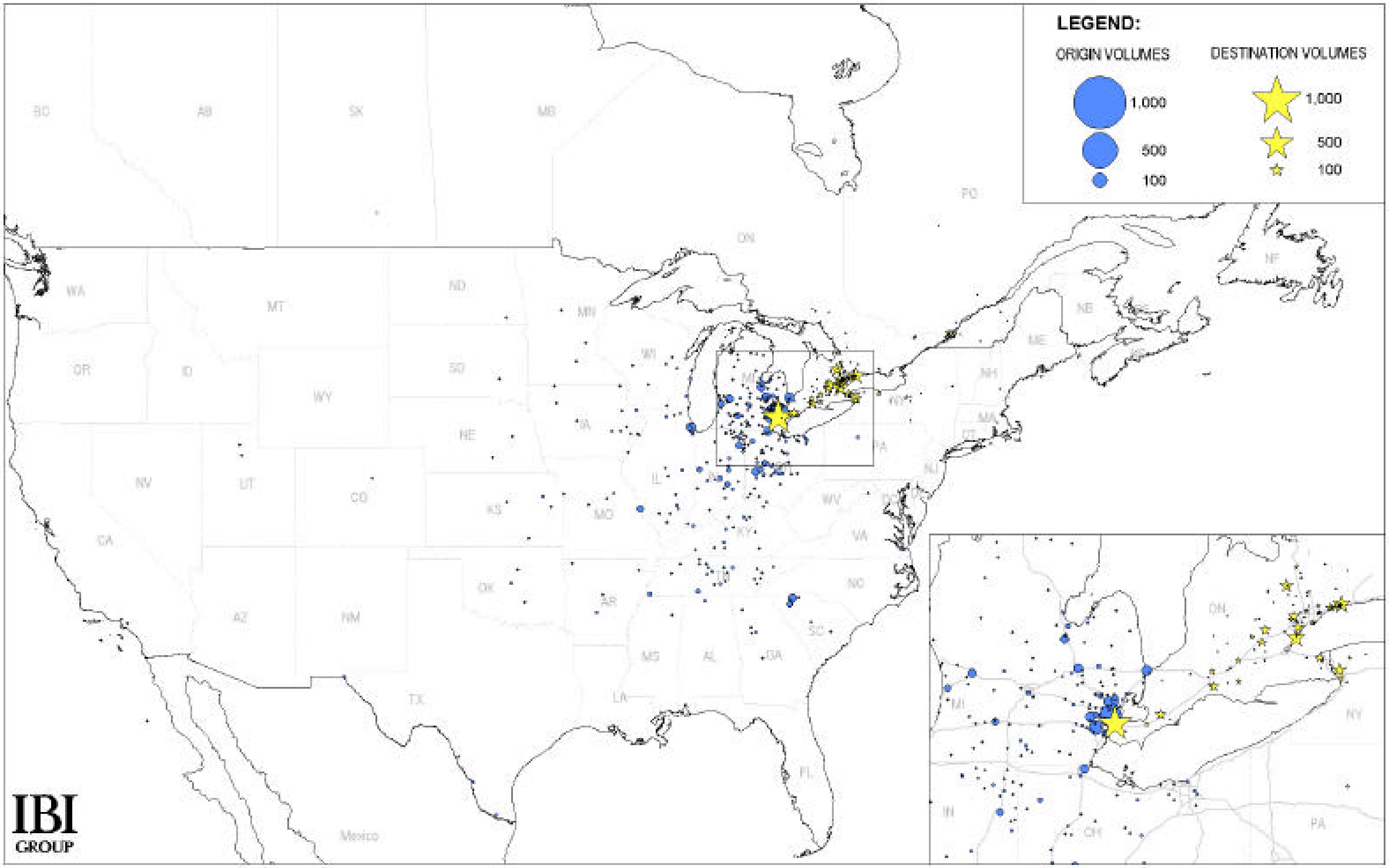


EXHIBIT 2.45 (CONT.): WEEKDAY AUTO INDUSTRY ORIGINS AND DESTINATIONS, 2000

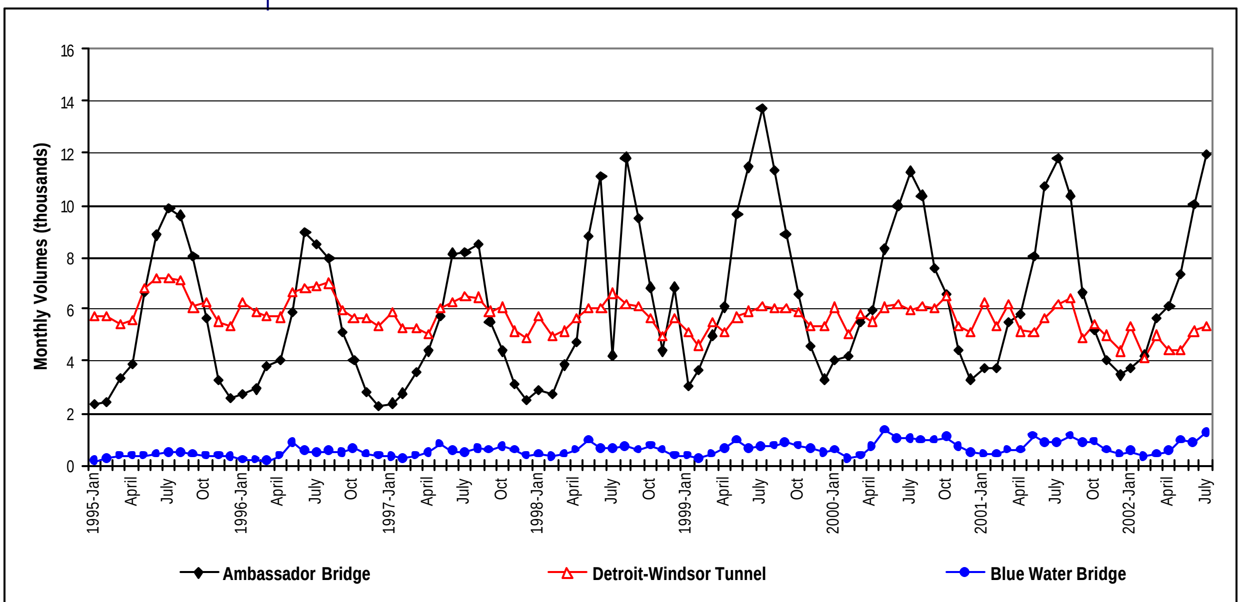
B. US TO CANADA



2.4. Local and Intercity Bus

Local and intercity bus comprises approximately 0.5% and 0.2% of the vehicular traffic crossing at Detroit-Windsor and at Sarnia-Port Huron, respectively. In a summer month, there are approximately 12,000 buses for the Ambassador Bridge, 5,300 for the Detroit-Windsor Tunnel and 1,200 for the Blue Water Bridge. The trend in bus traffic by crossing from 1995 to 2002 is shown in Exhibit 2.46, based on BTOA data. The highest volumes and greatest seasonal fluctuations are shown for the Ambassador Bridge, given high intercity, tour and charter bus volumes during peak summer vacation periods. The Detroit-Windsor Tunnel shows much lower variation, given the more Windsor-Detroit-based traffic served through local bus services.

EXHIBIT 2.46: SEASONAL TRENDS IN BUSES AND MISCELLANEOUS TRAFFIC BY CROSSING, 1995-2002



Source: Bridge and Tunnel Operators Association as provided by MTO Data Management and Analysis Office.

Windsor Transit operates the Tunnel Bus between downtown Windsor and downtown Detroit via the Detroit-Windsor Tunnel. Detroit DOT, Sarnia Transit and Blue Water Area Transit (Port Huron) do not offer cross-border services.

The Windsor Transit Tunnel Bus operates seven days per week at regular headways (generally 20 minutes in peak periods and 30 minutes off-peak). The last bus leaves Windsor at 12:00 midnight and Detroit at 12:30 AM. The cost of the service is $2.60 CAN. The service operates from the Windsor Downtown Bus Terminal to Detroit via the tunnel and serves the Renaissance Center, then circulates on Beaubien, Congress, Woodward Avenue and Jefferson Avenue to Cobo Hall/Joe Louis Arena. The service then extends north to Washington Boulevard/Michigan Avenue and return to the tunnel, serving the Windsor Casino before returning to the bus terminal. Special Tunnel Bus services are also provided to all Detroit Lions home games at Ford Field and Detroit Tigers home games at Comerica Park for a $3.30 (CAN) fare.

Annual ridership information for the Windsor Tunnel bus service was obtained from the City of Windsor. In the year 2001, ridership was 257,000 passengers. The majority of bus users (82%) pay a cash fare rather than using a pass, indicating that most of the bus users are discretionary users, as opposed to commuters. On average, ridership for the first six months in 2002 was down about 15% compared to the same months in 2001, due to 9/11 and reduced Windsor Casino traffic.

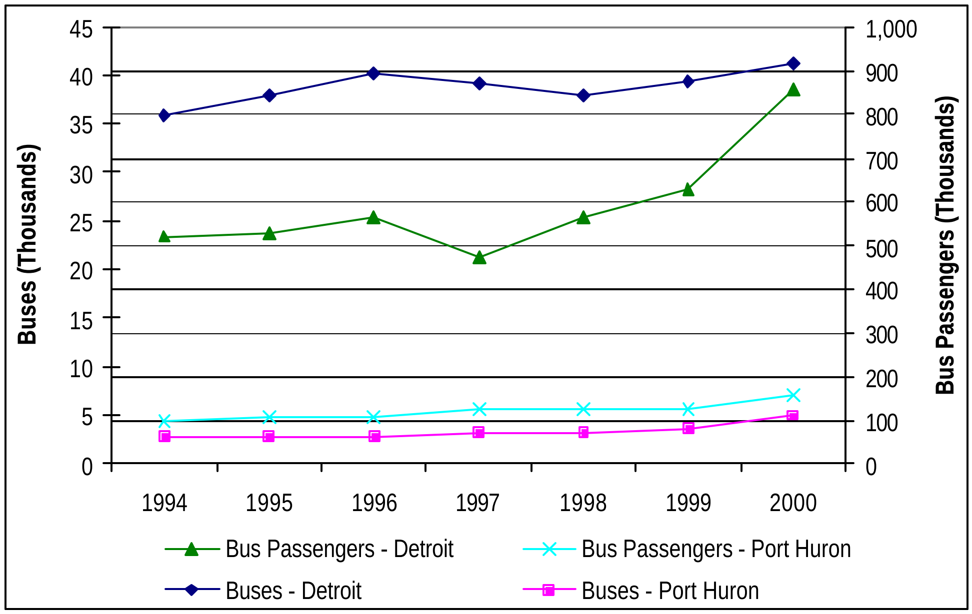
There are approximately 1.4 million bus passenger trips crossing between SE Michigan and SW Ontario, representing 3.3% of passenger trips.

Data on intercity bus ridership are not readily available, given operations by private for-profit carriers. However, both the US BTS and the BTOA maintain records of total (e.g. local plus intercity bus activity. In the year 2000, there were 860,000 passengers entering the US by bus through Detroit and 155,100 passengers entering through Port Huron. Historical trend data on passenger bus demand are tabulated by the Bureau of Transportation Statistics, but is not broken down by type of bus (intercity or local). However, based on the figures discussed above, the bus volumes would be dominated by intercity carriers.

Exhibit 2.47 illustrates the trends in total passenger bus traffic between 1994 and 2000. There have been fairly steady increases in bus volumes at both crossing locations. At the Detroit crossings, there was a significant decline in bus passengers in 1997, although the number of actual buses dropped only slightly. In 2000, there was an average of 14 passengers per bus crossing at Detroit, while buses crossing at Port Huron averaged 35.

The total number of intercity and local bus passengers represent some 1.4 million annual trips or about 3.3% of the total passenger market for travel Southeast Michigan and Southwest Ontario.

EXHIBIT 2.47: TRENDS IN BUS TRAFFIC ENTERING THE US, 1994-2000



Note: 1997 Buses – Detroit data point is interpolated from 1996 and 1998 data points.
Source: USDOT, BTS based on data from US Customs Service, Mission Support Services, Office of Field Operations, Operations Management Database.

2.5. Rail Passenger

VIA/Amtrak provides Toronto to Chicago service daily in each direction, seven days a week.

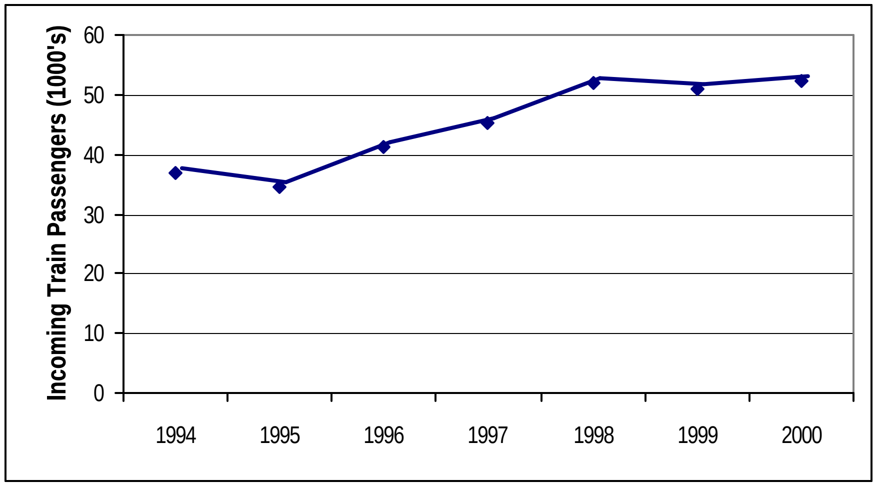
There are approximately 54,000 annual rail trips, representing 0.2% of the cross-border passenger traffic between SE Michigan and SW Ontario.

At present, there is one cross-border passenger train service operating between Toronto and Chicago, which utilizes a Sarnia-Port Huron crossing. The service is a joint VIA/Amtrak routing with service frequencies of 1 train per day in each direction, seven days a week. Presently there is no through passenger rail service between Windsor and Detroit, although VIA passengers can travel from Toronto to Windsor and transfer to Amtrak services in Detroit using another mode. Amtrak is also considering shifting the Toronto-Chicago service to operate through Detroit.

Data on rail passenger traffic was obtained from a special run produced by the US Bureau of Transportation Statistics for passengers entering the US. In the year 2000, there were 53,700 annual passengers entering the US by train across the Ontario-Michigan border. Of these, 40,630 entered at Port Huron, 11,800 at Detroit and 1,300 at Sault Ste. Marie, MI. As the only through train service is at via Sarnia-Port Huron, rail passengers travel at the other crossings reflected the use of more than one mode used for the international trip, with the rail mode used as the main access and/or egress mode to/from the border. In total, it is estimated that travel by passenger rail accounts for approximately 0.2% of the passenger traffic crossing between Southeast Michigan and Southwest Ontario.

Trends in rail passenger traffic entering the US in Michigan are shown in Exhibit 2.48. With the exception of a slight drop in taffic in 1995, rail passenger volumes have been increasing fairly steadily, with 2000 volumes 42% higher than in 1994.

EXHIBIT 2.48: TRENDS IN PASSENGER RAIL TRAFFIC ENTERING MICHIGAN, 1994-2000



Source: USDOT, BTS based on data from US Customs Service, Mission Support Services, Office of Field Operations, Operations Management Database.

2.6. Rail Freight

Rail freight carries approximately 20% of the value of goods between SE Michigan and SW Ontario.

Canada to the US is the dominant direction (85% by weight).

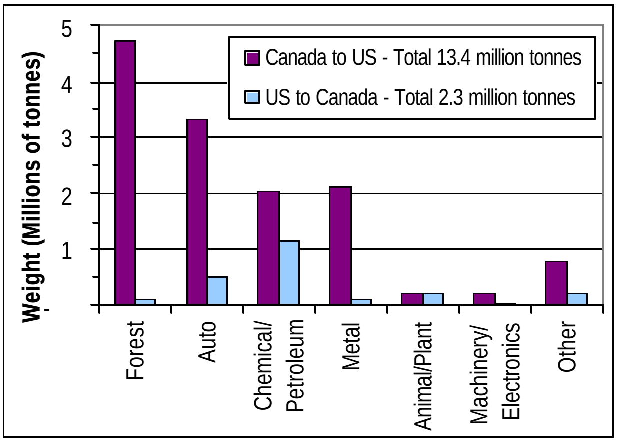
Existing rail freight traffic through Southeast Michigan and Southwest Ontario is in the order of 40 trains per day (20 trains each way), moving through two tunnels that cross the border at Detroit-Windsor and one at Port Huron-Sarnia (although one of the two at Detroit-Windsor is rarely used). This section provides a brief overview of rail freight traffic, while a description of the system elements is provided in Section 3.4.

The dominant direction of rail traffic is from Canada to the US (85% by weight). Primarily the auto, chemical and petroleum, forest products, and metal commodity sectors use the rail mode. The automotive sector includes finished goods (autos and trucks in purpose-built multi-level cars) and considerable traffic in auto parts, which is a growth area for intermodal services. The chemical and petroleum sector includes dry and liquid bulk chemicals and fertilizers that move in heavy shipments (often multiple carloads), and often need special handling as dangerous commodities. The forest products sector is a traditional export sector and covers wood pulp, pulp and paper, and lumber.

Exhibit 2.49 shows the weight by commodity and direction of rail-transported goods moving between Southeast Michigan and Southwest Ontario in 2000, and the value by direction from 1994 to 2000. The total value of goods moving across the border by rail has increased over time, driven by growth in Canadian exports to the US. Meanwhile, the value of goods shipped to Canada from the US by rail has declined slightly through this corridor in recent years.

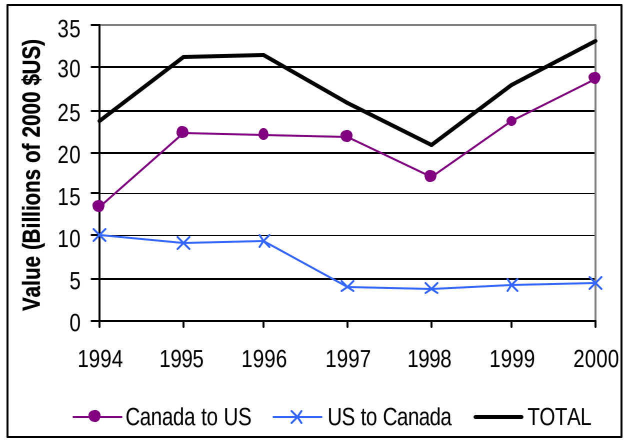
EXHIBIT 2.49: WEIGHT AND VALUE OF RAIL FREIGHT TRAFFIC

WEIGHT, 2000[1]



[1] Does not include in-transit shipments.
Source: CCRA

VALUE, 1994-2000[2]



[2] Values after 1996 do not include in-transit shipments.
Source: BTS

To maintain consistency among data sources used in this study, value and weight information are taken from trade data obtained from the Bureau of Transportation Statistics (BTS) and the Canada Customs and Revenue Agency (CCRA). Where specific weight information is not available, it is estimated from conversion factors calculated from BTS import data (i.e. exports from Ontario to the states of Ohio, Michigan, Illinois and Indiana) for each commodity grouping.

Trade data are captured by commodity groupings using the Harmonized System (HS) of the World Customs Organization. Transportation data are captured using the Standard Commodity Transportation Groupings (SCTG). The two systems are reconcilable according to conversion tables that are publicly available. A problem arises, however, because source in the case of customs data is different from the waybill information that is used for transportation reporting. Customs data report commodity descriptions based on contents, but transport data taken from waybills provide only the type of container; and the commodity description used in transportation of containers and trailers falls into a catch-all miscellaneous category. Trade data from customs sources are more consistent for the purposes of this study; consequently, they are used as the basis for describing traffic and projecting forecasts.

In recent years, trade across the study area border has been showing a tendency to shift from truck to rail. Exhibit 2.50 indicates the rail share of rail and truck traffic from Canada to the US over the most recent four-year period. The share of rail as a percent of freight weight and value is reported based on traffic originating in Ontario and destined to Michigan, Ohio, Illinois and Indiana (as representative of trade through the study area).

EXHIBIT 2.50: RAIL SHARE OF TRUCK/RAIL TRAFFIC BY WEIGHT AND VALUE BY YEAR, ONTARIO TO MICHIGAN/OHIO/ILLONOIS/INDIANA, 1998-2001

Category	1998	1999	2000	2001
Weight	25.8%	28.7%	33.5%	32.0%
Value	25.3%	31.9%	37.1%	36.1%

Source: BTS Transborder Freight Database

Another difference between trade data and transport data is scope of coverage. Trade data cover only goods actually exchanged between Canada and the US. Transport statistics, and traffic reported by railway operators, include "in-transit" traffic – that is, trade with other countries via Canadian deep-sea ports, and US or Canadian domestic traffic that is routed through the other country and passes through this corridor. This is significant, and it could account for as much as 15% of total rail traffic.

Despite the caveats concerning data, it is apparent that intermodal and automotive rail traffic is increasing market share. Information from the annual reports of CN and CPR is summarized in Exhibit 2.51.

EXHIBIT 2.51: CN AND CPR INTERMODAL AND AUTOMOTIVE REVENUE, 1997-2001

Sector	Category	1997	1998	1999	2000	2001
Intermodal	Revenues (2000 millions)	1,493	1,545	1,628	1,727	1,754
	Revenue ton-miles (millions)	34,507	36,231	41,961	46,472	46,776
Automotive	Revenues (2000 millions)	694	648	763	865	824
	Revenue ton-miles (millions)	4,958	4,298	5,201	5,755	5,493

Source: CN/CPR

2.7. Marine Services

There are currently three cross-border ferry services operating in the study area, consisting of the Walpole Island Ferry, Marine City Ferry and Detroit-Windsor Truck Ferry. Each service has relatively limited vehicle capacity; however, the Detroit-Windsor Ferry services a specialized hazardous goods market in the Detroit-Windsor area that cannot be transported on the other Detroit-Windsor crossings. The services are described in more detail in Section 3.6.

The Detroit-Windsor Truck Ferry is by far the most dominant ferry service in the study area. It operates at one-hour headways for 10-hour days and can shuttle 8 trucks per crossing. As this ferry currently handles about 40 trucks per day on average, it is operating at about 25% of capacity. At full capacity, this ferry would carry about 160 trucks per day, accounting for 1.6% of the approximately 10,000 commercial vehicles that cross through Windsor-Detroit on an average day in year 2000.

The ferry provides a significant distance savings to trucks carrying dangerous goods, oversized loads or heavy loads by allowing them to cross at Windsor-Detroit, as opposed to having to travel to alternate ports that support this market. The alternative for vehicles with dangerous goods within the study area is Port Huron-Sarnia; very heavy vehicles must cross much further away by land between Minnesota and Ontario. It is estimated that more than 50% of the ferry crossing trips are from London (i.e. the point at which travel distances across the corridor via Port Huron-Sarnia and Detroit-Windsor are similar) westward, with a similar market range on the Michigan side.

The Walpole Island and Marine City ferries are relatively low-volume passenger and commercial services, connecting small island communities on each side of the St. Clair River. The relative volumes carried are extremely low compared to overall passenger and goods movement between Southeast Michigan and Southwest Ontario, comprising less than 0.1% of the volumes.

There are also four major active commercial ports in this study area at Windsor, Detroit, Sarnia and Port Huron. Detroit and Windsor each have organized port commissions called the Detroit/Wayne County Port Authority and the Windsor Port Authority. In the most recent year for which statistics are available, Detroit handled 15.7 million metric tonnes in 2000 and Windsor 5.8 million tonnes in 1998. In both cases, almost all of the cargo is North American bulk cargo moving between these ports and other Great Lakes harbours. The most important commodity in Detroit is iron ore, followed by stone/aggregates, coal and cement. The major commodities handled in Windsor are stone, salt, grain and general cargo. In addition, there are active commercial ports located at Marysville, St. Clair, Marine City and Algonac (occasional use only), which handle over 10 million tons of cargo annually.

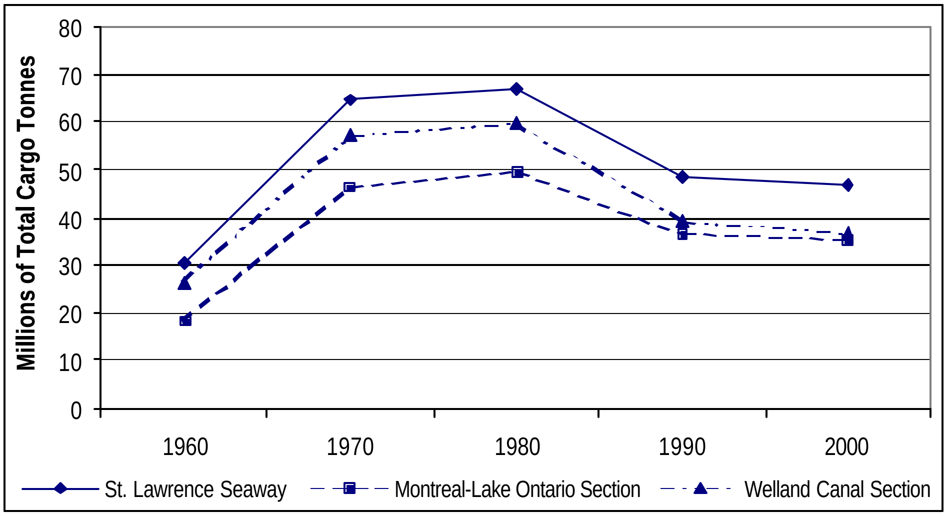
The majority of goods handled by these ports is transported via the Great Lakes-St. Lawrence Seaway System, consisting of the Montreal to Lake Ontario section and the Welland Canal section. The weight of goods transported on these sections and the St. Lawrence Seaway as a whole since 1960 is presented in Exhibit 2.52. These amounts peaked in the 1970s and 1980s after large growth, but have since declined due to the introduction of containerized traffic carried by intermodal rail/truck transport for the inland haulage (discussed further in Section 4.6).

2.8. Air Passenger

There are three airports with scheduled passenger service in the immediate study area:

- **Detroit –** The major airport in Detroit is Detroit Metropolitan Airport, operated by Wayne County. In the year 2000, over 35 million passengers were handled. Detroit Metro Airport is the eighth busiest airport in North America in terms of passengers handled, and the thirteenth in the world. Detroit also has a second airport, Detroit City Airport, but scheduled operations have been discontinued.
- **Windsor –** Windsor Airport is used for both scheduled and charter services. The major destination for scheduled services is Toronto.
- **Sarnia –** Sarnia Airport is also served by flights to and from Toronto.

EXHIBIT 2.52: WEIGHT OF GOODS MOVEMENT VIA THE ST. LAWRENCE SEAWAY SYSTEM, 1960-2000



Source: http://www.greatlakes-seaway.com

Air passenger travel through the study area that could otherwise reasonably be made via ground-based modes consists of trips between the cities of Chicago, Detroit, Lansing and Grand Rapids on the US side and Toronto and London on the Canadian side. The Sarnia and Windsor airports provide negligible cross-border service.

The USDOT maintains historic data on the number of passengers, seats and departures from major US airports to major Canadian destinations. It reports that about 1,290,000 passengers travelled cross-border between these cities in 2000, representing over 2% of total person crossings in that year. However, as it is impossible to distinguish between stop-over (connecting) flights and those that are final destinations, this number is over-representative of the proportion of trips that might otherwise be made by ground-based modes. For example, Detroit Metropolitan Airport acts as a hub for Northwest Airlines, providing connecting flights for many of the approximately 300,000 air passengers that flew between this airport and Toronto or London.

3. Transportation System Profile

This chapter provides an overview of the road, rail and marine border crossing facilities in the study area, and the transportation infrastructure that supports them. The first section describes the highway context of the border crossings, while the second section describes the access road system. The third section describes the infrastructure and operations of the border crossings themselves in greater detail. The fourth section provides a discussion of the travel route choice considerations. The fifth section provides a rail freight system profile, while the sixth provides a marine system profile.

3.1. Highway System

The road border crossings in the study area are served by a network of provincial highways in Ontario and interstate highways in Michigan. The layout of the highway network in the broad geographic study area is a key aspect of cross-border route selection. The highway system in the broad study area could be seen in Exhibit 3.1.

The main Canadian highway corridors are Highway 401 to Windsor and Highway 402 to Sarnia.

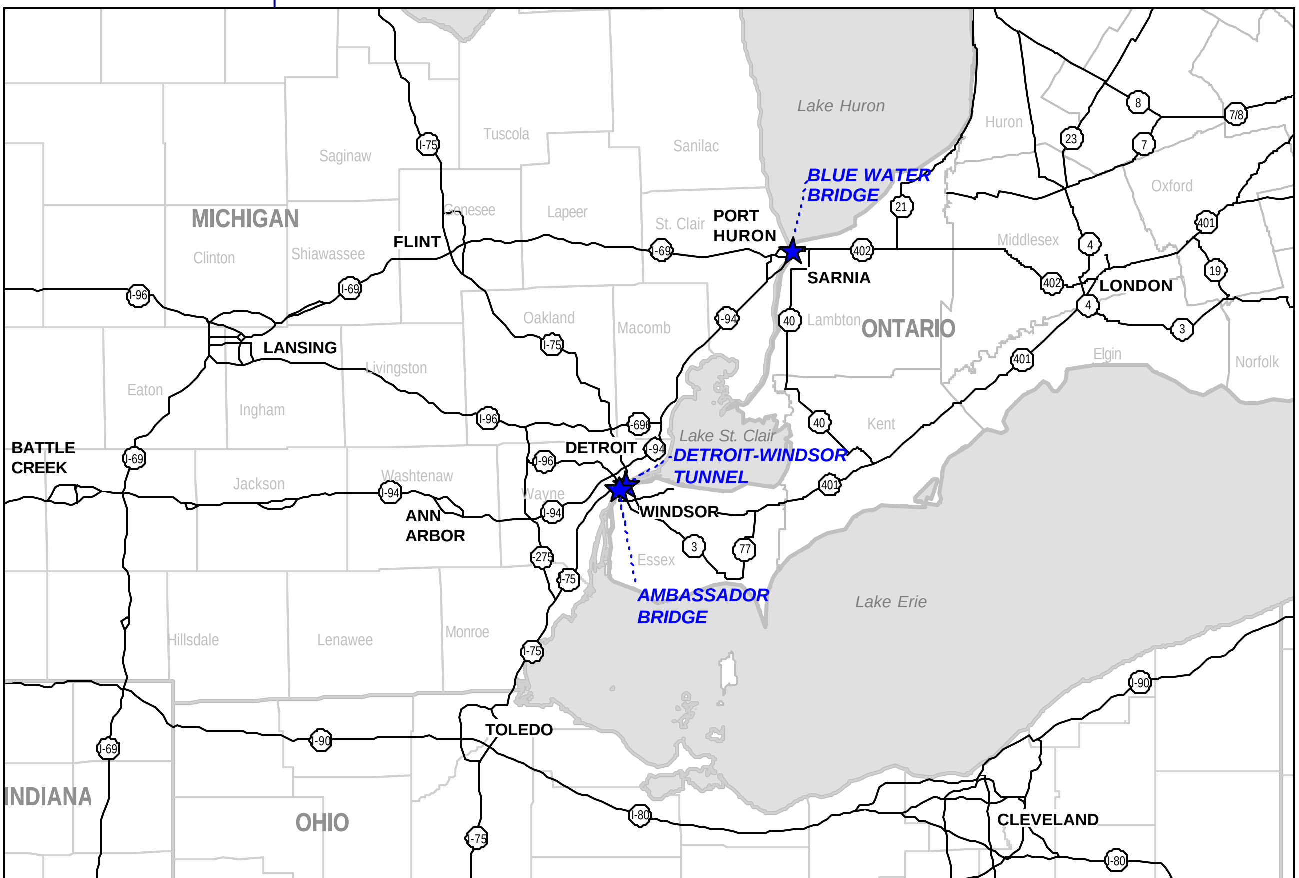
In the US, the main highway corridors to/from Detroit are I-94 west to Chicago and I-75 to the mid and south US.

Highway 401 is the dominant corridor in Canada, extending from beyond the Greater Toronto Area to Windsor, with local road access to the Ambassador Bridge. In Detroit, the Ambassador Bridge connects with the interstate system, with the main travel flows to the I-75 for travel to south US and to I-94 for travel east to Chicago and beyond. For travel using the Sarnia-Port Huron crossing, Highway 402 branches off of Highway 401 west of London to Sarnia and connecting with the Blue Water Bridge. In the US, I-94 connects with the Blue Water Bridge and provides freeway access south to Detroit. I-69 provides a westward connection from Port Huron, linking with I-94 near Battle Creek.

A number of interstate highways are arranged like spokes from the hub of Detroit. Beginning clockwise the south of Detroit and the west shore of Lake Erie, these are as follows:

- **Interstate 75** – This north-south travel corridor runs almost directly north/south right from Canada to Florida. South of Detroit, this highway passes through Toledo, Cincinnati and Atlanta, and ultimately to Miami.
- **Interstate 94** – This highway extends westerly from Detroit, passing through Ann Arbor and Kalamazoo in Michigan, then Chicago, Minneapolis, and to the state of Montana.
- **Interstate 96** – This highway runs west/northwesterly from Detroit, through Lansing, Grand Rapids, and ending at Michigan Road 31, which runs along Lake Michigan's east shore.
- **Interstate 75** – I-75 also continues northwesterly from Detroit, through Flint, Saginaw, through to the Upper Peninsula of Michigan and into Northern Ontario at Sault Ste. Marie.
- **Interstate 94** – I-94 also continues north as far as Port Huron.

EXHIBIT 3.1: HIGHWAY SYSTEM



The other interstate highway connecting to Port Huron is **Interstate 69**. The I-69 corridor connects Port Huron with Flint, Lansing and Battle Creek in Michigan, and continues southerly toward Indianapolis, a hub connecting a variety of interstate highways to continue travel throughout the US.

Highway 401 is the major travel and trade corridor between the Windsor area and other points in Canada. This highway spans the entire southern portion of the province, running approximately along the north shores of Lake Erie, Lake Ontario and the St. Lawrence River. It also connects with Highway 403 near Woodstock for travel to/from Hamilton, Niagara, and New York State along the Queen Elizabeth Way. Approximately 175 km (100 mi) from Windsor, in London, **Highway 402** branches off from Highway 401 for travel to/from Sarnia/Port Huron.

For many longer-distance trips, those to/from London easterly (e.g. the Greater Toronto Area, or the Niagara Peninsula), and to/from Battle Creek southwesterly (e.g. Chicago), either a Detroit-Windsor or Sarnia-Port Huron crossing choice may be feasible. Travelling from Canada, one could choose to continue along Highway 401 from London southwesterly to Detroit, and travel along Interstate 94 to Battle Creek. Alternatively, one can drive along Highway 402 from London to Port Huron, then continue on Interstate 69 to Battle Creek. The difference in driving distances between these two routings is approximately 3 km (2 mi).

3.2. Access Road System

Windsor Border Crossing Access Roads

The main traffic capacity problem in Windsor is Huron Church Road, due to high levels of international traffic mixed with local traffic, together with significant truck queues.

Traffic demand on Ouellette Avenue currently exceeds capacity, due to international traffic mixed with local traffic.

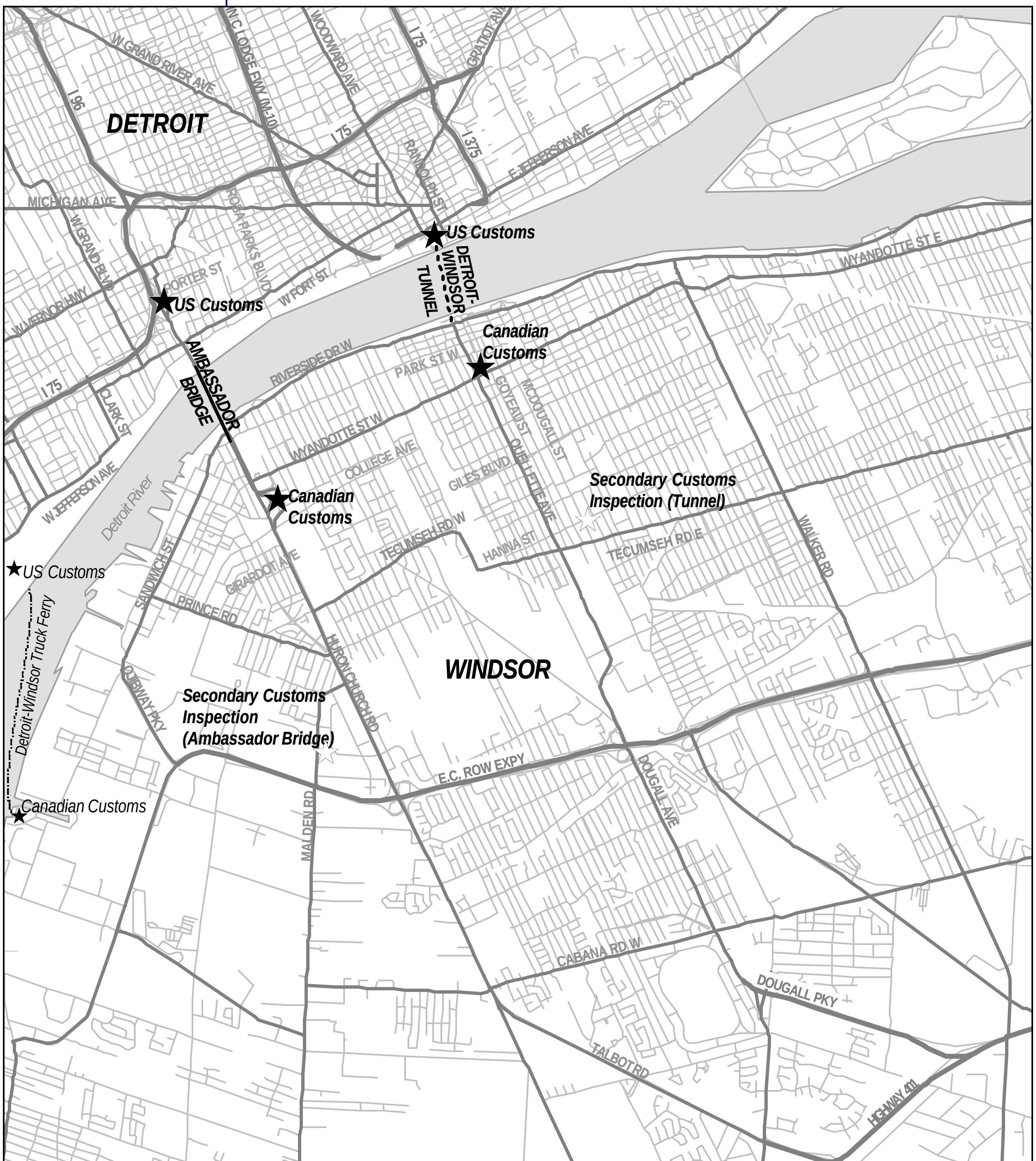
Queues from the Detroit-Windsor Tunnel often cause gridlock on city streets.

Exhibit 3.2 shows the road system and access roads in the vicinity of the Ambassador Bridge and the Detroit-Windsor Tunnel in Detroit/Windsor

Major arterial roads used to access the border crossings in Windsor include the following:

- **Huron Church Road** (County Road 3) – This north/south road has a vital role in linking Highway 401, used by most non-local cross-border traffic, to the Ambassador Bridge. Due to its importance as an access route, as well as high congestion and queuing levels experienced on this road due to border crossing traffic, it has the prime focus in the discussion below.
- **Dougall Avenue** and **Ouellette Avenue** – This linked north/south street (Ouellette follows the Dougall Avenue alignment north of E.C. Row Expressway) links Highway 401 directly to the Detroit-Windsor Tunnel. From within central Windsor, north/south **Goyeau Street** provides the entry to the Detroit-Windsor Tunnel.
- **Wyandotte Street** – This east-west street provides a secondary access to the Ambassador Bridge east of Huron Church Road for trips to the US east of Downtown Windsor.

EXHIBIT 3.2: ACCESS ROADS IN THE VICINITY OF THE AMBASSADOR BRIDGE AND DETROIT-WINDSOR TUNNEL



- **Tecumseh Road** – This road provides an east-west arterial route through the predominantly industrial area south of Downtown Windsor. South of Tecumseh, **E.C. Row Expressway** provides another east-west route.

Traffic characteristics on these roads are described in further detail below.

To access the **Detroit-Windsor Truck Ferry**, commercial vehicles can travel west to the end of E.C. Row Expressway, continue south on Ojibway Parkway, then turn right onto Sprucewood Avenue and right onto Maplewood Drive.

Huron Church Road

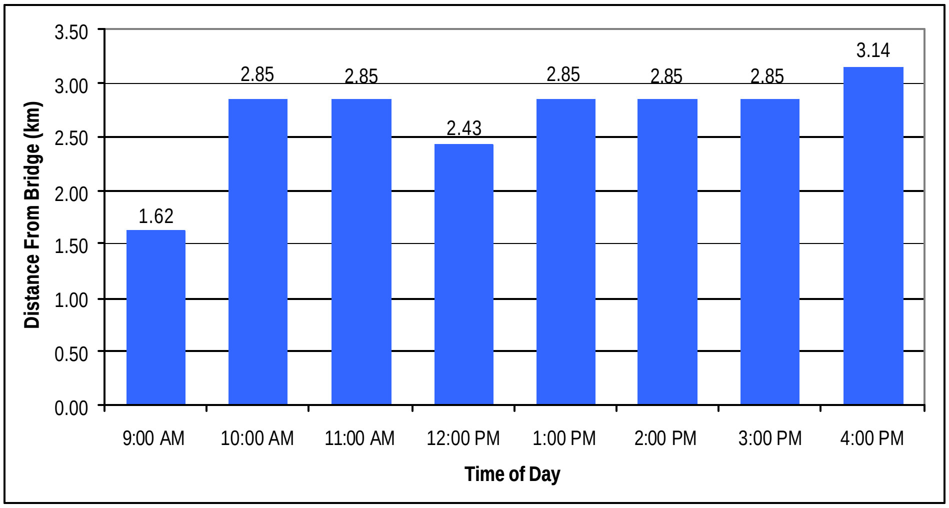
Huron Church Road is a 6-lane urban arterial road linking Highway 401 to the Ambassador Bridge via Talbot Road. The road provides a markedly different traffic environment compared to Highway 401. The posted speed limit on Huron Church Road is 80 km/h from Talbot Road to Pulford Street (south of E.C. Row Expressway), and 60 km/h from Pulford Street to College Avenue, adjacent to the access to the Bridge. Community Safety Zone signs advising of increased fines for speeding are posted on Huron Church Road. No street parking is permitted along Huron Church Road. There are 16 signalized intersections on Huron Church Road between Highway 401 and the Ambassador Bridge.

Ambassador Bridge carries the highest volume of cross-border commercial vehicle truck traffic of all Canada-US border crossings. Consequently, Huron Church Road carries a higher proportion of through truck traffic than any other road in Windsor. North of the intersection of Huron Church Road and Cabana Road, overhead signs direct commercial vehicles to use the centre lane, local traffic to use the right lane, and international cars to use the left lane. Further north, at Northwood Street (north of the E.C. Row Expressway) cars are directed to use the left lane, while commercial vehicles use the centre and right lanes.

Significant development and facilities along Huron Church Road also contribute to traffic levels on this route. Significant traffic generators along Huron Church Road include, from north to south, Assumption High School at Wyandotte Street, the University of Windsor at College Avenue, the University Mall at Tecumseh Road, and, further south on the Highway 401/Huron Church corridor, St. Clair College on Talbot Road. A secondary customs inspection facility for commercial vehicles leaving Ambassador Bridge, located west of Huron Church Road between Malden Road and Industrial Drive, generates truck-turning movements at the intersections of Huron Church Road and Malden Road, and at Huron Church Road and Industrial Drive.

During peak border crossing periods, there can be significant truck queuing and traffic delay on Huron Church Road, with the queues of commercial vehicles extending back from the Ambassador Bridge. Queuing delays can lead to diversion of commercial vehicles onto other city streets to avoid congestion on Huron Church Road. Surveys of queuing carried out by City of Windsor staff on Huron Church Road in June 2002 showed five hourly observations where the back of the two-lane truck queue was approximately 2.85 km from the bridge plaza entry point (see Exhibit 3.3). A queue of this length would extend to Malden Road. At times, queues have been observed as far back as Cabana Road/St. Clair College.

EXHIBIT 3.3: COMMERCIAL VEHICLE QUEUES ON HURON CHURCH ROAD, JUNE 2002



Source: City of Windsor, from a survey conducted by staff on June 27, 2002
Note: The number of commercial vehicle inspection booths was increased from 6 to 9 in September 2002.

Traffic signals along Huron Church Road between College Avenue and Pulford Road (south of the E.C. Row Expressway) are operated by the City of Windsor, while signals south of Pulford Road are operated by the MTO. From Pulford Road northerly, the signals on Huron Church Road are co-ordinated and operated on two timing plans for different periods of the day. One timing plan is implemented between 6:00 AM and 11:00 PM, while the other plan covers the nightly period between 11:00 PM and 6:00 AM. During the day, the signals have a cycle length of 130 seconds. Signalized intersections elsewhere in Windsor typically use four different signal timing plans to reflect different traffic demands during the morning peak period, mid-day period, evening peak period and overnight. The use of one timing plan on Huron Church Road between 6:00 AM and 11:00 PM can therefore be interpreted as an indication of relatively steady traffic demand during that period.

Signal phases for left turns from Huron Church Road, and for traffic on side streets with the exception of Tecumseh Road, are only operated if vehicle detectors are triggered. In the absence of any left turn or side street traffic demand, all green time is given to the through movement on Huron Church Road. This traffic signal strategy is intended to maximize the through capacity of Huron Church Road. However, when commercial vehicles are in queue, through capacity cannot be maximized.

Traffic count data at the intersection of Huron Church Road and College Avenue from June 2000 show that approximately 1,100 cars and 250 commercial vehicles travelled north on Huron Church Road between 7 AM and 8 AM, and approximately 325 cars and 210 commercial vehicles travelled south. Between 5 PM and 6 PM, approximately 640 cars and 280 commercial vehicles travelled north, and 800 cars and 240 commercial vehicles travelled south on Huron Church Road.

The Essex Terminal Railway level crossing on Huron Church Road immediately north of College Avenue stops all traffic flow when the crossing gates are lowered to allow a train to pass over Huron Church Road. Trains typically cross Huron Church Road several times per day, stopping traffic entering and exiting the bridge plaza for approximately 3 to 4 minutes each time.

The operating level-of-service (LOS) on Huron Church Road was assessed using the Highway Capacity Manual (HCM) Urban Streets methodology, which is based on average travel speed on links and through intersections, and considering Huron Church Road as a suburban principal arterial road. Between College Avenue and Tecumseh Road, Huron Church Road was found to have LOS D during the morning peak hour and LOS E during the evening peak hour, based on a combination of intersection delay and link delay. LOS D for an urban arterial road borders on the range where small increases in flow may cause substantial increases in delay and decreases in travel speed. LOS E for an urban arterial road is characterized by significant delays and reduced travel speeds.

Tecumseh Road at Huron Church Road has a high east-west crossing demand and the signals have a setting that provides green time to the east-west movement every signal cycle. The other intersections along Huron Church Road only provide green time to the east-west movements when there is a demand registered by detectors. Consequently, the intersection of Huron Church Road and Tecumseh Road has traffic demand and operating characteristics that make the intersection a critical point on the Huron Church Road corridor.

LOS at critical intersections along Huron Church Road was calculated for the 2000 base year, using the signalized intersection methodology contained in the HCM. Levels-of-service for the intersections are summarized in Exhibit 3.4. For operations on Huron-Church Road, LOS does not indicate performance of the roadway, as performance is largely affected by queuing at the border. The exhibit shows that the LOS at intersections in the AM peak hour on Huron Church Road is currently unacceptable at Tecumseh Road, and that the LOS in the PM peak hour is currently unacceptable at Tecumseh Road. It is noted that the HCM analysis does not take into account the effect of queues on Huron Church Road due to delays on the Ambassador Bridge. When extended queues occur, the operation of intersections along Huron Church Road is adversely affected.

EXHIBIT 3.4: LEVEL-OF-SERVICE AT HURON CHURCH ROAD INTERSECTIONS, 2000

Intersection	AM Peak Hour	PM Peak Hour
College Avenue	B	B
Girardot Street	B	B
Tecumseh Road	D	E

Note: Performance of roadway is largely affected by queuing at the border.

Dougall Avenue, Ouellette Avenue and Goyeau Street

In central Windsor, the Detroit-Windsor Tunnel is accessed from Goyeau Street, an arterial road in the central business district. From Highway 401, the route to the tunnel follows the urban arterial roads of Dougall Avenue/Ouellette Avenue, then Wyandotte Street and Goyeau Street to the tunnel entrance in downtown Windsor. For trips arriving in Canada from the Tunnel, exit from the Tunnel into Windsor is onto Park Street, then either onto Goyeau Street or Ouellette Avenue.

The route along Dougall Avenue/Ouellette Avenue is a four-lane urban arterial road. The Dougall Avenue exit on westbound Highway 401 is signed on the highway as a route to the Detroit-Windsor Tunnel, although the primary function of these roads are as local roads.

Land uses on the Dougall Avenue corridor that generate truck movements include a CPR rail yard on the west side of Dougall Avenue and south of Tecumseh Road, and a Canada customs secondary truck inspection point on Hanna Street east of McDougall Street. Devonshire Mall is also located on Howard Avenue, south of the interchange with the E.C. Row Expressway.

Most arterial roads in Windsor are designated as truck routes. However, a City of Windsor by-law prohibits commercial vehicles from using Ouellette Avenue between Tecumseh Road and Wyandotte Street between 6 PM and 8 AM. During this restricted time, commercial vehicles travelling to and from the tunnel via Ouellette Avenue can divert to a truck route along Tecumseh Road to McDougall Street, Giles Boulevard and Goyeau Street.

Commercial vehicles arriving in Canada via the tunnel exit onto Goyeau Street between 8 AM and 6 PM, but are restricting to exiting onto Park Street outside of these hours. The truck route from the tunnel uses Goyeau Street, Giles Boulevard and McDougall Avenue and passes the secondary customs inspection facility on Hanna Street. Cars can exit onto Park Street at all times.

City of Windsor and Detroit-Windsor Tunnel staff have indicated that congestion and queuing from the Tunnel toll plaza frequently results in queues extending onto Goyeau Street. LOS at the intersection of Goyeau Street and Wyandotte Street were calculated for the base year of 2000 using the HCM signalized intersection methodology. The AM peak hour has the heaviest traffic levels for the left turn from Wyandotte to Goyeau Street. The LOS for this approach at this time is B. The PM peak hour is the heaviest traffic time for the southbound approach to this intersection. The LOS for this approach during the PM peak hour is calculated as C. With this analysis, the LOS for both approaches is considered acceptable. However, it is noted that the capacity analysis does not take into account the effect of queues extending from the Detroit-Windsor Tunnel toll plaza onto Goyeau Street, which can block Goyeau Street and impact on the operation of the intersection with Wyandotte Street.

On Ouellette Avenue, the critical location is at the intersection of Ouellette Avenue and Tecumseh Road. At this location, a high volume of local east-west trips on Tecumseh

Road crosses the international and local traffic on Ouellette Avenue. Due to the high east-west demand, the available green time for north-south traffic is limited, which in turn reduces the capacity for northbound and southbound movement.

LOS at the intersection of Ouellette Avenue and Tecumseh Road were calculated for the base year of 2000, using the signalized intersection methodology contained in the HCM. LOS for the northbound and southbound approaches (during the AM and PM peak hours, respectively) of the Ouellette Avenue/Tecumseh Road intersection are F, which is unacceptable from a traffic operations perspective.

Wyandotte Street

Wyandotte Street is generally a four-lane urban road that provides an east-west link through downtown Windsor. In sections where the traffic demand is lower, Wyandotte Street is reduced to two lanes to allow parking on one or both sides.

Wyandotte Street provides a secondary entrance to the Ambassador Bridge for trips to the US originating east of Huron Church Road. East of Downtown Windsor, the Ford engine plant on Henry Ford Centre Drive and the General Motors transmission plant on Walker Road generate truck trips along Wyandotte Street that are destined to the Ambassador Bridge.

Wyandotte Street also provides an important link to the Detroit-Windsor Tunnel, with the Tunnel access being located just north of the intersection of Wyandotte Street and Goyeau Street. Wyandotte Street West via Huron Church Road and Patricia Road provides an alternative route from Highway 401 to the Detroit-Windsor Tunnel.

Tecumseh Road

Tecumseh Road provides an arterial east-west route through the predominantly industrial area south of Downtown Windsor. The E.C. Row Expressway runs as a parallel route to the south of Tecumseh Road, also serving the industrial area south of Downtown Windsor.

The Ford engine plant on Henry Ford Centre Drive, the General Motors transmission plant on Walker Road, and the Chrysler minivan plant on Chrysler Centre Drive generate truck trips along Tecumseh Road and the E.C. Row Expressway to access the Ambassador Bridge.

The secondary inspection point for commercial vehicles entering Canada via the Detroit-Windsor Tunnel is located on Hanna Street east of McDougall Street. Tecumseh Road provides a link from McDougall Street to and from Ouellette Avenue, allowing commercial vehicles to move back onto the main route to and from Highway 401.

Detroit Border Crossing Access Roads

The border crossings from Detroit to Windsor are in close proximity to the State and Interstate freeway system. Exhibit 3.2, as previously shown, displays the roads in the vicinity of the Ambassador Bridge and Detroit-Windsor Tunnel.

Current connections from the Ambassador Bridge to Interstates 96 and 75 via Porter Street are confusing for drivers and hazardous due to weaving.

Connections from the Detroit-Windsor Tunnel to Interstate 375 and the John C. Lodge Freeway mix international traffic with downtown Detroit traffic.

Queues from the Detroit-Windsor Tunnel plaza often cause gridlock on city streets.

For traffic using the **Ambassador Bridge**, cars and commercial vehicles have distinct travel options. Cars exit onto Porter Street, which has ramps at signalized intersections to/from Interstates 75 and 96 and intersects with service roads paralleling the freeways. All commercial vehicles entering the US from the Ambassador Bridge follow a ramp to the truck customs inspection facility, and then exit onto West Fort Street, south of the plaza. Commercial vehicles can link with Interstate 75 by travelling west on Fort Street then north on Clark Street, or by travelling east then north on Rosa Parks Boulevard. I-75 provides a connection south toward Ohio and north toward Northern Michigan. It can also be used to access I-96, which connects to western Michigan, and is the link to I-94, to travel toward Chicago. The arrangement from the bridge to the Interstate freeway systems is a confusing arrangement for drivers and hazardous due to the high level of weaving traffic. The Ambassador Bridge Gateway Project, planned for construction, will address these traffic issues.

At the **Detroit-Windsor Tunnel**, commercial vehicles are part of the same traffic stream as cars. All traffic entering or leaving the Detroit-Windsor Tunnel must pass through the signalized intersection of the Tunnel access to the south, Randolph Street to the north, and Jefferson Avenue to the east and west. Interstate 375 and M-10 (John C. Lodge Freeway) link with Jefferson Avenue in close proximity to the Tunnel. The M-10 provides access to the I-96 and I-75 freeways from the tunnel.

West of downtown Detroit, commercial vehicles using the **Detroit-Windsor Truck Ferry** use West Jefferson Avenue/Springwells as a link between the ferry and the I-75. In Windsor, access is provided via EC Rowe Expressway/Ojibway Parkway.

The following key border crossing access roads in Detroit are discussed further below:

- Porter Street
- West Fort Street
- Jefferson Avenue

Porter Street

Porter Street connects directly to the Ambassador Bridge Plaza. All Canada-bound traffic arriving from I-96 and southbound I-75 must cross Porter Street to access the Ambassador Bridge. Traffic on northbound I-75 can reach the Ambassador Bridge through a Duty Free area south of Porter Street. All US-bound automobiles must cross Porter Street to reach the I-75 and I-96 access ramps.

The intersection of the Ambassador Bridge access and the freeway ramps is noted in the **Ambassador Bridge/Gateway Project Interchange Justification Study** as having poor geometries, confusing signage, ill-defined lanes and conflicts between left-turning traffic. The accesses leading to and from the Ambassador Bridge via Porter Street are to be modified significantly as a result of the Ambassador Interchange Justification Study.

West Fort Street

All truck traffic entering the US from the Ambassador Bridge exits the primary US customs inspection booths onto West Fort Street via a signalized intersection.

The Ambassador Bridge interchange justification study notes that the Fort Street/Clark Street route (both part of Michigan Highway M-3) takes approximately 64% of daily truck traffic exiting the US customs truck inspection facility. The same study also noted an operational problem due to commercial vehicles avoiding the Clark Street and Rosa Parks Boulevard routes to the freeway by accessing Porter Street and turning onto the I-75 and I-96 from there.

Jefferson Avenue

From the Detroit-Windsor Tunnel to the east along Jefferson Avenue, access ramps lead to I-375, which links to I-75, I-94 and to I-96 via I-94. To the west, the M-10 links with Jefferson Avenue and provides access to and from I-75, I-94 and I-96. Also west on Jefferson Avenue is access to underground parking from the median. Entry to the parking is at the intersection of Jefferson and Woodward, and exit lanes feed onto Jefferson Avenue eastbound and westbound west of Randolph Street.

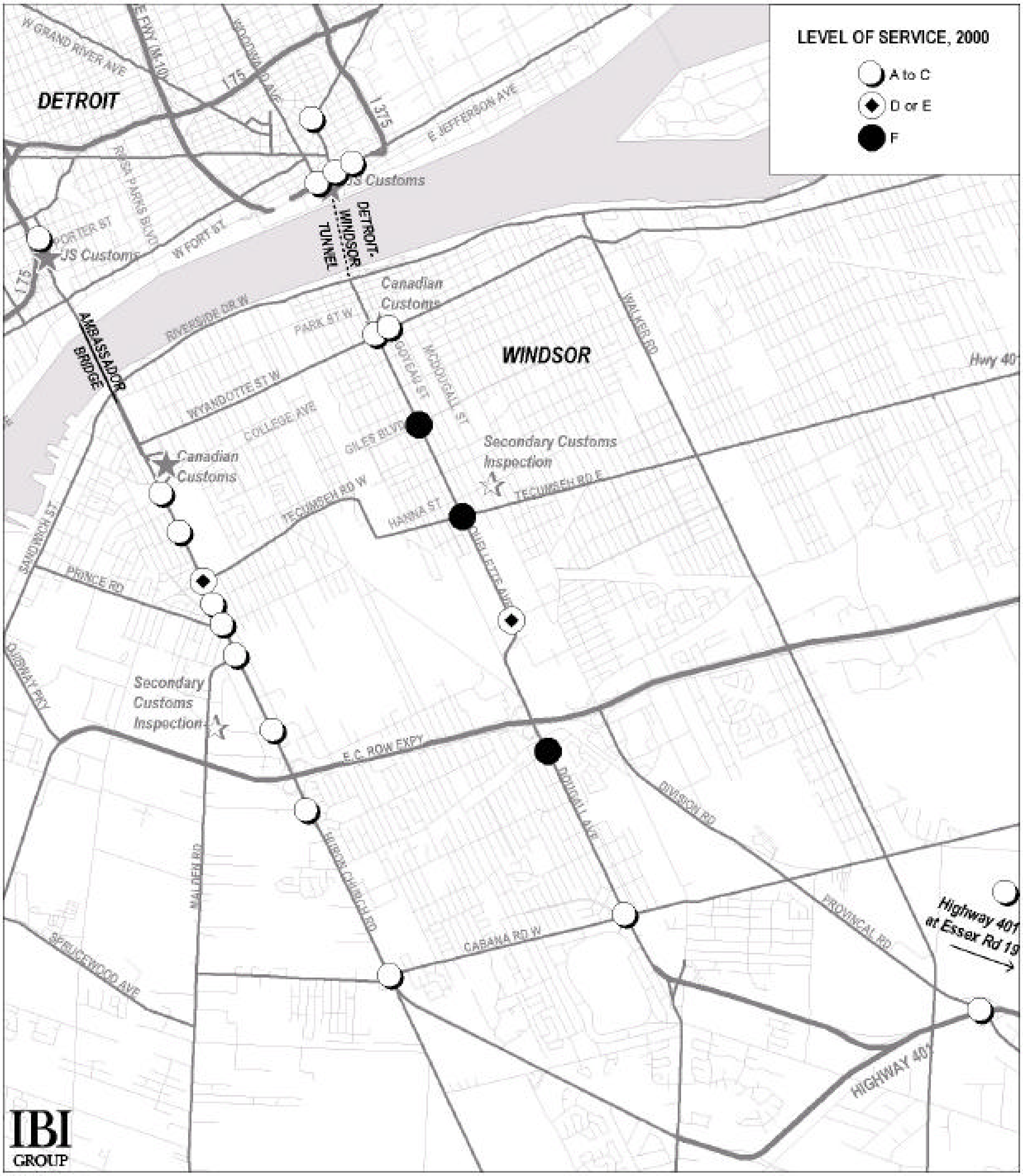
Jefferson Avenue has four lanes in each direction in the vicinity of the Tunnel entrance. Like most arterial roads in Detroit, Jefferson Avenue has a wide median, and does not allow left turns at intersections. The State of Michigan prohibits left turns at many wide arterials and requires motorists to turn right and then make a U-turn, or proceed through the intersection, make a U-turn and then a right. The left turn from westbound Jefferson Avenue is an exception to this rule, allowing for the left turn into the tunnel entrance. Elsewhere at the intersection of Jefferson Avenue and Randolph Street, U-turn lanes are provided in the medians to allow vehicles to make indirect left turns. Randolph Street provides a link from the Detroit-Windsor Tunnel access directly north into downtown Detroit. Immediately north of Jefferson Avenue, Randolph Street has three lanes in each direction.

From discussions with the Detroit-Windsor Tunnel management, significant queuing occurs on Jefferson Avenue during peak border crossing periods. Using HCM analysis under current operating conditions, it was estimated that the intersection of Jefferson Avenue and Randolph Street at the Detroit-Windsor Tunnel access has capacity for approximately 1900 exits and 2450 entries.

Levels of service at the intersection of Jefferson Avenue and Randolph Street were calculated for the base year of 2000, using the signalized intersection methodology contained in the HCM. The northbound approach from the tunnel is LOS C during the AM peak hour and the southbound approaches are LOS E during the PM peak hour. The southbound LOS in the PM peak hour is considered unacceptable.

Exhibit 3.5 summarizes the level of service at selected intersections in 2000. These do not take into account the impact on traffic operations of queues from the border crossings, in which case delays are much greater.

EXHIBIT 3.5: INTERSECTION LEVEL-OF-SERVICE AT SELECTED DETROIT-WINDSOR INTERSECTIONS, 2000

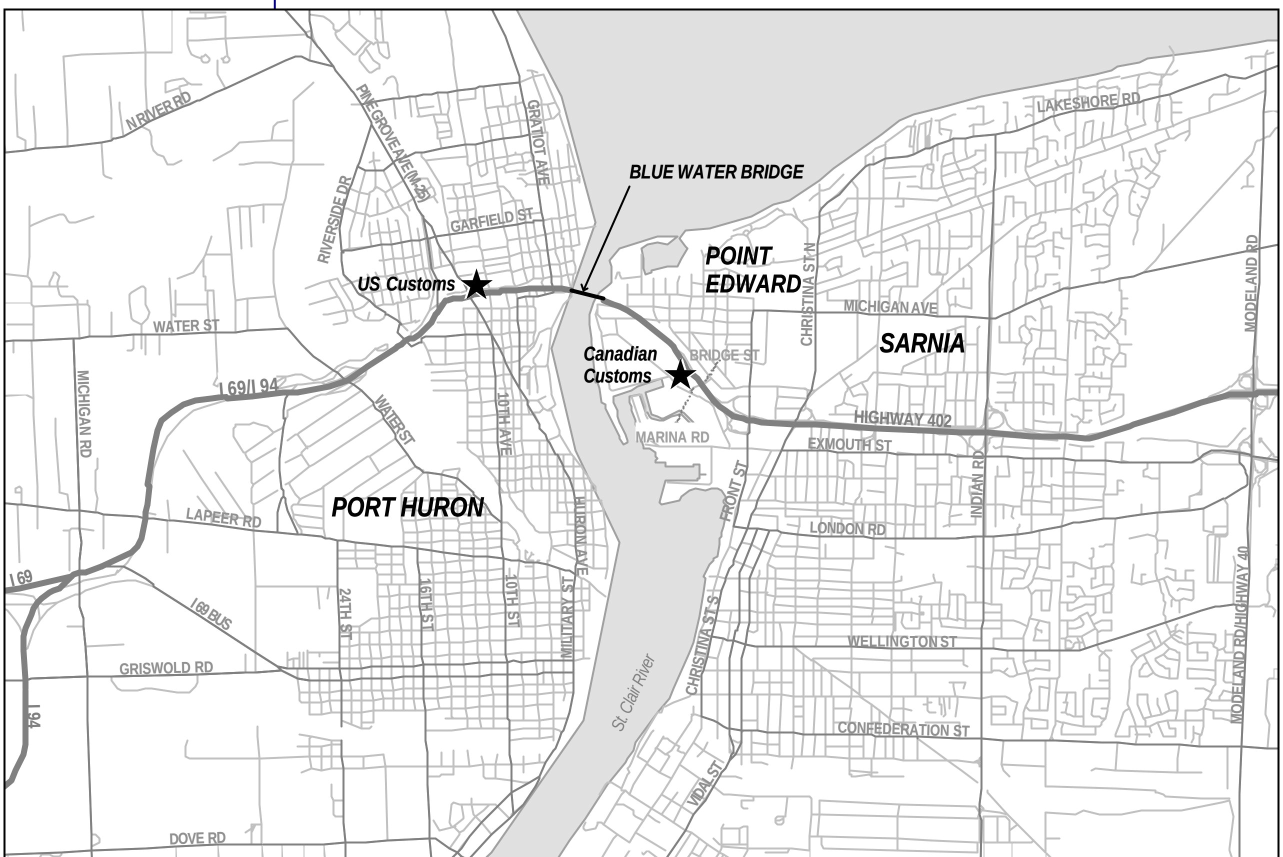


Note: Level-of-service calculations do not indicate the performance of the roadway, as performance of these roadways is largely affected by queuing at the border.

Sarnia Border Crossing Access Roads

Exhibit 3.6 shows the access road system in the vicinity of the Blue Water Bridge in Sarnia.

EXHIBIT 3.6: ACCESS ROADS IN THE VICINITY OF THE BLUE WATER BRIDGE



Current Marina Road and Bridge Street connections to Highway 402 cause operational problems.

Truck queues on the Blue Water Bridge plaza often extend along Highway 402 and block ramps to and from local streets.

Highway 402 is the major highway route linking Sarnia and Point Edward with the rest of Ontario. Highway 402 also links Sarnia with the major industrial and population centres in south and central Ontario through its connection with Highway 401, approximately 100 km east, close to London. This highway is four lanes wide and feeds directly to the Blue Water Bridge plaza in the Village of Point Edward, where local widening occurs to facilitate traffic moving to and from the Blue Water Bridge. Provincial Highways 40 and 21 link Sarnia with areas to the south, which includes several petrochemical plants.

At the entry to the Canadian toll booths at the Blue Water Bridge plaza and on the Highway 402 approach, commercial vehicles must be in the right-hand lane. However, at the US customs inspection on the Port Huron side, commercial vehicles must be in the left-hand lane. A one-lane 'pinch point' is provided following the toll booths on the approach to the bridge to allow commercial vehicles to merge and move to the left lane in a low-speed environment.

Some of the significant roadways that are part of the Blue Water Bridge access road system in Sarnia are as follows:

- **Front Street –** Front Street is a north-south arterial with an interchange with Highway 402 and therefore provides access to the Blue Water Bridge. The Front Street interchange is the first full interchange east of the Blue Water Bridge and is the signed exit for access to downtown Sarnia. Front Street has two lanes in each direction, and provides auxiliary left turn lanes for vehicles turning onto the Highway 402 entry ramps. The truck queue from the toll plaza regularly extends past the Highway 402 westbound entry ramp, and can block access for traffic destined for the Blue Water Bridge. The interchange at Front Street and the ramp connections at Marina Road and Bridge Street are likely to be reconfigured in the future to address safety and operational concerns. A study is currently under way to investigate improvement alternatives.

- **Christina Street –** Christina Street is a north-south arterial with a partial interchange with the westbound lanes of Highway 402 only. While the street provides an access to the Blue Water Bridge via Highway 402 for travellers from downtown Sarnia, it cannot be accessed by traffic arriving from the US. Christina Street has two lanes of traffic in each direction.
- **Indian Road –** At 3 km east of the Blue Water Bridge, Indian Road runs north/south and has the second full interchange with Highway 402 east of the border crossing. Indian Road links with Highway 40 to the south and provides access to the industrial area along the St Clair River. Two lanes in each direction are provided along most of the road's length.
- **Highway 40 –** primary route for commercial vehicle traffic to petroleum refineries located south of Sarnia. The highway is currently a limited access road and MTO is currently studying opportunities tom make it controlled access.

Port Huron Border Crossing Access Roads

Exhibit 3.6, as previously shown, displays the road system in the vicinity of the Blue Water Bridge in Port Huron.

Current ramp connections to and from Interstate 69/94 limit flow to one lane in each direction.

The current route from Interstate 69/94 to the Duty Free area and the Blue Water Bridge is inadequate for commercial vehicles.

At Port Huron, the Blue Water Bridge is continuous with the four-lane Interstate 69/94. Interstate 94 branches off to the south toward Detroit, while Interstate 69 continues west then south toward Indianapolis, linking with numerous strategic transportation corridors for travel throughout central and Midwest US and Mexico.

At the entry to the US customs inspection, commercial vehicles must be in the left-hand lane. Following the inspection, commercial vehicles must then make an S-turn to the right and merge with automobile traffic, which is an operational and a safety issue. The current connections between the Blue Water Bridge plaza and I-69/I-94 have bottlenecks that limit flow to one lane in each direction. It is understood that improvements to the Blue Water Bridge plaza are currently under investigation.

Two major arterials intersect with I-69/I-94 in Port Huron:

- **Pine Grove Road** (Michigan Road 25) – Pine Grove Road runs northwest/southeast through Port Huron, and generally provides two lanes in each direction with auxiliary turning lanes at intersections. Pine Grove Road is one of the major links to I-94, and forms part of the I-94/I-69 Business Loop around Port Huron. Entry to a duty free store and direct entry to the Blue Water Bridge for Canada-bound traffic is achieved via an access from Pine Grove Road.
- **Water Street** – The I-69/94 Water Street interchange is the first full interchange for traffic entering the US from Canada. Water Street runs northwest to southeast into downtown Port Huron, and generally provides two lanes in each direction with auxiliary turning lanes at intersections.

From discussions with Port Huron staff, it is understood that traffic to/from the Blue Water Bridge does not cause significant problems for the road network within Port Huron, with a few exceptions. Problems that were identified include the route between eastbound I-69/I-94 and the duty free store located on Pine Grove Road, a movement that is difficult for semi-trailers and other large commercial vehicles due to the geometry of the right turn from Hancock Street onto Pine Grove Road. This is the same route that must be followed for access to downtown Port Huron. Other problems can occur due to closures of sections of the I-94 resulting from bridge maintenance at the Black River bridges, where all freeway traffic must be diverted onto Port Huron Roads.

International Travel and Routing

A greater understanding of cross-border travel can be gained by examining the routing and road facilities used to access the border crossings. This is discussed for each crossing. The route assignments are based on results from the Regional Model developed for this study, described in the **Travel Demand Analysis Process Working Paper**.

Exhibit 3.7 shows the routes made by passenger car and by commercial vehicle traffic using the **Ambassador Bridge** in the PM peak hour, when the peak direction of flow is from the US to Canada. The Ambassador Bridge has a higher proportion of long-distance traffic than the Detroit-Windsor Tunnel. Most of the passenger car traffic from the US accesses the bridge from four main facilities: I-96, I-94, I-75 (N) and I-75 (S). Traffic arriving via I-96 is from the west and northwest area of Detroit and is mainly shorter-distance traffic. Traffic using I-94 to access the bridge is from the southwest area of Detroit and includes longer distance traffic such as from Chicago. I-75 serves traffic from the north and south, much of which arrives via I-75 south representing longer-distance traffic.

The bridge connects to Huron Church Road on the Canadian side. The main flow of traffic continues on Huron Church Road, predominantly to access Highway 401. For passenger cars accessing the Windsor downtown and casino areas, the routings are via Riverside

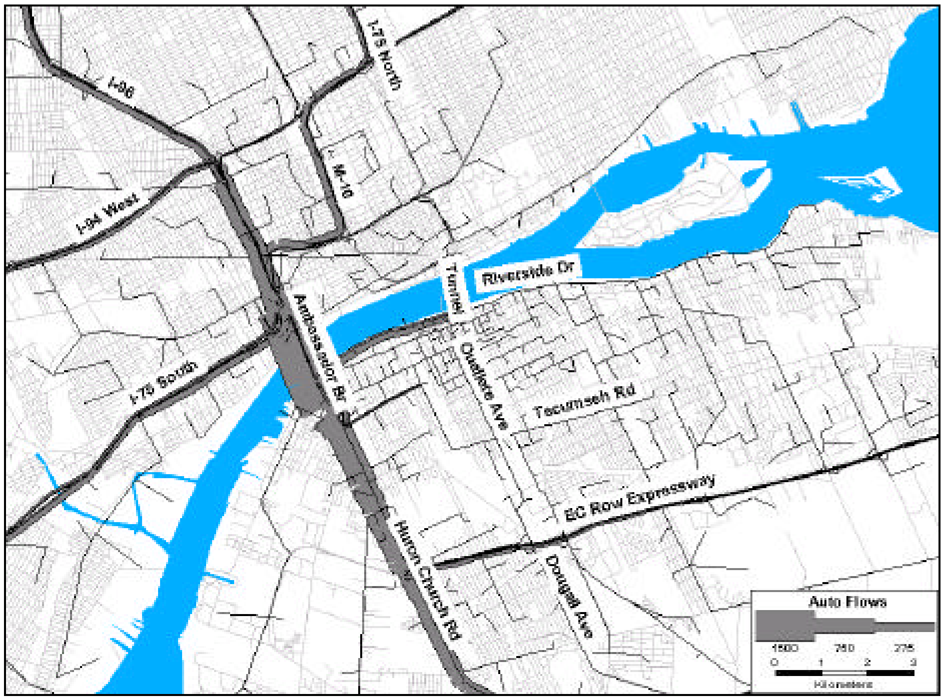
Drive, to central Windsor via Tecumseh Road, and to east and southeast of Windsor via the EC Row Expressway.

Cross-border commercial vehicle trips involve a much higher proportion of long-distance than passenger car trips. The origins/ destinations in the central Windsor/Detroit area are more focused on a few industrial areas. From the US side, most of the traffic is from the west or south, roughly one-third accessing the bridge via I-94 (from northwest US, Chicago and west Detroit) and half using I-75 from the south (southwest and southeast US). A smaller proportion accesses the crossing from I-96 (west Detroit) or I-75 from the north.

Upon arriving in Canada, over 90% of the commercial vehicle traffic continues south on Huron Church Road, with other traffic turning north and east onto local roads such as College Avenue and Wyandotte Street, which provide access to the north Windsor GM and Ford car plants. Many of these roads have relatively low volumes of local traffic and consequently have very high proportions of traffic to and from the bridge. Over 60% of the car and commercial vehicle traffic (measured in passenger car equivalent, or PCE, flows) on the roads around Ambassador Bridge are cross-border trips. For Huron Church Road, three-quarters of traffic is travelling to or from the US. A small proportion of commercial traffic accesses central Windsor via University Avenue and Tecumseh Road, with the bulk of local Windsor traffic connecting onto the E.C. Row Expressway, which provides good access for most of the car plants. The vast majority of commercial vehicles continue south on Huron Church Road bound for Highway 401.

EXHIBIT 3.7: TRAVEL ROUTING FOR THE AMBASSADOR BRIDGE, MODELLED 2000 PM PEAK HOUR

A. PASSENGER CARS



B. COMMERCIAL VEHICLES

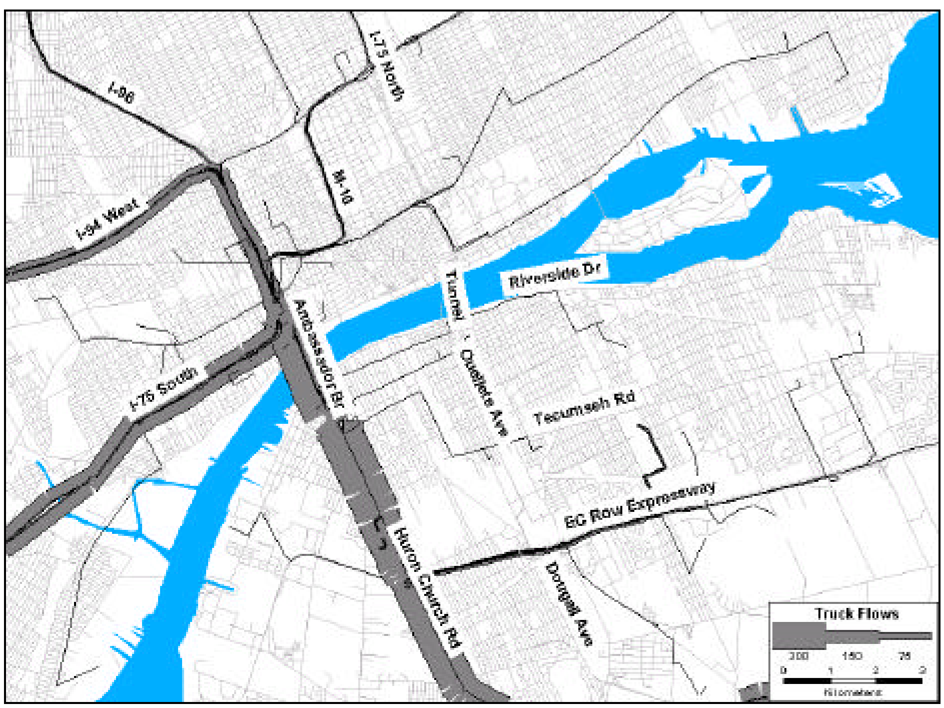


Exhibit 3.8 shows the routes used to travel to and from the **Detroit-Windsor Tunnel** in the PM peak hour based on traffic assignments from the Regional Model results.

The tunnel serves a higher proportion of local traffic than does the Ambassador Bridge, as it connects the downtown areas of Windsor and Detroit more directly. On the US side, traffic arrives at the bridge via I-375, I-75, and M-10, with the largest proportion of traffic arriving from the north via the I-375 and I-75. These facilities are accessed by I-94 East and West, I-96 and I-75 North and South.

In Canada, the tunnel connects to downtown Windsor, from which traffic disperses to many road facilities within a few blocks of the tunnel entrance. A small proportion of cars are destined to northeast and southeast Windsor via Riverside Drive, Wyandotte Street and other local roads. Approximately one-third of the tunnel traffic travels south via Ouellette Avenue, McDougall Street and Howard Avenue. Almost half of this southbound traffic connects o the E.C. Row Expressway to travel to east Windsor, with most of the remainder continuing south on Dougall Avenue towards Highway 401.

Commercial vehicle trips using the Detroit-Windsor Tunnel are also generally local in nature. From the US, I-375, I-75, M-10 and I-94 are used to access the tunnel, with most of the trips from the north. These routes connect to the tunnel via Jefferson Avenue, which as a downtown road carries significant local traffic, with only about 20% of traffic passenger car equivalents in the vicinity of the tunnel representing cross-border traffic.

In Windsor, approximately 30% of traffic (PCEs) on streets within a block of the tunnel represents cross-border traffic. The majority of commercial vehicles use Ouellette Avenue and the E.C. Row Expressway, which provides good access to the automotive plants and other industrial sites. Approximately one-quarter of total tunnel traffic continues south towards Highway 401 and the east.

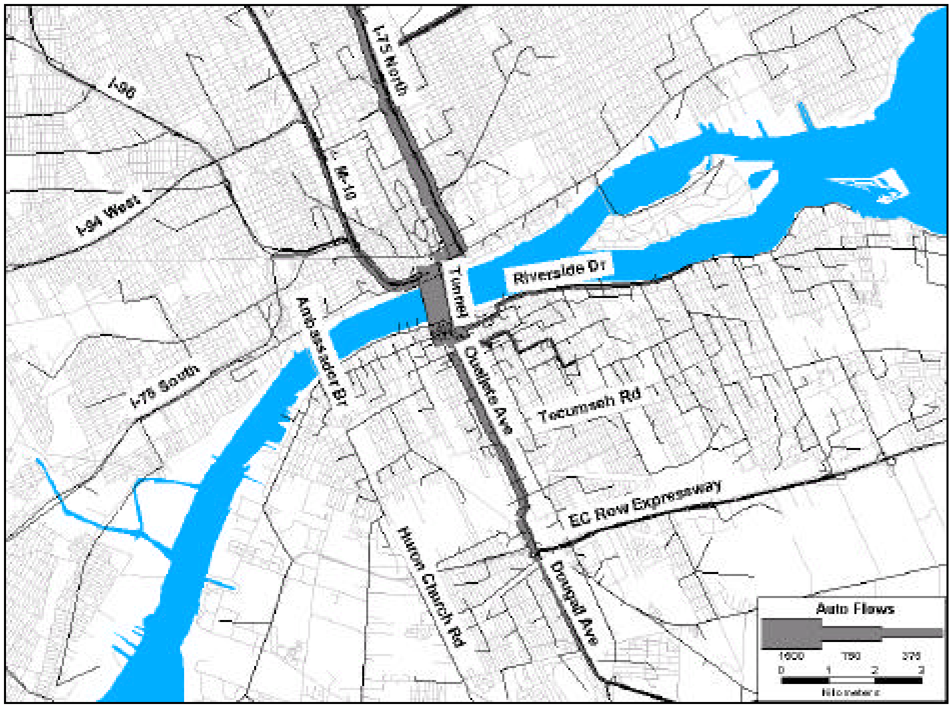
Exhibit 3.9 shows the routes used to access the Blue Water Bridge, based on the Regional traffic model for the PM peak hour. The Blue Water Bridge is used mainly by long-distance traffic, and connects directly to I-94 in the US and Highway 402 in Canada.

From the US, the vast majority of passenger car traffic accesses the bridge via either I-94 (from the south) or I-69 (from the west), with a small proportion of traffic originating from Port Huron and connecting to I-94 mainly via Highway 25. The bridge connects directly into Highway 402 in Canada, with a significant proportion of trips terminating in Sarnia, largely representing returning Canadian commuters. A small proportion of trips travel south via Highway 40 for areas of Lambton and North Chatham.

Commercial vehicle trips using the Blue Water Bridge are predominantly long-distance trips, with very few local Sarnia-Port Huron trips. Approximately two-thirds of commercial vehicles access the bridge from the west via I-69, with the remainder accessing via I-94 from Detroit and southerly before continuing on Highway 402 in Canada.

EXHIBIT 3.8: TRAVEL ROUTING FOR THE DETROIT-WINDSOR TUNNEL, MODELLED 2000 PM PEAK HOUR

A. PASSENGER CARS



B. COMMERCIAL VEHICLES

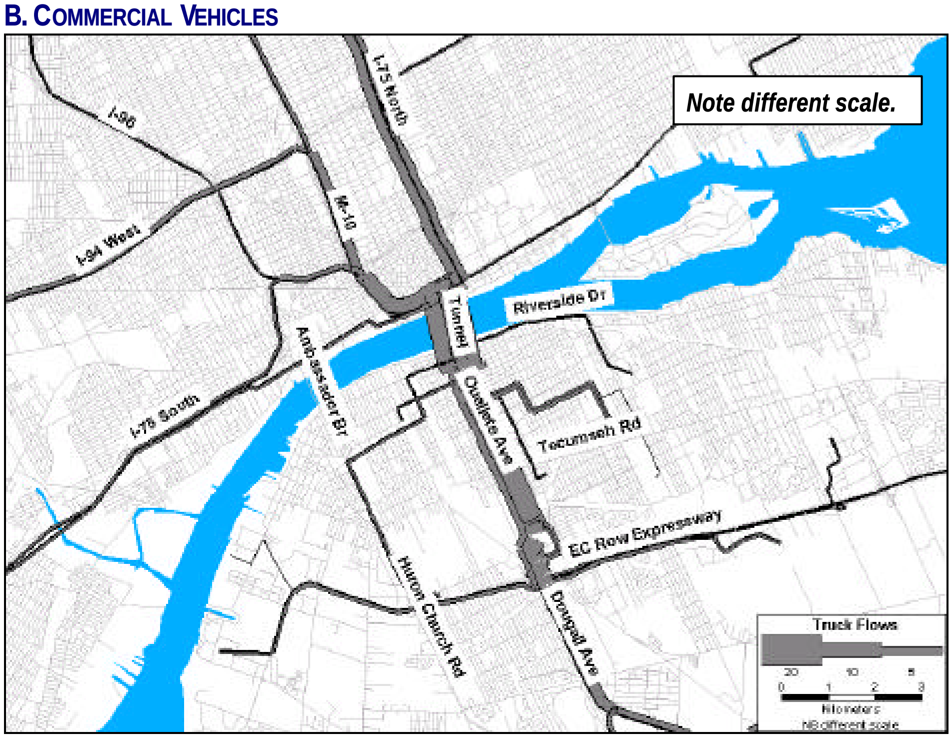
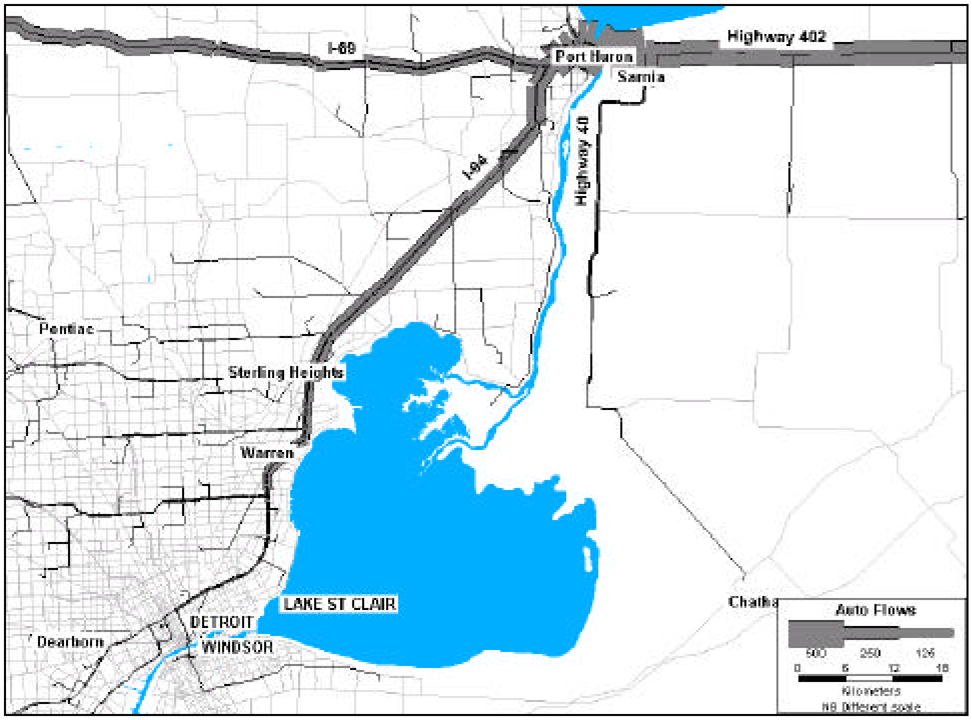
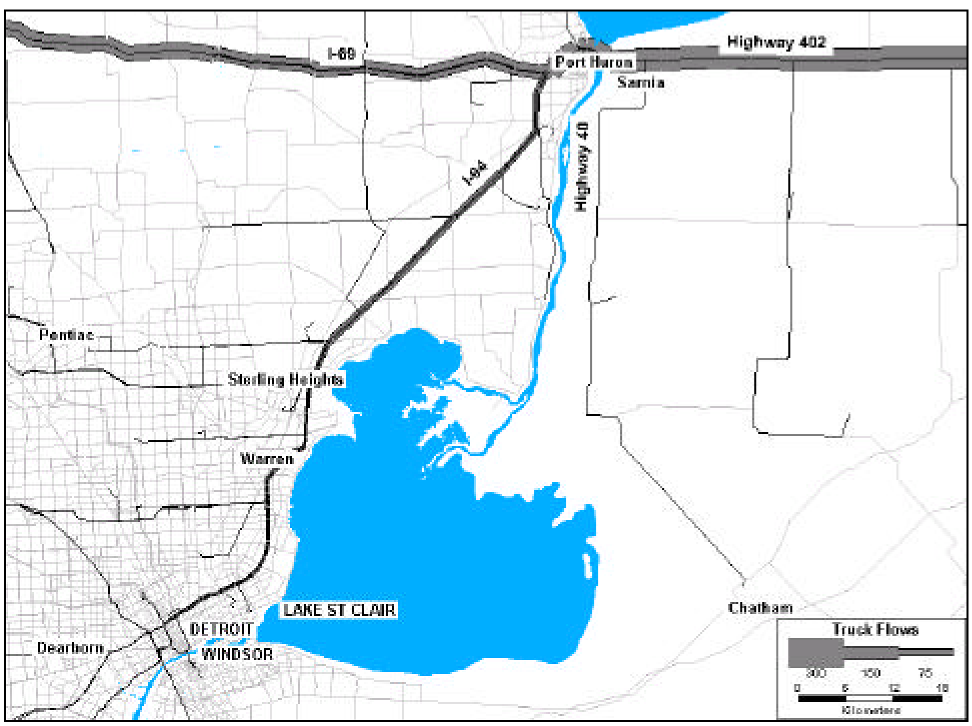


EXHIBIT 3.9: TRAVEL ROUTING FOR THE BLUE WATER BRIDGE, MODELLED 2000 PM PEAK HOUR

A. PASSENGER CARS



B. COMMERCIAL VEHICLES



3.3. Road Border Crossing Facilities

The border crossing facilities at the Ambassador Bridge, the Detroit-Windsor Tunnel, and the Blue Water Bridge are each described in this section. Supporting processing facilities at road border crossing locations consist of toll collection as well as customs and immigration inspection facilities. Duty free stores are also provided at each crossing location, either inside or adjacent to the bridge and tunnel plazas.

Ambassador Bridge

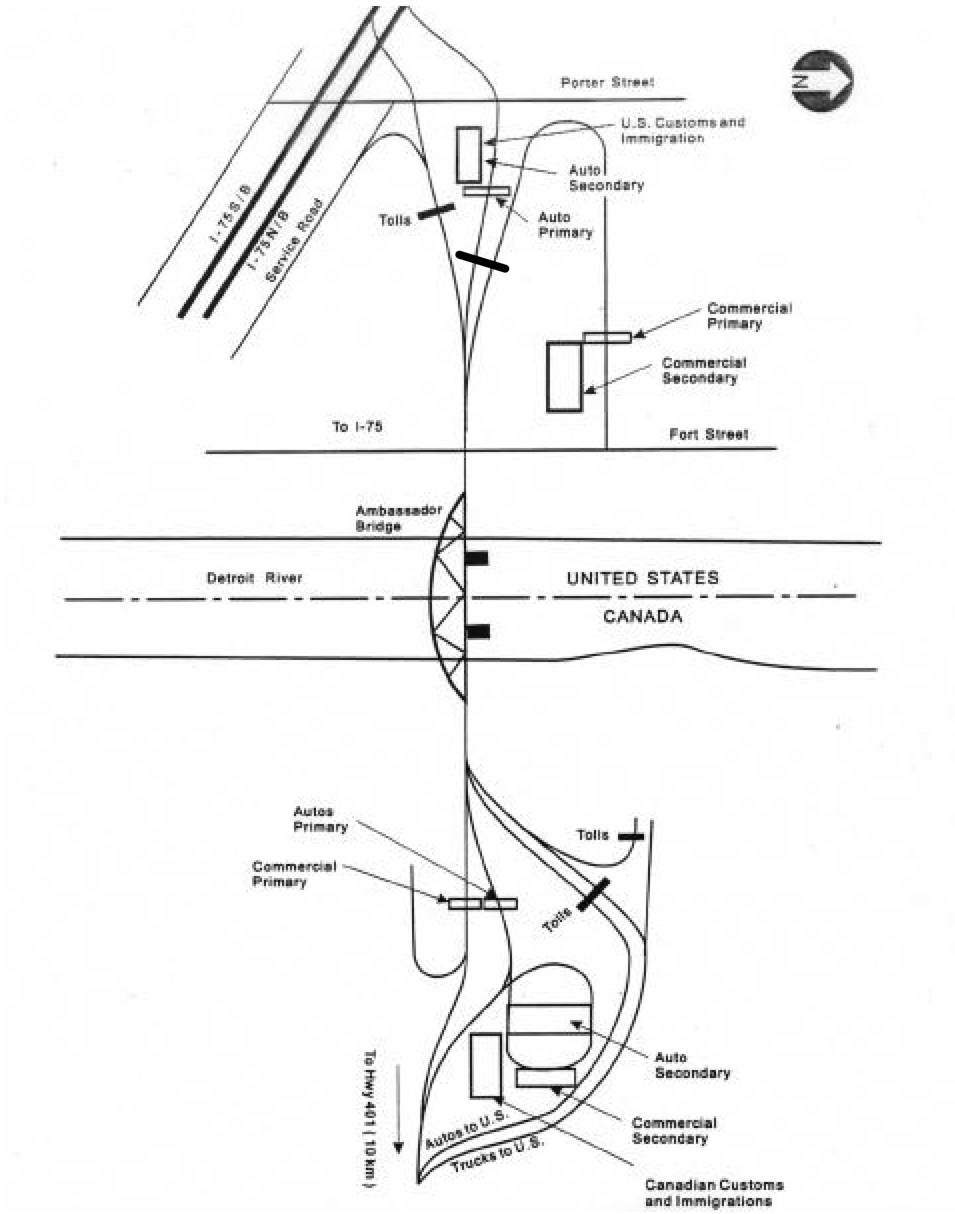
Exhibit 3.10 provides a schematic layout of the plazas on both sides of the Ambassador Bridge. From entrance to exit, the suspension bridge is 9,200 feet (2.8 km) long, and rises as high as 152 feet (46 m) above the Detroit River at its centre. Two lanes in each direction are provided along its length; currently one is used for cars and one for commercial vehicles.

All tolls are collected on the US side of the bridge, although toll collection facilities also exist on the Canadian side. Customs and immigration inspection facilities are provided at the entry to both Canada and the US.

Entry to the US has completely separate facilities for commercial vehicles and for passenger vehicles. US customs has commercial vehicles routed via a ramp to a processing area below and to the east of the bridge with nine primary inspection booths. Passenger vehicles continue straight ahead from the Bridge to 12 primary inspection booths. Toll booths are provided after the primary inspections for cars and commercial vehicles.

Entry to Canada is controlled by a group of 20 primary customs booths, with ten truck primary booths on the right-hand side and ten auto booths on the left-hand side. Secondary inspection for cars takes place beyond the primary inspection booths. Secondary inspection for commercial vehicles is located off-site at Malden Road, approximately 2 km south off of Huron Church Road, although there is a small area for secondary commercial inspection at the plaza itself.

EXHIBIT 3.10: SCHEMATIC VIEW OF AMBASSADOR BRIDGE BORDER CROSSING



Source: **Canada/U.S. International Border Crossing Infrastructure Study**, McCormick Rankin Corporation.
Note: Toll booths for travel to the US have been recently relocated to the US Plaza.

Detroit-Windsor Tunnel

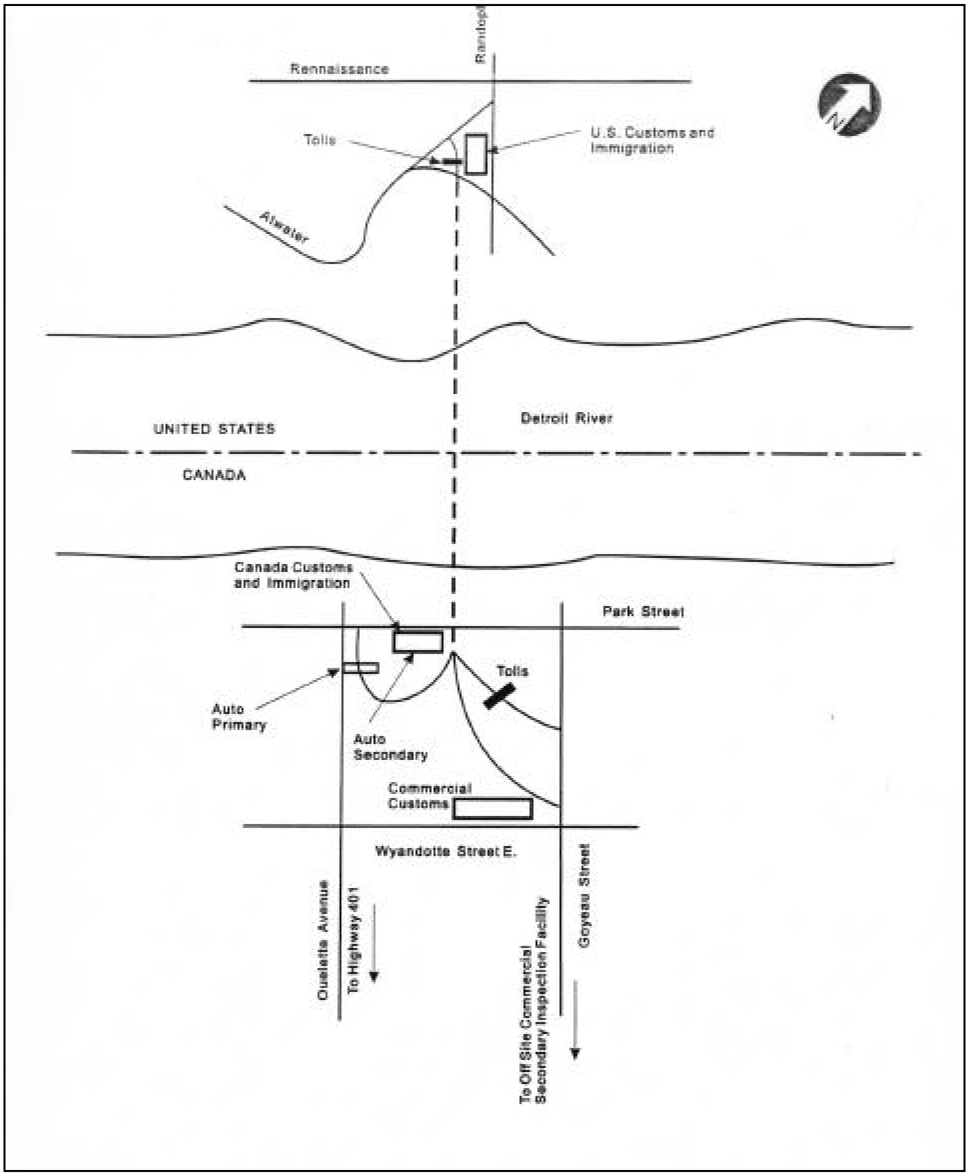
Exhibit 3.11 shows a schematic layout of the plazas on both sides of the Detroit-Windsor Tunnel. The tunnel is almost 1 mile (1.6 km) long from entrance to exit, and runs 75 feet (23 m) below the surface of the Detroit River. The tunnel is illuminated and ventilated. One lane is provided in each direction. The tunnel has a height clearance of 13'2" (4.0 m). A 30 degree bend in the tunnel is difficult for some larger vehicles to negotiate. This restricts the types of commercial vehicles that can use the tunnel.

Tolls are collected at the country of origin. Primary customs and immigration inspection facilities are provided at the entry to both Canada and the US. Due to the downtown location of the plazas, the space for secondary commercial inspection is limited and most secondary inspection for commercial vehicles is carried out off-site.

After passing through toll booths accessed from Goyeau Street in Windsor, entry to the US is controlled by 12 primary inspection booths, including three booths available for use by commercial vehicles. Secondary inspection for cars is carried out immediately adjacent to the primary inspection.

Entry to Canada is controlled by 12 primary customs booths, with truck primary booths to the east of the tunnel exit portal and leading onto Goyeau Street. Inspection booths for cars are on the west side of the tunnel exit portal, leading onto Park Street. Secondary inspection for cars is located directly after passing through the primary inspection. Secondary inspection for commercial vehicles is located off-site at Hanna Street, approximately 1.5 km south of the tunnel plaza, although there is a small area for secondary commercial inspection on the plaza itself.

EXHIBIT 3.11: SCHEMATIC VIEW OF DETROIT-WINDSOR TUNNEL BORDER CROSSING



Source: **Canada/U.S. International Border Crossing Infrastructure Study**, McCormick Rankin Corporation.

Blue Water Bridge

Exhibit 3.12 shows a schematic layout of the plazas on both sides of the Blue Water Bridge. The original 3-lane, 6,200-foot (1.88-km) cantilever truss bridge over the St. Clair River has been in place since 1938. A second 3-lane, 6,100-foot (1.86 km) continuous tied arch bridge was opened in 1997 to allow the closure of the first span for major deck rehabilitation. In 1999, both spans were open to traffic, providing a significant increase in roadbed capacity.

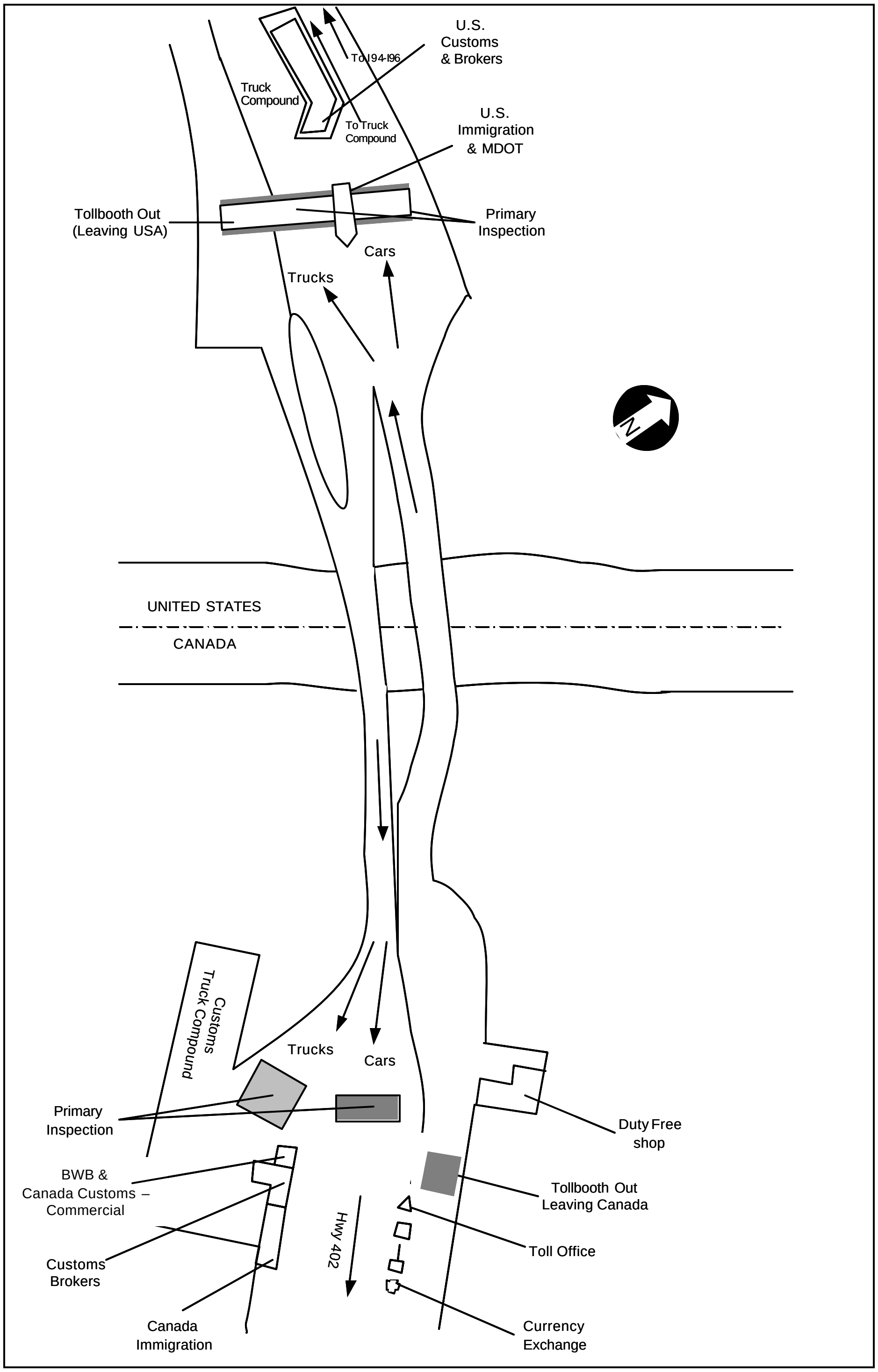
Tolls are collected at the country of origin for vehicles using the Blue Water Bridge. Primary and secondary customs and immigration inspection facilities are provided at the entry to both Canada and the US.

US-bound truck traffic must negotiate lane-changes and make difficult manoeuvres to pass through customs inspection and rejoin the traffic flow to the I-94/I-69. On the Canadian side of the Blue Water Bridge, one group of toll collection booths is provided, with truck booths on the right-hand side. Across the bridge, entry to the US is controlled by 13 primary inspection booths, including 5 booths available for use by commercial vehicles on the left hand side of the plaza. Therefore, commercial vehicles must move from the right-hand lanes at the Canadian toll plaza to the left-hand lane at the approach to the US customs plaza. Commercial vehicles allowed through after primary inspection must make a right-hand S-curve to merge back with automobile traffic and continue onto I-94/I-69.

Due to the size and layout of the plaza, the space for secondary commercial inspection is limited. Secondary inspection for cars is carried out immediately adjacent to the primary inspection.

Entry to Canada is controlled by 12 primary customs booths for cars and eight truck primary booths to the right of the plaza. Secondary inspection for cars is located directly after passing through the primary inspection. Secondary inspection for commercial vehicles is located in a customs compound on the south side of the plaza. Commercial vehicles exit the commercial inspection areas onto Marina Road, where they must turn left to return to Highway 402.

EXHIBIT 3.12: SCHEMATIC VIEW OF THE BLUE WATER BRIDGE BORDER CROSSING



Source: derived from Blue Water Bridge website, http://www.bwba.org.

3.4. Route Choice Characteristics

It is important to understand the basic factors that could influence the route choice of passenger and commercial vehicle drivers. Drivers will generally chose the route that provides the shortest time and lowest cost, although route familiarity and other factors can also influence the route choice for cross-border trips. This section provides a discussion of the factors that could influence travel choices.

Border Crossing Times

Border crossing times can influence decisions on the use of a particular crossing. Information on border crossing times in minutes for commercial vehicles is available from a recent FWHA study[1] and shown in Exhibit 3.13. These crossing times are based on 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 FWHA data, which were collected prior to 9/11, indicate that the crossing time for commercial vehicles using the Blue Water Bridge for trips entering the US is higher than at the Ambassador Bridge. There is also significantly more variability in the crossing times.

No data on crossing times for automobiles were included in the FHWA study. The delays for cars are generally much shorter.

EXHIBIT 3.13: OBSERVED TRUCK BORDER CROSSING TIMES, 2001

Crossing and Direction	Baseline Time (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

Notes: Data reflect year 2001 (pre-9/11) conditions.
Source: ***Measurement of Commercial Motor Vehicle Travel Time and Delay at U.S. International Border Stations***, FWHA, 2001.

[1] ***Measurement of Commercial Motor Vehicle Travel Time and Delay at U.S. International Border Stations***, FWHA, 2001.

A second source of truck crossing time data was provided from a Transport Canada commercial vehicle travel time study[2], which analyzed tractor logs for a sample of commercial vehicles crossing international borders in Southern Ontario. This small, homogeneous sample is not representative of all truck types, but indicative of delays. The study found the average time to cross the border at the Ambassador Bridge to be higher than at the Blue Water Bridge based on post 9/11 conditions:

- Ambassador Bridge – 25 minutes to US / 18 minutes to Canada;
- Blue Water Bridge – 20 minutes to US / 12 minutes to Canada.

Border Crossing Fees

Basic toll rates ($CAN) for passenger cars are as follows:

Ambassador Bridge	$3.50 (increased to $4.00 July 2002) ($2.75 US)
Detroit-Windsor Tunnel	$3.50 (increased to $4.00 September 2002) ($2.50 US)
Blue Water Bridge	$2.50 ($1.75 US)

Toll rates ($CAN) for commercial vehicles vary based on weight and number of axles as follows for the three facilities:

Ambassador Bridge	$0.0335 per 100 lbs gross weight 2-7 axles ($0.0230 US) $0.03698 for 8 axles or more ($0.0255 US) Minimum toll ranges from $4.25 for 2 axles to $26.50 for 12 axles. ($3.00 to $18.25 US)
Detroit-Windsor Tunnel	$2.75 plus $0.037 per 100 lbs gross weight ($2.25 plus $0.025 US) (discounts for frequent users)
Blue Water Bridge	$2.75 per axle ($2.00 US)

There are no tolls on existing routes leading to and from the border crossings.

In relative terms, particularly for longer-distance trips, the differences in toll rates for many passenger car trips are likely not sufficient to influence travel decisions. For example,

[2] **Using GPS-Encoded Tractor Logs to Estimate Travel Times at Borders in Southern Ontario**, Transport Canada, June 2002.

For a trip between Toronto and Chicago, a routing through Sarnia-Port Huron via Highway 402/I-69 is only 3 km longer than the same trip through Windsor-Detroit via Highway 401/I-94.

assuming a value of time of $15/hr, a 50-cent difference in toll rates would equate to about 2 minutes. For very short trips, where the bridge and tunnel offer similar travel times, differences in tolls could play a small role in travel choices.

For commercial vehicle travel, there can be significant differences in the toll rate between the Ambassador Bridge and Blue Water Bridge. For example, consider two different vehicles, the first a 5-axle truck weighing 40,000 gross pounds and the second an 8-axle truck weighing 100,000 gross pounds. The first truck would be charged a toll of $13.40 ($9.20 US) at the Ambassador Bridge and $13.75 ($10.00 US) at the Blue Water Bridge, a difference not likely to affect choice of crossing. The second truck, on the other hand, would be charged $36.98 ($25.50 US) at the Ambassador Bridge and $22.00 ($16.00 US) at the Blue Water Bridge. The difference of $15 ($9.50 US) would likely have some impact on drivers of heavier commercial vehicles to choose the Blue Water Bridge crossing.

Driving Distances

For several major trip origin-destination pairs between Ontario and Michigan, trip distances via a Highway 402 routing through Sarnia/Port Huron are similar to those via a Highway 401 routing through Windsor/Detroit. To illustrate the differences, trip distances have been calculated for several representative origin-destination pairs by major highway routings, as shown in Exhibit 3.14 with the travel distances shown in Exhibit 3.15. All trips are compared using London, Ontario as the starting point as this is where the decision point between a Highway402/Sarnia and Highway 401/Windsor route choice is made when travelling to the United States. A trip from London, Ontario to Detroit would only be 13 km (8 miles) shorter via Windsor than via Sarnia. For trips to Lansing and Flint, the Sarnia/Port Huron crossing provides a significant distance savings. For trips to Chicago, there is approximately only a 3 km (2 mile) difference between the two routes.

The results of the travel distance comparison indicates that the Sarnia-Port Huron crossing provides competitive travel times for many of the longer distance border crossing trips between Ontario and Michigan. As discussed later in this chapter, there is an inherent preference towards the Detroit-Windsor crossings among travellers, as the calculated travel distance would suggest greater use of the Sarnia-Port Huron crossing in comparison to observed travel. A possible reason is that a Highway 401/Interstate 94 routing appears to be flatter and shorter in distance on a map. Also, the greater familiarity with Windsor-Detroit and Highway 401 and increased roadside services (e.g. gas stations, restaurants, attractions in Windsor/Detroit) may also bias travel to Windsor/Detroit crossings. For commercial vehicles, there are lower toll rates at the Ambassador Bridge for lighter vehicles compared to the Blue Water Bridge, while heavier vehicles tend to favour the Blue Water Bridge, where rates are lower for these types of vehicles.

Analysis of year 2000 summer weekday cross-border travel patterns shows that some 3,900 commercial vehicle trips (32%) and 1800 passenger car trips (7%) currently using the Ambassador Bridge could use a routing via the Blue Water Bridge without incurring significant travel time changes. Meantime, some 2,400 commercial vehicle trips (36%) and 1,100 passenger car trips (8%) currently using the Blue Water Bridge could use a routing via the Ambassador Bridge without significant additional travel time.

EXHIBIT 3.14: ROUTING CHOICES FOR SELECTED TRIPS

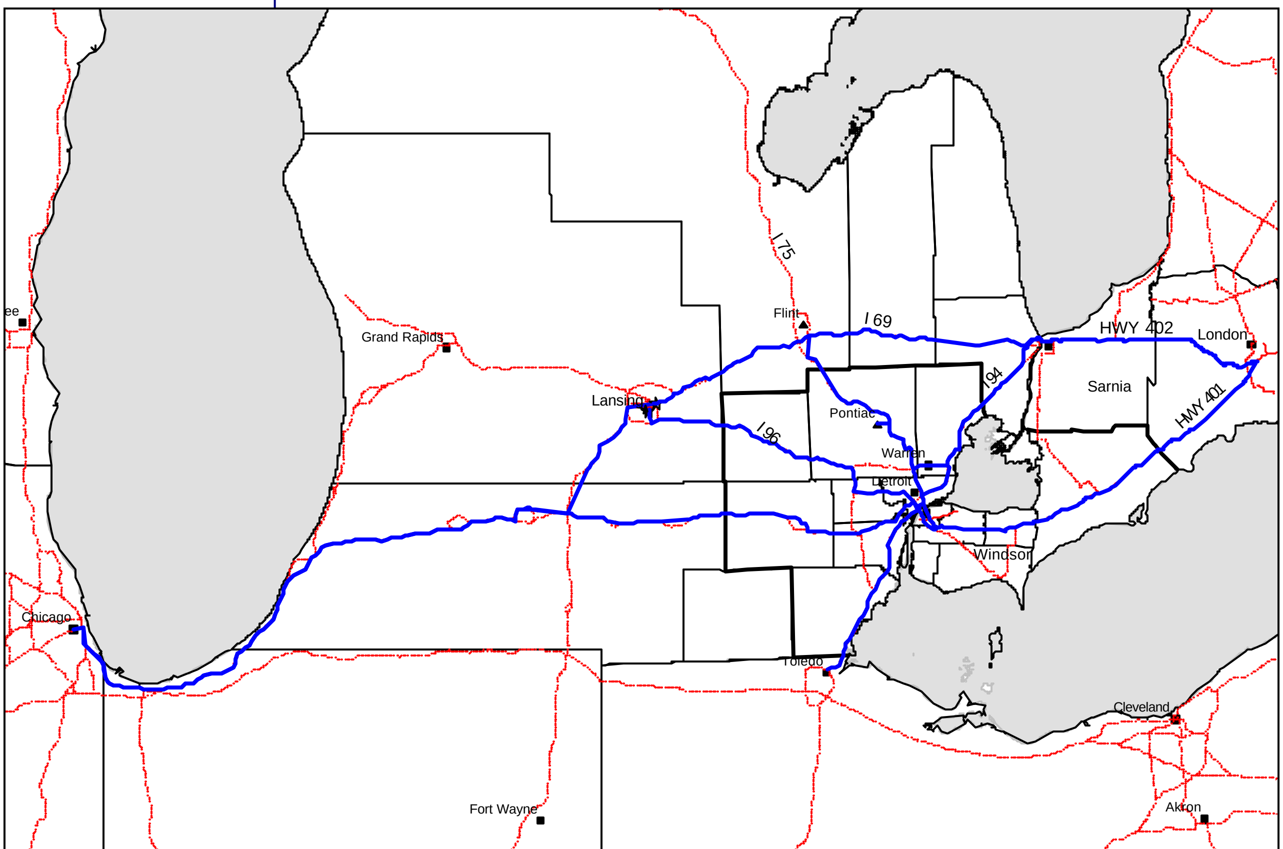


EXHIBIT 3.15: COMPARISON OF DRIVING DISTANCES FOR SELECTED TRIPS

Trip Interchange	Via Windsor-Detroit (Hwy 401)	Via Sarnia - Port Huron (Hwy 402)	Difference (SA-PH Relative to WI-DET)
London / Detroit	190 km (119 mi)	203 km (127 mi)	+13 km (+8 mi)
London / Pontiac	229 km (142 mi)	222 km (138 mi)	-6 km (-4 mi)
London / Flint	296 km (184 mi)	210 km (131mi)	-86 km (-53 mi)
London / Lansing	328 km (204 mi)	285 km (177 mi)	-43 km (-27 mi)
London / Toledo	269 km (167 mi)	290 km (180 mi)	21 km (13 mi)
London / Chicago	629 km (391 mi)	632 km (393 mi)	3 km (2 mi)

Additional Factors for Commercial Vehicles

Interviews were conducted with trucking and auto industry representatives to obtain better insights on truck volumes crossing the border, origin-destination patterns and factors influencing the choice of border crossing (e.g. processing times, congestion, toll rates, travel times/distances). Representatives from the trucking and auto industry interviewed included the following:

- Auto Manufacturers – Daimler Chrysler, Ford, General Motors;
- Logistics – Ryder;
- Carriers – JB Hunt, SLH Transport, Sysco Food Services;
- Associations – Auto Parts Manufacturers Association, Canadian Trucking Alliance, Ontario Trucking Association, Canadian Vehicle Manufacturers Association;
- Government/Municipal – SEMCOG, City of Windsor.

There is a preference to use the Ambassador Bridge over the Blue Water Bridge, even when the trip distances are similar via either crossing.

In choosing between which crossing to use, the logistics groups of the auto industry are well informed of the factors that affect what is truly the shortest route. Distances, congestion and processing times are carefully considered when determining routes and crossings. However, smaller operators and those that use the crossings less frequently are less aware of these factors. The preference to use the Ambassador Bridge crossing is acknowledged by the Ontario Trucking Association and others. Through discussions with these associations, it is felt that the reasons for this preference include the following:

- operators are more familiar with the routing and comfortable with customs brokers at the Ambassador Bridge, resulting in the formation of travel habits;
- the Blue Water Bridge has only had increased capacity for a relatively short period of time, not long enough for the increased attractiveness of this crossing to have broken these habits;
- it is easier (or habitual) for the administrative departments of operators to deal with one bridge (typically the Ambassador Bridge) for matters such as pre-clearance papers. Once pre-cleared for a particular crossing, a driver cannot change crossings to avoid delays;
- aggressive voucher redemption program and marketing by the Ambassador Bridge;
- convenient rest stop at the Ambassador Bridge;
- there is better access to I-75 south of Detroit via Windsor, as travelling down I-94 via Sarnia-Port Huron requires going through the core of Detroit; and
- there is a perception of a shorter distance via the Ambassador Bridge for more of the total trips between Ontario and Michigan.

3.5. Rail Access and Border Crossing Facilities

Rail Network

The rail network serving the study area roughly parallels the US interstate/Ontario provincial road system. Exhibit 3.16 is a map of the rail network and operators.

A Canadian National Railway (CN) line runs from London to Sarnia along the Highway 402 corridor, and continues through Port Huron, following I-69 to Battle Creek, then continues toward Illinois and beyond. VIA rail and Amtrak passenger services use this line. Another CN line roughly follows the Highway 401 corridor from London to Windsor, with VIA passenger service. The line continues through Detroit, northwest toward Flint. Amtrak services are available on this line from Detroit to Pontiac. In Canada, this line roughly parallels a Canadian Pacific Railway (CPR) line from London to Windsor. The CPR line continues through Detroit to Lansing, Chicago, and beyond. A CN line connects Detroit and Port Huron on the Michigan side.

Other rail operators have connections in Detroit. A Norfolk Southern (NS) line, used by Amtrak, runs between Detroit and Chicago roughly along I-94. Another NS runs south toward Toledo then branches east and west. An Indiana & Ohio Railway (IORY) line runs south toward Cincinnati. CSX Transportation (CSXT) lines run north toward Saginaw, and south toward Cincinnati or Columbus. A Tuscola and Saginaw Bay Railway Company (TSBY) line connects in Ann Arbor to service northwest Michigan. A CSXT line also links Sarnia and Chatham on the Canadian side, roughly along the Highway 40 corridor.

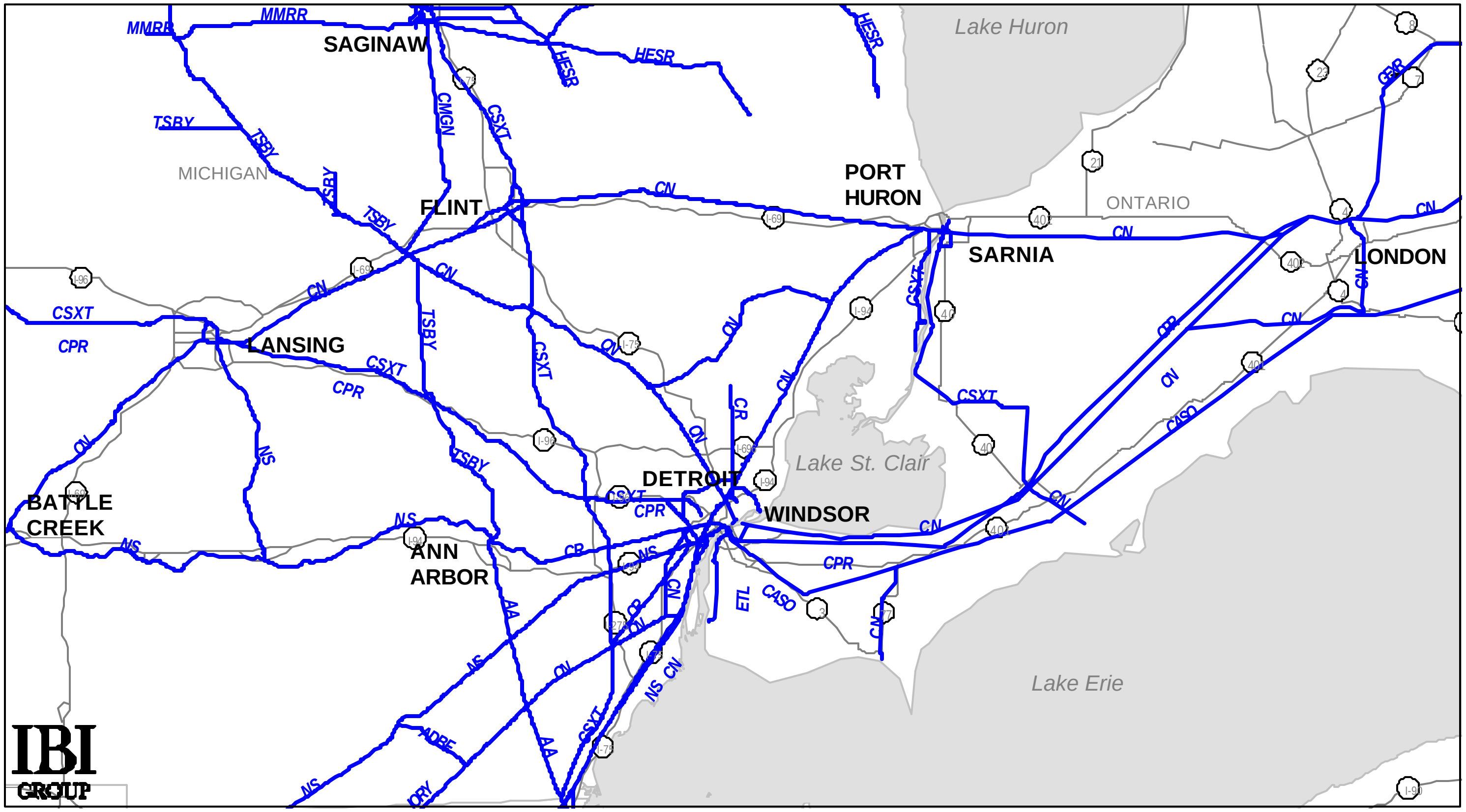
Border Crossing Facilities

For passenger rail, passengers must make their own way between Detroit/Windsor and Sarnia/Port Huron, using a taxi or cross-border transit service.

For rail freight, two underground railway crossings are located at Sarnia-Port Huron and at Detroit-Windsor. The former is owned and controlled by CN and the latter, comprised of one well-used line and one unused line, is controlled by CPR and owned by a joint venture of CPR and Borealis Infrastructure Fund. The locations of these tunnels are shown in Exhibits 3.17 and 3.18.

During the 1990s, both crossings were expanded to accommodate larger vehicles. The CN tunnel at Sarnia accommodates the largest vehicles that operate across the North American railway system. CPR expanded one of the two existing tunnels between Detroit and Windsor to the maximum dimensions structurally possible; this is not quite as large as the CN tunnels and cannot accommodate double stack containers; however, it is capable of handling double stack international containers, intermodal trailers on flat cars (TOFC), as well as domestic auto tri-level cars which were the primary target market.

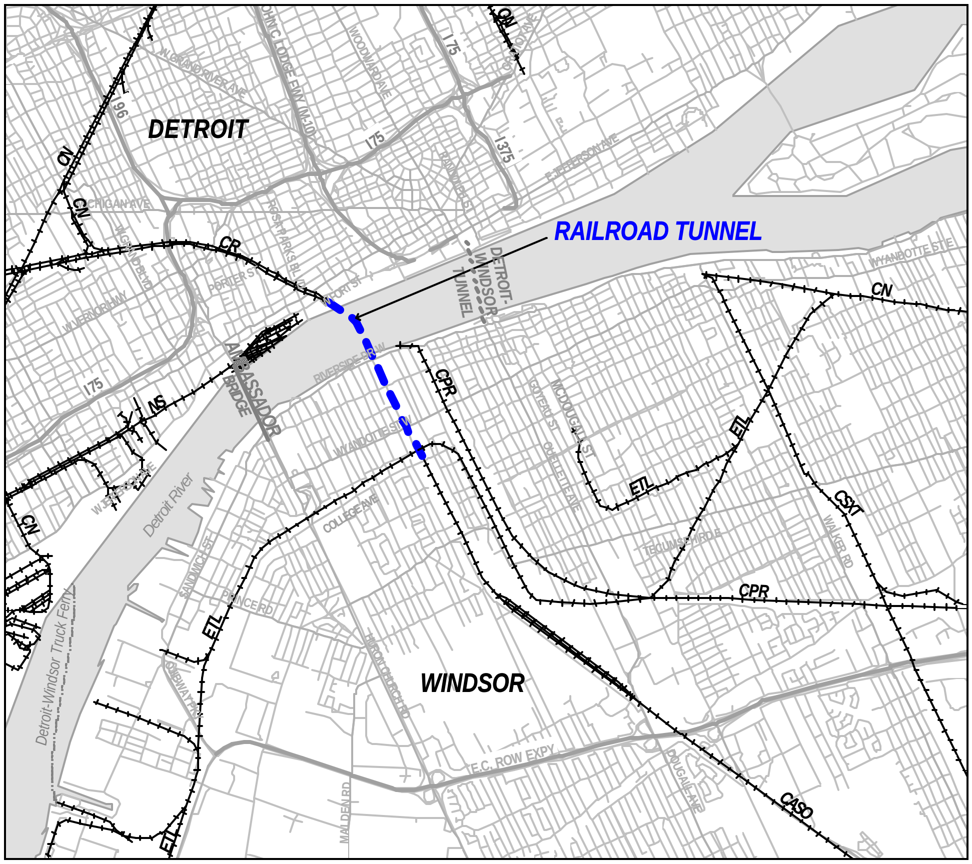
EXHIBIT 3.16: RAIL NETWORK AND OPERATORS IN SOUTHWEST ONTARIO/SOUTHEAST MICHIGAN



RAILWAY OPERATORS:

AA	Ann Arbor Railroad
ADBF	Adrian & Blissfield Railroad Co.
CASO	Joint CPR, CN operations
CMGN	Central Michigan Railway Co.
CN	Canadian National Railway
CPR	Canadian Pacific Railway
CR	Consolidated Rail
CSXT	CSX Transportation
ETL	Essex Terminal Railway Company
GEXR	Goderich-Exeter Railway Co. Ltd.
HESR	Huron & Eastern Railway Inc.
IORY	Indiana & Ohio Railway Company
MMRR	Mid-Michigan Railroad Inc.
NS	Norfolk Southern Corporation
TSBY	Tuscola and Saginaw Bay Railway Company

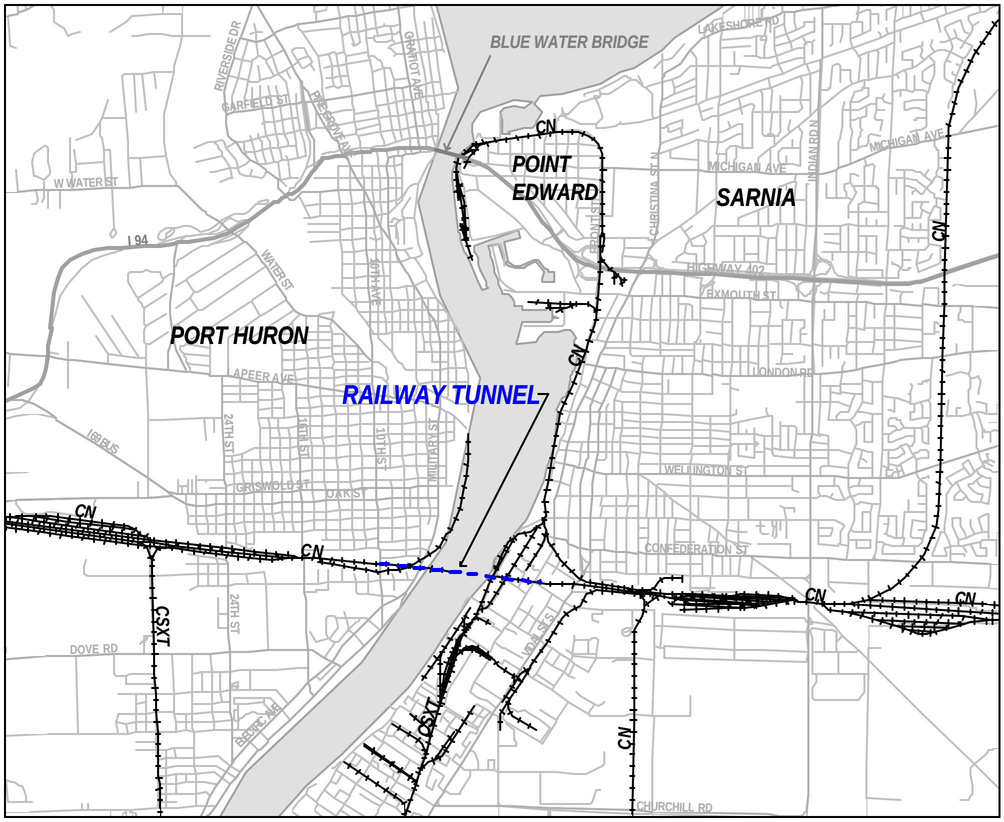
EXHIBIT 3.17: LOCATION OF CROSS-BORDER RAIL TUNNEL AT DETROIT-WINDSOR



RAIL OPERATORS:

CASO	Joint CPR, CN operations
CN	Canadian National Railway
CPR	Canadian Pacific Railway
CR	Consolidated Rail
CSXT	CSX Transportation
ETL	Essex Terminal Railway Company
NS	Norfolk Southern Corporation

EXHIBIT 3.18: LOCATION OF CROSS-BORDER RAIL TUNNEL AT SARNIA-PORT HURON



RAIL OPERATORS:

CN Canadian National Railway

CSXT CSX Transportation

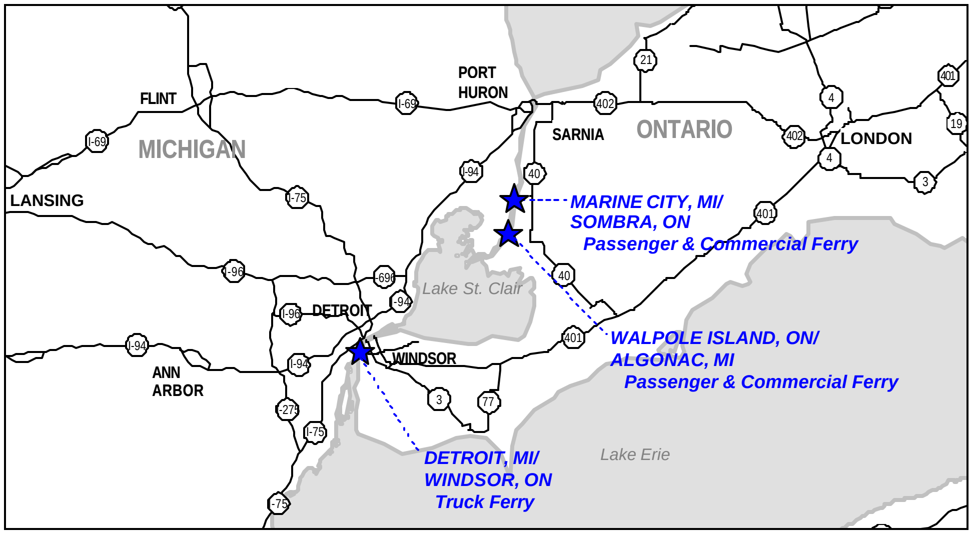
Traffic through both tunnels is growing steadily. The North American railway industry is increasingly integrating services to provide seamless transportation to customers on the north-south and east-west axes of the continent. Both CN and CPR have substantial railway holdings in the United States that connect their networks through the tunnels. Also, CSX Transportation and Norfolk Southern Railway operate services directly into Canada through both tunnel routes. The end result is that all of these Class 1 railways operate trains through all of the tunnels, using a variety of track access and interchange arrangements.

3.6. Marine Border Crossing Facilities

There are currently three ferry services operating in the study area, consisting of the Walpole Island Ferry, Marine City Ferry and Detroit-Windsor Truck Ferry. The locations of these are shown in Exhibit 3.19. Each service has relatively limited vehicle capacity;

however, the Detroit-Windsor Ferry services a specialized market in the Detroit-Windsor area that is not catered by either of the road crossings there. A description of each follows.

EXHIBIT 3.19: SOUTHWEST ONTARIO/SOUTHEAST MICHIGAN MARINE SERVICES



The Detroit-Windsor Truck Ferry plays in important role in transporting dangerous goods across the border, given the ban on using the Ambassador Bridge and Detroit-Windsor Tunnel for these goods.

The **Walpole Island Ferry** provides daily service at 20-minute headways between Algonac, Michigan and Walpole Island, Ontario at the northern end of Lake St. Clair, weather permitting. Two boats are available, each capable of servicing 20 passenger cars and/or small commercial vehicles. Ferries leave Walpole Island from 6:20 AM to 9:45 PM, and return from Marine City from 6:50 AM to 10:00 PM. The one-way cost is $4 US and travel time is 6 minutes.

The **Marine City Ferry** operates daily between Marine City, Michigan and Sombra, Ontario, weather permitting. Two boats are used when busy. The ferries can transport 12 passenger vehicles each, but will also take commercial vehicles. The service runs every 20 to 30 minutes at a cost of $5 US per car each way. Ferries leave Sombra from 6:40 AM to 10:15 PM, and return from Marine City from 7:00 AM to 10:30 PM. Travel time is 7 minutes.

The **Detroit-Windsor Truck Ferry** was started in 1990 for the purpose of handling commercial vehicles carrying dangerous goods (Classes 1, 3, 7 and 8), which are banned from the bridge and tunnel crossings in accordance with Michigan State law. The ferry also handles over-sized loads that cannot use the bridge or tunnel, but in no way restricts its use to these two markets. The ferry operates hourly 10 hours per day and can accommodate 8 trucks per crossing.

The cost of a one-way crossing is $75 to $100 CAN ($45 to 75 US) in comparison to a $15 to $20 CAN ($10 to $15 US) dollar toll fee for the bridge or tunnel, dependent on truck gross weight. Travel time is about 30 minutes and is currently unaffected by congestion delay. Thus, the ferry is a slower traverse (about 2 to 3 times longer) but is more reliable, given the variation in wait times possible at the road-based crossings.

The truck ferry provides a significant distance savings to commercial vehicles carrying dangerous goods or heavy loads by allowing them to cross at Windsor-Detroit as opposed to having to travel to alternate ports that support this market. The alternative for vehicles with dangerous goods within the study area is Port Huron-Sarnia; very heavy vehicles must cross much further away by land between Minnesota and Ontario. It is estimated that more than 50% of the ferry crossing trips are from London (i.e. the point at which travel distances across the corridor via Port Huron-Sarnia and Detroit-Windsor are similar) inward, with a similar market range on the Michigan side.

4. Social and Macro-Economic Trends and Outlooks

Travel demand is commonly derived from the projected behaviour of social (or demographic) measures of the study area such as population and employment. As the impact of travel resulting from commercial goods movement/trade is also of critical importance to this study, the behaviour of economic performance measures such as economic production and the rate of currency exchange must also be considered. This chapter illustrates the past trends of these measures and provides the outlooks on their likely behaviour over the study period as assumed for this project. This projected behaviour subsequently guides the demand forecasts presented in the next chapter and employed by the travel demand model for this project.

4.1. Population and Employment Trends and Projections

*Over the next 30 years, **population** is projected to increase by the following:*

Windsor 22% growth
Ontario 32%
SEMCOG 12%
Michigan 6%

Population and employment trends that may influence cross-border travel demand include those of the Province of Ontario and the State of Michigan, as well as the more focused study areas of the Windsor Area Land use and Transportation Study (WALTS) and the South East Michigan Council of Governments (SEMCOG) models. Past trends for each are shown in tabular form in Exhibit 4.1. Historic trends are also plotted for Ontario and Michigan in Exhibit 4.2.

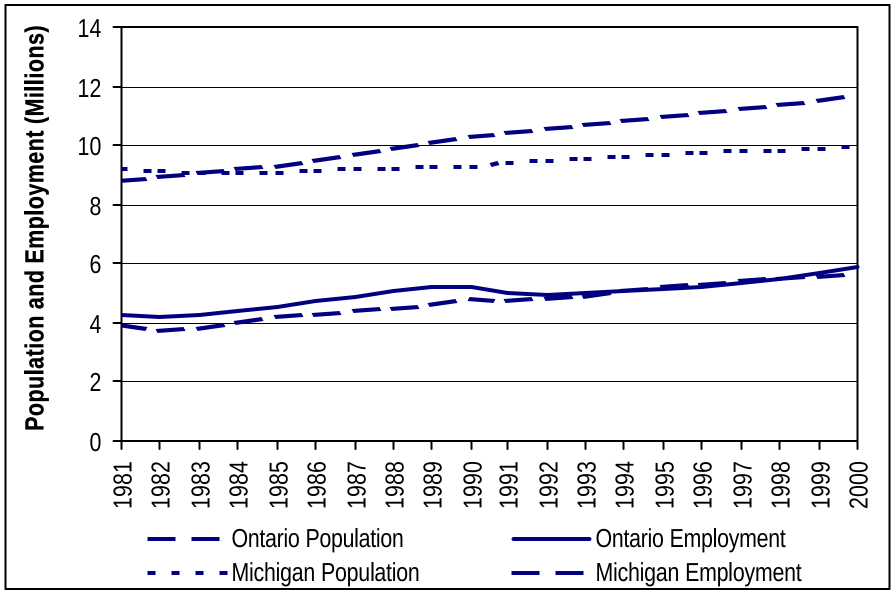
Over the past two decades, employment levels in Michigan and Ontario have grown at similar rates of about 1.7% and 1.6% annually, respectively. Populations, on the other hand, have grown at substantially different rates of 0.4% and 1.5% in Michigan and Ontario.

EXHIBIT 4.1: POPULATION AND EMPLOYMENT TRENDS, 1980-2000 (THOUSANDS)

Trend	Area	1980	1990	2000	Annual Growth 1980-2000
Population	Ontario	8,745	10,300	11,685	1.46%
	WALTS	245	n/a	270	0.49%
	Michigan	9,262	9,295	9,952	0.36%
	SEMCOG	4,683	4,590	4,833	0.16%
Employment	Ontario	4,290	5,191	5,872	1.58%
	WALTS	n/a	115	130	0.61%[1]
	Michigan	4,039	4,826	5,652	1.69%
	SEMCOG	2,106	2,350	2,673	1.20%

Source: Statistics Canada; US Census Bureau; MDOT; WALTS; SEMCOG
[1] Derived from 1990 and 2000 values.

EXHIBIT 4.2: POPULATION AND EMPLOYMENT TRENDS FOR ONTARIO AND MICHIGAN, 1981-2000



Source: Statistics Canada; US Census Bureau; MDOT

Forecasts of population and employment for these areas come from a variety of sources. Official projections of population were available for Michigan and Ontario from the Michigan State Demographer and from Statistics Canada, respectively. As neither projected to the horizon year of 2030, these projections were linearly extrapolated. Growth in each model's study area was defined prior to the development of the models and is applied within the travel demand model for the forecasts' horizon years. For the WALTS model, forecasts were only available to 2016 and were linearly extrapolated to the 2030 horizon year of this study. Windsor and Essex County are in the process of revising its population and employment forecasts. No official state/provincial forecasts of employment were available. For the purposes of this study, these were acquired using a linear projection of the historical data presented above.

The forecasted population and employment totals are shown in Exhibit 4.3, and historic and forecasted trends are shown graphically in Exhibit 4.4 for Ontario and Michigan. Population in Michigan and Ontario is projected to grow annually by 0.3% and 0.9% over the study period and employment will increase by 0.5% and 1.0% annually, respectively. This particularly low population growth forecast in Michigan is a continuation of the trend observed over the last two decades. Michigan employment is also forecast at much lower growth than observed in the last two decades, given this continued low population growth.

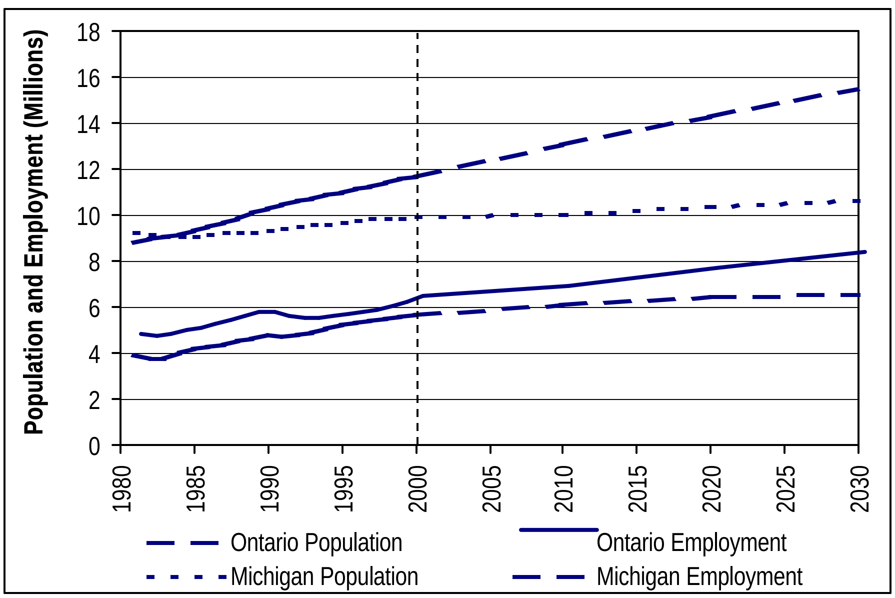
While the WALTS and SEMCOG forecasts are applied to the background traffic portion of the travel demand model, the state/provincial projections are incorporated into the methods used for the border crossing facility demand forecasts, which are presented in Chapter 5.

EXHIBIT 4.3: POPULATION AND EMPLOYMENT FORECASTS, 2000-2030 (THOUSANDS)

Forecast	Area	2000	2010	2020	2030	Annual Growth 2000-2030
Population	Ontario	11,685	13,042	14,269	15,482	0.94%
	WALTS	270	293	313	330	0.67%
	Michigan	9,952	10,121	10,455	10,800	0.27%
	SEMCOG	4,833	5,036	5,221	5,408	0.38%
Employment	Ontario	5,872	6,377	7,097	7,817	0.96%
	WALTS	130	151	162	173	0.96%
	Michigan	5,652	6,115	6,400	6,526	0.48%
	SEMCOG	2,673	2,891	3,035	3,109	0.50%

Source: Statistics Canada; Michigan State Demographer; WALTS; SEMCOG

EXHIBIT 4.4: POPULATION AND EMPLOYMENT HISTORIC AND FORECAST TRENDS FOR ONTARIO AND MICHIGAN, 1981-2030



Source: Statistics Canada; US Census Bureau; MDOT; Michigan State Demographer

Cross-Border Employment

Statistics Canada's (Census) Place-of-Residence/Place-of-Work data for the Windsor Census Metropolitan Area (CMA) provides data on the number Windsor area residents working in the US. In 1996, approximately 3% of the total workers living in Windsor travelled to work destinations in the US. This translates into about 7,000 daily trips (3,500 one-way) across the border from Windsor to Detroit. The figure is very close to the reported number of work trips from Canada to the US in the 2000 **Ontario-Michigan Border Crossing Traffic Study**, as discussed below. Historic Windsor cross-border employment trend data, as summarized in Exhibit 4.5, indicates that the number of work trips from Windsor to the US was substantially lower in 1991 than in 1981, but then recovered in 1996. Data for Sarnia were not available to the study team, nor were more recent data from the 2001 Census.

According to the border crossing study, approximately one-third of weekday passenger car trips are work related for the Detroit-Windsor crossings, compared to 22% for the Blue Water Bridge in Sarnia-Port Huron.

EXHIBIT 4.5: CENSUS PLACE-OF-WORK TRENDS FOR WINDSOR, 1981-1996

Census Year	Place of Residence	Work Destinations Outside Canada	Total Work Destinations	% Outside Canada
1981	City of Windsor	2,690	80,170	3.4%
	Windsor CMA	3,165	102,805	3.1%
1991	City of Windsor	1,915	83,095	2.3%
	Windsor CMA	2,545	117,710	2.2%
1996	City of Windsor	2,545	89,275	2.9%
	Windsor CMA	3,545	130,775	2.7%

Source: Statistics Canada

Types of Cross-Border Employment

Approximately 5,250 Windsor area residents work in Detroit, compared to approximately 1,210 Detroit area residents working in Windsor.

Work trips represent approximately one-third of weekday passenger car trips for Windsor-Detroit crossings.

A more detailed understanding of the types of cross-border employment was gained by analysing responses to the 2000 Ontario-Michigan Border Crossing Traffic survey. For trips where the destination activity purpose was reported as "work", employment type was inferred from place name information (e.g. hospital name or auto plant), where this type of information was included in the passenger car survey database. The percentages obtained this way were applied to all work places, including those that did not provide place name information, to result in the values presented. Exhibit 4.6 shows estimated work trips by type of employment for each crossing. The table shows that Michigan employs more Canadian workers in the health care/medical industry (1,650 destinations in total) than in the auto industry (1,450 destinations), while the majority of US residents who work or do business in Ontario do so in the auto industry (920 of 1,210 destinations).

EXHIBIT 4.6: WEEKDAY CROSS-BORDER PASSENGER CAR WORK TRIP VOLUMES BY INFERRED INDUSTRY TYPE, 2000

Industry Type	Ambassador Bridge & D-W Tunnel		Blue Water Bridge	
Michigan Work Destination				
	Volume	%	Volume	%
Auto Industry	1,410	27%	40	5%
Medical	1,650	31%	350	45%
Casino	100	2%	0	0%
Border Services	140	3%	70	9%
Other	1,960	37%	330	42%
TOTAL	5,250	100%	790	100%
Ontario Work Destination				
	Volume	%		
Auto Industry	920	75%	Small sample size	
Medical	40	3%		
Casino	10	1%		
Border Services	20	1%		
Other	230	19%		
TOTAL	1,210	100%	110	

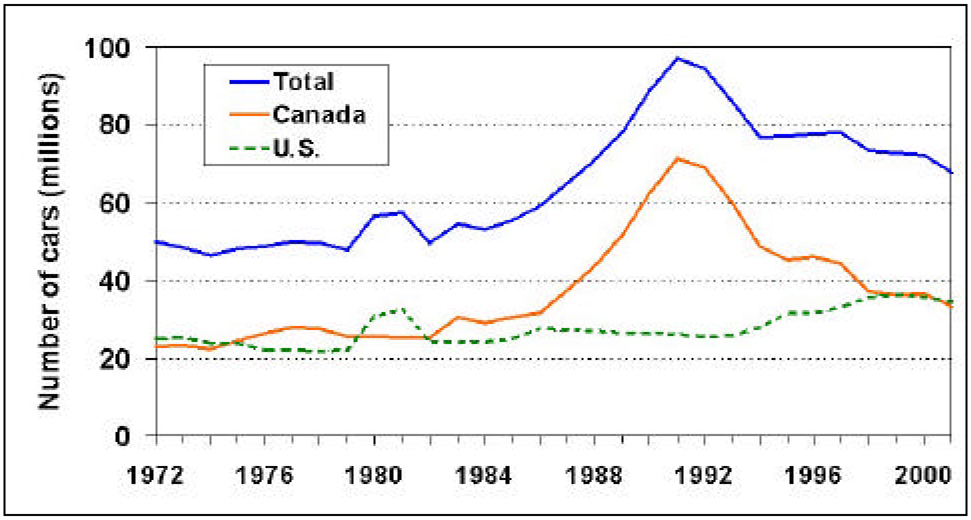
Source: Derived from 2000 Ontario-Michigan border crossing survey database.

4.2. Trip Purpose Trends

The International Travel Survey conducted by Statistics Canada provides passenger cross-border trends for travel between Canada and the US. While trend data for individual crossings was not available to this study, long-term cross-border trends from 1972 to 2001 for all travel between the US and Canada were examined to help understand the Southeast Michigan/Southwest Ontario border crossings.

Exhibit 4.7 indicates the trends in annual passenger car volumes by Canadian and US residents over the past three decades. While cross-border travel by Canadian residents has fluctuated significantly over the past three decades, the number of cross-border trips by US residents has increased very slowly but steadily, even with wide fluctuations in the Canadian dollar relative to the US dollar. Historically, the number of cross-border trips made by Canadian and US residents were similar over the 1972 to 1984 period. However, from the mid-1980s to early 1990s, the number of cross-border trips by Canadian residents increased substantially, owing to price and exchange differentials, which brought rise to the Canadian cross-border shopping phenomenon. In the peak travel year of 1992, approximately 97 million cross-border trips were made, with the number of trips made by Canadian residents some 2.7 times greater than those made by US residents.

EXHIBIT 4.7: CROSS-BORDER PASSENGER CAR TRIPS BY NATIONALITY, 1972-2000



Source: Provided by Transport Canada, based on Statistics Canada, International Travel Section
Notes: Levels are derived by doubling one-way flows into Canada.

Same day trips account for more than 85% of the passenger car trips between SE Michigan and SW Ontario.

During the 1990s, restructuring and improved price competitiveness in Canada and significant decline in the value of the dollar, which fell from 86 cents US in 1990 to 67 cents US in 1999 (see Section 4.5), led to a significant reduction in cross-border travel by Canadian residents. Over this period, total cross-border travel between the two countries decreased from approximately 97 million to 68 million trips, representing a 30% decrease in travel.

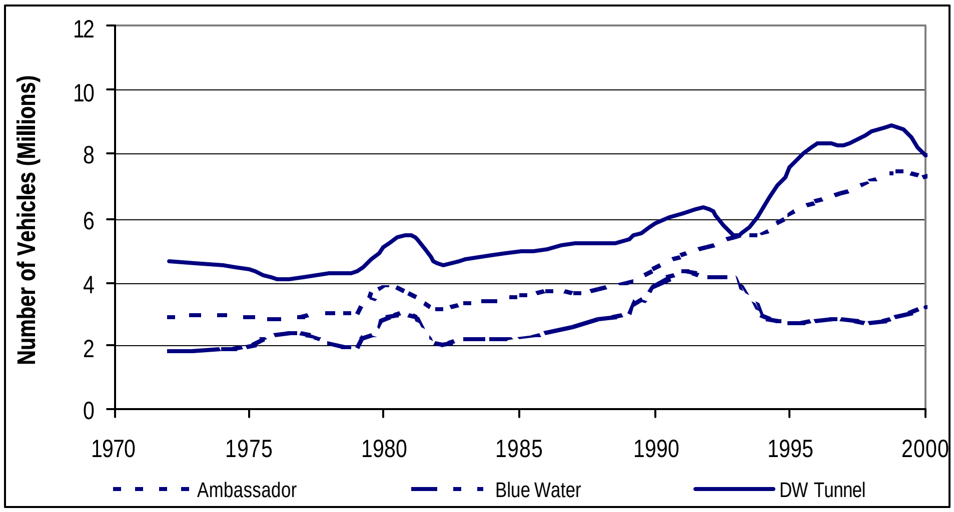
The three Southeast Michigan/Southwest Ontario crossings exhibited similar trends, but have shown more steady and consistent growth over the 1972 to 2000 time period (approximate 85% increase versus approximately 50% increase for the entire border). In addition, the three crossings did not suffer the same degree of losses in traffic during the 1990s, with passenger trips actually increasing by 13% compared to a decrease of approximately 30% for all US-Canada border crossings.

Exhibit 4.8 illustrates the trends in same-day and overnight travel at all three crossings since 1972. Same day trips are approximately 5 times greater than overnight trips.

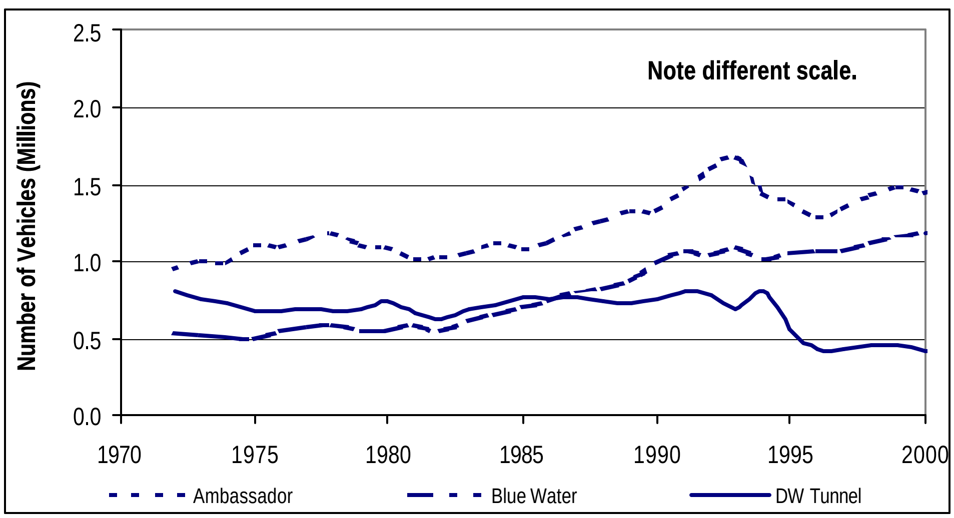
Exhibit 4.9 provides a more detailed look at passenger travel between Canada and the US and the US and Canada for both overnight trips and same-day travel by trip purpose for the 1990 to 1999 time period. As shown, the most common purpose for overnight travel is for pleasure or tourism and fluctuations in pleasure/tourism travel correspond closely with the historic changes, noted above. Between 1990 and 1999, overnight travel by Canadians to the US for pleasure/tourism decreased by approximately 30%, reflecting the vast majority of decrease exhibited during this time period. Conversely, pleasure/tourism trips by US residents have been on the rise, again reflecting the fact that the purchasing power of the US dollar in Canada is very high. Overnight business trips seem to be less affected by the value of the Canadian dollar and have been on the rise for both Canadian and US residents.

EXHIBIT 4.8: PASSENGER CAR TRENDS FOR SAME-DAY AND OVERNIGHT TRIPS, 1972-2000

SAME-DAY

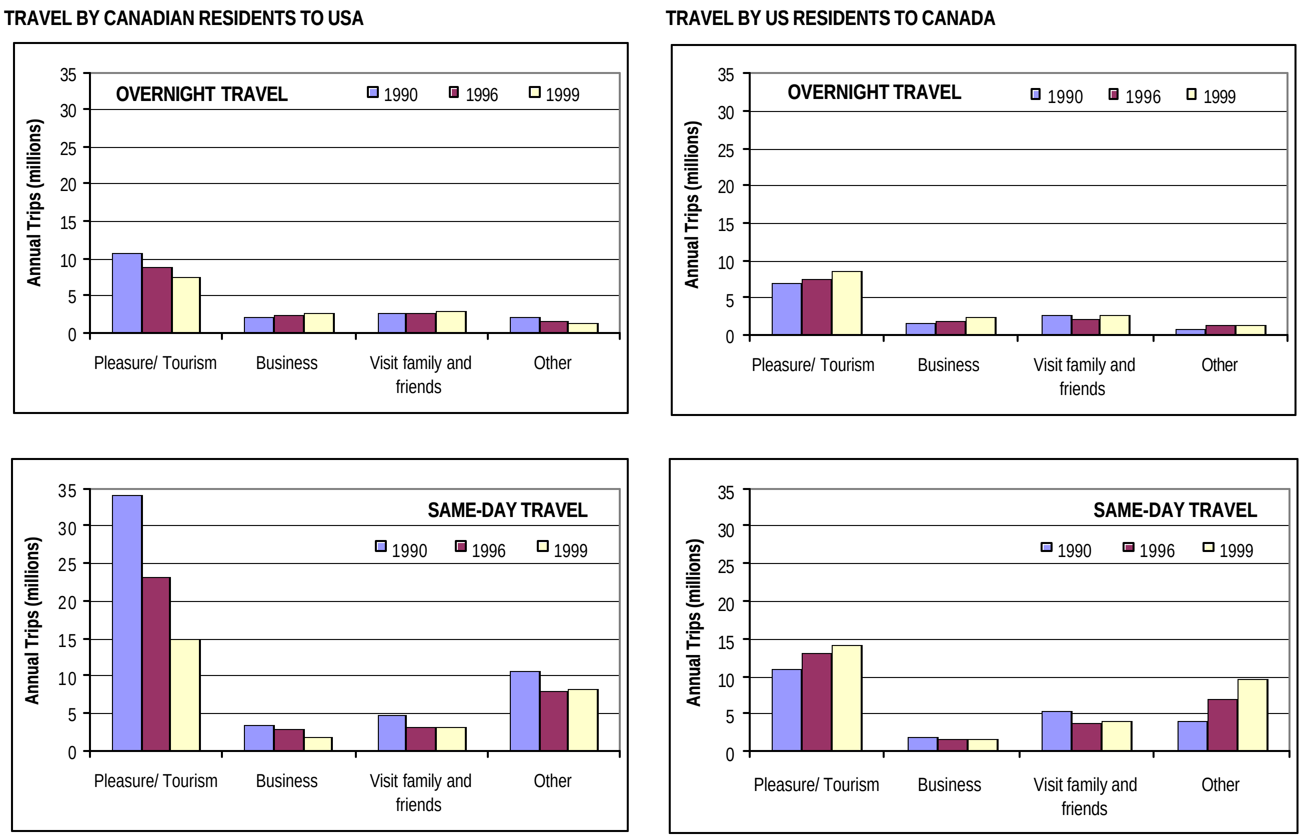


OVERNIGHT



Source: Transport Canada

EXHIBIT 4.9: NATIONAL BORDER CROSSING PASSENGER TRAVEL TRENDS, 1990-1999



Source: **Statistics Canada International Travel Survey**

4.3. Casinos

In summer 2000, there were approximately 11,000 daily Windsor Casino related trips, representing approximately one-quarter of the weekday traffic.

Cross-border travel to gaming establishments located on both the US and Canadian sides of the border represent a major component of bridge and tunnel traffic. Exhibit 4.10 provides an overview of the statistics for the primary casinos in the study area. Windsor Casino is by far the largest casino in the study area based on number of slots and the largest trip generator in terms of cross-border traffic. Opened in 1994, the Windsor Casino reached a peak in annual patronage in 1996, with attendance decreasing marginally over the period to 2000, as shown in Exhibit 4.11.

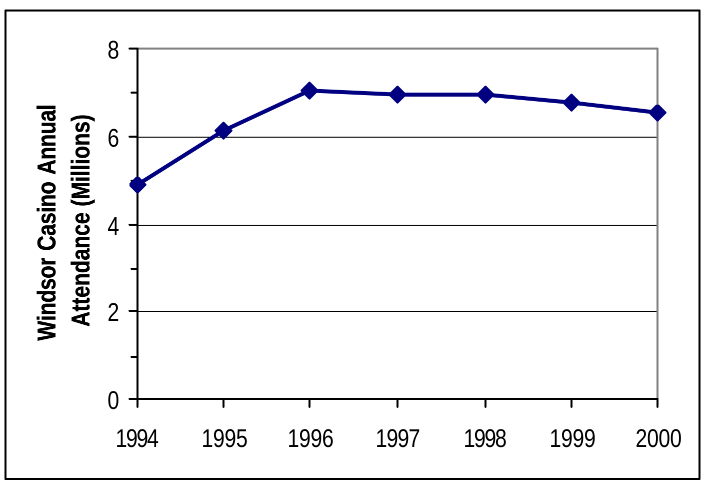
In summer 2000, the Windsor Casino generated approximately 11,000 daily cross-border trips based on the Ontario-Michigan Traffic Study Survey, which was approximately one-quarter of the Windsor-Detroit traffic. Approximately 6,000 trips, or 62% of the cross-border casino-destined traffic, used the Detroit-Windsor Tunnel to make this trip compared to 4,300 trips or 38% using the Ambassador Bridge.

EXHIBIT 4.10: SUMMARY OF STUDY AREA CASINOS

CASINO	OPENING/CLOSING DATE	NUMBER OF SLOTS IN OPENING YEAR	NUMBER OF EMPLOYEES	AVERAGE DAILY VISITORS IN OPENING OR AVERAGE YEAR
CANADA				
Windsor Temporary Casino	May 1994 (closed July 1998)	1,700	3,500 (includes Northern Belle)	13,000 – 15,000
Northern Belle Casino - Windsor	December 1995	830		6,200
Windsor (permanent) Casino	July 1998	3,000	5,000	17,900
Point Edward Casino	April 2000	450	700	3,200
Windsor Racetrack Slots	N/A	750	N/A	N/A
US				
Greektown Casino – Detroit	November 10, 2000	2,500	4,000	20,000
MGM Grand Detroit Casino	July 29, 1999	2,700	N/A	N/A
Motor City Casino	December 14, 1999	2,500	N/A	N/A

N/A – Figures were not available for this study

EXHIBIT 4.11: ANNUAL PATRONAGE AT WINDSOR CASINO FROM OPENING, 1994-2000



Source: Ontario Lottery and Gaming Corporation

Since 9/11, Windsor Casino attendance has decreased in the order of 20% and Detroit-Windsor Tunnel traffic has decreased accordingly. The recent opening of new casinos in Detroit (Greektown Casino, MGM Grand Detroit Casino and Motor City Casino) has provided US residents with a local casino alternative. This, combined with delays at the border, general declines in international travel, and a possible end to the novelty effect of the Windsor Casino could lead to Windsor Casino attendance and cross-border traffic to the casino remaining below 9/11 levels over the long term.

4.4. Macro-Economic Trends and Projections

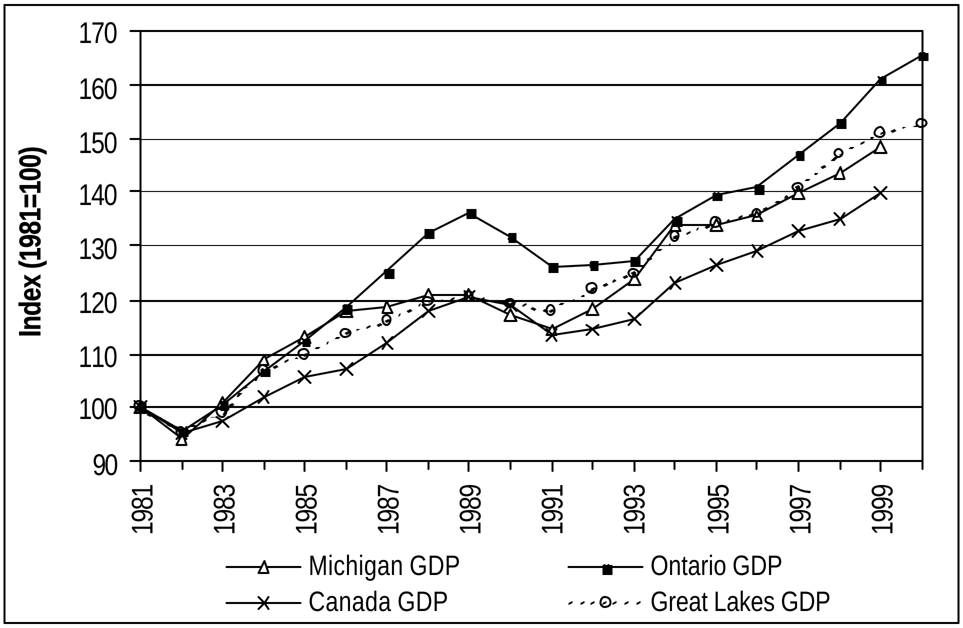
Long-term economic projections are abundant and varied. Projections of growth can be fairly wide-ranging with growth rates differing by as much as 100% depending on the source. The challenge is to find the appropriate set of assumptions that best represent the prospects for trade across the Ontario-Michigan border at Detroit-Windsor and Port Huron-Sarnia. The most recent and commonly referenced investigation of this is a previous study for the Eastern Border Transportation Coalition (EBTC), **Trade and Traffic across the Eastern U.S.-Canada Border**, carried out in 1997. This was a comprehensive study of all traffic, including commercial vehicles at Port Huron-Sarnia and Detroit-Windsor. This study, and others carried out during the robust economic growth of the late 1990s, produced large annual growth rates. These were developed with the best insights available at the time; however, in 2001 there were two significant events that altered downward projections for future economic growth.

The first event was the collapse of the high-technology industry sector, both in the stock markets and in terms of the performance of the companies. Many large communications infrastructure investments were abruptly halted and the ramifications of this reverberated throughout the world economies. This resulted in a major market correction that will take two to five years to resume normal growth because of overcapacity. The expectation in this work is that when normal growth is restored, it will be coupled with economic growth trends.

The second event, which exacerbated the effects of the economic downturn, was the tragedy that occurred on September 11, 2001. This has substantially changed the manner in which international borders function; border congestion and delays at the Detroit-Windsor and Port Huron-Sarnia crossings reached crisis levels for certain periods.

Trends in economic growth are commonly characterized by the economic production of a region as Gross Domestic (national or state/province) Product (GDP). For this study, regions of interest include Michigan, Ontario, the Great Lakes region (consisting of Michigan, Ohio, Indiana, Illinois, and Wisconsin) and Canada. The economic performance of these regions in particular will directly impact trade volume in the study area. Exhibit 4.12 shows the indexed economic production of these regions since 1981. As can be seen, Ontario production has grown at the highest rate over this period, at 2.7% annually. Michigan and the Great Lakes have each grown at 2.2%, while Canadian GDP has increased by 1.9% annually. Despite the varying growth rates, however, the general behaviour is similar for all regions during this period, indicating strong interdependencies amongst the economies.

EXHIBIT 4.12: ECONOMIC PRODUCTION OF REGIONS AFFECTING STUDY AREA, 1981-2000



Source: US Bureau of Economic Analysis; Statistics Canada

Other major sourc es of economic forecasts reviewed in this study include:

- Economic forecasts prepared for Transport Canada by Informetrica concerning merchandise trade between Canada and the US and other countries. These forecasts were prepared in July 2002 and therefore reflect the current economic downturn and events of 9/11.

- **Canada in the 21st Century – North American Economic Integration: 25 years Backward and Forward**; Industry Canada Research Public Publications Program, by Gary C. Hofbauer and Jeffrey J. Schott, Institute for International Economics, Washington (DC). November 1998; and

- Internal research by this study team, canvassing various projections. The key economic indicators for Canada, Ontario, the US and Michigan are the main focus of this work. It is also observed that the general trend for Michigan appears to be representative of growth rates for other Great Lakes States (Ohio, Indiana and Illinois) that constitute the main catchment area for commercial vehicle traffic in the scope of this study.

Economic projections for long-term growth of Gross Domestic Product in the study area are based on these sources. There is convergence among them regarding growth rates, within a few decimal percentage points in virtually all cases. The projected GDP growth rate assumed for the study is 2.8% per annum from 2000 to 2010. From 2010 to 2020 the

GDP growth rate is projected to be 2.2%, and, for the period 2020 to 2030 a compound annual growth rate of 1.8% is projected. This is based primarily on Canadian-side growth projections as Canadian GDP has a much greater influence on trade trends than does US GDP. Throughout the study horizon, the automotive industry sector will continue to be the dominant generator of trans-border traffic, although growing at a lower rate than observed during the 1990s.

In developing the traffic forecasts, the focus was placed on five critical sectors that contribute the majority of trans-border traffic in the study area. These are:

- Animal and Plant products (i.e. live animals, agricultural products);
- Automotive products (i.e. cars, commercial vehicles and vehicle parts);
- Forest products (i.e. lumber, pulp and newsprint).
- Machinery and Electronic equipment (e.g. industrial machinery, consumer electronics); and
- Metal (e.g. ores and crude metal produc ts).

All other commodities, consisting of chemical and petroleum products, rubber and plastics, textiles, minerals and stone/ceramic/glass, are grouped as ‘Other’ for the purposes of projecting merchandise trade growth. For the purposes of forecasting, the automotive and metal sectors will also use a common growth rate, resulting in five forecast groups (including Other).

Projections of US-Canada trade growth were obtained from two sources. The Federal Highway Administration Office of Freight Management’s Freight Analysis Framework (FAF) and Transport Canada’s Informetrica forecasts provide projections to 2020 and 2025, respectively, providing both a US and Canadian outlook of future trade. The FHWA forecasts are of weight while the Transport Canada forecasts are in value.

By consolidating the forecasts to the common commodity group framework described above, the two can be compared in terms of percentage growth rates. However, as the forecasts are in different units, a comparison of growth assumes that value-to-weight relationships will remain constant over the time period. Exhibit 4.13 presents both forecasts by commodity group for the time periods common to both.

EXHIBIT 4.13: COMPARISON OF FHWA AND TRANSPORT CANADA TRADE PROJECTIONS

Commodity	2000 to 2010						2010 to 2020					
	Canada to US			US to Canada			Canada to US			US to Canada		
	TC	FHWA	Diff.	TC	FHWA	Diff.	TC	FHWA	Diff.	TC	FHWA	Diff.
Animal/Plant	3.6%	4.9%	1.3	4.9%	2.8%	-2.1	3.0%	4.6%	1.5	3.9%	2.7%	-1.2
Auto	1.9%	4.3%	2.4	1.6%	4.5%	2.9	2.3%	3.7%	1.3	1.9%	3.0%	1.2
Forest	0.1%	3.7%	3.6	0.7%	2.2%	1.5	-0.2%	3.3%	3.6	2.2%	1.5%	-0.7
Machinery/Electronics	4.4%	5.6%	1.2	2.8%	6.5%	3.8	4.4%	5.4%	1.0	3.1%	5.0%	1.9
Metal	1.9%	4.3%	2.4	1.6%	4.5%	2.9	2.3%	3.7%	1.3	1.9%	3.0%	1.2
Other	2.7%	2.5%	-0.2	1.7%	2.8%	1.1	4.1%	2.0%	-2.1	3.0%	2.0%	-1.0

The FHWA FAF projections use a 1998 base year whereas the Transport Canada Informetrica forecasts are based in 2002. Exhibit 4.13 reveals that the FHWA FAF projections generally forecast higher growth across most commodity groups than the Transport Canada Informetrica projections. This can be explained by the different base years used by each source; that is, the effects of the economic downturn and 9/11 mentioned previously could not be captured by the 1998-based FHWA FAF forecasts, which therefore continued the aggressive growth trend of the 1990s. Given that the Transport Canada Informetrica forecasts are more recent and consider this downturn (and project to a further forecast year), they are used as the trade projections employed by the goods movement demand forecasting process presented in Section 5.6.

4.5. International Trade Policies

The strong dependency of Canada on international trade, particularly with its largest trading partner the United States, is extensively documented. The largest component of this trade is between Ontario and Michigan, and that most of this business is transacted over the border crossings of interest to this study.

Over the period from 1972 to 1995, bilateral trade in goods and services has grown faster than GDP. Ontario-Michigan trade growth is the strongest among all pairings across the border, at times having achieved annual growth rates in excess of 10%. This might suggest that the forecast trade volume across the Ontario-Michigan border should be considerably greater than the Gross Domestic Product of any of the jurisdictions. In fact, this was a natural conclusion for studies carried out in the 1990s. However, at this time there appear to be a number of mitigating circumstances in the trade relationship between the countries, which provoke a more conservative outlook.

A major driving factor in trade growth has been the implementation of a series of trade agreements involving Canada and the US. The Auto Pact of 1965 has been a long-term major influence. This expanded scope in 1989 with the Free Trade Agreement between the US and Canada, and was followed by the North American Free Trade Agreement (NAFTA) in the 1990s. The original Auto Pact has recently expired, and as a result of the more recent NAFTA the trade relationship now involves Mexico in addition to Canada and the United States. Discussions have taken place with a view to extending this Agreement across all of the Americas. Chile, in particular, has been moving in this direction.

Extending the scope of trade agreements bodes well for transportation industries and growth in traffic demand. It is less certain that future demand will be as concentrated in the Southeast Michigan/Southwest Ontario corridor as it has in the past. The Auto Pact was industry specific, resulting in significant growth in the only corridor in which the industry was located. Much broader coverage of future agreements, in terms of the industries involved, suggests that future economic activity will be more evenly distributed, with the implication that growth will be proportionately higher in other corridors than Ontario-Michigan.

Trade agreements have not eliminated sources of irritation between Canada and the US. Some disputes could mitigate the salutary effects of formal trade agreements. Examples of disputed topics include:

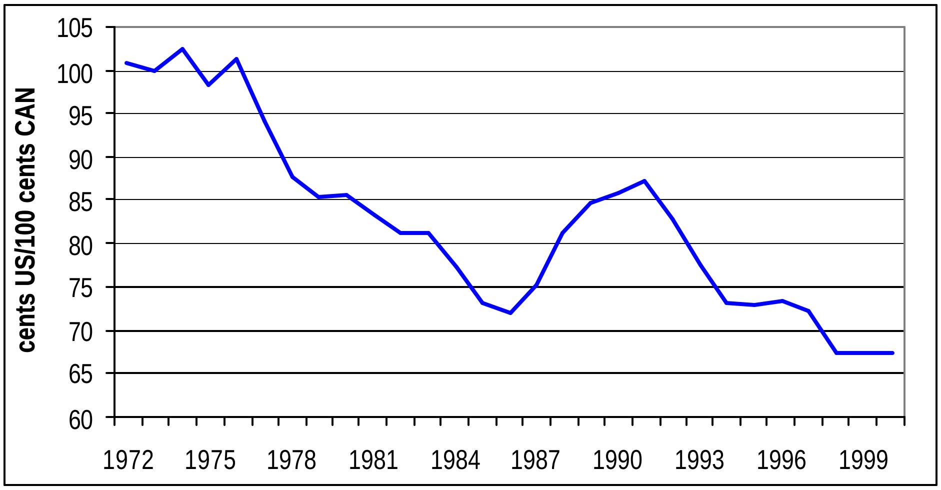
- Countervail and anti-dumping measures employed by the US in the steel and softwood lumber sectors;
- Trade sanctions by the United States that extend trans-nationally to trading partners through multinational corporations;
- Agricultural subsidies; and
- Other non-tariff barriers by both countries.

Notwithstanding disputes and difficulties in close trading relationships, there is evidence from North American trends, the European Community and from other trading blocks to suggest that trade agreements stimulate growth over and above the level of trade that would be possible in the absence of open markets, as noted in the study for Industry Canada by the Institute for International Economics. This study shows that participants in free-trade relationships have experienced growth in the range of 20% to 30% greater than that which would have taken place without the trade agreements and that this growth enhancement is reciprocal; it works both ways.

One other major concern regarding trade traffic forecasts lies in the relative trading value of the currencies of the two countries. At present, and inherent in the economic forecasts of this study, the Canadian dollar is projected to be in the range of 65 to 85 cents US. This represents a recovery from the steady decline observed over the past three decades, as illustrated in Exhibit 4.14. Forecasts in this study are based on gradual progress to the upper limit of this range. As will be discussed in Section 5.5, a higher relative value for Canadian currency would likely reduce total trade volume, and a lower value would increase the forecast traffic.

It is early to predict whether any disputes will degenerate into an acrimonious relationship with an adverse effect on trade, or whether the normal course of close trading relationships will prevail to enhance the growth of traffic volumes across the most important border (in terms of trade value). The history of Canada-US trade relationships encourages an optimistic view of the future.

EXHIBIT 4.14: US-CANADA CURRENCY EXCHANGE RATE TREND, 1972-2000



Source: Statistics Canada

4.6. Goods Movement Trends

The third aspect in projecting long-term demand for commercial freight traffic, after considering economic production and trade policy, is estimating the split between the truck, rail and marine modes of freight transportation. Air is not considered as it carries only low tonnages of cargo compared with the other modes. Rail and truck carry the largest share of North American commercial traffic. In addition, three marine ferries are operating in the study area.

Road and Rail

There have been many changes in road and rail modes of transportation over the last decade. The most apparent and dramatic change is the pervasiveness of electronic commerce and satellite monitoring systems. These new technologies can track the position of vehicles, update information on the status of vehicles and contents and make the information generally available to shippers and carriers. This is a new phenomenon. These technological developments have contributed to steady reduction in costs of transportation by both the rail and highway modes.

In the highway mode, the size and weight of vehicles on the road system has increased, improving average cargo weight and productivity of tractors, trailers and drivers. Engine technology has resulted in fuel consumption efficiency to reduce both environmental emissions and tractor operating costs per mile. New vehicles are more reliable and less expensive to maintain, further enhancing the productivity of this mode of transportation.

The major development in the rail mode is rationalization of rail networks into regional and short line railroads for lower density areas as well as mainline networks for line haul. This began in the 1980s in the US (an anticipated result of the Staggers Act of 1980), and then expanded into Canada after passage of the Canada Transportation Act in 1996. Deregulation in both countries also facilitated rapid introduction of new technology to reduce operating costs. The rail mode is also taking the lead in the development of intermodal technology.

New intermodal terminals are being built throughout North America with modern computers efficiently controlling inventory and handling systems to operate quicker, reduce costs, and schedule appointments so that motor carriers can get in and out of intermodal terminals with minimum waiting time. Also, new technology is being deployed in trackside communications and monitoring systems with further improvements in service and productivity.

The end result is that transportation rates paid by customers have shown steady decline in both real and absolute terms for a considerable period of time. Most of the cost savings are passed on to customers promptly because of the competitive nature of the industry. Any cost advantage that the industry achieves is fairly quickly passed on to customers through aggressive pricing behaviour of individual companies attempting to increase market share. This applies both within modes of transportation and between modes of transportation.

With respect to shippers, various studies have shown that there are five principal factors governing selection of mode and carriers for transportation services. The relative ranking and weights of factors may vary from customer to customer, and some parties consider issues other than these. Nevertheless, general consensus shows that the five most dominant characteristics are:

- time in transit (how fast can it get there?);
- reliability of time in transit;
- equipment supply (the right vehicle, in good condition at the right time and in the right place);
- loss and damage experience; and
- price.

Generally, the motor carrier industry has had the advantage over rail in almost all categories, but recent advances in the rail industry are shifting the balance slightly in its favour. Great advances have been made with respect to reliability of time in transit, loss and damage (particularly for intermodal traffic), and equipment supply. At the same time, the motor carrier industry is making improvements of its own to maintain its competitive position.

The rail mode is naturally more cost-effective over longer distances. Line haul cost on a railway is generally less than $1 (US) per kilometre for the equivalent of a highway trailer. The rail mode's cost and service challenge is in its terminals for marshalling cargo and rolling stock. Many rail improvements are focused on minimizing exposure to terminals, and for the time that is spent in terminals the focus is to handle traffic much more quickly and reliably, and only once if possible.

The highway mode is more expensive than rail for the road portion only. Line haul tractor and trailer operation costs generally vary in the range of $1 to $2 (US) per kilometre. Many shipments are carried near the low end of this range in a very competitive marketplace. While the line haul portion is more expensive, motor carriers have a great advantage being more flexible to meet customer needs and much less costly for the origination and termination shipments.

Before improvements to both modes of transportation in the 1990s, the cost break-even between highway and rail occurred at distances around 1,000 km (roughly 600 miles)[3]. For longer trips, rail had a cost advantage and trips of shorter distances were dominated by the trucking industry with both cost and service superiority. The changes discussed above appear to be shrinking this cost break-even distance. Given recent trends, it is conceivable that a cost break-even distance of 500 km (300 miles) or less is reasonably achievable in the timeframe of this study. For example, with its "Expressway" service, discussed further below, CPR is already handling trailers between Montreal and Toronto on behalf of motor carriers. The rail distance is around 500 km between the closest pair of terminals taking traffic.

Marine

In this study, the “marine mode” can be defined as consisting of three distinct components. Ferries provide transport across waterways to passenger and commercial land-based vehicles. General freight marine services transport consumer goods such as automobiles, machinery, electronics, etc. Bulk cargo marine services transport raw materials such as ores and grains.

Currently, the primary market for the Detroit-Windsor Truck Ferry service is dangerous goods and oversize truck traffic across the border, although the capability of this mode of transportation is larger in scope. The two other ferries carry trucks and autos across the St. Clair River.

General freight is carried by ocean vessels between overseas and Great Lakes ports. Generally this is on board vessels of state-controlled enterprises from developing countries that are seeking foreign currency. In these instances time and costs are less important (so long as the costs are in their home currency) than maximizing foreign currency. It is likely that as long as there are port facilities to accommodate such movements, they will continue. However, the total amount of traffic is unlikely to be significant in comparison with the road and rail volumes under consideration in this study.

[3] Based on largely unpublished work by the Association of American Railways and the Railway Association of Canada.

Bulk carriers carry both North American and overseas bulk cargo longitudinally along the Great Lakes. These do not have much interaction with the flow of goods crossing the border in this area.

Over the years there have been various proposals from interested parties to re-establish general freight services between Great Lakes ports. Previous studies have shown that these services are not competitive with the truck and rail modes in terms of service and costs.[4] Such services operated on the Great Lakes before the 1980s. The large vessels that achieve great efficiencies on the High Seas are not capable of navigating beyond Montreal because of St. Lawrence Seaway limitations on vessel dimensions and draft. Consequently, for container vessels to navigate into the Great Lakes, there would be a cost penalty either in terms of the reduced efficiency of a smaller vessel for an entire voyage, or handling and storage (as frequency of service would more likely be in terms of trips-per-week rather than in terms of trips-per-day) of containers while transferring from the ocean-going vessels to feeder vessels. In turn, these feeder vessels would be restricted to calling at ports and could incur additional handling and drayage charges to reach inland destinations.

Over the last 30 years, since containerization has become prominent in international and domestic trade, marine feeder services have been tried, but at present none are operating. The characteristics of containerization and inter-modality are such that the combined advantages of speed, flexibility and cost using efficient deep-sea liner ships and rail/truck for inland haulage preclude serious consideration of significant general cargo services on the Great Lakes.

Speed is defined in terms of both transit time and frequency of service. Rail/truck can combine destinations and origins with multiple trips on a daily basis and terminate shipments very close to the final point of production or consumption. Trains and commercial vehicles working together can ensure safe final delivery of cargo in the Chicago area within 2 days of arrival of a deep-sea vessel at Montreal, Halifax, New York or Norfolk. More than twice this amount of time would be needed for a vessel to make the journey up stream under the most favourable set of assumptions. The length of time and the uncertainty of transit time require relatively large inventory costs for the consumer of goods to protect it from stock-out situations.

Flexibility is defined in terms of the ease of loading and unloading containers and the number of inland terminals. Ship-rail-truck combinations can be adjusted fairly quickly to accommodate emerging service needs. Shipments can be expedited or held back with relatively minor cost penalties.

The issue of re-establishing general freight services has recently surfaced again in a reconnaissance study by the US Army Corps of Engineers called the **Great Lakes Navigation System Review**. This study investigated the feasibility of options for expanding the capacity of Great Lakes waterways to be capable of facilitating 300-metre ocean-going "Panamax" freighters (i.e. vessels that are currently used on the Panama

[4] **Ontario Ports Study**, Transport Canada/Ontario Ministry of Transportation, 1984.

Canal), which would carry general cargo, probably in containers from overseas sources. Other studies have investigated the potential environmental benefits of maritime freight transport in the Great Lakes/St. Lawrence River region, pointing to reduced fuel consumption, air pollutant emissions, noise, traffic congestion and accidents relative to truck and rail transport.[5] The project would involve significant physical alterations to these waterways, with possible negative environmental impacts.

If implemented so that the St. Lawrence Seaway and related Great Lake channels are enlarged sufficiently to accommodate direct overseas container services, there could be a decrease in cross-border commercial vehicle flows. Some trans-Atlantic container traffic currently passing through the ports of Halifax and Montréal and destined to the US Midwest, could reach Detroit or Chicago directly, thus eliminating the land segment between Michigan and the ports in Halifax/Montréal.

Overall, however, it is expected that marine traffic will continue to provide an important role in serving bulk cargo and is projected to maintain its current market share of total trade traffic in the study area over the study horizon.

Intermodal Rail

Within the last 10 years North American railways have introduced new technology to improve service and lower operating costs. They have also made changes in business systems to simplify use of intermodal services for their customers. The first significant test of new technology was the introduction of the “RoadRailer” by Norfolk Southern Triple Crown in the 1980s and early 1990s. RoadRailer is a system that permits highway trailers to run directly over railway tracks hauled by a locomotive.

Two versions are in use. In one version the highway trailer carries both rubber and steel wheels and in the other version rail bogies are removable. There is only one axle set per trailer, at the rear; there is a patented coupling mechanism by which the railway axle supports its own trailer and the one immediately following. The train of trailers can be assembled quickly, requiring only a tractor to move the trailers and possibly a forklift truck to manipulate the rail bogies.

A service was introduced in the early 1990s by Norfolk Southern through Detroit (but not picking up freight in Detroit) to Toronto in collaboration with CPR. Today, RoadRailer services are offered extensively on the CN network in Canada and the Norfolk Southern intermodal network in United States. CN operates a Montreal/Toronto to Chicago RoadRailer service through its Sarnia-Port Huron tunnel.

In the mid-1990s, CPR introduced “Expressway” as a service directly offered to private and for-hire motor carriers serving Montreal and Toronto. The service is designed to accept conventional highway trailers without any special attachments or strengthening of the structure of the trailer, and it features a very simple and quick loading and unloading

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[5] **Great Lakes and St. Lawrence River Commerce: Safety, Energy and Environmental Implications of Modal Shifts**, Great Lakes Commission, 1993.

operation using a portable ramp that travels with the train. The service has been successful in the Montreal-Toronto market, and it has recently been expanded to Windsor and Detroit. There are future plans for further expansion into the US market.

New intermodal technologies, such as these, and presumably further innovations represent the type of modal integration that will form the basis of future growth expectations of the railway mode in the study area.

Apart from intermodal trailer and container services, other significant railway volumes are generated by the automotive industry. Assembled vehicles and automobile and truck parts moving back and forth between manufacturing facilities around the world constitute a significant amount of rail and truck traffic at the border crossings.

Future Trends

The future direction of government policies on both sides of the border is toward promotion and encouragement of sustainable transportation. A strong emphasis is being placed on reduction of fuel consumption and resultant emissions. It is likely that future policies will influence industry, through market forces, to shift behaviour towards greater accountability for fuel efficiency. This would suggest a trend towards integration of transportation services to make the best use of all modes of transportation. This would encourage, in turn, more long distance transportation by rail, greater development of intermodal terminals and attempts to divert traffic from highly congested areas such as large urban centres and border crossings.

The pressure on the trucking industry to conserve fuel will continue both as a consequence of the long-term policy direction towards sustainability and as a consequence of volatile energy markets creating cost uncertainty. Driver shortages for long distance transportation are becoming more prominent, and are also likely to influence long-term modal split. The lifestyle of long distance trucking is much less attractive to young people today compared with a generation ago. At the same time new regulations concerning security, safety and qualification of drivers are making entry to the industry much more difficult. In the meantime, demand continues to increase; the natural long-term consequence of increasing demand in the face of constrained supply is higher cost. The motor carrier industry may be forced to look to collaborative arrangements with railways simply to accommodate growth.

All of these factors suggest excellent prospects for modal shift from highway to rail in the study area, particularly where road congestion delays are consistently present. Trends in the last five years indicate that the process of shifting is already occurring. The rail mode is now carrying an increasing share of the value of trade, and it is gaining (albeit from a much smaller base) on the highway mode in long-distance traffic.

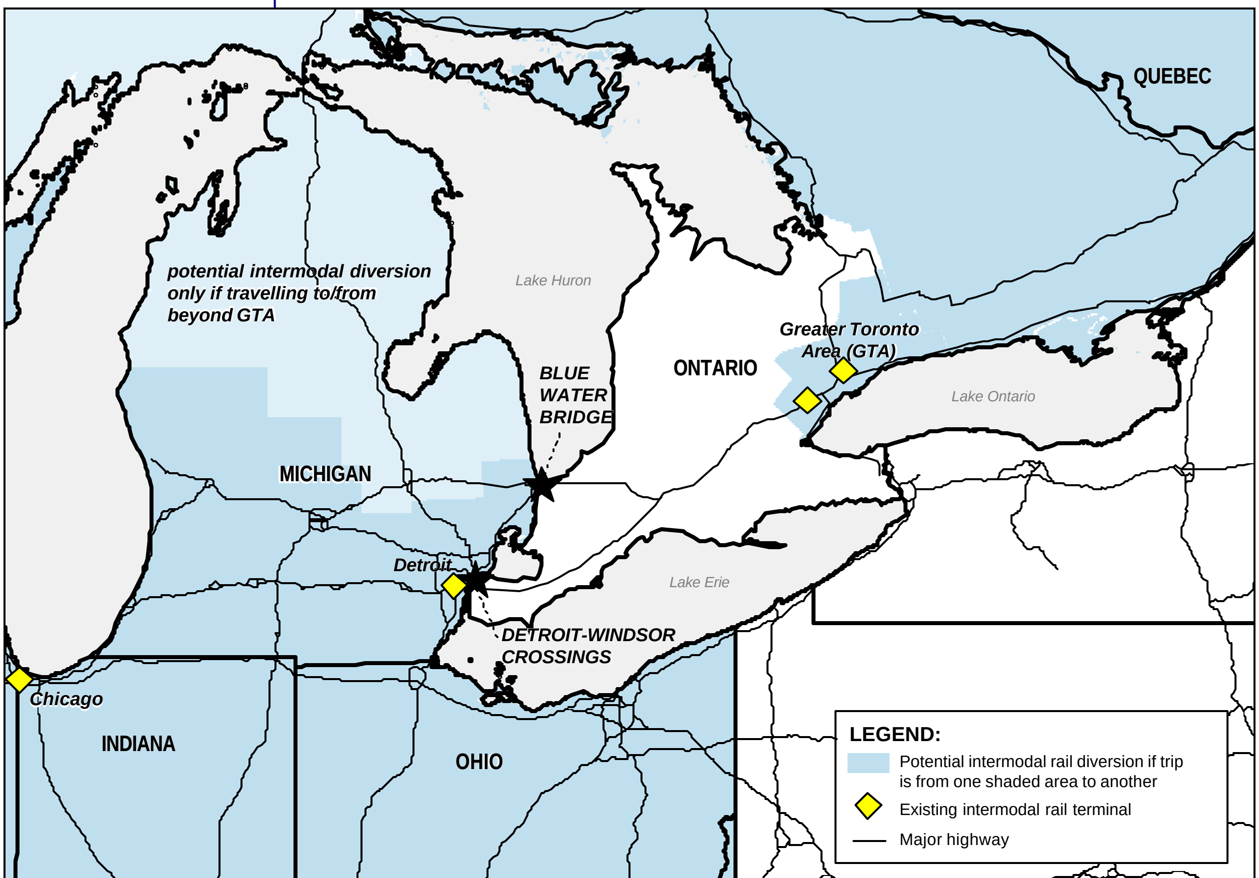
Analysis of the NRS/MTO commercial vehicle data indicates that up to approximately 18% of the corridor's current total cross-border truck traffic is potentially divertible to intermodal rail. This is based on an examination of origin-destination flows and commodity mix carried by commercial vehicles in relation to current intermodal services and expected intermodal improvements. The primary diversion market includes commercial vehicles that travel at least as far as the western border of the Greater Toronto Area on the Canadian side and Detroit on the US side. These are considered to be potentially divertible to intermodal rail given the long distance travelled and the presence of intermodal terminals in the Toronto and Detroit area, which are expected to increase in capacity over the study horizon. Other potential diversion markets to intermodal rail were identified in other major rail corridors connecting primary market nodes, which are more numerous but less well defined on the US side. The potential intermodal rail market area is shown graphically in Exhibit 4.15 and it is estimated that 43% of the commercial vehicle movements travelling between Southeast Michigan and Southern Michigan are “in-scope” long distance trips that have origins and destinations that correspond with this market area.

However, there are several factors that combine to form an upper bound on the potential market penetration of intermodal rail. These include:

- the size of the firms involved, such that there is a minimum, “critical volume” of goods to be shipped at any one time to warrant the use of rail;
- the type of commodity being shipped, as certain goods are not suitable for transfer by rail (e.g. delicate items, some perishables, etc.); and
- comfort of shippers with current goods movement behaviour and practices.

For these reasons, a range of 20% to 40% of in-scope or long distance trips is considered as realistically divertible from truck transport to intermodal. This corresponds to approximately 9% to 18% of total commercial vehicle movements (short and long distance trips).

EXHIBIT 4.15: POTENTIAL CROSS-BORDER INTERMODAL RAIL MARKET AREA



Many factors can influence faster or slower growth in this penetration estimate. Key issues that could emerge as government policy on either side of the border to influence the rate of the change include the following:

- introduction of carbon taxes would penalize higher fuel consumption and could increase costs over the road relative to rail;
- urban growth policies in major centres such as Detroit, Toronto and Windsor that would designate corridors for specific purposes. Such policies may influence the manner in which commercial vehicles access their markets and general indications are that more use of rail could be expected if such policies were implemented;
- changes in truck cabotage laws, which currently does not permit non-citizen truck drivers to pick-up/haul goods and denies Canadian carriers opportunities to carry back-haul cargos from the US unless the driver is aboriginal or has dual Canadian/American citizenship. As such, the proportion of empty truck movements across the border is currently high compared to domestic movements, increasing costs to Canadian and American shippers;

- harmonization of road weight and dimension regulations between the US and Canada, allowing larger and heavier vehicles to operate on long-distance services in the US and encouraging greater use of highway transport; and
- significant changes in transportation regulations (e.g. CAFÉ standards for commercial vehicles) could affect the ability of carriers to continue to improve service and enhance the competitiveness of their services.

The above factors have all recently received some degree of attention. The debate over whether to increase fuel taxes as part of full-cost user pricing for road users, greenhouse gas reduction initiatives as per the Kyoto Protocol as well as “smart” urban planning techniques and practices have all received substantial media coverage in the past few years. Although much less publicized, the topic of US and Canadian road regulation harmonization has also surfaced to some degree, however discussions with the Ontario Trucking Association suggest that there is currently little drive by either side to advance this initiative.

5. Travel Demand Forecasts

This chapter describes the development of demand forecasts for the movement of goods and people between Southeast Michigan and Southwest Ontario. The forecasts are provided for passenger car, commercial vehicle, rail and bus modes over a 30-year horizon. The forecasts are unconstrained and reflect the potential demand that could be realized, given anticipated market conditions and expected need. This chapter provides an overview of the general forecasting approach, followed by a qualitative and quantitative analysis of historical trends and causal factors separately for each mode. Finally, demand forecasts for cars and commercial vehicles are presented for three time horizons.

Based on the forecasts presented in this chapter, existing border crossing capacity and the relationship to future travel demand forecasts is discussed in Chapter 6. The analysis of possible improvement options and new crossings will be examined in subsequent reports.

5.1. Overview of the Forecasting Process

Detailed origin-destination survey data for passenger car and commercial vehicle travel provide solid base year data..

Trip markets were identified and forecasted separately by trip purpose for passenger car trips and by commodity group for commercial vehicle trips.

The use of complex mathematical models to estimate cross-border traffic has proven to be extremely difficult in past, with no single model being capable of capturing all of the relationships and interactions between the different modes and markets/sub-markets describing cross-border travel. Further, the large influence and uncertainty associated with many key factors including international trade (e.g. NAFTA, Auto Pact), policies (e.g. tariffs, tobacco taxes), US/Canada economies (e.g. exchange rate, imports/exports, GDP growth) and others (e.g. casinos, border processing times) have overwhelmed the predictive ability of any mathematical model. This finding is also supported by a review of forecasting techniques used in previous cross-border studies, as provided in Appendix B. As well, future estimates must also consider the complex dynamics and on-going structural changes in the Canadian and United States economies that dramatically influence cross-border traffic and trade and which cannot be captured within a mathematical model.

Recognizing these uncertainties about future conditions, a forecasting approach that is based on consensus on key assumptions, sensitivity testing and a fundamental understanding of the factors and rationale behind key assumptions has been developed and applied for this study. The approach focuses 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 this knowledge. The approach exploits the comprehensive passenger car and commercial vehicle origin-destination data available to this study, allowing examination of specific markets rather than overall trends and volumes. The specific techniques employed were:

- **Trend/causal factor analysis** – A large number of variables with potential influence on cross-border traffic were examined in relation to historical cross-border trips. This helped identify factors strongly correlated with cross-border trips, so that they could be carried forward for more detailed analyses.
- **Multivariate regression analysis** – Multivariate regression analysis related border crossing traffic (the dependent variable) to independent or explanatory variables. Using mathematical relationships established using historical data, forecasts were developed by entering expected future values for the explanatory variables.
- **Time series trend analysis** – This involves the linear extrapolation of past trends to develop of future forecasts. Time series analysis does not take into account possible changes in the underlying factors of cross-border traffic. As will be discussed later in this chapter, two time series trends are described, consisting of a trend based on data from the past 30 years and a trend based on data from the past 10 years. In some cases these trends are quite different.

The findings and statistical relationships from the regression and time series analyses are provided in Appendix C.

The products of the travel forecasting process are 10-, 20- and 30-year horizon traffic forecasts of cross-border traffic by mode. A detailed description of the forecasting process and methodology is described in the **Travel Demand Analysis Process Working Paper**. Traffic growth rates and Base Case forecasts were developed for annual two-way traffic at the three border crossings for various modes and trip categories/purposes.

For passenger travel, base forecasts were established for three categories of passenger demand:

- same-day work/business trips;
- other same-day trips (primarily recreation trips); and
- overnight trips (primarily vacation trips).

The above breakdown of passenger car travel is made possible through the use of travel survey data gathered in the August 2000 **Ontario-Michigan Border Crossing Traffic Study**. This survey provides comprehensive travel information for over 23,000 passenger car trips and unprecedented data on cross-border travel characteristic and origin-destination information. None of the previous studies examining passenger car demand at the Southeast Michigan/Southwest Ontario border crossings have had access to such high quality data.

For goods movement forecasts, five groups are defined based on the main commodities that are presently being transported between Southeast Michigan and Southwest Ontario, as:

- automotive/metal industry products (combined);
- forest products;
- machinery and electronics;

- animal and plant; and
- other (including chemical and petroleum products, rubber and plastics, textiles, minerals and stone/ceramic/glass, among others).

Commercial vehicle traffic forecasts are prepared for each of the above commodity groups and are based on the commercial vehicle data from the **1999/2000 NRS/MTO Commercial Vehicle Survey** and trade data by commodity from the Bureau of Transportation Statistics and Canada Customs and Revenue Agency (CCRA)**.** The commercial vehicle survey, like the above passenger car survey, provided comprehensive truck characteristic, commodity and origin-destination information for cross-border truck trips that is unprecedented. Again, no other cross-border study has had access to such high quality data as a basis to prepare cross-border commercial vehicle forecasts for the Southeast Michigan/Southwest Ontario border crossings.

5.2. Base Case Forecast Assumptions

The Base Case forecasts prepared in this study reflect a most probable future forecast based on existing trends and committed plans and land use forecasts as established by the municipalities and region and state/provinces within the Broad Geographic Area established for this study. They do not account for major policy shifts with respect to customs, border security or economic trade. The Base Case forecasts are also unconstrained in demand terms, with growth based on market conditions and expected need. In other words, the forecasts are independent of current roadway/rail/marine capacities, border crossing processing capacities or access links. Similarly, the forecasts do not assume any major shift between the three existing crossings due to changes in policy or capacity constraints, nor do they account for any new crossing or related infrastructure.

Base Year

The year 2000 is used to describe existing conditions and as a base for the preparation of forecasts. Year 2000 provides a consistent base for the majority of the data sources used in this study. It is the year that the passenger car and commercial vehicle origin-destination data was collected and was a census year in the United States, 2001 being the closest Canadian census year.

The choice of 2000 as the base year also represents a condition of typical travel demand not impacted by the events of September 11, 2001 (9/11), as the significant reductions in cross-border traffic that resulted would provide an atypical base on which to establish future forecasts. Comparing 2000 and 2001 annual demand, passenger vehicle volumes were 10% lower in 2001 and truck volumes were 5% lower. In the last quarters (September to December) of both years only, passenger car demand dropped by 30% between 2000 and 2001. An examination of data to July 2002 indicates that cross-border passenger-car traffic is approximately 18% lower than 2001 for comparable months (pre-September), while commercial vehicle traffic has remained steady.

Transportation System Improvements

The Base Case forecasts assume the existing transportation system plus committed improvements that have been established in state/provincial, regional or municipal transportation plans, have had the necessary planning and environmental studies completed and have funding commitments for its construction.

Road and Highway Improvements – Committed road and highway improvements were identified through consultation with SEMCOG, MTO, City of Windsor and a review of the relevant transportation plans for the respective agencies. A list of the assumed committed improvements and year of implementation is provided in Appendix D. The most significant road improvements in terms of impact on future cross-border vehicle traffic flow are:

- Ambassador Bridge Gateway Project – A new connection between the Ambassador Bridge and I-96 and I-75 on the US side of the facility, significantly improving access to the US interstate highway system for cross-border commercial vehicle and passenger car trips. It includes the construction of a new at-grade toll plaza west of the existing bridge to support toll facilities for Canada-bound traffic and to be compatible with a potential sec ond Ambassador Bridge span;
- I-375 Interchange – Improvements to the interchange between I-375 and Jefferson Avenue, improving access to the interstate highway system for Detroit-Windsor Tunnel users;
- Jefferson Avenue – Roadway improvements from US-10 to I-375, also facilitating access to the Detroit-Windsor Tunnel;
- Highway 401 – Widening from 4 to 6 lanes in the Windsor area from 0.5 km east of Highway 3 to 1.0 km east of County Road 42;
- Highway 402 – Major reconstruction of a 20-kilometre stretch of the highway approaching Sarnia area. A preliminary design and environmental study to improve operations of Highway 402 from the Blue Water Bridge Authority plaza to Airport Road will be completed in the near future and will recommend interchange improvements at four locations to set the stage for the future widening of Highway 402 to six lanes, as traffic volumes dictate; and
- Huron-Church Road – Near-term operational improvements to address current congestion, including vehicle detection upgrading, incident management video system, LED traffic signals, variable message signs and data collection systems.

Passenger Rail – No significant investment is committed to improving passenger rail services (VIA Rail or Amtrak) leading to Detroit-Windsor or Sarnia-Port Huron crossings. Moderate improvements in service frequency are assumed within the existing infrastructure to accommodate increases in rail ridership associated with a continuation in current market shares. No new cross-border rail services are assumed. Amtrak is exploring the possibility of moving the current cross-border passenger train service through Sarnia-Port Huron to operate through Windsor-Detroit, but this is not assumed in the Base Case forecasts.

Bus – No new local or intercity services are assumed, with increased frequencies assumed at levels to support a continuation of current market shares.

Freight Rail – Committed investments in intermodal facilities by the railways are assumed, including the Detroit Intermodal Freight Terminal and technology and other related investments by CN and CPR that have been implemented in recent years. The Base Case forecasts do not include CPR's plans for extending their existing Expressway intermodal rail service to Chicago, which currently operates between Toronto and Detroit. They also propose to increase the amount of service provided; currently two trains per day in each direction are operated.

Marine – No new services are introduced in the Base Case forecast to the current operation of existing ferry services, which include the Detroit-Windsor, Walpole Island and Marine City ferries. Proposals have been submitted by private interests to operate new ferry services between Windsor and Detroit.

Economic Growth and Trade Forecasts

Future projections of people and goods movement flows are based on economic forecasts prepared for Transport Canada by Informetrica. The forecasts provide estimates of merchandise trade by commodity groupings between the US and Canada for the period extending to 2025. These projections are described previously in Chapter 4 and in Section 5.6, as part of the development of the goods movement forecasts by commodity groups.

Population and Employment Forecasts

Population and employment projections used as input into the future estimation of travel demand for this study are based on the most recent official state/provincial, regional and municipal forecasts, as documented in the land use plans of the respective agencies. A brief overview of these forecasts is provided in Chapter 4.

5.3. Factors Affecting Passenger Demand

The purpose of this section is to provide an analysis of the key factors that have had an influence on cross-border passenger trips. Given that most passenger trips are made by passenger car, the majority of the discussion is on this mode.

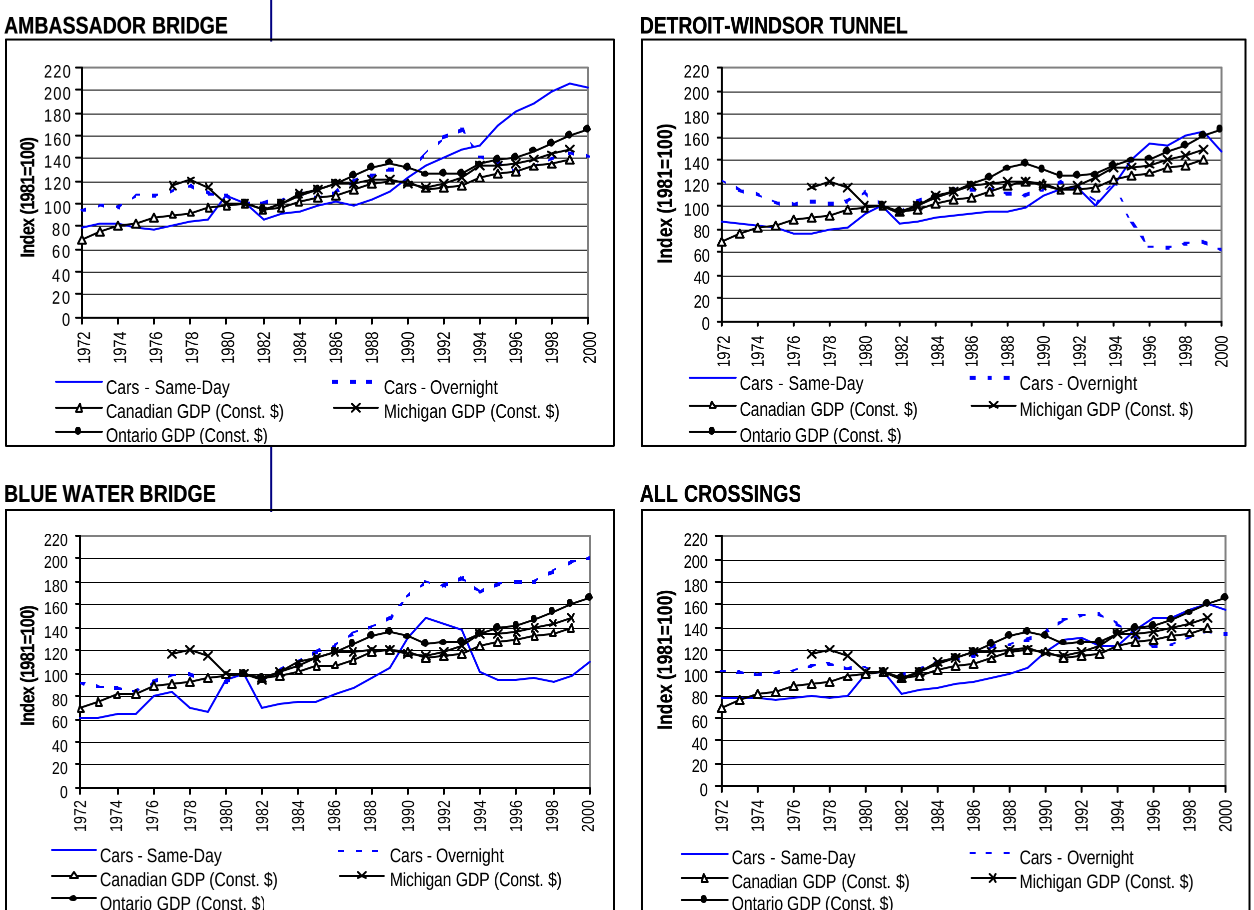
Economic Production

Several measures of economic growth exist, with the primary measure being Gross Domestic Product (GDP). GDP is the market value of all goods and services produced in a year within the borders of a country (or other geographical area), and is the standard measure of the overall size of the economy. Since GDP is a measure of the income generated by production within Canada or the US, it is also a factor that affects travel; that is, the more disposable income available to a household, the more likely household members are to travel.

In addition to country GDP, state GDP indicators can provide a measure of the economies of the regions adjacent to the border crossings. State product indicators are essentially the same as country GDP, except that they are defined by state or provincial boundaries.

Exhibit 5.1 shows an indexed plot of annual border crossings versus several key economic measures. With the exception of Michigan GDP in the late 1970s, Canadian GDP, Ontario GDP and Michigan GDP are all closely linked.

EXHIBIT 5.1: ANNUAL PASSENGER CAR CROSSINGS AND ECONOMIC PRODUCTION, 1972-2000



In general, trends in border crossings are consistent with the economic indicators. When all crossings are combined, the index for the economic indicators and travel demand are within a relatively close range in 2000. There are some anomalies for the individual crossing and travel categories such as with the Blue Water Bridge and the Ambassador Bridge where there were fairly significant increases in demand in the late 1980s and early 1990s, which coincided with reductions in country and state GDP. For overnight travel on the Blue Water Bridge and the Ambassador Bridge, the trend reversed around 1992 when economic trends began to increase but border crossings saw a decrease. Thus, there is a close link between cross-border trips for all three crossings combined and economic indicators; relationships by individual crossing are less clear.

Population

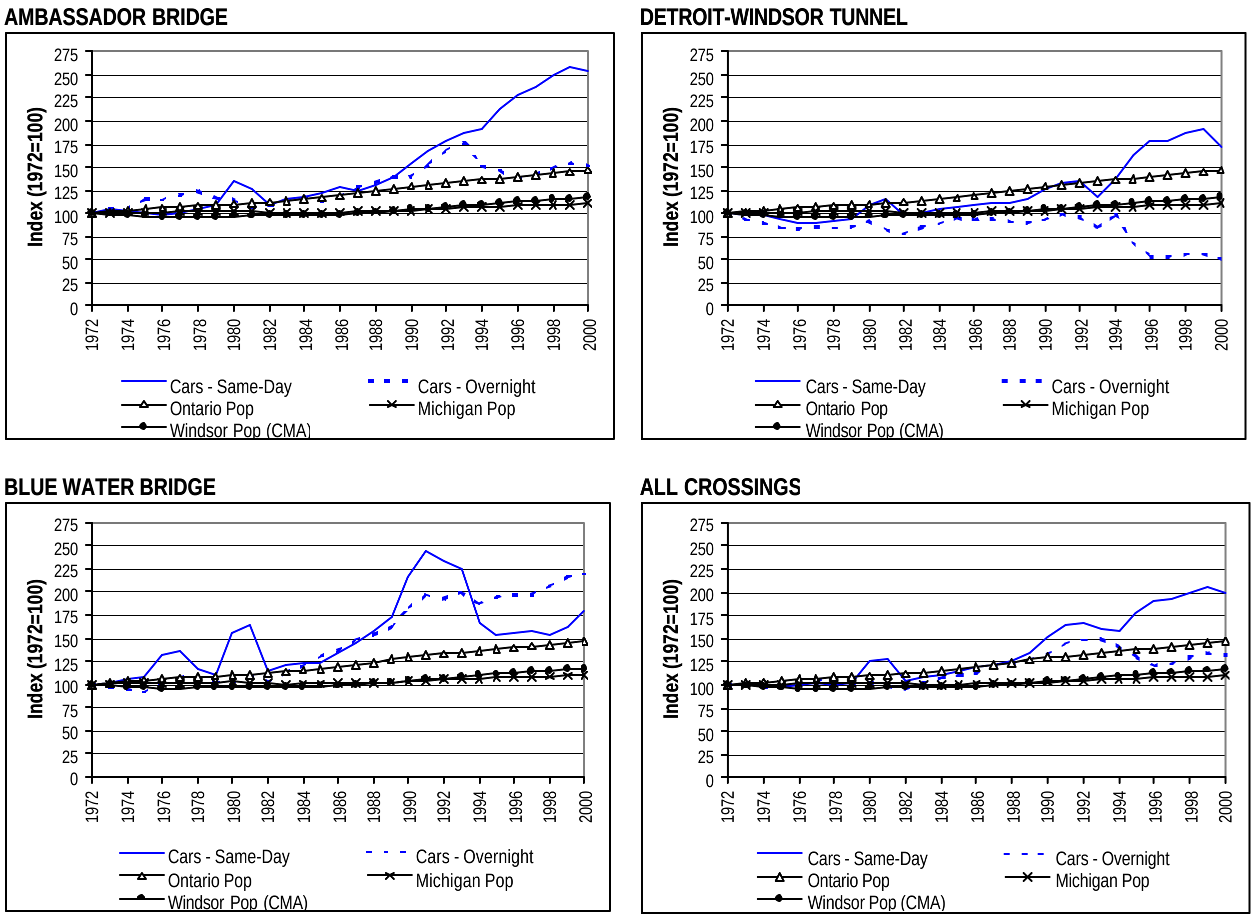
Population is another indicator of growth, with an increase in population leading to increased border crossing demand, all else being equal. In general, same-day trips would be affected by local population changes, given the level of interaction and integrated economies exhibited between Windsor-Detroit and Sarnia-Port Huron. Vacation or overnight travel would typically involve longer distance travel and be affected by state and provincial population and beyond in addition to economic factors, as described above.

Exhibit 5.2 illustrates the relationships between border crossings and population. When all crossings are considered, same-day border crossing demand has increased at a much faster rate than population. The majority of cross-border travel is by Canadians. Over the last 30 years, the population of Ontario increased by approximately 50% whereas same-day border crossing have increased by over 100%. The majority of this increase has occurred since 1986. Overall, overnight crossings have tracked fairly well with the population of Ontario, although the trend has dropped below that of population growth in the last 5 years, suggesting a reduced propensity for longer-distance vacation travel by road.

When examined on an individual crossing basis, the relationships between border crossing demand and population are less clear. For the Blue Water Bridge, overnight trips have generally been increasing faster than regional population, reflecting the generally higher proportion of longer distance travel and vacation travel through this crossing. There does not appear to be any link between regional population and same-day crossings. For the Ambassador Bridge, overnight trips have, on average, increased at basically the same rate as population, although there have been minor deviations from the population trend. Same-day travel on the Ambassador Bridge has grown substantially faster than the population of Windsor, again suggesting there are other factors that are influencing this travel category. For the Detroit-Windsor Tunnel, passenger vehicle border crossings tracked relatively closely to population trends until 1994, when same-day travel through the tunnel started to increase fairly dramatically. As discussed later in this section, this increase was at least partially driven by the opening of the Windsor Casino.

In summary, Ontario population, taken in combination with other factors, is an important underlying factor in explaining cross-border trips, particularly overnight trips.

EXHIBIT 5.2: ANNUAL PASSENGER CAR CROSSINGS AND POPULATION, 1972-2000



Employment

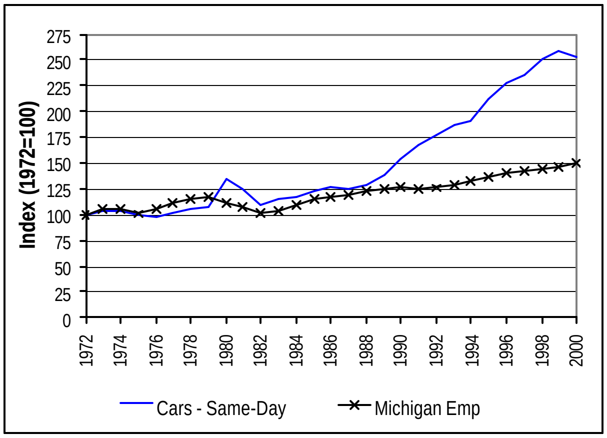
Based on the 2000 **Ontario-Michigan Border Crossing Traffic Study**, there were approximately 52,000 daily trips between Ontario and Michigan at Detroit-Windsor crossings on a typical Thursday, of which 14,000 (27%) were work/business trips. This represents a significant proportion of cross-border traffic.

As discussed previously in Chapter 3, most work-related border crossing trips are by Canadians to US employment destinations, which is approximately six times higher than the number of Americans working in Canada. Medical and auto industries represent the two major areas of employment among Canadians working in the US in the study area

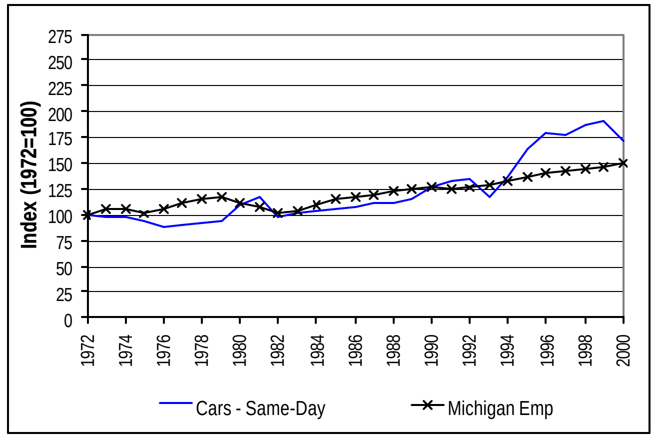
In the past, between 2.2% and 3.1% of the Windsor area labour force has been employed in the US based on Census data for 1981 to 1996, with no discernable trend towards upwards or downwards, examined previously in Chapter 4. To further examine possible relationships between employment and cross-border travel, Exhibit 5.3 plots Michigan employment against same-day cross-border passenger trips, as annual trend data for work trip commuting is not available.

EXHIBIT 5.3: ANNUAL PASSENGER CAR CROSSINGS AND EMPLOYMENT, 1972-2000

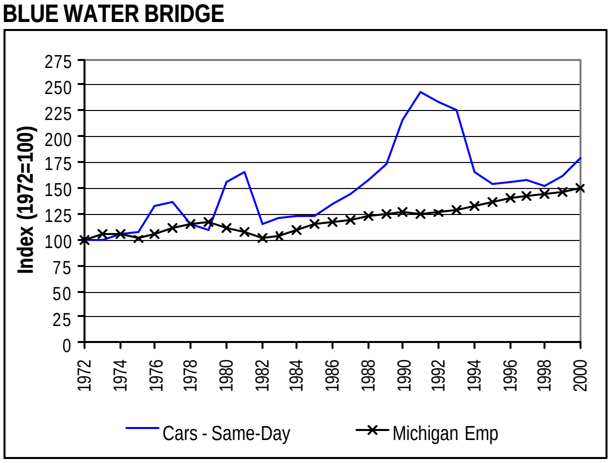
AMBASSADOR BRIDGE



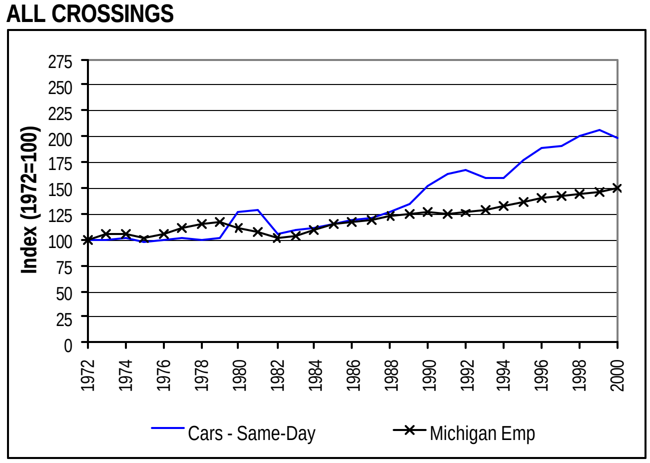
DETROIT-WINDSOR TUNNEL



BLUE WATER BRIDGE



ALL CROSSINGS



There is very little correlation between Michigan employment and same-day border crossing trips across the Blue Water Bridge, as work trips account for a much lower portion of Blue Water Bridge trips compared to the Detroit-Windsor crossings (17% of trips from Canada to the US and 13% of trips from the US to Canada). On the other hand, there was a very close link between Michigan employment and same-day cross-border trips using the Detroit-Windsor Tunnel up until 1994. The jump after 1994 is largely due to Casino trips as discussed below.

For the Ambassador Bridge, there was a very close relationship between Michigan employment and cross-border trips throughout the 1970s and 1980s. For example, during the late 1970s and early 1980s, declines in Michigan employment were followed by declines in same-day cross-border trips. Starting in about 1990, cross-border trips on the Ambassador Bridge started to increase at a much faster rate than Michigan employment.

This diversion cannot be explained by Casino traffic, as the Windsor Casino did not open until 1994.

In summary, taken in combination with other factors, Michigan employment provides some indication of the level cross-border travel for work purposes for the Detroit-Windsor crossings.

Casinos, Recreation and Shopping

As noted above, traditional factors such as the economy, population and employment explain a large part of the trends in cross-border trips until approximately 1994. The introduction of casinos in Windsor, Detroit and Point Edward (Sarnia) since 1994 have significantly influenced cross-border traffic levels, as discussed previously in Chapter 4.

In the year 2000, casino and recreation/entertainment trips accounted for 50% of the trips for the Detroit-Windsor tunnel and 41% of the trips for the Ambassador Bridge on a typical weekday (Thursday). Trips to/from the Windsor Casino represent some 6,900 trips or 27% of Detroit Windsor Tunnel trips and 4,300 or 17% of Ambassador Bridge trips.

To illustrate the magnitude casino related travel has on the Detroit-Windsor Tunnel, Exhibit 5.4 shows what crossing volumes would have been based on linear trends from 1972 to 1993. Compared to the trend forecast, the year 2000 demand is nearly 30% higher, indicating the significance of the casino on cross-border tunnel trips. The relationship between trips across the Ambassador Bridge and casino attendance is less direct than for the tunnel, given the diverse mix of traffic using this facility, although some 4,300 vehicles cross the Ambassador Bridge on a typical weekday for Windsor Casino related travel.

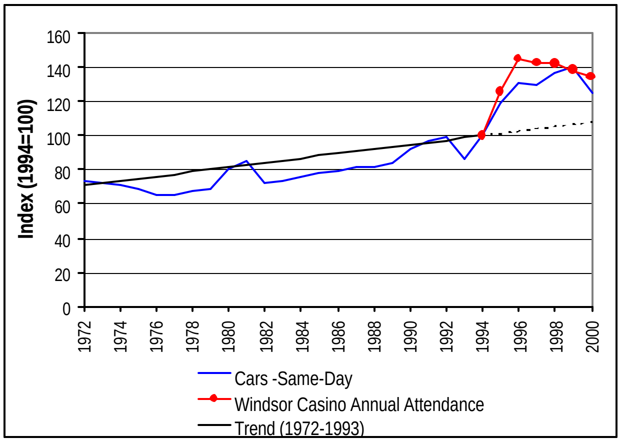
Since 9/11, passenger car traffic has decreased significantly for the Detroit-Windsor Tunnel, which corresponds highly to similar decreases in Windsor Casino attendance. New casinos in Detroit are believed to have intercepted many Americans who formerly visited the Windsor Casino. In addition, the possible reduced novelty of the Windsor Casino and overall suppressed cross-border travel given cross-border delays and security/terrorist concerns may have long-term effects.

In summary, casino activity has a significant impact on cross-border trips, more so for the Detroit-Windsor Tunnel than the Ambassador Bridge, and the extent to which past cross-border Casino related travel can be recovered/maintained will have a significant impact on future cross-border traffic levels. A slow but steady trend to reduced attendance at the Windsor Casino in the four years before 9/11 suggests that there is little prospect for future growth under current conditions.

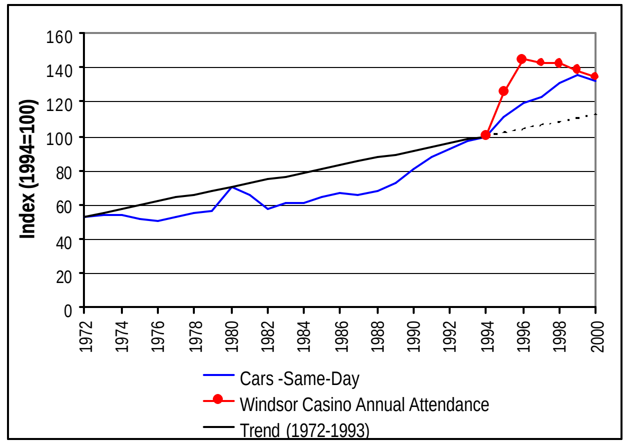
Further to casino-related activity, there are many other types of recreation activities that generate cross-border trips, including visiting bars/restaurants, shopping, sporting events and other activities. Traditionally, there has been a significant amount of cross-border trips generated by American youths who can legally consume alcohol in Canada but cannot do so in the US due to higher legal drinking ages. There are no trend data to suggest whether this travel component is increasing or decreasing.

EXHIBIT 5.4: ANNUAL PASSENGER CAR CROSSINGS AND CASINO ATTENDANCE, 1972-2000

DETROIT-WINDSOR TUNNEL



AMBASSADOR BRIDGE



Price Variables

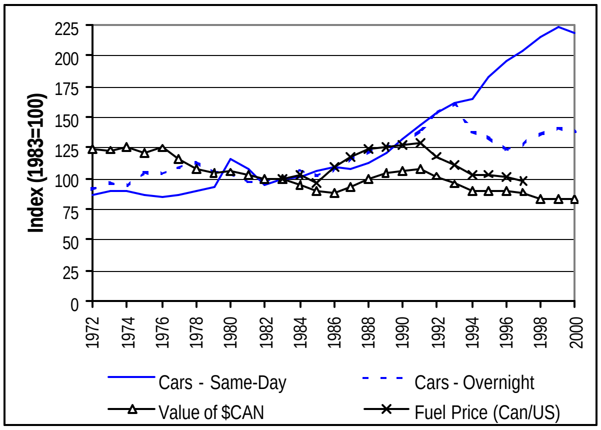
Price differential between Canadian and US goods can be expected to affect both same-day and overnight trips. Generally, the larger the price differential (in either direction), the higher the propensity for cross-border travel. Changes in the dollar introduce different relationships. For Canadians, same-day trips generally should increase as the value of the Canadian dollar increases, given increased Canadian purchasing power. However, same-day trips by Americans would increase as the Canadian dollar declines, providing Americans increased purchasing power. As discussed in Chapter 4, there were twice as many Canadians making same-day trips to the US than Americans making trips to Canada in 1990 before the value of the Canadian dollar started to decline significantly. This is no longer the case, with slow but steady increases in American visitation, while travel by Canadians remains well below historic highs.

For overnight trips, the trends are similar. When the value of the Canadian dollar is high, Canadians are more apt to make trips to the US, although the magnitude of the impact seems to be less than for same-day trips.

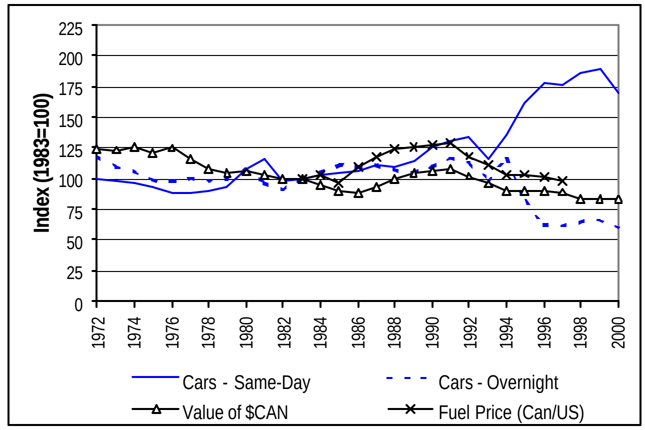
Exhibit 5.5 shows the impact of selected price variables on cross-border travel between Southeast Michigan and Southwest Ontario. Overall for the three crossings, there appears to be some relationship between overnight travel and the value of the Canadian dollar. Overnight travel peaked in 1992-1993, whereas the dollar started to decline in 1992. It is reasonable to expect some lag in the overnight trip trends, as people tend to plan these trips fairly far in advance. Since 1996, overnight cross-border trips have been increasing, mainly due to US residents taking advantage of the low Canadian dollar for vacation travel.

EXHIBIT 5.5: ANNUAL PASSENGER CAR CROSSINGS AND PRICE, 1972-2000

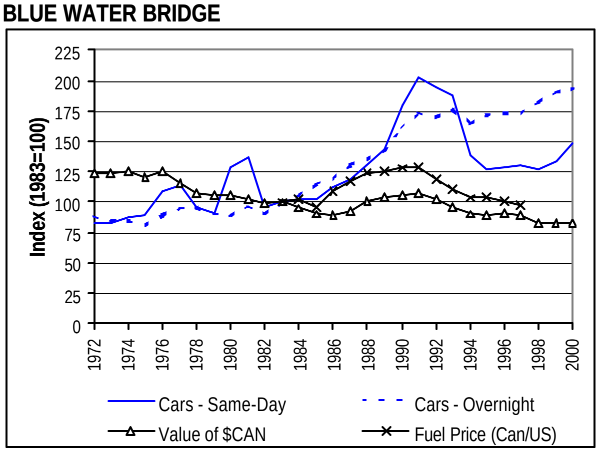
AMBASSADOR BRIDGE



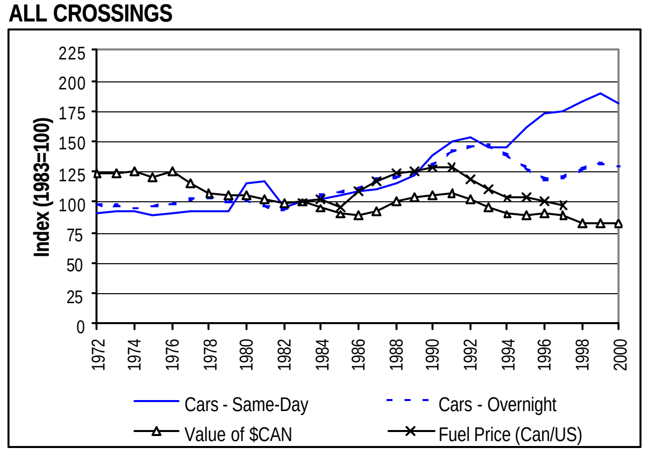
DETROIT-WINDSOR TUNNEL



BLUE WATER BRIDGE



ALL CROSSINGS



For the Blue Water Bridge, where overnight trips play a higher role in cross-border traffic, the trend in overnight trips does not seem to be as affected by the relative value of the dollar, although there was a dampening of growth starting around 1990. Declines in overnight trips on the Ambassador Bridge in 1993 are likely related to the drop in the Canadian dollar starting in previous years.

The impacts of price variables are considerably different depending on the crossing location. For the Blue Water Bridge, the significant drop in traffic that occurred between 1993 and 1994 is related to the end of the cross-border shopping phenomenon, when it was no longer cost-effective for Canadians from Sarnia to cross into the US to purchase goods such as groceries and fuel. The Detroit-Windsor crossings have continued to grow over this same period, mainly due to the introduction of casinos as discussed above.

It should be noted that the price of fuel was initially thought to be very significant factor in passenger car crossing volumes, in particular for Canadians travelling to the US to purchase fuel that has consistently been cheaper since the mid-1980's. Testing of the relationship between the ratio of fuel prices (in which the Canadian price reached as high as 165 times the US price in 1991) and crossing volumes, however, revealed no statistically significant relationship. The exception to this occurred during the fuel crisis of 1981, when the price of US fuel relative to Canadian fuel was exceptionally high, corresponding to a peak in volumes at all three road crossings in that year. Given that a repeat of such an extreme disparity in price is unlikely (and unpredictable), fuel price is not considered as a distinct factor affecting demand.

In summary, the lower value of the Canadian dollar compared to the US dollar and associated purchasing power disparities has had a strong influence on overnight cross-border trips. The integration of Canadian and US economies, free trade and improved competitiveness of Canadian retailers have eliminated many or most of the price disparities, reducing the demand for cross-border shopping. The very high cost for Canadians to vacation in the US has reduced travel in recent years, but would likely increase with an increase in the value of the Canadian dollar.

Summary and Key Points

The analysis of past border crossing trends and causal factors has revealed several key points:

- There is no single factor or set of factors that can explain all of the trends in border crossing traffic. The level of cross-border traffic is very complex and dynamic and cannot be captured solely through statistical relationships;
- Where there has been a significant change in border crossing traffic over a short period, many of the changes can be explained by changes in the value of the Canadian dollar; the impacts of the dollar are most pronounced at the Blue Water bridge;
- The introduction of casinos in Windsor and subsequently in Detroit has had a pronounced impact on cross-border passenger demand; the Detroit-Windsor tunnel demand appears to be most impacted by casino activity.

Same-day trips over the Ambassador Bridge seem to be relatively insensitive to changes in price variables or other factors and have continued to grow at an average annual rate of 3.4% over the last 30 years.

5.4. Passenger Demand Forecasts

Drawing on the analysis of past trends and causal factors, this section outlines the Base Case passenger demand forecasts. Exhibit 5.6 summarizes the projected growth rates for the Base Case forecasts by trip market along with the key assumptions about the causal factors affecting growth. The multivariate and trend analyses were undertaken to estimate passenger car travel by trip purpose and used as a basis to assist in the determination of future growth rates. The multivariate regression analyses results were not directly applied given their inability to properly capture all of the complex border crossing relationships. In all cases, however, the adopted forecast growth by trip purpose is higher than that predicted by the multivariate regression techniques alone.

EXHIBIT 5.6: PASSENGER CAR BASE CASE ANNUAL GROWTH FORECASTS

A. WORK TRIPS

Influencing Factors	Historic Growth 1972-2000	Historic Growth 1990-2000	Forecast Growth 2000-2010	Forecast Growth 2010-2030
Michigan Employment	1.46%	1.59%	0.79%	0.33%
Windsor CMA Population	0.56%	1.22%	1.10%	0.60%

Crossing	Historic Growth Same-Day Trips		Base Case Growth Forecast		
	1972-2000	1972-1993	2000-2010	2010-2020	2020-2030
Ambassador Bridge	3.38%	3.01%	2.0%	1.5%	1.0%
Detroit-Windsor Tunnel	1.94%	0.76%	1.5%	1.0%	1.0%
Blue Water Bridge	2.11%	3.95%	1.5%	1.5%	1.0%

B. OTHER SAME-DAY TRIPS (CASINO/RECREATION)

Influencing Factors	Historic Growth 1972-2000	Historic Growth 1990-2000	Forecast Growth 2000-2010	Forecast Growth 2010-2030
Michigan Population	0.35%	0.69%	0.17%	0.33%
Windsor CMA Population	0.56%	1.22%	1.10%	0.60%

Crossing	Historic Growth Same-Day Trips		Base Case Growth Forecast		
	1972-2000	1972-1993*	2000-2010	2010-2020	2020-2030
Ambassador Bridge	3.38%	3.01%	1.5%	1.0%	0.5%
Detroit-Windsor Tunnel	1.94%	0.76%	0.8%	0.5%	0.5%
Blue Water Bridge	2.11%	3.95%	1.5%	1.0%	0.5%

C. OVERNIGHT TRIPS

Influencing Factors	Historic Growth 1972-2000	Historic Growth 1990-2000	Forecast Growth 2000-2010	Forecast Growth 2010-2030
Ontario Population	1.38%	1.27%	1.10%	0.86%
Canadian GDP	2.64%	1.81%	2.80%	2.00%

Crossing	Historic Growth Overnight Trips		Base Growth Forecast		
	1972-2000	1990-2000	2000-2010	2010-2020	2020-2030
Ambassador Bridge	1.50%	0.84%	1.5%	1.0%	1.0%
Detroit-Windsor Tunnel	-2.42%	-5.94%	1.5%	1.0%	1.0%
Blue Water Bridge	2.85%	1.87%	1.5%	1.0%	1.0%

* 1972-1993 period reflects the growth trend before the cross-border shopping/casino phenomena. The 10-year trend, which includes the impacts of these phenomena, is not presented since it is not considered sustainable in the future.

Note also that the use of growth projections by different trip purposes/markets implicitly accounts for auto occupancy, as occupancies are typically lower for work trips and higher for other same-day and overnight trips. This assumes that occupancy remains constant by market throughout the study horizon. Thus, it would not be reasonable to assume that it remains constant overall, given the different growth of each market.

The following section outlines each of the key travel markets and the projected growth over the 30-year planning horizon of this study.

Passenger Car Work/Business Trips

Work and business trips account for approximately one-third of Ontario-Michigan border crossing traffic on a typical weekday. The majority of cross-border work and business trips are same-day trips from Canada to the US, by Windsor and Essex County residents. At Sarnia, there is a more even directional split for works trips; however, work trips account for a somewhat smaller proportion of total trips.

The proportion of cross-border work trips has not changed dramatically in the past 15 years. Future work trips are projected to increase at similar rates to the projected growth in labour force and employment in the Windsor-Detroit areas.

A review of Census place-of-residence/place-of-work trends for the Windsor area, as presented previously in Section 4.2, indicated that the proportion of the Windsor labour force working in the US ranged between approximately 2 to 3% between 1981 and 1996 with no definite upwards or downwards trend. Assuming the propensity for Canadian residents to work in the US remains the same as today, cross-border work trips should increase in relation to Windsor labour force or population. Over the past 10 years, Windsor population has grown by an average of 1.22% per year; however, this is expected to slow down somewhat over the next thirty years based on City of Windsor forecasts.

Considering these factors, growth in work trips should continue in the future, resulting in corresponding growth in border traffic. As shown in Exhibit 5.6, annual growth rates for work trips are forecast to be between 1.0% and 2.0% per year depending on the crossing and time period. This forecast is slightly higher than the 1981 to 1996 period where work trips from the Windsor Census Metropolitan Area to the US increased at an average of 0.8% annually.

The continued growth in cross-border work related travel reflects continuation of initiatives to facilitate free trade and free movement of workers between the two countries and the integrated economies of Windsor-Detroit areas. As well, increased convenience in cross-border travel through the NEXUS program for frequent, low risk travellers is expected to encourage cross-border commuter travel in the future.

Over the study horizon to 2030, work trips are projected to increase by 56% to 14,400 weekday trips for the Ambassador Bridge, with the Detroit-Windsor Tunnel increasing 42% to 11,900 annual trips and the Blue Water Bridge increasing 49% to 4,500 weekday trips.

Passenger Car Other Same-Day Trips

Other same-day trips are presently dominated by casino and recreation trips but also include a variety of trip purposes such as shopping and visiting friends/relatives. Other same-day trips account for 53% of all Ontario-Michigan border crossing trips on an annual basis.

In the past, same-day trips have accounted for most of the increases in border traffic, namely due to cross-border shopping phenomenon of the early 1990s and the opening of the Windsor Casino in 1994. Cross-border casino traffic has dropped dramatically since 9/11 and it is not clear that the drop can be recovered in the future, let alone grow beyond 2000 levels. Additional marketing to areas beyond southeast Michigan may bring some increased recreational travel to the Windsor area. However, the Windsor Casino, the Windsor racetrack casino and the Point Edward Casino could potentially face stable or even declining attendance, given the strong competition for recreational spending in the Windsor-Detroit area.

Without casino or cross-border shopping related trips to fuel future growth, same day recreational and other trips are projected to grow in line with Windsor and Detroit area population increases.

In addition to casino travel, cross-border recreation trips to restaurant/bars, shopping, bingo and other attractions remain popular and there is no expectation that future economic circumstances will dramatically alter matters. The Canadian dollar is presently near an all time low and expectations are that the value of the dollar will increase, resulting in an expected increase in same-day shopping/recreation trips by Canadians. This may be partially offset by a reduction in same-day trips by US residents to Canada. It is expected that American visitation will continue to grow slowly but steadily as long as the Canadian dollar is low.

Considering these factors, growth in same-day trips is likely to be lower than the 25-year historical trend, given that the historical trend has been elevated by the introduction of casinos in Windsor and Sarnia and cross-border shopping phenomenon. For the Ambassador Bridge and Blue Water Bridge, annual growth rates of 1.5% per year have been adopted for the short term, decreasing to 0.5% per year in the longer term. Lower growth rates have been assumed for the Detroit-Windsor Tunnel, as same-day traffic on this facility appears to be closer linked to casino trends, which are expected to stabilize. This growth rate is in line with population growth expected in Windsor-Detroit area.

Over the study horizon to 2030, other same day trips are projected to increase by 35% to 17,100 weekday trips for the Ambassador Bridge, with the Detroit-Windsor Tunnel increasing 20% to 18,200 weekday trips and the Blue Water Bridge increasing 35% to 9,800 weekday trips.

Passenger Car Overnight/Vacation Trips

Compared to same-day trips, overnight trips account for a lower percentage of border crossing traffic – 14% of trips on an annual basis. Overnight trips are dominated by vacation trips but also include other trip purposes such as business trips and visiting friends.

Overnight travel growth is projected to grow at a modest but stable rate, in line with Ontario population growth.

Historically, overnight trips have grown at a lower rate than same-day trips, with the exception of the Blue Water Bridge where overnight trips did not experience the same drop as same-day trips in first half of the 1990s. As discussed previously, overnight border crossing trips have tracked fairly closely to growth in the Canadian GDP and Ontario's population. Both of these factors are expected to increase fairly steadily over the next 30 years.

For forecasting purposes, it is assumed that future growth rates in overnight trips will increase in the same proportion of the Ontario population. Hence, slightly lower growth rates have been adopted for the longer term, reflecting the outlook for Ontario's population by the Ministry of Finance. In addition to population growth, an increase in the Canadian dollar should help maintain or increase the number of overnight trips by Canadian residents to the US, although there may be a slight reduction in visitors to Canada from the US.

Over the study horizon to 2030, other same day trips are projected to increase by 42% to 6,600 weekday trips for the Ambassador Bridge, with the Detroit-Windsor Tunnel increasing 42% to 2,500 annual trips and the Blue Water Bridge increasing 42% to 5,500 annual trips.

Total Passenger Car Demand

Total passenger demand forecasts were developed by applying the Base Case growth rates by trip market to year 2000 travel demand. This is shown for all three crossings in Exhibit 5.7, which displays trend and forecast volumes for same-day (work/business and other) and overnight trips.

The number of annual passenger car trips crossing between SE Michigan and SW Ontario is projected to increase 37% from 21.5 million in 2000 to 29.4 million in 2030.

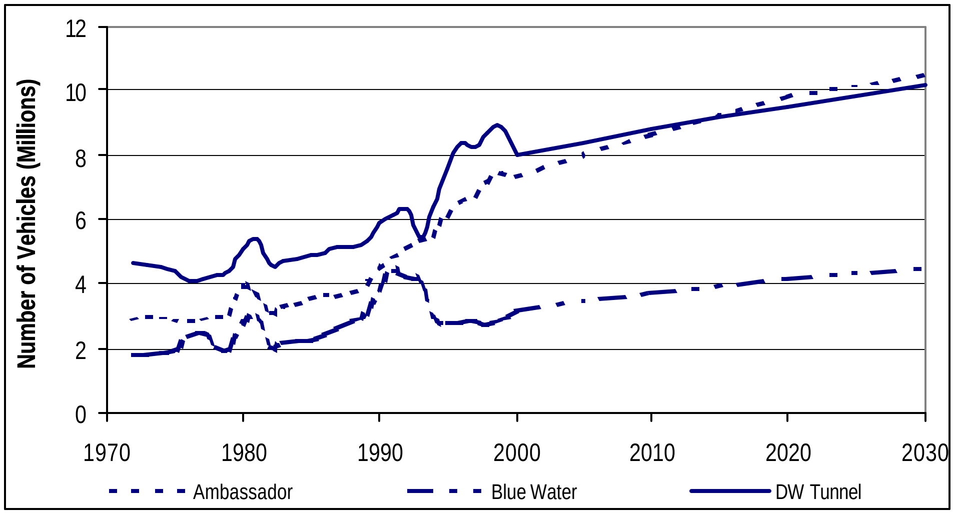
The resulting base forecast for total passenger cars is shown in Exhibit 5.8. To assist in interpreting the magnitude and to provide context to the forecasts, Exhibits 5.9 through 5.11 also present 10-year and 25-year trend lines based on historic traffic levels. The forecast estimates using multivariate regression analysis are also displayed.

Overall, the forecasts reflect passenger car traffic growth that is lower than the 25-year trend at each of the three crossings. However, the Base Case forecasts are also higher than those predicted using multivariate regression techniques.

The Base Case forecast for the Ambassador Bridge, shown in Exhibit 5.9, generally follows the 25-year trend line and is substantially lower than the 10-year trend line. This suggests that the significant growth experienced in the past decade is not sustainable in the future, as the dramatic increase in traffic related to cross-border shopping and Windsor Casino has essentially run its course and there are no new prospects on the horizon to stimulate increased cross-border travel. Hence, future traffic growth is related to more modest levels of growth consistent with future increases in population and employment on each side of the border. Improvements in the Canadian dollar relative to the US dollar is projected over the study horizon, which would help stimulate Canadian visitation to the US and increase overall cross-border demand.

EXHIBIT 5.7: PASSENGER CAR FORECASTS FOR SAME-DAY AND OVERNIGHT TRIPS

SAME-DAY



OVERNIGHT

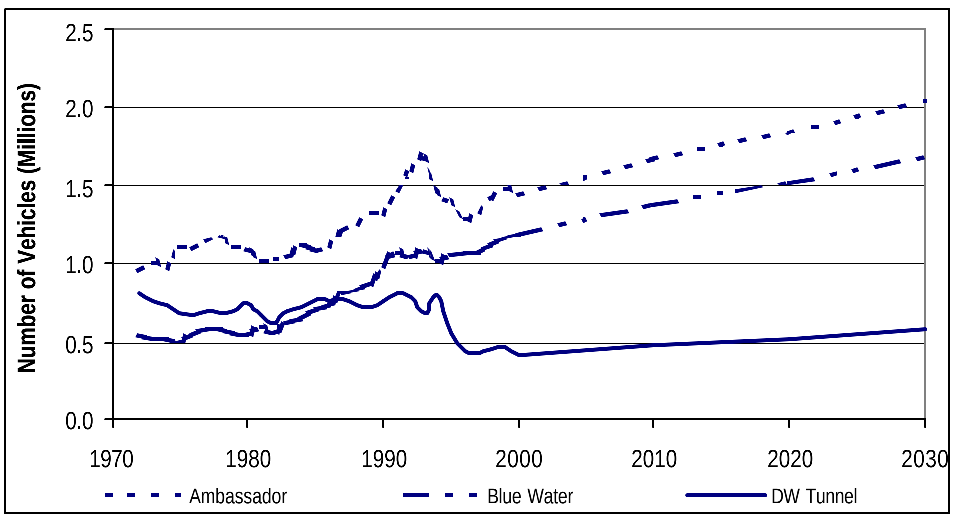


EXHIBIT 5.8: FORECAST BASE CASE ANNUAL PASSENGER CAR VOLUMES

Year		Ambassador	D-W Tunnel	Blue Water	Total
2000	Total	8,734,000	8,368,000	4,390,000	21,491,000
2010	Total	10,313,000	9,322,000	5,095,000	24,730,000
	Growth	18.1%	11.4%	16.1%	15.1%
	Avg. Annual Growth	1.68%	1.09%	1.50%	1.41%
2020	Total	11,598,000	10,007,000	5,689,000	27,293,000
	Growth	12.5%	7.3%	11.6%	10.4%
	Avg. Annual Growth	1.18%	0.71%	1.11%	0.99%
2030	Total	12,525,000	10,749,000	6,130,000	29,403,000
	Growth	8.0%	7.4%	7.8%	7.7%
	Avg. Annual Growth	0.77%	0.72%	0.75%	0.75%
2000 to 2030	Growth	43%	28%	40%	37%
	Avg. Annual Growth	1.21%	0.84%	1.12%	1.05%

EXHIBIT 5.9: PASSENGER CAR FORECASTS FOR AMBASSADOR BRIDGE

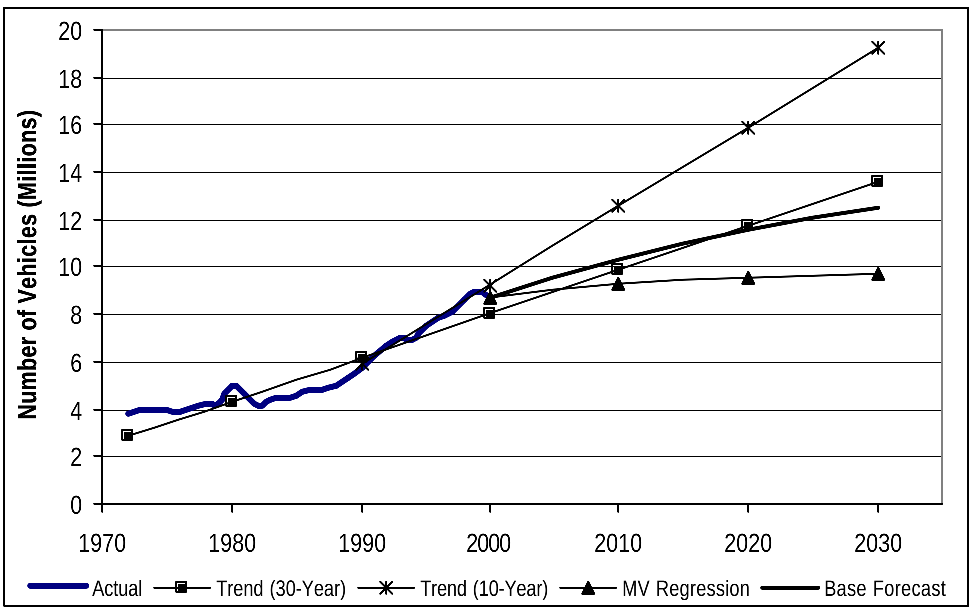


Exhibit 5.10 shows the base forecasts for the Detroit-Windsor Tunnel. The Base Case forecast is slightly lower than the 25-year trend projection and considerably lower than the 10-year trend projection. This reflects the fact that historical trends have been escalated by very substantial increases in same-day trips resulting from casino activity. The base forecast is also lower than the trend line because it starts from the year 2000, which was nearly 1 million trips below the peak traffic level reached in 1999.

Travel forecasts for the Blue Water Bridge, as shown in Exhibit 5.11, are somewhat below the 25-year trend projection but substantially higher than the 10-year trend, which includes a major decline in trips between 1993 and 1994. Expectations are that the value of the Canadian dollar will increase, which may bring back some of the same-day trips that occurred in the early 1990s at this crossing.

EXHIBIT 5.10: PASSENGER CAR FORECASTS FOR DETROIT-WINDSOR TUNNEL

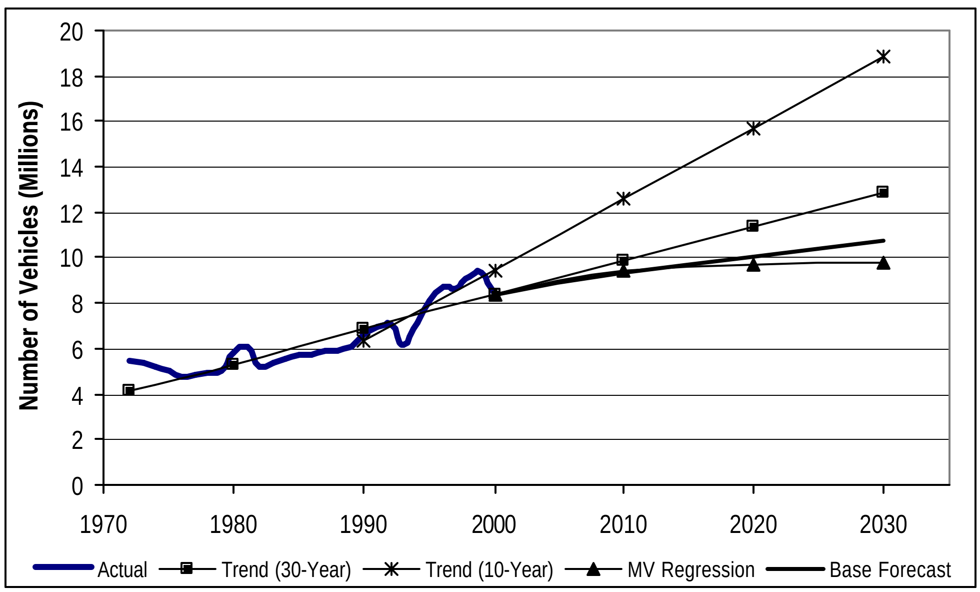
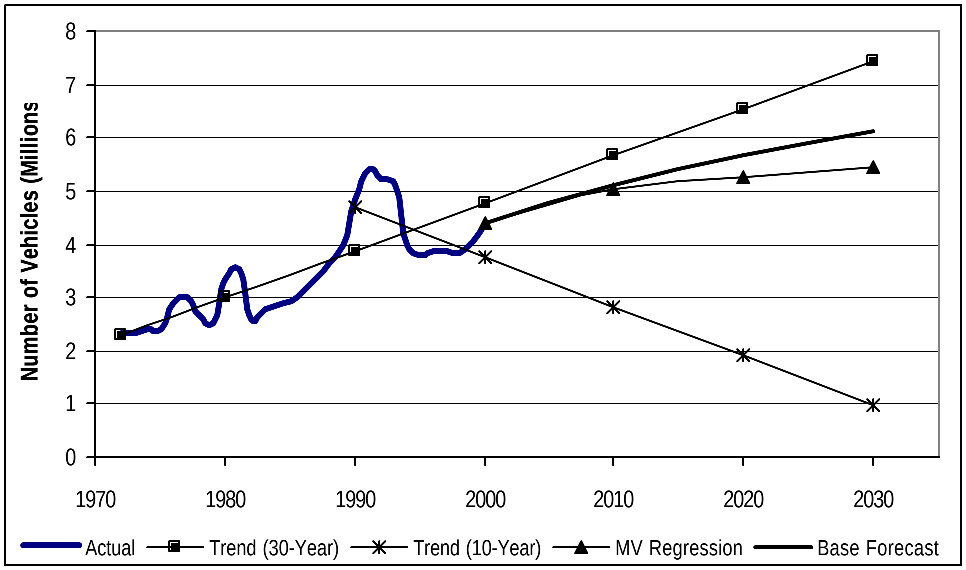


EXHIBIT 5.11: PASSENGER CAR FORECASTS FOR BLUE WATER BRIDGE



Bus Passenger Demand

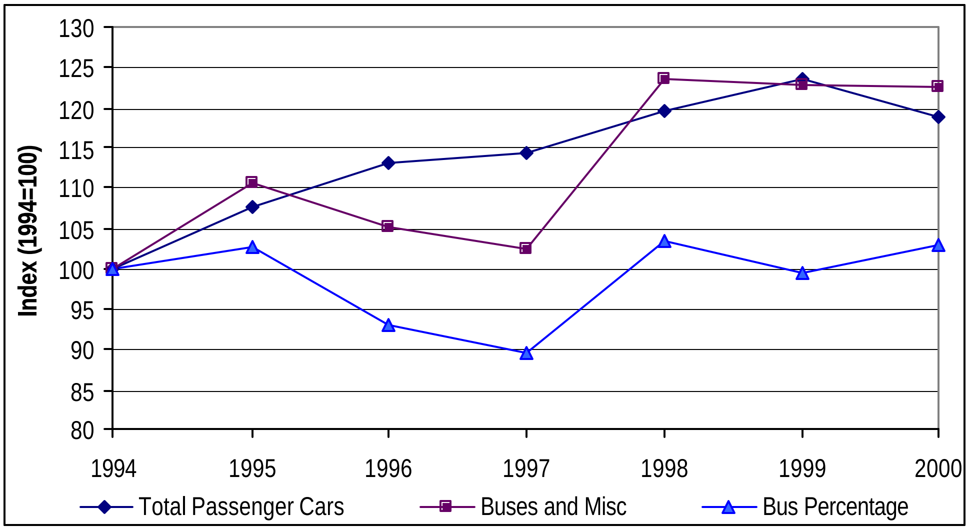
In the year 2000, approximately 0.9% of all passenger vehicles crossing at Windsor-Detroit were buses or other miscellaneous vehicles. At Sarnia-Port Huron, approximately 0.1% of all passenger vehicles were buses. In terms of persons, 3.3% of all passengers crossing the study area border (about 2 million) did so by bus. Given these relatively low percentages, a detailed analysis of bus demand is not warranted.

For the Base Forecasts, it is assumed that bus mode shares will remain constant. This implies that the factors that affect passenger car demand will affect bus volumes in the same general manner. As shown in Exhibit 5.12, this has generally been the case since 1994, except for a slight drop in bus mode shares (as a percent of passenger vehicles) in 1996 and 1997. Annual bus traffic is projected to increase from 161,000 vehicles to 220,000 by 2030 between Southeast Michigan and Southwest Ontario.

Rail Passenger Demand

In the year 2000, approximately 105,000 (0.2% of total) passengers travelled between Southeast Michigan and Southwest Ontario by rail, representing approximately 0.2% of total passenger traffic. For the Base Forecasts, passenger rail mode shares are assumed to remain constant, with the projected growth to 2030 representing 144,000 annual trips between Southeast Michigan and Southwest Ontario.

EXHIBIT 5.12: BUS TRAFFIC TRENDS IN RELATION TO PASSENGER VEHICLES, 1994-2000



Source: BTOA

5.5. Factors Affecting Demand for Goods Movement

The purpose of this section is to provide an analysis of the various components of goods movement demand and to describe key factors that influence border crossing activity by commercial vehicles.

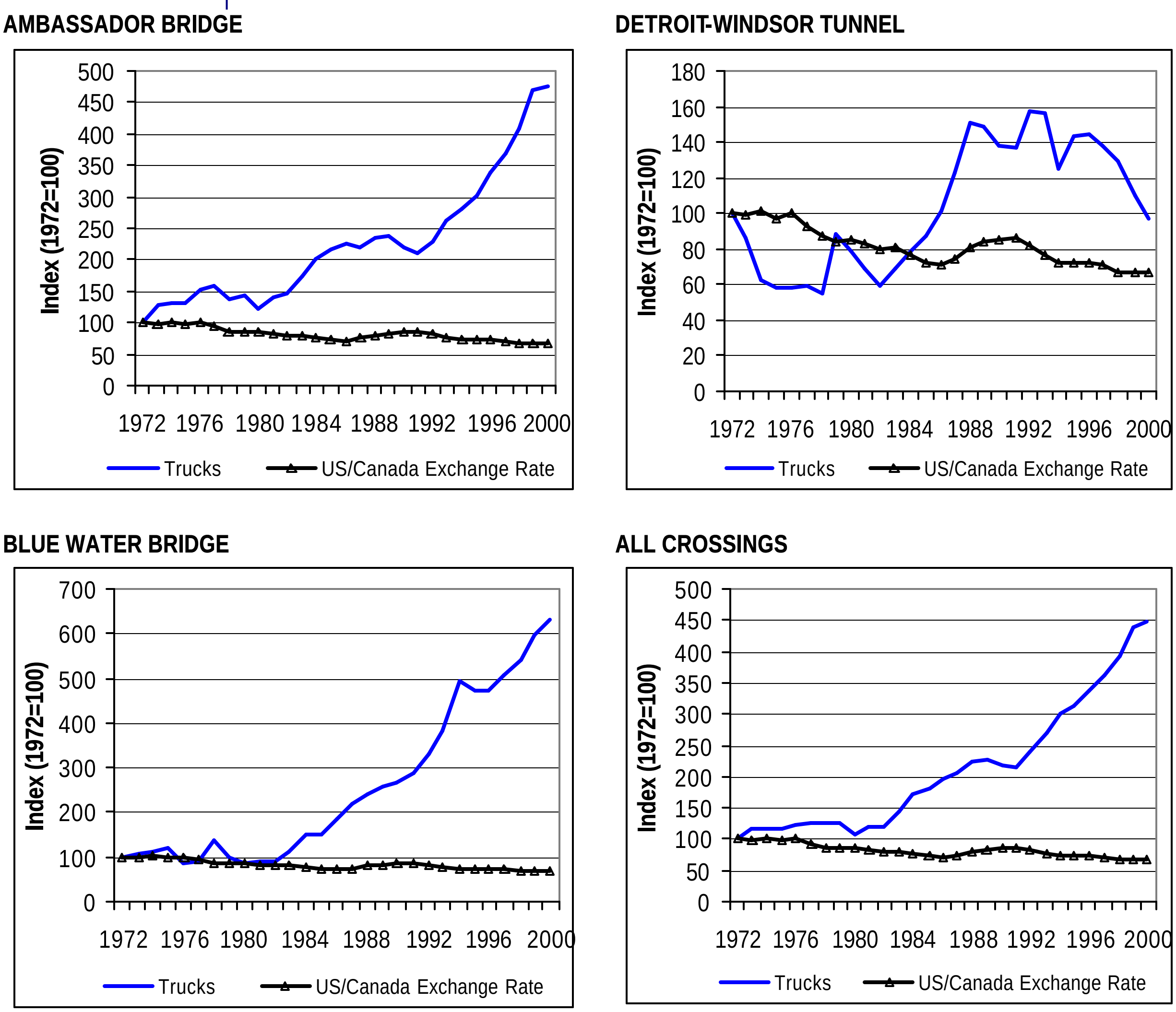
The previously illustrated trends in annual truck crossings presented in Section 2.3 can be linked to several explanatory factors that are socio-economic in nature. However, the factors of population and employment, mentioned in the previous section as affecting passenger demand, are also highly correlated with cross-border goods movement. As these factors are themselves indicators of such macro-economic measures as GDP, they are considered as indirectly affecting goods movement. Their inclusion as factors affecting goods movement would be redundant.

The factors described in this section, therefore, focus on the direct indicators of goods movement only. These consist of the US-Canada currency exchange rate and the GDPs of various geographical areas of each nation. GDP is then broken down into several commodity type groupings developed for the study and consistent with those prevalent within the study area. Trade of these commodity groups forms the basis of the methodology used to forecast truck volumes on each crossing. While the focus is on the truck mode, it is implied that these factors affect rail, marine and intermodal transport as part of the overall goods movement and commercial vehicle demand on border crossings.

US-Canada Currency Exchange Rate

The currency exchange rate between the US and Canada appears to have an inverse relationship with commercial vehicles crossing the border, at least over the course of the previous 30 years, which have seen the exchange rate drop from about par to its present value of about 65 cents US per Canadian dollar. The inverse relationship observed over the past 30 years has resulted from the increased attractiveness of Canadian exports to US customers due to an increased buying power from a decreasing exchange rate. This can be seen in Exhibit 5.13, which shows an indexed plot of annual truck volumes for each border crossing against the exchange rate. The relationship is strong for all crossings with the exception of the Detroit-Windsor Tunnel. This is explained by the relatively small number of commercial vehicles using the tunnel, which results in a more erratic trend behaviour that is difficult to draw relationships from.

EXHIBIT 5.13: ANNUAL TRUCK CROSSINGS AND EXCHANGE RATE, 1972-2000



Source: BTOA; Statistics Canada

As mentioned in Chapter 4, the Canadian dollar is projected to climb to a maximum of 75 to 85 cents US within the study period. While it is extremely difficult to project fluctuations of this rate through to year 2030, it is unlikely that the Canadian dollar will surpass this level, even within this long period. The consequence of this climb will be a moderate decrease in the growth of truck traffic crossing the border relative to if the exchange rate remained at current levels.

Economic Production

Exhibit 5.14 shows an indexed plot of the relationship between annual truck volumes by border crossing and the economic production of various geographical regions associated with the study area. The term Great Lakes refers to the states of Michigan, Ohio, Indiana, Illinois and Wisconsin collectively. In general, truck crossings are directly related to the GDP of surrounding regions. As GDP consists of the value of goods produced for domestic use as well as for export, changes in the amount of goods produced on either side of the border will have impacts on the amount of trade. Increases in goods production and trade will result in increases in the number of commercial vehicles required for goods transport. As can be seen, this relationship is strong on the Ambassador and Blue Water Bridges, for which truck traffic represents a substantial proportion of the total. Again, truck traffic trends on the Detroit-Windsor Tunnel are more volatile and difficult to relate to any explanatory variable.

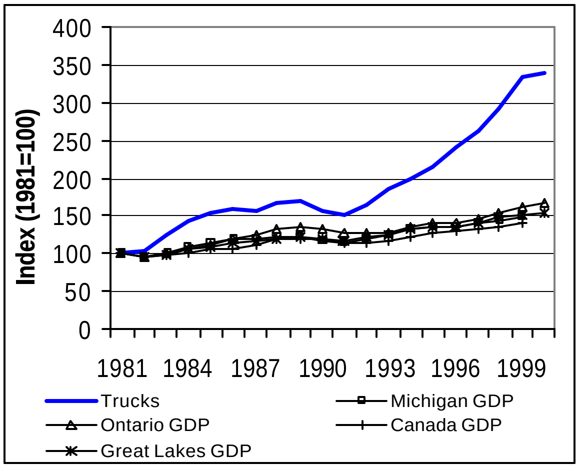
Commodity Trade

The relationship between GDP growth and vehicle traffic provides useful empirical evidence against which to test the results of the commercial traffic forecasts. As mentioned in previous sections, the main source of information used is trade data by commodity. Merchandise trade projections are also based on GDP and other factors. Projections used by Transport Canada and developed by Informetrica are based on macro-economic models of the national economies that also take into account inter-industry linkages. The projections of merchandise trade between Canada and the US are made on a nationwide basis. Constant-dollar projections of specific Canada-US merchandise trade to 2025 (and extrapolated to 2030) are used to project overall growth and trade value for the following sectors:

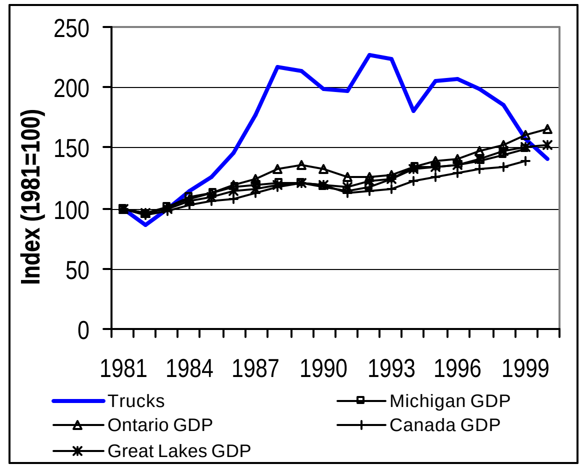
- Animal and Plant products, using live animal and agricultural food projections;
- Automotive/Metal products, using cars, commercial vehicles and vehicle parts combined with ore and crude metal products projections (explained below);
- Machinery and Electronic equipment, using industrial machinery and electronic equipment projections;
- Forest products, using lumber, pulp and newsprint projections; and
- Other commodities, using the difference of total trade and the above projections.

EXHIBIT 5.14: ANNUAL TRUCK CROSSINGS AND ECONOMIC PRODUCTION, 1972-2000

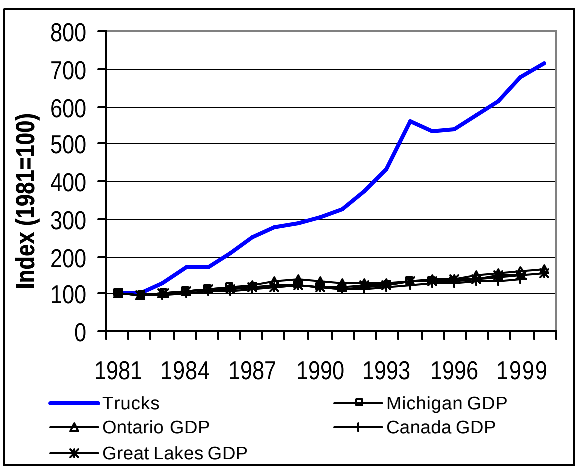
AMBASSADOR BRIDGE



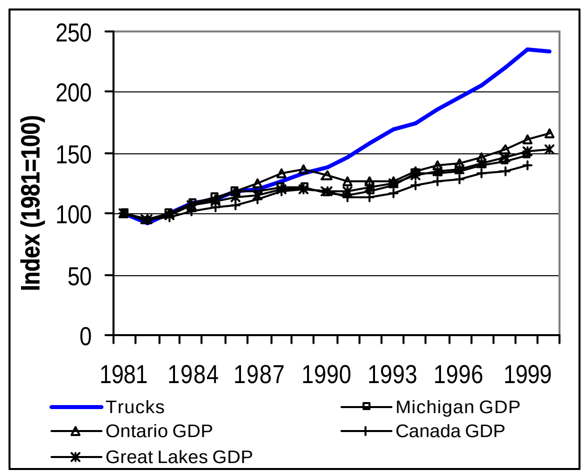
DETROIT-WINDSOR TUNNEL



BLUE WATER BRIDGE



ALL CROSSINGS

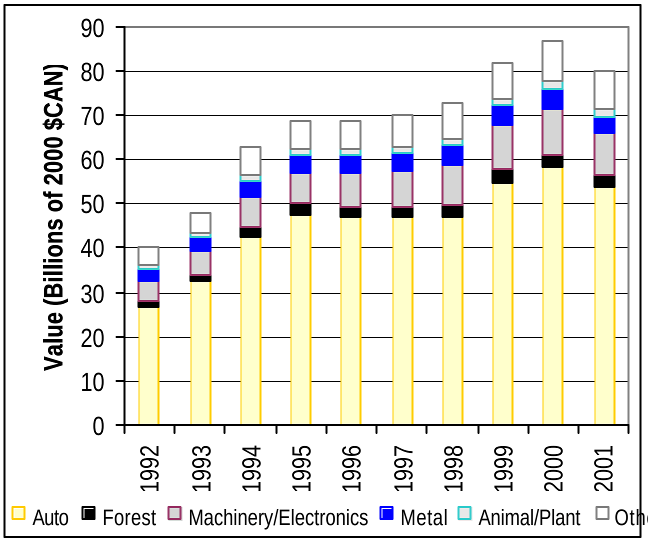


Source: BTOA; Statistics Canada; US Bureau of Economic Analysis

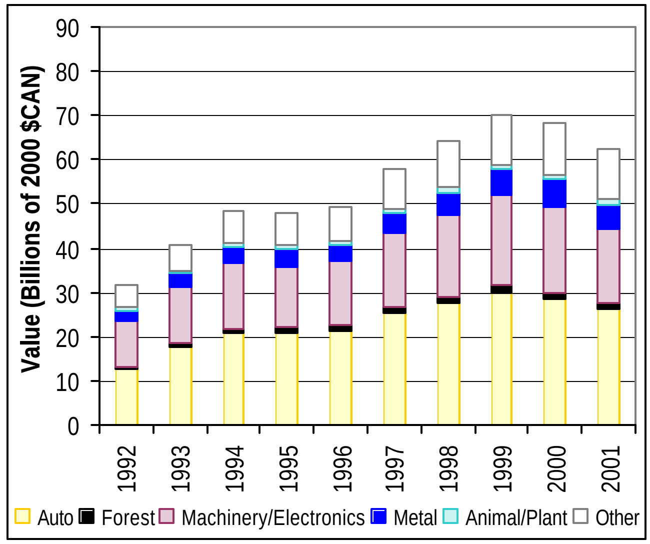
The base data and historical trend information for the border crossings are taken from customs authorities of both countries. Exhibit 5.15 shows the trend in the value of goods by each commodity group moving between Ontario and the states of Michigan, Ohio, Indiana and Illinois between 1992 and 2001. Steady growth is evident between 1992 and 2001, at which point the effects of an economic downturn and the events of 9/11 are evident. The dominance of trade in this area by the auto industry is very apparent, followed next by the machinery and electronics sector. The significance of Canada as a net exporter to the US can also be seen.

EXHIBIT 5.15: HISTORICAL TRENDS IN VALUE OF COMMODITY TRADE BETWEEN ON AND MI/OH/IN/IL, 1992-2001

CANADA TO US



US TO CANADA



Source: Industry Canada

5.6. Goods Movement Demand Forecasts

The following outlines the method used to develop forecasts of goods movement trade value, weight and traffic for the study area and present the results for the Base Case forecast.

Commodity Trade Forecasts

Data regarding commodity trade by the Detroit-Windsor and Port Huron-Sarnia ports specifically were available for 2000 from the Canada Customs and Revenue Agency, providing a complete illustration of the differing mixture of goods moving through each port by mode and direction. To illustrate the differences in trade patterns and characteristics that exist amongst the commodity groups, the following describes historical trade trends and the 2000 transport characteristics of three commodity types in terms of the value traded between Ontario and Michigan, Ohio, Indiana and Illinois between 1992 and 2001 as well as the mode, port and directional splits that occurred in 2000 at the study area crossings, respectively. It should be reiterated that the data used to determine transport characteristics is port-of-entry specific (i.e. based on data for Port Huron-Samia and Detroit-Windsor). However, as historical data by port was not available, the historical trade values shown here between Ontario and Michigan, Ohio, Indiana and Illinois are used as a proxy. This is a reasonable proxy for the trade trends through these ports, typically accounting for about two-thirds of the total value of trade. Projected growth rates, as developed from Transport Canada forecasts (Informetrica), are also presented for all commodity groups.

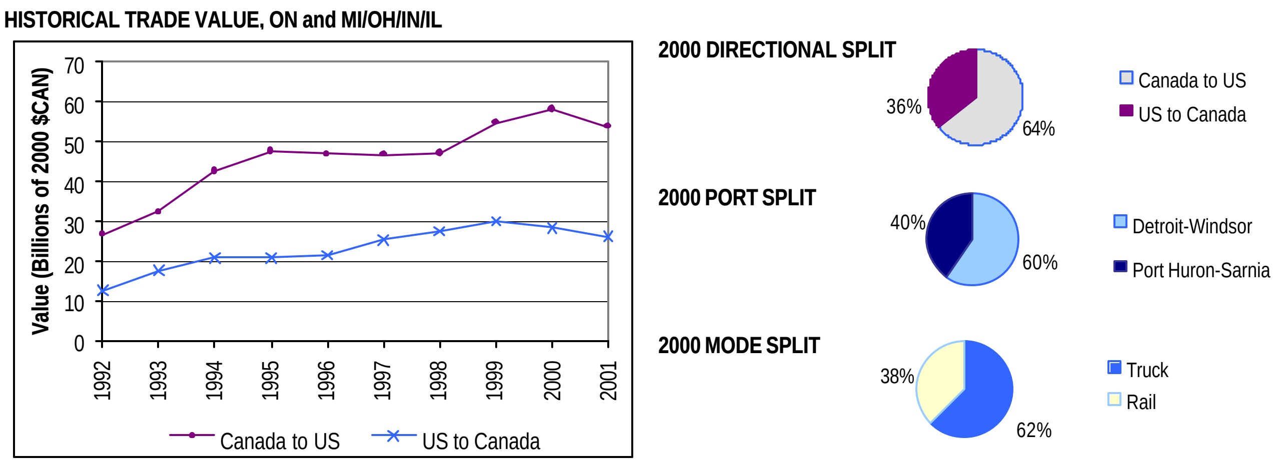
Automotive

Trade for the automotive sector is projected to grow at a lower rate than overall Canada-US trade, given competition from southern US, Mexico and Latin America for automobile manufacturing .

Automotive sector trade is presented in Exhibit 5.16. Trade growth has been high in the past decade, with total value (traded between ON and MI/OH/IN/IL) increasing 8.3% annually from 1992 to 2001. While the directional and mode splits are as expected, a surprisingly high proportion travels through Port Huron-Sarnia in relation to Detroit-Windsor. This is mainly due to the relatively large amount that is shipped from Canada to the US via rail at this crossing.

The railway tunnels at Port Huron-Sarnia have full dimensional capacity to handle high-cube traffic, some of which is containerized and moved in double-stacked trains. It is also the most direct rail route from South-western Ontario to Chicago. All four major railways use these tunnels, and the main industry sector served is automotive. The distribution of traffic between Detroit-Windsor and Port Huron-Sarnia is also a function of active competition for general merchandise traffic between CN and CPR. Historically, CN has enjoyed a larger share of the North American market and CPR is stronger in the international in-transit market. The latter traffic typically moves through the Detroit-Windsor port.

EXHIBIT 5.16: AUTO SECTOR TRADE AND TRANSPORT CHARACTERISTICS



Source: Industry Canada; CCRA

The consensus among public and private sources in general is that the automotive industry in Ontario and Michigan is on the threshold of transition. The Auto Pact has run its course, and Latin America will likely play a more significant role in production and distribution for the automotive sector. Plant closings in Canada have been announced by all major automotive companies, and distribution of production activities continues to be rationalized while the variety in the number of makes and models produced appears to be diminishing. All of this suggests that the transition is towards a short-term decline in transportation demand across the border. Once a new equilibrium is reached, then growth rates may recover.

The Transport Canada merchandise trade projections indicate that exports of finished cars will decline throughout the study horizon from Canada to the US, while US exports to Canada will show strong growth in the first decade, reduced growth in the second decade and negative growth in the period 2020 to 2030. Growth in the automotive sector will be driven by Canadian truck exports (assembled units), growing at increasing rates throughout, and vehicle parts in both directions, although there will be a shift in growth from Canadian producers to US sources.

The decline in automobile trade is consistent with population and demographic projections discussed elsewhere in this study, indicating that, over the long run, growth rates will level off. Also, there will be a shift in production away from Canadian sources.

As noted above, growth rates for the automotive and metal sectors are the same and are calculated based on an agglomeration of representative components from each sector. Given the dominance of the automotive industry in the study area, it is likely that the trade in the metal sector is composed of material destined for automotive uses. As the trade data does not make such a distinction, the two are combined to represent this interdependency. The metal sector is forecasted to grow at a much higher rate nationwide, however it represents a somewhat smaller proportion (about 15% to 20%) of both the combined value and traffic moving through the corridor. As such, growth for these two sectors is dominated by the automotive sector. These sectors are forecast at 1.9%, 2.3% and 3.1% for US imports and 1.6%, 1.9% and 1.8% for Canadian imports in each decade, respectively. Overall, this equates to increases of about 19% and 23% in trade traffic across the border for both sectors in the first two decades and 28% and 29% increases in automotive and metal over three decades, respectively.

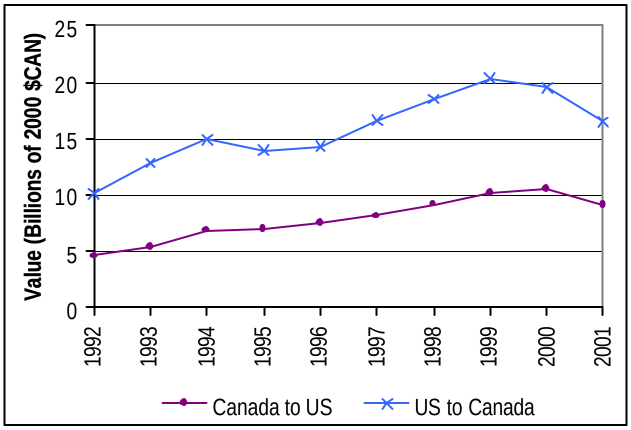
Machinery and Electronics

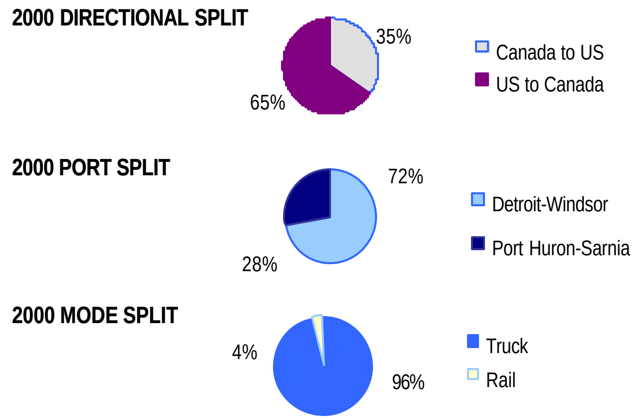
Trade and transportation characteristics of the Machinery and Electronics sector are shown in Exhibit 5.17. The dominant direction of movement is from the US into Canada via Detroit-Windsor. The vast majority is transported by truck given the delicate nature of this commodity. Total trade grew by 6.4% annually between 1992 and 2001.

This sector showed both the most dramatic growth through the 1990s and the most dramatic decline with the collapse of the high-tech sector. It is anticipated that growth will be restricted at least until major capacity additions in telecommunications networks are resumed. This depends on many factors, including overall performance of the economy and consumer behaviour patterns.

EXHIBIT 5.17: MACHINERY AND ELECTRONICS SECTOR TRADE AND TRANSPORT CHARACTERISTICS

HISTORICAL TRADE VALUE, ON and MI/OH/IN/IL





Source: Industry Canada; CCRA

The merchandise trade forecast provided by Transport Canada projects dramatic growth, meeting or exceeding GDP throughout the study. During the first decade, growth is expected to be particularly strong: US imports growing 4.4% per annum in the first two decades and 4.0% per annum growth in the third; Canadian imports growing 2.8% per annum, 3.1% per annum and 3.0%. Overall, this equates to 41%, 44% and 42% increases in trade traffic across the border for the three decades, respectively.

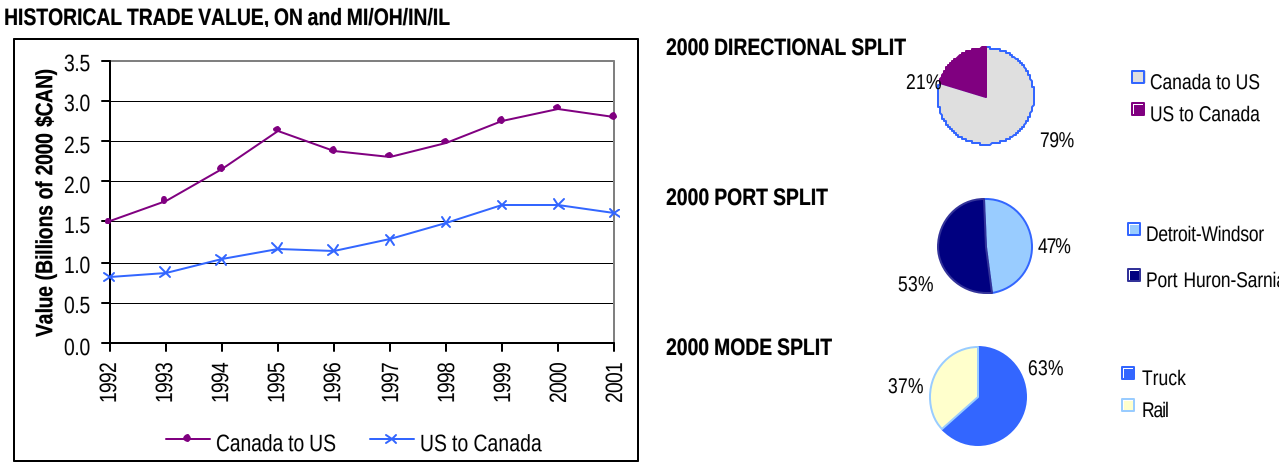
Forest

Trade characteristics of the Forest sector are presented in Exhibit 5.18. The dominance of Canadian exports to the US is evident, moved equally through each port predominately by truck. Total trade in this sector has grown by 7.4% annually since 1992.

The forest products sector includes pulp and paper, wood pulp, softwood and hardwood lumber and a variety of other product descriptions. For all of these, the dominant flow is from Canada to the United States. Pulp and paper is dominated by the newspaper industry, and it tends to move in cycles with consumer spending, driven by advertising. This part of the business is cyclical in nature, moving up and down in price and volumes. The demise of this industry has been predicted on many occasions, to be replaced by electronic communications, particularly over the Internet. Despite the dire predictions, newsprint continues to be produced and consumed.

The other large component of forest products is lumber and related products. This component experienced considerable growth recently, particularly as many participants in the market attempted to get inventories in position in the United States before the onslaught of punitive duties that, in effect, raised the price of Canadian softwood lumber by 30%.

EXHIBIT 5.18: FOREST SECTOR TRADE AND TRANSPORT CHARACTERISTICS



Source: Industry Canada; CCRA

Yet another cause for uncertainty in this sector is prospective changes in environmental legislation that could have an impact on the costs of production for pulp and paper as well as lumber products. In recent years, the industry has had to adopt new technology to keep in line with policies regarding sustainability of the environment. In the face of uncertain demand and volatile prices, some industries may shutdown rather than assume the risk of new capital investments. Such eventualities are not immediately comprehended, and a business as usual approach is assumed for the purposes of these projections.

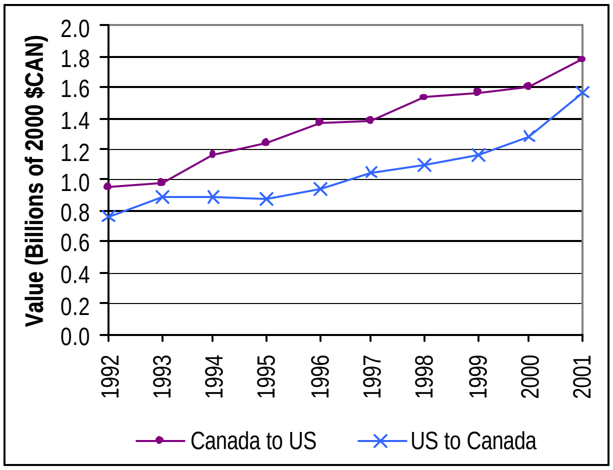
At the time of this writing, negotiations between trade representatives of Canada and the US are taking place to find a solution to this trade problem. Clearly, recent historical trend data are not very helpful in arriving at a forecast for this sector. For purposes of predicting corridor traffic, volumes of the year 2000 are held more or less constant through 2030. Actually, Transport Canada's merchandise trade forecasts predicted an overall growth of only 9%, cumulative over the study period, resulting from annual growth rates in the range of –0.1% to 0.8%. US imports are projected at 0.1%, -0.2% and 0.2% per annum, while Canadian imports are expected to be higher at 0.1%, 2.2% and 5.7% per annum in each decade, albeit from much smaller absolute values. Overall, this equates to 2%, 4% and 23% increases in trade traffic across the border for the three decades, respectively.

Remaining Commodities

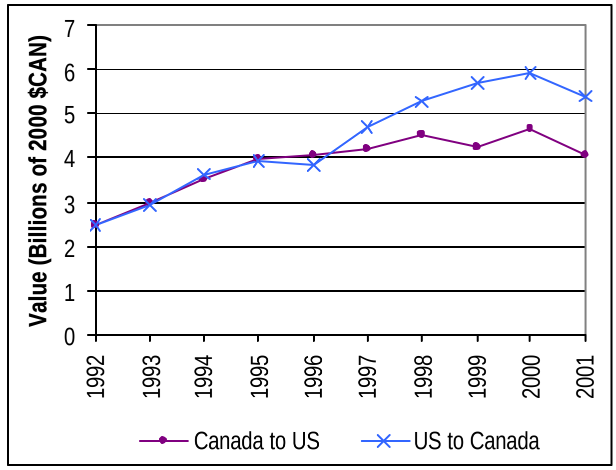
The two remaining commodity sectors consist of those with more stable trade behaviour and/or less dominant historical trade volume but that remain important as entities distinct from the 'other' category given the proportion of truck traffic that is required to facilitate their trade. The historical trade value of each is presented in Exhibit 5.19.

EXHIBIT 5.19: TRADE AND TRANSPORT CHARACTERISTICS OF REMAINING COMMODITIES

ANIMAL AND PLANT



METAL



Source: Industry Canada

The Animal and Plant sector is highly dominated by transport via the truck mode, mostly through Detroit-Windsor with a fairly even directional split. Between 1992 and 2001, this sector grew by 7.8% annually. US imports are projected at 3.6%, 3.0% and 2.6% per annum, while Canadian imports are expected to be higher at 4.9%, 3.9% and 2.9% per annum in each decade. Overall, this equates to 53%, 42% and 32% increases in trade traffic across the border for the three decades, respectively.

The Metal sector's direction of transport split is even, occurring mostly through Detroit-Windsor by truck. Total trade increased by 7.6% annually from 1992 to 2001. Again, projected trade traffic growth for this sector is the same as that for automotive.

To summarize, the projected growth for the commodity sectors shown above as well as for Other (again, consisting of chemical and petroleum products, rubber and plastics, textiles, minerals and stone/ceramic/glass) are presented in Exhibit 5.20 for each decade and trade direction. Absolute values shown represent trade via the road, rail and marine roads.

Goods Movement Forecast Methodology

The goods movement forecasting approach for truck and rail traffic estimates the combined rail/commercial vehicle goods movements between Canada and the US for 2010, 2020 and 2030 horizon years and then allocates them to the rail and commercial vehicle modes in a secondary step. For the Base Case Forecasts, a constant mode share between commercial vehicle and rail over the study horizon is assumed. As an initial step, future year commodity trade values are calculated for each port and direction for truck- and rail-transported goods, based on the growth rate projections presented in the preceding section. These growth rates are based on national projections of trade expressed in value as prepared by Informetrica (July 2002) and presented in Exhibit 5.20 by commodity group.

EXHIBIT 5.20: SUMMARY OF PROJECTED VALUE OF COMMODITY TRADE

A. DECADE ANNUAL GROWTH RATES

Commodity	2000 to 2010		2010 to 2020		2020 to 2030	
	Canada to US	US to Canada	Canada to US	US to Canada	Canada to US	US to Canada
Animal/Plant	3.6%	4.9%	3.0%	3.9%	2.6%	2.9%
Auto	1.9%	1.6%	2.3%	1.9%	3.1%	1.8%
Forest	0.1%	0.7%	-0.2%	2.2%	0.2%	5.7%
Machinery/Electronics	4.4%	2.8%	4.4%	3.1%	4.0%	3.0%
Metal	1.9%	1.6%	2.3%	1.9%	3.1%	1.8%
Other	2.7%	1.7%	4.1%	3.0%	4.5%	3.9%

B. TOTAL GROWTH FROM BASE YEAR (PERCENT)

Commodity	2000 to 2010		2000 to 2020		2000 to 2030	
	Canada to US	US to Canada	Canada to US	US to Canada	Canada to US	US to Canada
Animal/Plant	42%	62%	91%	137%	146%	216%
Auto	20%	17%	52%	41%	107%	68%
Forest	1%	7%	-2%	33%	1%	133%
Machinery/Electronics	53%	31%	135%	78%	249%	141%
Metal	20%	17%	52%	41%	107%	68%
Other	31%	18%	96%	60%	204%	135%

C. TOTAL GROWTH FROM BASE YEAR (MILLIONS OF 2000 $CAN)

Commodity	2000	2010	2020	2030	2000-2030 Growth	Percent Increase
Animal/Plant	8,792	13,452	19,036	25,070	16,278	185%
Auto	98,697	117,740	145,952	190,396	91,699	93%
Forest	9,857	10,041	10,407	12,640	2,783	28%
Machinery/Electronics	62,446	86,808	123,773	173,906	111,460	178%
Metal	18,768	22,316	27,503	35,310	16,542	88%
Other	44,180	55,192	79,023	119,963	75,783	172%
TOTAL	242,740	305,550	405,693	557,285	314,545	130%

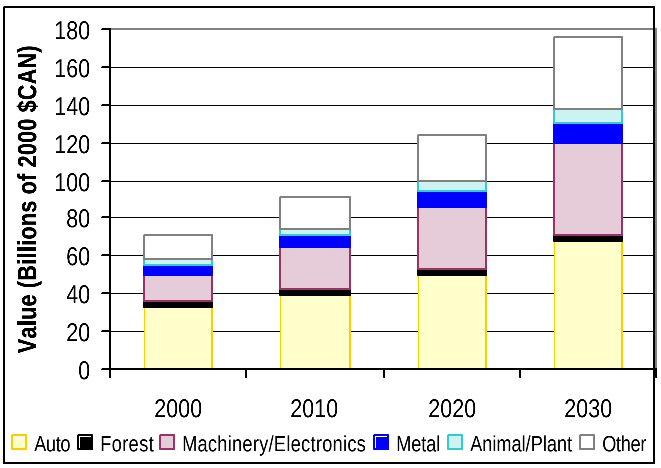
Source: Analysis of Informetrica trade forecasts

Exhibit 5.21 shows the actual (year 2000) and projected value of goods moving through each port by truck/rail by direction to 2030. These graphs indicate that Canada will continue to be a net exporter to the US over the study period. This approach allows the specific goods movement markets at each crossing to be explicitly identified in the forecasting process and reflect the commodity mix characteristics at each of the individual crossings (e.g. high automotive sector proportion in Windsor-Detroit).

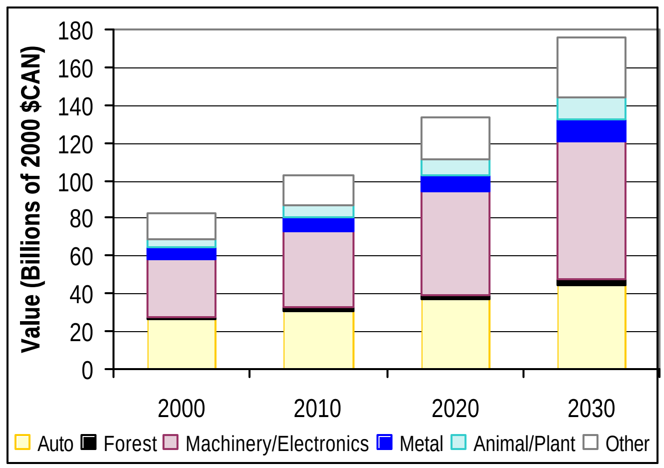
To estimate future traffic, the projected growth rates by commodity group and direction are applied to the base year annual truck volumes determined by corresponding commodity, crossing and direction categories based on annual totals and proportions observed in the NRS/MTO CVS.

EXHIBIT 5.21: ACTUAL AND PROJECTED VALUE OF COMMODITY TRADE BY PORT AND DIRECTION, 2000-2030

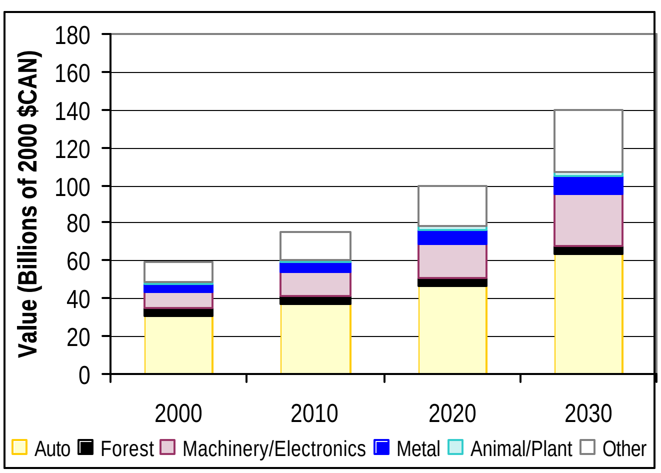
Detroit-Windsor, Canada to US



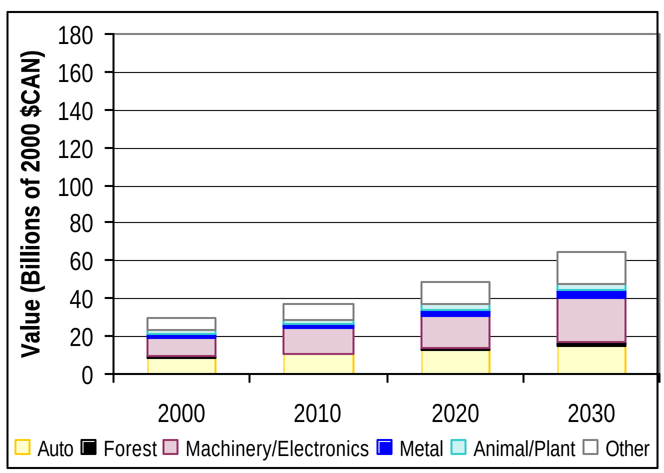
Detroit-Windsor, US to Canada



Port Huron-Sarnia, Canada to US



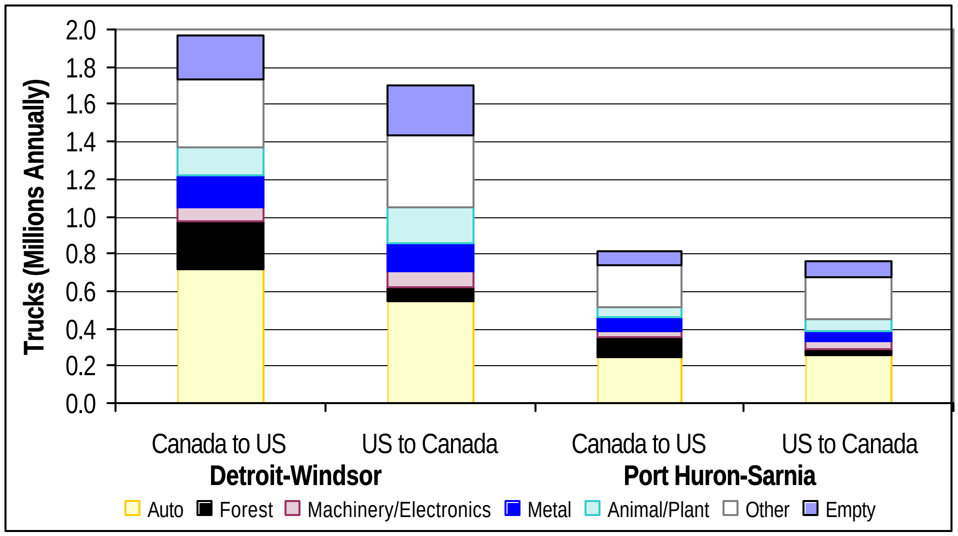
Port Huron-Sarnia, US to Canada



Source (2000 data): CCRA

Exhibit 5.22 shows the estimated number of commercial vehicles for each commodity in 2000. The future projections assume the proportion of empty vehicles and the value-to-weight relationships by commodity group remain constant over the study horizon.

EXHIBIT 5.22: ESTIMATED NUMBER OF COMMERCIAL VEHICLES BY COMMODITY, PORT AND DIRECTION, 2000



The final step is to obtain the present and future weight of goods transported over the border to provide an overall control between commercial vehicle and rail goods movement. The commodity trade values are converted into estimated weight based on the individual characteristics of each commodity grouping. The value-to-weight factors are based of data from four years (1998 to 2001) from the US BTS, the only source that provided both value and weight by commodity type (for goods imported to the US only). Averages obtained from shipments originating in Ontario and destined for Michigan, Ohio, Illinois and Indiana were taken as representative of all origins and destinations. To illustrate the value-to-weight relationships that exist, Exhibit 5.23 graphically shows the conversion of 2000 commodity trade value across the border into weight by commodity as proportions of each total. The Base Case forecasts of future weights of goods transported by rail and truck are also presented in the next sub-section. These assume no diversion of goods from truck to the rail/intermodal mode. Diversion considerations are discussed in the next chapter as sensitivity analyses.

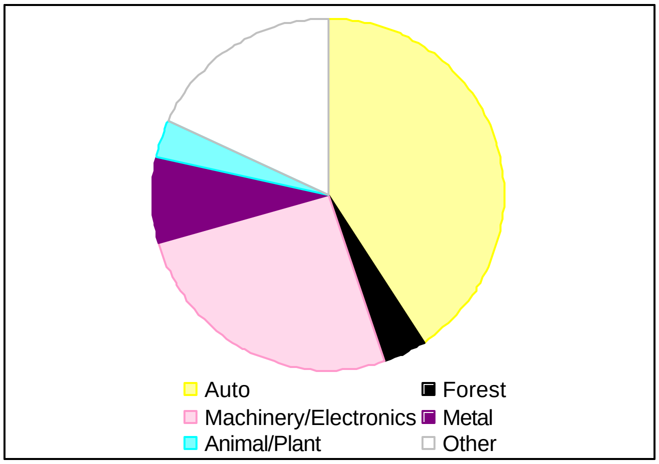
Total Goods Movement Demand

Commercial vehicle traffic between SE Michigan and SW Ontario is projected to grow by approximately 120% from approximately 5.25 million in 2000 to approximately 11.5 million in 2030.

The forecast number of commercial vehicles at each of the existing crossings for Base Case scenario is shown in Exhibit 5.24. The results show a 119% increase in traffic crossing the Southwest Ontario/Southeast Michigan border over the 30-year study period, comprised of a 122% increase at the Blue Water Bridge and a 118% increase in traffic crossing the Ambassador and Detroit-Windsor Tunnel combined. The sensitivity of these forecasts to alternative scenarios, as defined by a shift from truck to intermodal/rail transport as well as the diversion of truck traffic from Detroit-Windsor to Port Huron-Sarnia, are discussed in the next section.

EXHIBIT 5.23: COMMODITY TRADE VALUE AND WEIGHT AS PROPORTION OF TOTALS, 2000

VALUE



WEIGHT

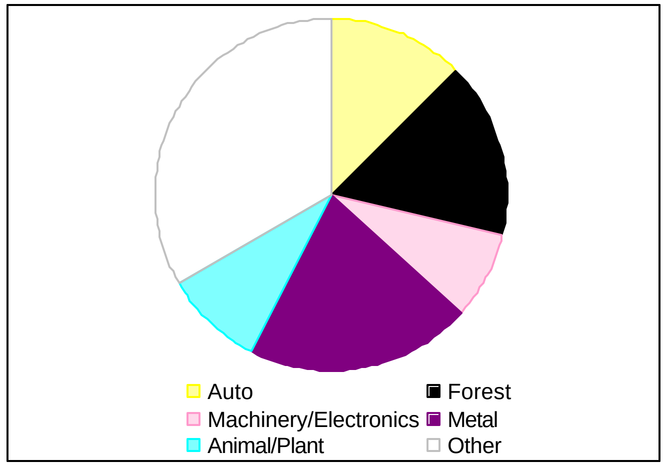


EXHIBIT 5.24: BASE CASE FORECAST ANNUAL TRUCK VOLUMES

Year		Ambassador	D-W Tunnel	Blue Water	Total
2000	Total	3,486,000	182,000	1,577,000	5,245,000
2010	Total	4,300,000	227,000	1,941,000	6,468,000
	Growth	23.3%	24.4%	23.1%	23.3%
	Avg. Annual Growth	2.12%	2.21%	2.10%	2.12%
2020	Total	5,592,000	295,000	2,546,000	8,433,000
	Growth	30.1%	30.0%	31.1%	30.4%
	Avg. Annual Growth	2.66%	2.66%	2.75%	2.69%
2030	Total	7,593,000	394,000	3,496,000	11,484,000
	Growth	35.8%	33.6%	37.3%	36.2%
	Avg. Annual Growth	3.11%	2.94%	3.22%	3.14%
2000 to 2030	Growth	118%	116%	122%	119%
	Avg. Annual Growth	2.63%	2.60%	2.69%	2.65%

Growth in the weight of goods transported by truck and rail between Southeast Michigan and Southwest Ontario for the Base Case forecast is presented in Exhibit 5.25. The growth in the amount transported by rail is 111% over the study period, due to growth in trade and the increased volume of in-transit goods movement (included here). Rail capacity of the corridor, however, is more than sufficient to accommodate this growth given moderate improvements to the existing composite facilities.

EXHIBIT 5.25: BASE CASE FORECAST ANNUAL WEIGHT OF GOODS BY TRUCK AND RAIL (TONNES)

Year		Truck	Rail
2000	Total	65,674,000	19,296,000
2010	Total	81,567,000	23,828,000
	Growth	24.2%	23.5%
	Avg. Annual Growth	2.2%	2.1%
2020	Total	108,145,000	30,516,000
	Growth	32.6%	28.1%
	Avg. Annual Growth	2.9%	2.5%
2030	Total	150,124,000	40,790,000
	Growth	38.8%	33.7%
	Avg. Annual Growth	3.3%	2.9%
2000 to 2030	Growth	129%	111%
	Avg. Annual Growth	2.8%	2.5%

The Base Case results presented above represent the expected future truck volumes and are subsequently used to determine capacity issues at each crossing. As a check of their reasonableness, these are compared to time series trend and multivariate regression forecasts in Exhibits 5.26 through 5.28.

In general, the Base Case forecasts are concave upward in comparison to the other linear projections (occurring even with the multivariate regressions). This reflects Transport Canada's (Informetrica) forecast of trade behaviour over the next 25 years, which projects a stimulus in trade volume in the latter part of the study time period. The 25-year trends are typically much lower than the 10-year trends, with the exception of the variability evident with the tunnel. This is explained by the accelerated trade growth of the last 10 to 15 years, itself related to the accelerated economic production (GDP) and drop in value of the Canadian dollar, as explained in the preceding section.

Exhibit 5.26 presents forecasts for the Ambassador Bridge. The base forecast initially shows lower growth than the 10-year trend and regression forecasts; however, the 2030 values for all three are very similar. The 25-year trend is substantially lower.

Exhibit 5.27 presents forecasts for the Detroit-Windsor Tunnel. The 10-year and 25-year trends diverge considerably, as the 10-year trend is actually negative given the substantial decline in volume over the last decade. The demand for this facility is projected to increase due to growth in trade, such that the 2030 base projection lies almost exactly in between the ranges forecasted by the other methods. However, in absolute terms the projected commercial vehicle growth is very small compared to the Ambassador Bridge.

EXHIBIT 5.26: COMMERCIAL VEHICLE FORECASTS FOR AMBASSADOR BRIDGE

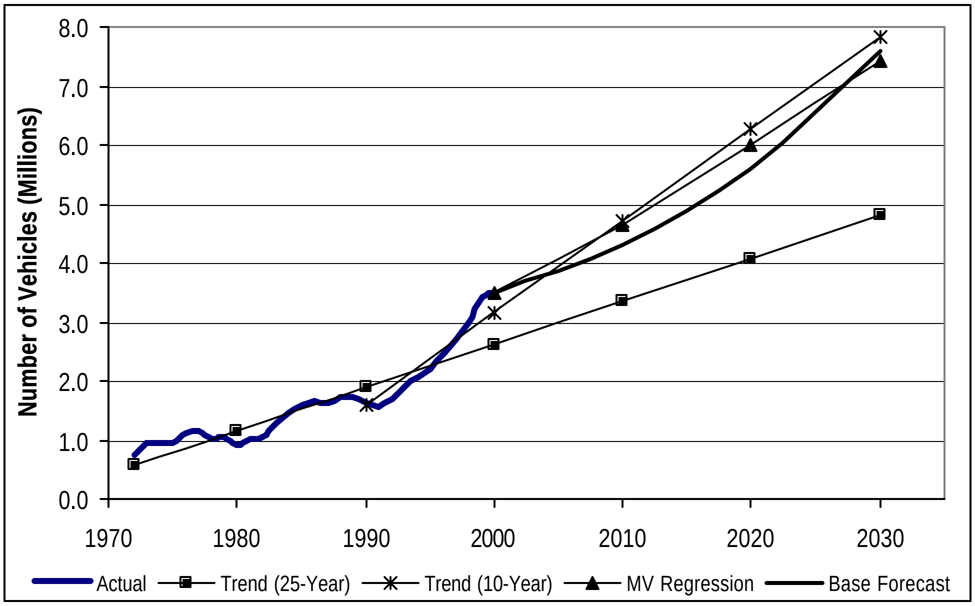
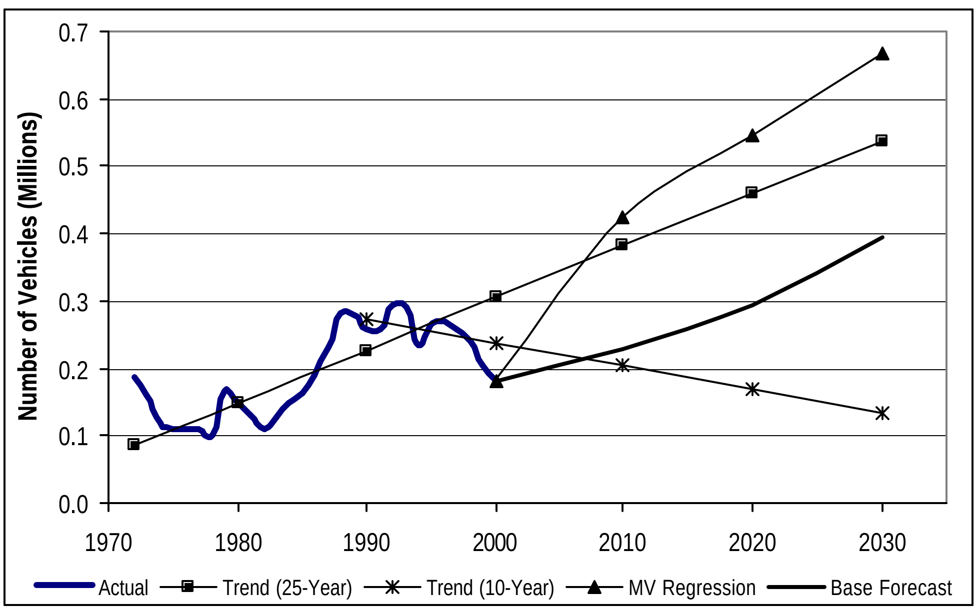
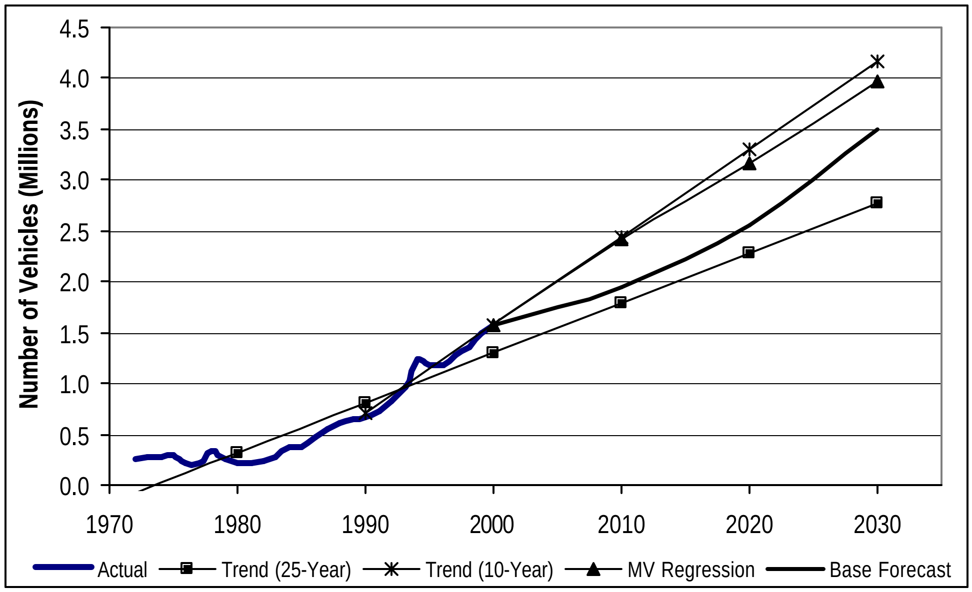


EXHIBIT 5.27: COMMERCIAL VEHICLE FORECASTS FOR DETROIT-WINDSOR TUNNEL



Finally, Exhibit 5.28 shows again that the 2030 base forecast for the Blue Water Bridge falls in between those of all other forecast methods. The 10-year trend and the multivariate regression results are very similar.

EXHIBIT 5.28: COMMERCIAL VEHICLE FORECASTS FOR BLUE WATER BRIDGE



5.7. Summary of Base Case Forecasts

Projected growth by mode for movement of people and goods between SE Michigan and SW Ontario for the Base Case forecasts:

Commercial Vehicles	*119%*
Passenger Cars	*37%*
Bus	*37%*
Rail Passenger	*37%*
Rail Freight	*111%*

An overall summary of the forecast results presented in this chapter is shown in Exhibit 5.29. In general, commercial vehicle traffic is projected to grow at substantially higher rates than passenger traffic. Passenger car traffic is forecast to increase from 21.5 million vehicles in 2000 to 29.4 million in 2030 (a 37% growth), while truck traffic is projected at 11.5 million vehicles in 2030 from a 2000 base of 5.2 million (a 119% growth). The overall result is a 53% increase in total road-based traffic over the study period.

Other recent studies by the MTO and EBTC also project traffic volumes at these border crossings. The MTO's **Southwestern Ontario Gateway Study** forecasted passenger and commercial vehicles to 2021 by developing growth rates tied to various socio-economic performance indicators. EBTC's recently released **Truck Freight Crossing the Canada-U.S. Border Study** (September 2002) looked at commercial vehicles to 2020 using time series trend analysis. Taking 2020 as a common point in time among all three studies, the range in forecast volumes by crossing and vehicle type is small for the Ambassador and Blue Water Bridges relative to the more varied results for the Detroit-Windsor Tunnel. Exhibit 5.30 compares the findings of this study to those of the MTO and EBTC.

Commercial vehicle traffic volume forecasts for 2020 are generally within 10% to 15% among all three studies for the bridge crossings and range by over 260,000 vehicles for the tunnel. This study's forecasts are higher for the Ambassador Bridge, lower for the Blue Water Bridge and in-between for the Detroit-Windsor Tunnel.

EXHIBIT 5.29: SUMMARY OF BASE CASE ANNUAL VOLUME FORECASTS (THOUSANDS)

Crossing	Vehicle Type	2000	2010	2020	2030	Overall Growth (2000-2030)	Avg. Ann. Growth (2000-2030)
Ambassador Bridge	Passenger Cars	8,734	10,313	11,598	12,525	43.4%	1.21%
	Commercial vehicles	3,486	4,300	5,592	7,593	117.8%	2.63%
	Buses	81	96	108	117	43.4%	1.21%
	Total	12,301	14,708	17,297	20,235	64.5%	1.67%
D-W Tunnel	Passenger Cars	8,368	9,322	10,007	10,749	28.4%	0.84%
	Commercial vehicles	182	227	295	394	116.6%	2.61%
	Buses	70	78	83	90	28.5%	0.84%
	Total	8,620	9,627	10,385	11,233	30.3%	0.89%
Ambassador Bridge & D-W Tunnel	Passenger Cars	17,102	19,635	21,605	23,274	36.1%	1.03%
	Commercial vehicles	3,668	4,526	5,887	7,987	117.8%	2.63%
	Buses	151	174	191	206	36.5%	1.04%
	Total	20,921	24,335	27,683	31,467	50.4%	1.37%
Blue Water Bridge	Passenger Cars	4,390	5,095	5,689	6,130	39.6%	1.12%
	Commercial vehicles	1,577	1,941	2,546	3,496	121.7%	2.69%
	Buses	10	11	13	14	39.6%	1.12%
	Total	5,977	7,048	8,247	9,640	61.3%	1.61%
SE MI/SW ON Border	Passenger Cars	21,491	24,730	27,293	29,403	36.8%	1.05%
	Commercial vehicles	5,245	6,468	8,433	11,484	118.9%	2.65%
	Buses	161	185	204	220	36.7%	1.05%
	Total	26,898	31,383	35,930	41,107	52.8%	1.42%
	Rail Weight (tonnes)	19,296	23,828	30,516	40,790	111.4%	2.53%
	Rail Passengers	105	121	133	144	36.8%	1.05%

The MTO study projects passenger vehicles to reach about 11.4 million, 12.3 million and 5.9 million annually by 2020 for the Ambassador Bridge, Detroit-Windsor Tunnel and Blue Water Bridge, respectively. These values represent 198,000 (2%), 2,293,000 (23%) and 211,000 (4%) differences in forecasts relative to this study, respectively. The large difference in the tunnel forecasts is at least partly explained by the study base years. Whereas this study used 2000 as the base year, the MTO study used 1995. At this particular point in time, traffic in the tunnel had been experiencing large growth due, in part, to casino-related trips. While there is no doubt that such traffic will continue to have a large impact on traffic volumes in this facility, it is felt that there will be a levelling-off of the growth related to this attraction. Combined with other factors, such as projected population growth in the surrounding areas, this study forecasts a more conservative growth to 2020.

EXHIBIT 5.30: COMPARISON OF BASE CASE TO OTHER STUDIES

Crossing	Actual 2000	2020			Annual Growth		
		Base Case	EBTC	SWO	Base Case	EBTC	SWO
Commercial Vehicles (Thousands)							
Ambassador Bridge	3,486	5,592	5,051	5,100	2.39%	1.87%	1.92%
D-W Tunnel	182	295	187	450	2.44%	0.14%	4.63%
Blue Water Bridge	1,577	2,546	2,944	2,750	2.42%	3.17%	2.82%
Total	5,247	8,433	8,182	8,300	2.40%	2.25%	2.32%
Passenger Cars (Thousands)							
Ambassador Bridge	8,734	11,598	N/A	11,400	1.43%	N/A	1.34%
D-W Tunnel	8,377	10,007	N/A	12,300	0.89%	N/A	1.94%
Blue Water Bridge	4,390	5,689	N/A	5,900	1.30%	N/A	1.49%
Total	21,502	27,294	N/A	29,600	1.20%	N/A	1.61%

Source: **Southwestern Ontario Gateway Study**, MTO, 1998; **Truck Freight Crossing the Canada-U.S. Border Study**, EBTC, 2002

6. Implications of Future Cross-Border Demand Estimates

6.1. Border Crossing Analysis Approach

The road-based border crossing system consists of five components:

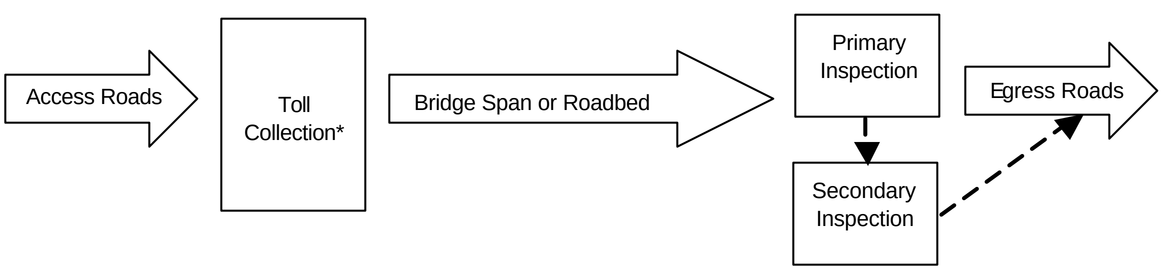
1. *Access Roads*
2. *Toll Collection*
3. *Bridge/Tunnel Roadbed*
4. *Border Processing*
5. *Egress Roads*

The lowest capacity component dictates overall throughput capacity for the crossing.

The assessment of international border crossing capacity and utilization is a complex issue as it involves unique facility requirements, with many factors influencing traffic processing capacity. There are no standardized procedures to assess border crossing capacity and traditional highway capacity approaches are not sufficient to analyze these components on their own. This is recognized in most of the literature on the topic of border crossing capacity, which itself is fairly limited and issue specific[1].

Road-based international border crossings must be considered as a system made up of individual components. The movement of vehicles across the Canada-US border involves a series of sequential activities. As illustrated in Exhibit 6.1, the border crossing system includes access roads leading to the border crossing, toll collection, the bridge span or physical crossing itself, border inspection (primary and secondary) and egress roads. Border crossing capacity is governed by the individual capacities of each of these components. The component exhibiting the lowest capacity governs the overall effective capacity of the crossing. For example, the ultimate roadbed capacity of a bridge or tunnel will not be realized if the border processing capacity or road access capacity is the limitation, or bottleneck, in the system.

EXHIBIT 6.1: THE BORDER CROSSING SYSTEM



* For the Ambassador Bridge, toll collection for all vehicles occurs on the US side of the bridge.

[1] Weissman, A. et al, Capacity Utilization of the Texas-Mexico Border Infrastructure, **Journal of the Transportation Research Forum**, 1995, pp. 119-135.

The following section examines the capacity and existing utilization of each road-based border crossing component to provide the base capacity assumptions for analysis purposes. The analysis assumes adequate staffing of all available toll and inspection booths, given the focus on planning for infrastructure needs for cross-border facilities. Discussion of the implications of inadequate staffing at these components is also provided. Where applicable, capacity utilization is expressed in terms of volume-to-capacity (v/c) ratios.

As with most transportation systems, border crossing traffic volumes are not consistent throughout the day, week or year. For the purpose of assessing utilization of existing facilities, this study focuses on peak-hour, peak-direction volumes and capacities. Separate peak hours are examined for commercial vehicles and passenger cars. The peak hour assumed for analysis purposes is discussed further in the **Travel Demand Analysis Working Paper**. Where required, peak hour assessments are translated into daily utilization rates, which is a more common comparison measure for border crossings.

6.2. Road-Based Border Crossing System Existing Conditions and Capacity

Access/Egress Roads

Road access to Windsor-Detroit crossings is currently at or nearing capacity during peak periods.

An assessment of current traffic operations on approach roads leading to and from the Ambassador Bridge, the Detroit-Windsor Tunnel and the Blue Water Bridge was provided in Chapter 3. The analysis indicated that access roads leading to the Ambassador Bridge and the Detroit-Windsor Tunnel are near capacity during peak periods and therefore only limited short-term growth in cross-border travel can be accommodated before the local road system becomes a constraint on throughput. The Blue Water Bridge is connected to freeways on both sides of the border and a high level-of-service is provided on the access roads, although delays are frequently incurred at the bridge due to border processing, as described below.

Toll Collection

The capacity of the toll collection component is a function of the number of lanes and toll collection booths and the time that is required to process each vehicle (which is dependent on how the toll is collected). In some cases, lane utilization may also impact processing capacity if all lanes are not equally accessible.

Toll collection is conducted manually and in both directions at all three Southeast Michigan/Southwest Ontario border crossings. At the time of this report, provisions for electronic toll collection utilizing transponders were being implemented at the Detroit-Windsor Tunnel and the Ambassador Bridge, but the systems were not yet in operation. All three crossing facilities offer discount tokens or commuter cards, which expedite toll processing for commuters.

Sources used to develop estimated processing times on which to base toll processing capacity included the following:

- **St. Clair and Detroit Rivers International Crossings Study**, prepared for the Ontario Ministry of Transportation, Michigan Department of Transportation and Transport Canada, June 1990.
- **Canada/U.S. International Border Crossing Infrastructure Study**, prepared for Transport Canada, February 1998.
- Informal on-site surveys.

Based on a review of the two reports and spot surveys/observations at toll booths, toll processing times of 8 seconds per car and 35 seconds per truck were adopted for all facilities. These values represent average values and vary depending on the mix of traffic (e.g. percentage of frequent travellers) and other factors.

Exhibit 6.2 summarizes the estimated capacities for tolling facilities at each of the crossings by direction and the associated utilization rates based on the specific peak hours for passenger car and commercial vehicle traffic. At present, the toll collection facilities are able to accommodate peak demands, although truck movements to the US at the Blue Water Bridge and to Canada at the Ambassador Bridge which is currently at capacity based on a toll processing time of 35 seconds.

EXHIBIT 6.2: ASSESSMENT OF EXISTING (2000) TOLL COLLECTION CAPACITY

Facility	Number of Booths	Processing Time (s/veh)	Capacity (veh/h)	Peak Demand (veh/h)	V/C Ratio	Period
Ambassador Bridge						
Autos to US	12	8	5,400	1,236	69%	AM Peak
Autos to CAN	7	8	3,150	1,616	51%	PM Peak
Trucks to US	6	35	611	357	58%	Mid-Day
Trucks to CAN	4	35	411	415	101%	Mid-Day
Detroit-Windsor Tunnel						
Autos to US	6	8	2,700	965	36%	AM Peak
Autos to CAN	5	8	2,250	1,226	54%	PM Peak
Trucks to US	1	35	103	40	39%	Mid-Day
Trucks to CAN	3	35	309	44	14%	Mid-Day
Blue Water Bridge						
Autos to US	6	8	2,700	610	23%	AM Peak
Autos to CAN	6	8	2,700	711	26%	PM Peak
Trucks to US	2	35	206	207	100%	Mid-Day
Trucks to CAN	2	35	206	177	86%	Mid-Day

With the introduction of electronic tolling, the capacity of the toll facilities should be improved considerably. The impact of electronic tolling will depend on the extent to which the public adopts the transponder technology and the reductions (if any) in manual toll collection capacity that are required to facilitate the electronic toll collection.

As discussed above, electronic toll collection is being implemented for the Detroit-Windsor crossings and will utilize a transponder technology. This will allow vehicles equipped with transponders to proceed through the toll booths with minimal delay. There are currently no readily available estimates on the potential uptake of transponders; however, it is expected that the majority of commuters and very frequent cross-border travellers will use the technology. In addition, there are initial discussions among the bridge and tunnel operators to implement a one-way tolling approach to improve efficiency and reduce collection costs. In this system, a return trip toll would be collected, with an equitable revenue distribution/sharing agreement set-up among the bridge and tunnel operators. Such a system has recently been instituted in the Niagara Region.

At present, the capacity of toll collection facilities is equal to or greater than that of border processing and thus toll collection does not represent a bottleneck in the current border crossing system. Given the expected future processing time benefits of electronic toll collection and the possibility of one-way tolling in the future, it is assumed that toll collection will not be a future constraint to cross-border system capacity and that the appropriate bridge/tunnel operators will make the necessary improvements to ensure that the revenue stream generated by cross-border traffic is not compromised by insufficient toll collection capacity.

Roadbed Capacity

There is available roadbed capacity on the bridges and tunnel to accommodate higher traffic levels.

The roadbed capacity refers to the physical capacity of the bridge or tunnel structure. Given the unique physical, traffic use and vehicle mix characteristics of international bridge and tunnel crossings, standardized traffic engineering techniques do not exist for these types of facilities. An accurate figure for the roadbed capacity of an international bridge is also complicated since border processing and/or access road capacity is often the bottleneck, thereby restricting the true roadbed capacity of the bridge to be realized.

In previous studies, highway capacity methods have been adopted to estimate roadbed capacity for an international bridge, most notably in the 1990 report by the MTO, MDOT and Transport Canada[2], which provided roadbed capacity estimates for the Ambassador Bridge, Detroit-Windsor Tunnel and Blue Water Bridge. The capacities presented in that report were calculated using the 1985 Highway Capacity Manual (HCM) procedures.

For this report, roadbed capacity estimates for the three crossings have been updated using HCM 2000 procedures, reflecting changes in car/truck composition and the recent widening of the Blue Water Bridge. These capacities are based on level-of-service E and are presented in passenger car equivalents (PCEs) for each crossing in Exhibit 6.3. The

[2] **St. Clair and Detroit Rivers International Crossings Study**, Ontario Ministry of Transportation, Michigan Department of Transportation and Transport Canada, Final Report, June 1990.

roadway capacity is defined 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. The capacities reflect existing lane configurations (e.g. width, lateral clearance, gradient, etc.).

EXHIBIT 6.3: ASSESSMENT OF EXISTING (2000) ROADBED CAPACITY

Results	Ambassador Bridge	Detroit-Windsor Tunnel	Blue Water Bridge
Estimated Daily Capacity (PCE/day)	87,000	33,000	141,000
Peak Hour Capacity (PCE/h/lane)	1,750	1,500	1,900
Number of Lanes (1-way)	2	1	3
One-Way Capacity (PCE/h)	3,500	1,500	5,700
Peak Hour Demand (2000)			
Autos	1,616	1,226	711
Commercial Vehicles	309	11	186
Peak Hour Total PCEs (1)	2,543	1,259	1,269
Peak Hour Volume/Capacity Ratio (2)	0.73	0.84	0.22

(1) Based on PCE factor of 3.0 for commercial vehicles.
(2) Based on peak hour, peak direction demands.

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 methods, heavy vehicles are factored into the level-of-service analysis by expressing heavy vehicles as PCEs. The HCM 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) grade at 4.5% (typical of the Ambassador Bridge), the recommended passenger car equivalent for commercial vehicles is 2.0.

A limitation of the HCM 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 Signalized 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. To verify the roadbed 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 capacity estimates are slightly lower than observed capacities, but very reasonable.

Based on the above approach and on-site observations, the peak hour capacity is estimated to be 1,750 PCE/h/lane for the Ambassador Bridge, 1,500 for the Detroit-

Windsor Tunnel and 1,900 for the Blue Water Bridge. Roadbed capacity may also be expressed in terms of daily capacity as this provides a simple picture of existing and future deficiencies for the roadbed capacity of the bridge or tunnel and provides a more suitable basis for determining future capacity needs and deficiencies. The daily capacities were estimated by factoring the peak hour roadbed capacity to reflect a daily total based on an assumed design hour volume percentage (DHV%), as typically employed in traffic engineering. The DHV% is the percentage of daily two-way traffic that travels in the peak one-hour.

The DHV% calculated for the three facilities are very low, with approximately 5% to 7% of the daily traffic occurring in the peak hour. This indicates a very high utilization of the crossings during off-peak periods and suggests there is very little or no opportunity for peak period traffic to spread to off-peak periods when available capacity could be used. This compares to an approximate 10% DHV% that is typically used for design capacity purposes for highways in major urban areas. Consequently, existing DHV% calculated for each bridge/tunnel was used to determine the respective daily capacity estimates.

Exhibit 6.3 also provides an estimate of the v/c ratio for each crossing facility during the peak hour in the peak month and based on available August 2000 data. The v/c ratio for the Ambassador Bridge is 0.72, indicating that the bridge is capable of carrying an additional 40% more vehicles in the peak hour before the roadbed capacity of the bridge is reached. The Detroit-Windsor Tunnel has a v/c ratio of 0.85, although traffic levels have decreased significantly on this facility post-9/11. The Blue Water Bridge is well under capacity with a v/c ratio of 0.22.

Border Processing

Border processing is at or near capacity at all three crossings on both sides of the border.

Queues and delays have been exacerbated by recent major staffing shortages at US Customs and Immigrations.

Border processing includes customs and immigration inspection on entry to Canada and to the US. Upon entry into the US, vehicles are required to stop at the primary inspection booths where customs and immigration inspectors perform checks on the vehicle and driver. Individuals requiring further questioning by either customs or immigration officials are directed to secondary inspection. The same general procedure occurs for vehicles and drivers entering Canada, with the exception that primary inspection is carried out by customs officials.

As with the toll collection system, the capacity of border inspection is a function of the number of lanes and booths and the processing time per vehicle. There is a high degree of variability in processing times depending on the circumstances of the driver and any passengers and nature of the contents of goods within the vehicle.

As part of this study, a considerable effort was placed on developing accurate estimates for border processing times and corresponding capacity. Meetings were held with the Canada Customs and Revenue Agency (CCRA), US Customs Service (USCS) and US Immigration and Naturalization Service (INS). Discussions were also held with the Canadian Transit Corporation (Ambassador Bridge), the Detroit-Windsor Tunnel Corporation and the Blue Water Bridge Authority. Information from these sources was supplemented with actual on-site measurements of processing times for both passenger cars and commercial vehicles. As well, previous reports, as referenced under the preceding sub-section, were used for comparative purposes, recognizing that conditions have changed somewhat since their publication.

To reflect conditions that existed in August 2000, corresponding to the base year data for this study, border processing times of 20 to 25 seconds per car at primary inspection have been estimated for automobiles entering Canada and entering the US during peak weekday periods. Discussions with US customs and immigration and Canadian customs officials indicate that since 9/11 processing times have been higher; reflecting additional security checks that are now necessary. During the period of heightened security levels immediately following 9/11 and for the following year, border processing times increased significantly, particularly for travel into the US. The US National Guard also provided additional security at border entry points until September 26, 2002. Border processing rates have since returned closer to the pre-9/11 rates, with estimated processing times per car estimated to be 33 seconds for entry into Canada and 30 seconds to the United States, based on discussions with customs and immigration officials and verified through on-site observations. These rates reflect normal conditions although it is likely that higher alert levels could double processing times and extend over several weeks. Since 9/11, higher alert levels have been instituted on two occasions.

For commercial vehicles, processing times are dependent on whether the driver has the appropriate documentation and whether the vehicle and driver are enrolled in a streamlined commercial clearance process, which allows customs to review information before the goods arrive. Required documentation generally consists of a “bill of lading” (including the waybill), certification of goods (including origin and destination of goods), commercial information (including the name of the shipper and receiver) and driver information.

Most commercial vehicle operators use the Pre-Arrival Review System (PARS), which allows pre-approved shippers/carriers to transmit documents electronically to customs in advance of arrival at the border to expedite customs processing. At present, about 75% of the commercial vehicles passing through Canada Customs at Windsor are using PARS. Another program in place is the FIRST program, which covers low-risk commodities such as aggregates.

Based on available information and insights, average processing times for primary inspection of trucks of 75 seconds and 80 seconds were applied for trucks entering Canada and trucks entering the US, respectively. These processing times allow approximately 20 seconds for stopping and starting of the vehicle at the inspection booth.

Processing times for commercial vehicles can vary significantly depending on the system that is being used to identify the goods shipped (e.g. bar-code system, transponder, paper) and the nature of the goods. Based on spot surveys carried out by the study team, processing times for commercial vehicles at primary inspection facilities at the Ambassador Bridge varied from as low as 5 seconds face-to-face time to more than 1.5 minutes, with an average processing times of 40 to 50 seconds per truck.

Vehicles requiring further processing are sent to secondary inspection. The capacity of secondary inspection facilities for passenger cars and commercial vehicles has an indirect impact on border crossing capacity. When operating within capacity, secondary inspection does not impact the general flow of traffic. However, if secondary inspection requirements exceed capacity, queues can extend back to the mainline and disrupt traffic flow. The capacity of secondary inspection is based on processing times as well as storage requirements. Estimates of average secondary inspection times range from 45 to 65 minutes. Currently, limited capacity at secondary inspection can affect operations for US bound traffic at the Ambassador and Blue Water Bridges during peak periods.

Demand and capacity of secondary inspection are also based on the percentage of commercial vehicles that are diverted from primary inspection. It is estimated that diversion rates for commercial vehicles entering Canada are 20%, 40% and 12% for the Ambassador Bridge, Detroit-Windsor Tunnel and Blue Water Bridge, respectively. Similar estimates are used for commercial vehicles entering the US. At present, Canadian secondary inspection for the Ambassador Bridge occurs at an off-site facility; vehicles use local streets to access this facility. Normally, secondary inspection activities do not affect main line capacity and are not discussed further in this section. This carries the implicit assumption that secondary inspection can be sized and staffed adequately.

Exhibit 6.4 summarizes the estimated processing rates and existing facilities inventory, which is used to determine existing 2000 border processing capacity for customs and immigration activities. The resulting capacity and volume-to-capacity ratios are also shown. Since these capacities assume full-staffing and efficient operation, the estimates reflect a best-case scenario. Recently, staffing shortages, particularly at US customs and immigration, have limited the ability to provide desired staffing levels during peak periods, resulting in border processing delays. However, for long-term infrastructure planning purposes, it is assumed that all booths could be staffed if necessary. It should be stressed that processing times are highly variable and the average times shown here may vary by time of day, season and other factors such as terrorism alert levels.

Based on existing (2000) conditions, Canadian border inspection is operating at over capacity for passenger cars entering Canada at the Ambassador Bridge during the PM peak period. Over capacity conditions translate to lengthy queues, as more vehicles arrive than can be processed during the peak hour. Based on discussions with Canada customs officials and visual observations, over capacity conditions have continued into 2002, with lower crossing volumes since 2000 offset by the higher processing times reflecting post 9/11 conditions. Similarly, Canadian border inspection is at or nearing capacity for passenger cars entering Canada at the Detroit-Windsor Tunnel during peak conditions and also for commercial vehicles entering Canada at the Ambassador Bridge.

EXHIBIT 6.4: ASSESSMENT OF EXISTING (2000) BORDER PROCESSING CAPACITY

Facility	Number of Booths	Processing Time (s/veh)	Capacity (veh/h)	Peak Demand (veh/h)	V/C Ratio	Period
Ambassador Bridge						
Autos to US	12	30	1,440	1,236	86%	AM Peak
Autos to CAN	10	25/33*	1,440	1,616	112%	PM Peak
Trucks to US	6**	80	270	357	132%	Mid-Day
Trucks to CAN	10	75	480	415	86%	Mid-Day
Detroit-Windsor Tunnel						
Autos to US	9	30	1,080	965	89%	AM Peak
Autos to CAN	9	25	1,296	1,226	95%	PM Peak
Trucks to US	3	80	135	40	30%	Mid-Day
Trucks to CAN	2	75	96	44	46%	Mid-Day
Blue Water Bridge						
Autos to US	8	30	960	610	64%	AM Peak
Autos to CAN	12	25	1,728	711	41%	PM Peak
Trucks to US	5	80	240	207	86%	Mid-Day
Trucks to CAN	7	75	360	177	53%	Mid-Day

* Pre 9/11 and Year 2000 processing times estimated at 25 seconds; 33 seconds is assumed for 2002 and future horizon years.

** The number of truck inspection booths was increased from 6 to 9 in September 2002.

For travel to the US, border processing is at capacity for commercial vehicle traffic crossing at the Ambassador Bridge. In 2000, six primary inspection booths were operated for commercial vehicles, resulting in extensive delays and queuing. Border staffing shortages post 9/11 further exacerbated the capacity deficiency with individual vehicles enduring delays of several hours during peak conditions and excessive vehicle queues on Huron Church Road in Canada. In September 2002, three additional commercial vehicle inspection booths were opened, which have greatly improved conditions. However, commercial vehicle inspection at the Ambassador Bridge is still believed to be at or near capacity based on visual observations and discussions with US customs officials.

Border processing operations are also nearing capacity for commercial vehicle traffic entering the US at the Blue Water Bridge and for passenger car traffic at the Detroit-Windsor Tunnel. Studies to improve the border inspection plazas have been initiated at both locations.

There are currently several initiatives that are being implemented or will be implemented to help expedite travellers or commercial vehicle movements between Canada and the US. These initiatives intend to provide faster clearance to low-risk travellers and to provide streamlined commercial clearance processes. The major initiatives are discussed below with an assessment of how they might improve border processing capacity.

CANPASS initiatives began in 1995 and included measures to expedite border crossings at selected locations for entry into Canada. CANPASS was discontinued following September 11, 2001 for security reasons, but was in place during the survey data collection, which provides the base year data for this study. It is also the precursor to NEXUS, as described below. CANPASS participants were pre-approved through a series of background checks and received a CANPASS highway package including a vehicle decal. Travellers displaying the decal while entering Canada at specified border crossings proceeded through primary inspection generally without being questioned by a customs or immigration officer, but with a random sample being questioned. CANPASS participants who made purchases out of the country had the option of stopping at the customs office to pay duty and taxes owing or completing a traveller declaration card, which they remitted as they drove through customs. Separate CANPASS lanes were provided for vehicles entering Canada. CANPASS was only available for travel into Canada and did not affect the Canada-to-US movement.

The **NEXUS** program is designed to simplify border crossings for pre-approved, low-risk travellers. It is a joint program implemented by the Canada Customs and Revenue Agency, Citizenship and Immigration Canada (CIC), the United States Customs Service, and the United States Immigration and Naturalization Service. NEXUS applies to travel in both directions. NEXUS is currently implemented at the Sarnia/Port Huron border crossing and will be expanded to include both the Ambassador Bridge and the Detroit-Windsor Tunnel by March 2003. As with CANPASS, NEXUS pass holders will use dedicated lanes at border crossings (where feasible), and are not regularly subject to the usual customs and immigration questioning. The NEXUS pass utilizes a proximity card technology. When drivers swipe their card near the reader, a photo identification of the driver is displayed to the border inspection officer. The officer then verifies the photo and driver and provides approval to proceed. It is estimated that the processing time for NEXUS vehicles, including stop-start time, will take approximately 10 to 15 seconds on average.

Although there is a fee for NEXUS users ($80 Canadian or $50 US per applicant every five years), the time saving offered by the program could be attractive for frequent travellers, particularly at the Windsor-Detroit locations where a large portion of trips are by daily commuters. It is estimated that up to 50% of daily commute trips would use NEXUS, assuming that priority access/queue jumping to the NEXUS booth is provided at the bridge or tunnel. If priority access is not provided, or the NEXUS lanes are inaccessible because of queuing of other vehicles, the uptake on NEXUS will be reduced as people may not gain enough travel time savings to out-weigh the program fee and application process. The lack of continuous dedicated lanes was cited as a possible limitation on the success of CANPASS, which was utilized by only a small portion of total border crossing traffic.

For the purpose of estimating future border crossing capacities presented later in this chapter, an average processing time of 33 seconds per passenger car is assumed for post 9/11 conditions for regular vehicles and 15 seconds for NEXUS vehicles, with 25% of the peak hour traffic assumed to be enrolled in the NEXUS program based on the trip purpose breakdown. Given this NEXUS participation level, the weighted average processing time is 30 seconds for passenger cars.

The Free and Secure Transport (**FAST**) program is an extension of existing programs such as Pre Arrival Review System (PARS), Customs-Trade Partnership against Terrorism (C-TPAT) and FIRST, which are in place to streamline goods movement at Canada-US border crossings for low-risk, pre-approved importers. The intent is to increase the security of goods while improving the flow of trade. Under this program, businesses must conduct comprehensive self-assessments of their supply chain using the security guidelines established by customs and must provide customs relevant information about their trucks, drivers, cargo, suppliers and routes. Once qualified, companies are eligible for expedited processing and reduced inspection. Hence, for low-risk goods being imported by a pre-authorized importer, a pre-authorized carrier and a registered driver, the pre-authorized carrier will provide customs with an electronic transmission with the shipment data in advance of the arrival at the border. When the shipment arrives at the border, it will be processed through a dedicated lane where the driver will present his registration card and, using bar code or transponder technology, identify the shipment.

It is estimated that average inspection times for FAST would be approximately 35 seconds per commercial vehicle, or 50 seconds including stop and start time. This compares to 75 to 80 seconds for commercial vehicles during present operations. It is estimated that approximately 60% of commercial vehicles will convert to the FAST system, most of which are already enrolled in the PARS program. This corresponds to a weighted average processing time of 60 seconds per commercial vehicle at primary inspection, based on the above assumptions regarding FAST.

Summary of Existing (2000) Peak Hour Capacity Utilization

Exhibit 6.5 provides a summary of the estimated capacity and utilization for the border crossing system components at the crossing itself (access roads, tolls, roadbed and border processing). It is based on the parameters described above and compares these to peak hour demand in August 2000.

Taking all border crossing system components into consideration, border processing capacity has been the limiting factor that has resulted in recurring delays and queues extending back from the Ambassador Bridge, Detroit-Windsor Tunnel and Blue Water Bridge. Most notably, extensive queues have been observed for commercial vehicle travel to the United States during the mid-day peak period and passenger car travel to Canada in the afternoon peak period, where demand consistently exceeds border processing capacity.

Further, the actual throughput realized through customs and immigration has been much lower than the theoretical capacity noted above, given staffing shortages, particularly for travel to the US. This shortage has not allowed all inspection booths to be in operation during peak periods in spite of high demand levels and resulting queues. Recent initiatives have addressed the staffing shortages, as evidenced by the opening of three new commercial vehicle inspection booths in September 2002 at the Ambassador Bridge.

EXHIBIT 6.5: ASSESSMENT OF EXISTING (2000) CAPACITY

Crossing	Existing (2000) Conditions				
	US Road Access	**US Border Processing**	**Bridge/Tunnel Roadbed**	**Can Border Processing**	**Can Road Access**
Ambassador Bridge	Near Capacity	At Capacity	Adequate	At Capacity	Near Capacity
Detroit-Windsor Tunnel	Near Capacity	Near Capacity	Adequate	At Capacity	Near Capacity
Blue Water Bridge	Adequate	Near Capacity	Adequate	Near Capacity	Adequate

In terms of the actual roadbed capacity of the bridges and tunnel, all facilities are presently operating under capacity and would be capable of accommodating additional traffic if the access road/toll collection/border processing system could feed or take traffic from the bridge or tunnel facility at a higher rate than presently possible.

6.3. Assessment of Future Base Case

The following sections examine the implications of future demand, as described by the Base Case forecast presented in Chapter 5. This is completed for each border crossing system component, consisting of:

- access/egress roads;
- toll collection;
- roadbed; and
- border processing.

Results are presented for the future Base Case, which is characterized by a continuation of existing modal trends and reflecting future population and employment growth, as documented in available municipal, state/provincial forecasts, and reflecting documented sources for economic growth and trade between the US and Canada. The Base Case therefore represents a business-as-usual scenario and therefore assumes no major policy changes, major economic events, fuel shortages or other unforeseen circumstances that could significantly affect cross-border travel. The possibility of shifts in routing or mode to off-load portions of the transportation system that are projected to experience capacity deficiencies are presented as part of the sensitivity analyses in the following section.

Future Base Case Capacity Analysis

The capacity implications of the projected demand for commercial vehicle and passenger car travel were assessed using the same techniques as were presented for existing conditions in the previous section. Exhibit 6.6 provides an overview of future access road operations based on the Synchro traffic model, which estimates level-of-service at intersections using HCM procedures. Volumes used in the assessment of access road capacity include both the future background traffic as well as border crossing traffic based on traffic forecasts developed for 2010, 2020 and 2030 horizon years.

Exhibit 6.7 shows the impact of the Base Case forecast on toll collection, roadbed and border processing components of the border crossing system, expressed in terms of the v/c ratio for travel during the 2030 peak hour. Among the three components indicated, roadbed capacity is the most critical, as any improvement involves a major capital expenditure involving hundreds of millions of dollars. As discussed previously, toll collection is not assumed to be a capacity constraint in the future, given the direction toward electronic tolling and the relative ease to increase toll collection capacity. Therefore, no future toll collection capacity analyses are presented in the table.

Border processing capacity calculations are based on the number of booths that exist in 2002, reflecting that are no current committed plans to increase this number, although various proposals have been put forward to address a known future need for additional border processing capacity. Customs and immigration officials have indicated that they will continue to respond to future cross-border needs. The extent of the growth and v/c ratio presented is indicative of the amount of additional future capacity that will be required in the future and provide a basis for determining future sizing of custom and immigration facility areas.

The implications with respect to utilization and capacity deficiencies are discussed below for the Ambassador Bridge, Detroit-Windsor Tunnel and Blue Water Bridge.

EXHIBIT 6.6: ACCESS ROAD LEVEL-OF-SERVICE IN WINDSOR-DETROIT, 2030

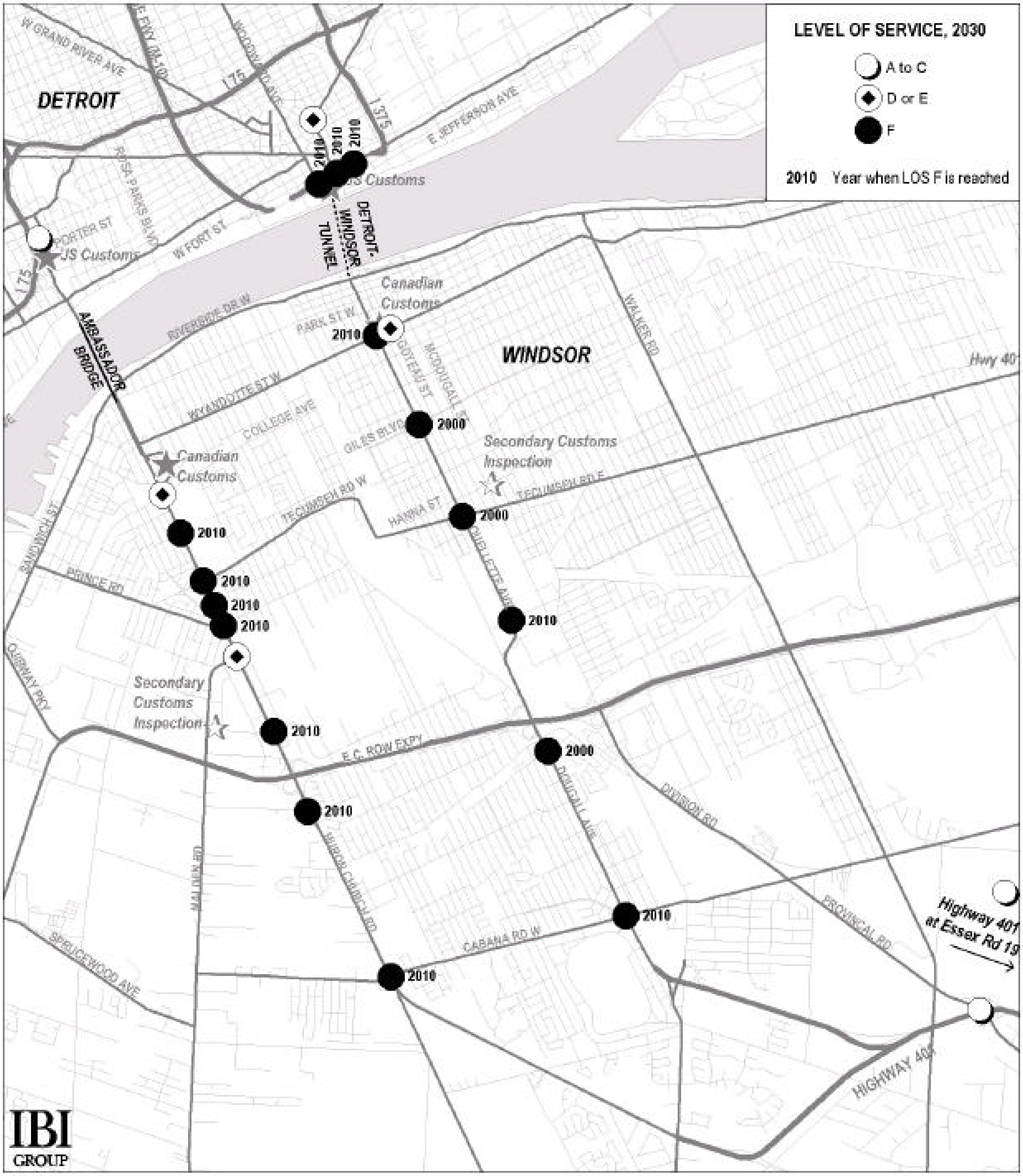


EXHIBIT 6.7: EXISTING AND FUTURE BASE CASE VOLUME/CAPACITY (PEAK DIRECTION)

Component	Ambassador Bridge	Detroit-Windsor Tunnel	Blue Water Bridge
Existing (2000)			
Access Road			
US	Near Capacity	Near Capacity	Adequate
Canada	Near Capacity	Near Capacity	Adequate
Toll Collection			
Autos	69%	54%	26%
Commercial Vehicles	101%	39%	100%
Roadbed			
Truck Lane	71%	-	-
Cars and Trucks (PCE)	73%	84%	22%
Border Processing			
Passenger Cars	112%	95%	64%
Commercial Vehicles	132%*	46%	86%
Projected (2030)			
Access Road			
US	Adequate**	Over Capacity	Adequate
Canada	Over Capacity	Over Capacity	Adequate
Toll Collection			
Passenger Cars	Adequate	Adequate	Adequate
Commercial Vehicles	Adequate	Adequate	Adequate
Roadbed			
Truck Lane	153%	-	-
Cars & Trucks (PCE)	135%	115%	41%
Border Processing			
Passenger Cars	193%	146%	89%
Commercial Vehicles	148%	79%	159%

Note: Component with highest volume-to-capacity ratio governs capacity for downstream components.
* Reflects 6 US truck inspection booths in 2000, which was increased to 9 in September 2002.
** Assumes Ambassador Bridge Gateway Project is completed.

Ambassador Bridge capacity is projected to be reached, within the following time frames:

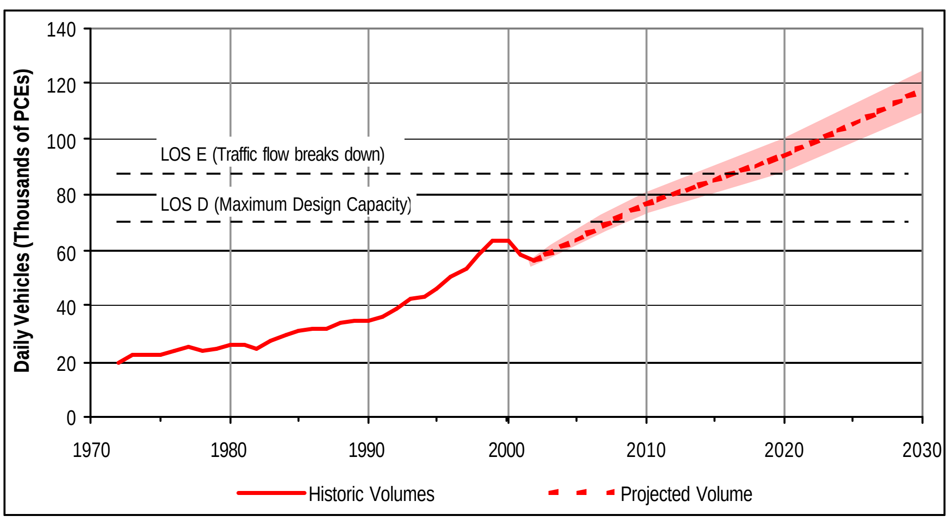
Access Roads	*< 5 yrs*
Roadbed	*10-15 yrs*
Border Processing	*< 5 yrs*

Ambassador Bridge

Access roads to the Ambassador Bridge are presently nearing capacity, with most of the intersections along Huron Church Road approaching capacity and several movements at critical levels. Through improvements to signal timing and other traffic management strategies, some additional capacity may be gained. However, increases in border crossing traffic, combined with modest growth in background traffic, will mean that Huron Church Road will likely exceed capacity within 5 years. On the US side, the major access road constraints are those to the freeway system. Ouellette Avenue will also exceed capacity, although it serves a primary local road function in addition to providing access to the Detroit-Windsor Tunnel. Without improvements, these access links will become significant constraints in the future. The Ambassador Bridge Gateway Project, which is committed for construction, will solve access problems between the Interstate highway/system and the Ambassador Bridge in Detroit, and should provide adequate capacity beyond 30 years.

At present, the roadbed capacity of the Ambassador Bridge is sufficient to handle typical peak hour demands. On a combined basis, the theoretical daily capacity of the Ambassador Bridge in passenger car equivalents is approximately 87,000. Compared to the current PCE demand of 63,000, this translates into a daily v/c ratio of 73%. Exhibit 6.8 examines the future roadbed capacity for the Ambassador Bridge, illustrating the relationship between future daily demand and infrastructure capacity. Based on combined passenger car and commercial vehicle traffic expressed on a PCE basis, the Ambassador Bridge roadbed is expected to reach capacity in approximately 10 to 15 years under the Base Case. At this time the bridge would be operating at maximum capacity and LOS E.

EXHIBIT 6.8: AMBASSADOR BRIDGE FUTURE DAILY VOLUME AND CAPACITY

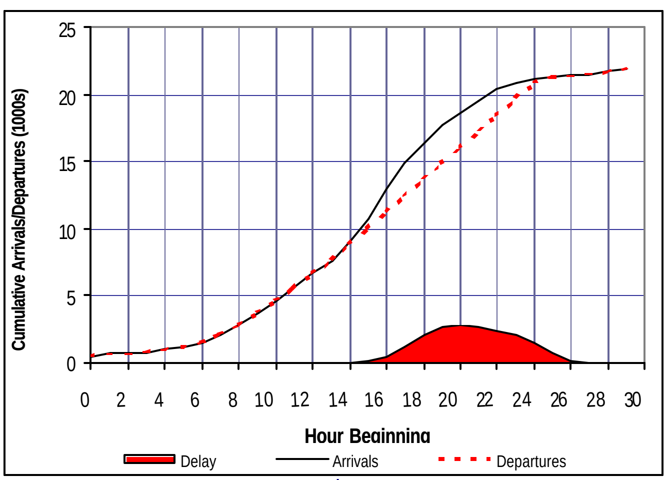


Border processing is currently the major constraint for crossing capacity, with existing facilities presently at or near capacity. Commercial vehicle traffic destined to the US is presently at or near capacity, even with the addition of 3 new inspection booths in 2002. Queues are also typical in the PM peak hour for vehicles entering Canada even with all booths open and operations are considered at capacity. The introduction of NEXUS may help to reduce processing times but, to be effective, dedicated lanes or priority access to NEXUS booths will need to be provided. Full staffing of inspection booths, the addition of new inspection booths at the Ambassador Bridge have provided relief to extensive queues and NEXUS and FAST programs will provide some benefits. However, with continued traffic growth, it is expected that border processing will be at capacity within 5 years.

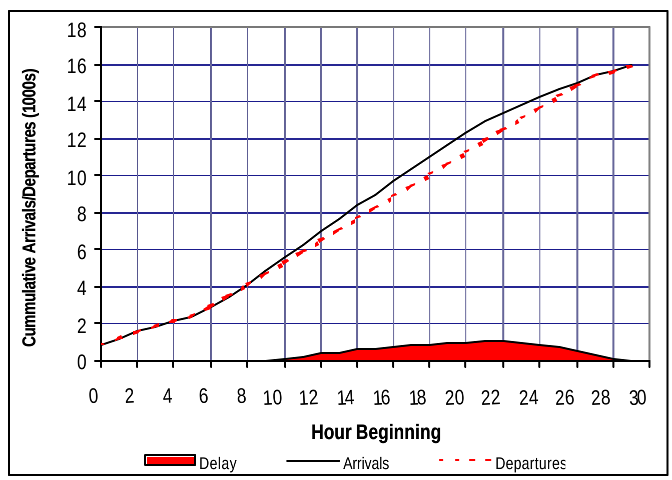
Among the three crossings, the extent of the growth and the degree to which the projected demand will exceed the current available capacity is greatest for the Ambassador Bridge. In theoretical terms, the current roadbed and border processing capacity will be significantly over capacity, with the resulting delays and queues significantly worse than existing conditions, which are already considered unacceptable. These theoretical conditions are presented in Exhibit 6.9, which plots the cumulative arrival of vehicles to the Ambassador Bridge versus the cumulative vehicle departures for 2030 weekday. When more vehicles arrive than can be served, queues and delays will occur, as indicated in the exhibit, with major passenger car queues for approximately 12 hours of the day for travel to the US and approximately 18 hours per day for commercial vehicles.

EXHIBIT 6.9: AMBASSADOR BRIDGE QUEUING ANALYSIS, US TO CANADA (2030)

PASSENGER CARS



COMMERCIAL VEHICLES



Detroit-Windsor Tunnel

Detroit-Windsor Tunnel capacity is projected to be reached, within the following time frames:

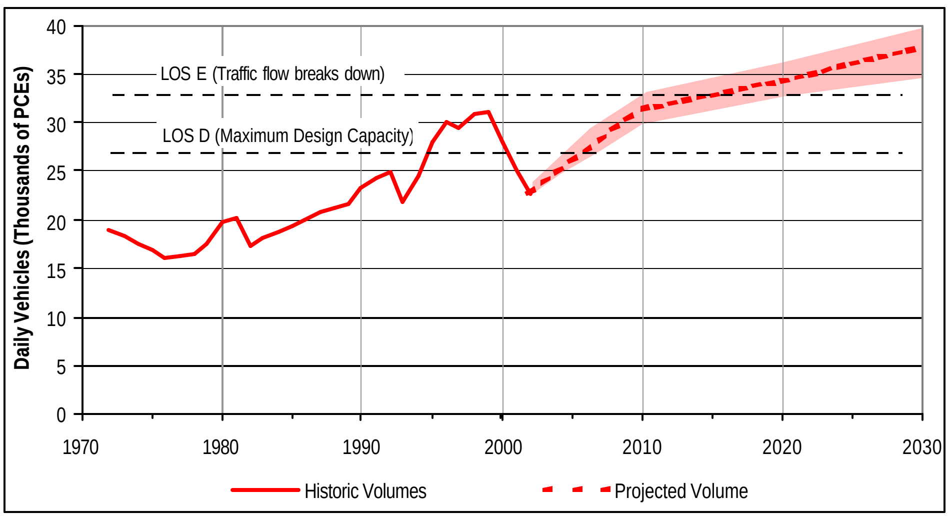
Access Roads	*< 5 yrs*
Roadbed	*10-15 yrs*
Border Processing	*< 5 yrs*

Access roads leading to the Detroit-Windsor Tunnel are at or near capacity, although both local traffic and cross-border traffic use these roadways. The access points to the tunnel are located in the downtown areas of Detroit and Windsor, limiting the improvements that could readily be made to improve access road capacity. The recent declines in tunnel traffic volumes between 1999 and 2001 have provided a reprieve for access road capacity to the tunnel. However, it is expected that access road capacity will be reached within 5 to 10 years, as there is a recovery from the downward effects of 9/11 and the recent decline in the US economy.

In terms of roadbed capacity, Exhibit 6.10 illustrates the capacity utilization of the Detroit-Windsor Tunnel over the study period for the Base Case. Given the growth projections, it is expected that the tunnel itself will reach capacity in 10 to 15 years based on a capacity associated with LOS E.

Border processing for the Detroit-Windsor Tunnel is also a limiting factor in achieving higher throughput levels. Based on staffing of all inspection booths, the PM peak demands for entry into Canada are approaching 100% of the capacity. During peak hours, it is not unusual for significant queues to form for travel entering Canada and entering the US.

EXHIBIT 6.10: DETROIT-WINDSOR TUNNEL FUTURE DAILY VOLUME AND CAPACITY



Blue Water Bridge capacity is projected to be reached, within the following time frames:

Access Roads	*>30 yrs*
Roadbed	*>30 yrs*
Border Processing	*5-10 yrs*

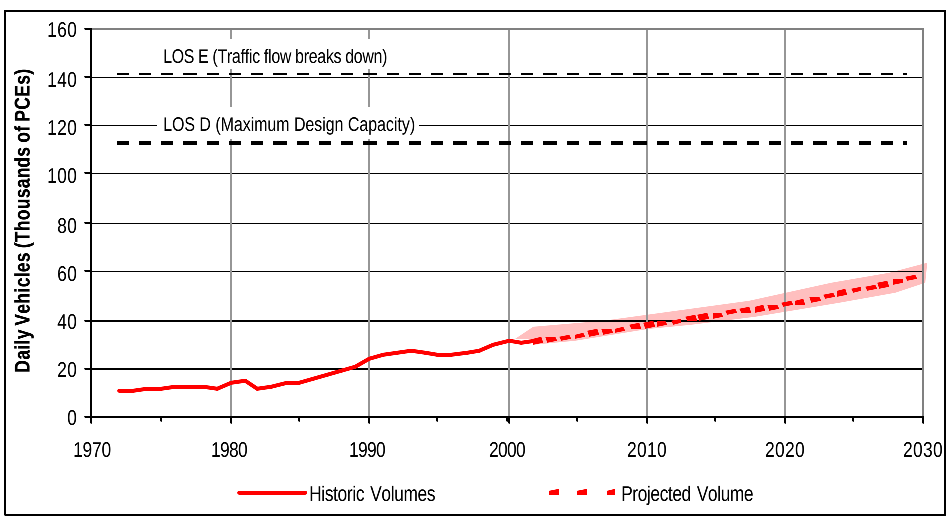
Blue Water Bridge

Daily travel demand over the Blue Water Bridge is more uniformly distributed throughout the day compared Detroit-Windsor crossings, making it somewhat easier to balance capacity with demand.

Road access to the Blue Water Bridge is provided by Highway 402 from Canada and by Interstate 94 from the US. These are controlled access freeways, which currently provide sufficient access capacity to the bridge. As discussed previously in Section 3.3, a current constraint at Blue Water Bridge is that all vehicles travelling westward from the toll collection plaza are forced to pass through a single lane in order for commercial vehicles to safely merge into the left lane to enter US Customs. A study is underway to identify improvement options for the Blue Water Bridge to eliminate this constraint. Improvements to Highway 402 leading to the bridge have been also been planned by the Province of Ontario, including a widening from four to six lanes as traffic volumes warrant. Planned widening of I-94 in Port Huron will ensure that highway access to and from the bridge is sufficient. As such, it is expected that road access capacity to the Blue Water Bridge will be adequate for at least the next 30 years.

Exhibit 6.11 indicates the projected growth in demand versus the estimated roadbed capacity for the Blue Water Bridge. Bridge capacity will be sufficient to handle the forecast traffic volumes over the study horizon based on the present six-lane cross-section. It is expected that roadbed capacity for the Blue Water Bridge will be sufficient to meet future demand for beyond the next 30 years.

EXHIBIT 6.11: BLUE WATER BRIDGE FUTURE DAILY VOLUME AND CAPACITY



Note: Blue Water Bridge was widened from 4 to 6 lanes in 1997.

In terms of border processing capacity, there is a sufficient number of inspection booths to handle typical peak demand for both passenger cars and commercial vehicles with full staffing. The fact that passenger car demands in 2000 at the Blue Water Bridge were almost 20% lower than peak volumes in 1991 is an indication that there is adequate spare capacity at this location. Border processing of commercial vehicle traffic entering the US is presently nearing capacity, with delays exacerbated if all booths are not fully staffed. It is projected that capacity will be reached in 5 to 10 years given commercial vehicle growth to the US crossing at this location. However, a major study is currently underway that will address future capacity deficiencies at US customs and immigration.

6.4. Rail Capacity

Sufficient cross-border rail capacity is available to accommodate very large increases in rail traffic growth.

The capacity of a typical rail facility is affected by a number of factors, including such rail-specific attributes as the length of vehicle (i.e. number of trailers), block length (i.e. distance between signals) and distance between terminals. To provide a preliminary indication of available rail capacity, the number of trains per day and the weight of goods transported per day were taken as the capacity-defining factors. As mentioned previously, current demand consists of approximately 40 trains per day (20 each way) moving through two of the three rail tunnels crossing the border at Sarnia-Port Huron and Windsor-Detroit. These trains collectively carry about 55,000 net metric tonnes of goods per day, or about 1,375 net tonnes per train per day.

The study team estimates that capacity is approximately double the current demand if the two tunnels continue to be used only, or three times if the abandoned second tube in Windsor-Detroit rail tunnel is rehabilitated and reopened at its current dimensions. This equates to a maximum capacity of 120 trains per day for the three tunnels combined. In addition, existing train lengths could reasonably be doubled to carry twice the weight of goods per train in the future than is currently achieved. Considering the existing demand and the estimated capacity of the corridor rail facilities, the volume-to-capacity ratio is about 33%, well below maximum potential. This does not account for the ability to lengthen trains.

To determine whether future growth in the amount of goods transported by rail across the border will approach the rail facility capacities, a similar volume-to-capacity ratio analysis was completed for the 2030 Base Case. This analysis assumed that a doubling of the amount of goods carried by each train to account for a lengthening of each train. This effectively halves the effect of the overall growth in demand on the number of trains required to transport the goods.

For the Base Case growth in demand of 111% (as presented in Exhibit 5.25), the 2030 ratio is slightly above the 2000 value at about 35% of capacity. Thus, future year growth will not strain existing rail facilities to any degree.

6.5. Sensitivity Analysis

The Base Case represents an extrapolation of existing trends, adjusted to reflect projected changes in population, employment and trade as reported in official projections available from municipal, state, provincial and federal agencies. This section examines the sensitivity of the Base Case to some key factors that could strongly affect international traffic and the impact on future capacity needs at Windsor-Detroit crossings, which are being driven by increases in commercial vehicle demands. The Ambassador Bridge carries the vast majority of commercial vehicle cross-border traffic in the Windsor-Detroit area and sensitivity analyses are performed to examine the impacts on future capacity needs for the Ambassador Bridge based on the following scenarios:

- High and low trade;
- Diversion of commercial vehicle traffic to rail;
- Diversion of commercial vehicle traffic to the Blue Water Bridge.

The High and Low Trade Scenarios reflect the uncertainties in future levels of trade between US and Canada, which is very highly correlated with cross-border commercial vehicle traffic. The Base Case commodity trade forecast is described in Section 5.6.

The Diversion Scenarios examine the possible impact of alternatives that could divert demand from over-capacity road-based crossings, as described in Sections 6.2 and 6.3, to other crossings/modes where there is excess capacity available. This would involve fundamental changes in the transportation characteristics and behaviour currently exhibited by the passenger and commercial vehicle users of the Southeast Michigan/Southwest Ontario border crossing facilities. This includes:

- a shift in the proportion of commercial vehicles to intermodal rail for trip markets that could be diverted where rail transportation has become (or is becoming) competitive with truck transportation in terms of price and service; and
- a shift in the proportion of vehicles using the Ambassador Bridge to Port Huron-Sarnia for divertible trips where the total trip distance travelled is such that there is no real distance savings in using one crossing over the other.

Divertible traffic generally consists of relatively long distance trips. As the vast majority of traffic at the Detroit-Windsor Tunnel is considered non-divertible (99.2% and 95.2% for autos and commercial vehicles, respectively), only traffic using the Ambassador Bridge and Blue Water Bridge crossings were considered in the diversion analyses.

Trade Scenarios

The Base Case trade forecast are based on econometric forecasts prepared for Transport Canada by Informetrica. The forecasts assume a continuation of sustained economic growth in Canada and the US, with trade between the two countries increasing at a higher rate than overall economic growth, consistent with the world economies as they become more integrated. The annual growth in trade in the Base Case is projected to be 2.3% over the next 10 years, although auto manufacturing, one of the key markets on both sides of the Ontario-Michigan border, is projected to occur at a lower rate than overall Canada-US trade over the short- and medium-term.

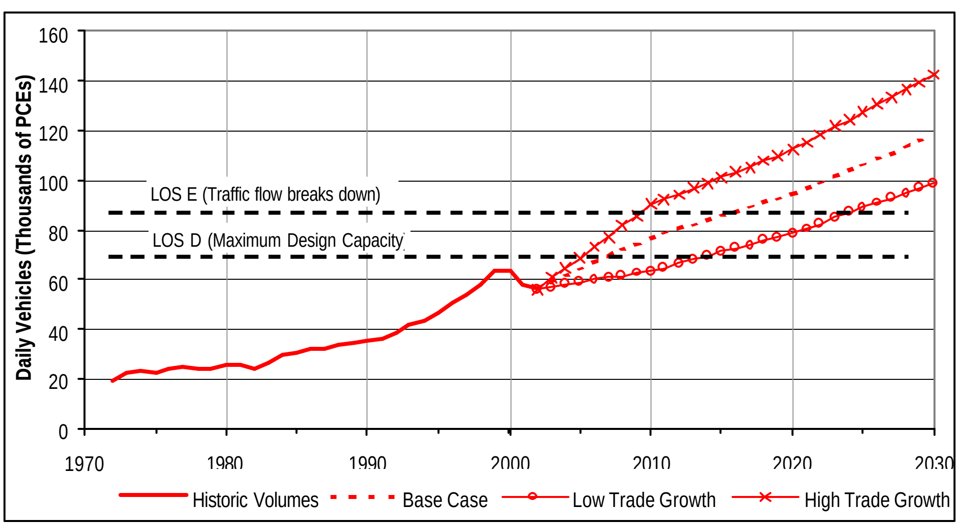
High and low trade scenarios were developed based on an examination of 30 years of bilateral trade data, described as follows:

- Low Trade Forecast – assumes no long-term recovery from the effects of the recent economic downturn and the events of 9/11. It assumes a 2002 starting base for trade and a 25% reduction in trade growth across all market sectors between 2002 and 2010, compared to the Base Case. Beyond 2010, the Base Case annual growth rate is assumed.
- High Trade Forecast – assumes near-term recovery from the effects of the recent economic downturn and 9/11, with an average annual growth of 5.0% between 2002 and 2010. Beyond 2010, the Base Case annual growth rate is assumed. Based on the variation in trade growth data from the past 15 years, there is an approximate 10% probability that this level of trade growth will be exceeded. In the past 25 years, trade growth of 5% or greater has been achieved 75% of the time; however, those historic rates are not considered sustainable.

Under a low trade forecast with no recovery from 9/11 and the recent recession, the need for a new road-based crossing is deferred by approximately 5 to 10 years.

Exhibit 6.12 shows the impact of high and low trade forecasts on future commercial vehicle traffic at the Ambassador Bridge. For the low trade scenario, the associated reduction in commercial vehicle traffic will defer the time when the roadbed capacity of the crossings is reached by approximately 5 to 10 years, compared to the Base Case, with the need for a new crossing in approximately the next 20 to 25 years. For the high trade scenario, the time when capacity is reached is moved forward by approximately 7 years.

EXHIBIT 6.12: IMPACTS OF LOW AND HIGH TRADE GROWTH FOR THE AMBASSADOR BRIDGE



Diversions to Intermodal Rail (Freight)

The recent emergence of intermodal rail has resulted in some diversion of commercial vehicle traffic to rail, which could have significant implications for future traffic. The commercial vehicle traffic considered in-scope or long distance and potentially divertible, as discussed in Section 4.6, represents approximately 43% of the current total volumes on the Ambassador and Blue Water Bridge crossings. The primary market that could be diverted to intermodal rail is commercial traffic that travels between the western border of the Greater Toronto Area on the Canadian side and Detroit and major rail corridors beyond Detroit connecting to primary market nodes on the US side.

Two alternative scenarios involving diversion to intermodal rail were examined:

- Base Diversion – A 10% diversion of in-scope commercial vehicles to intermodal rail in 2010, increasing to 15% in 2020 and 20% in 2030 for in-scope trips. This is an aggressive shift, but is considered realistic; and
- High Diversion – A 20% diversion of in-scope commercial vehicles to intermodal rail in 2010, increasing to 30% in 2020 and 40% in 2030 for in-scope trips. This is a very optimistic shift and represents an upper threshold on what could be achieved.

For this level of diversion to occur, significant investment in infrastructure and technology will be required, with a change in the current goods movement trends and patterns of which shippers are accustomed. As previously indicated, some investment and change in shipping patterns is already underway, but there is large uncertainty as to the degree of penetration into the commercial vehicle market that could be achieved. Reasons for the range in penetration used in these scenarios were also discussed in Section 4.6

To estimate the potential impacts of a diversion to intermodal rail, the commercial vehicle shift was identified and the appropriate number of commercial vehicles from each crossing (depending on the divertible traffic at each crossing) was removed. The estimated weight of goods carried by those commercial vehicles was added to the rail weight projections for each forecast year. It should be noted that as commercial vehicle market segments are forecast to grow at different rates and each of these has differing origin and destination patterns, the total amount of divertible traffic varies in each forecast year.

Diversion of commercial vehicle traffic to intermodal rail could defer the need for a new road-based crossing by approximately two years.

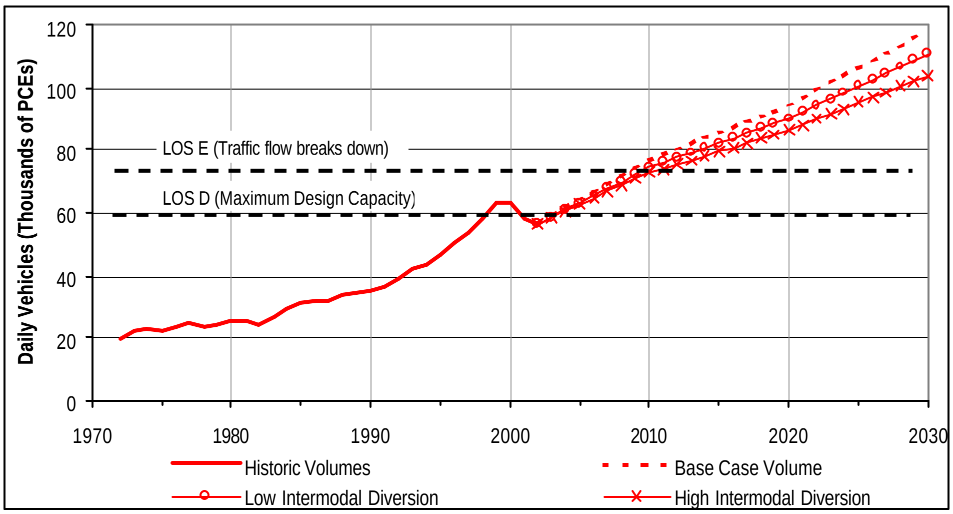
In the Base Diversion scenario, the net impact of diversion to intermodal rail is a 4.4% reduction in truck trips at the Ambassador Bridge in 2010, increasing to 8.9% in 2030. The Blue Water Bridge has a somewhat higher proportion of in-scope traffic, resulting in a 4.6% reduction in 2010 and 9.2% reduction by 2030. In the high, or optimistic diversion scenario, the impacts are essentially doubled.

Exhibit 6.13 illustrates the impacts of intermodal rail diversion on the Ambassador Bridge. The effect of the Base Diversion scenario is to postpone capacity shortfalls by about two years while the higher scenario would delay the shortfalls by approximately four years. The diversion of goods from commercial vehicles to intermodal rail shifts over 13 million tonnes to the total weight carried by rail across the border in 2030. This results in a 179%

increase in demand on rail facilities and an increase in the 2030 volume-to-capacity ratio from approximately 35% in the Base Case to 50%.

Even under the high intermodal scenario, the Ambassador Bridge would reach capacity by 2020. The diversion of goods from truck transport to intermodal rail shifts over 26 million tonnes (i.e. doubles) to the total weight carried by rail across the border in 2030. This results in a 246% increase in demand on rail facilities and a 2030 volume-to-capacity ratio approaching 60%, indicating that there is sufficient rail capacity to accommodate a high level of intermodal diversion if it should occur.

EXHIBIT 6.13: IMPACTS OF INTERMODAL RAIL DIVERSION FOR THE AMBASSADOR BRIDGE



Diversion to Port Huron-Sarnia (Passenger and Freight)

As noted previously in Section 3.4, the driving distances for many cross-border trips are similar for a routing via either Sarnia-Port Huron or via Windsor-Detroit. It was also noted that when travel distance is approximately equal via both routes, there is a preference for commercial vehicles to use the Ambassador Bridge, owing to such factors as increased familiarity with the routing, greater number of roadside amenities and other factors.

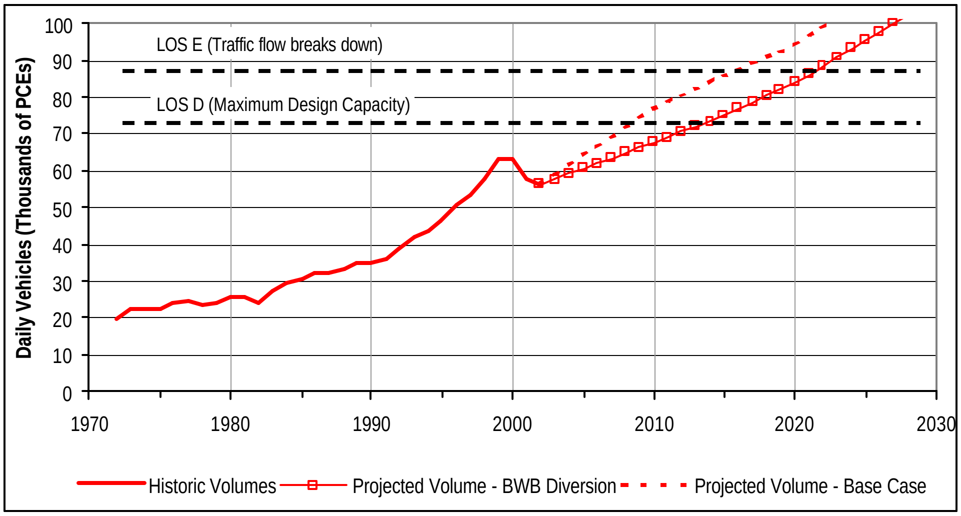
Diversion of passenger and commercial vehicle traffic to Port Huron-Sarnia could defer the need for a new road-based crossing by approximately five years.

Based on an analysis of origin-destination movements and travel times, it was estimated that approximately 7% of passenger car traffic and 30% of current commercial vehicle traffic currently using the Ambassador Bridge on a weekday could also use the Blue Water Bridge and not incur significant travel time increases. For sensitivity testing purposes, it was assumed that half of the potentially divertible market would divert from the Ambassador Bridge to the Blue Water Bridge.

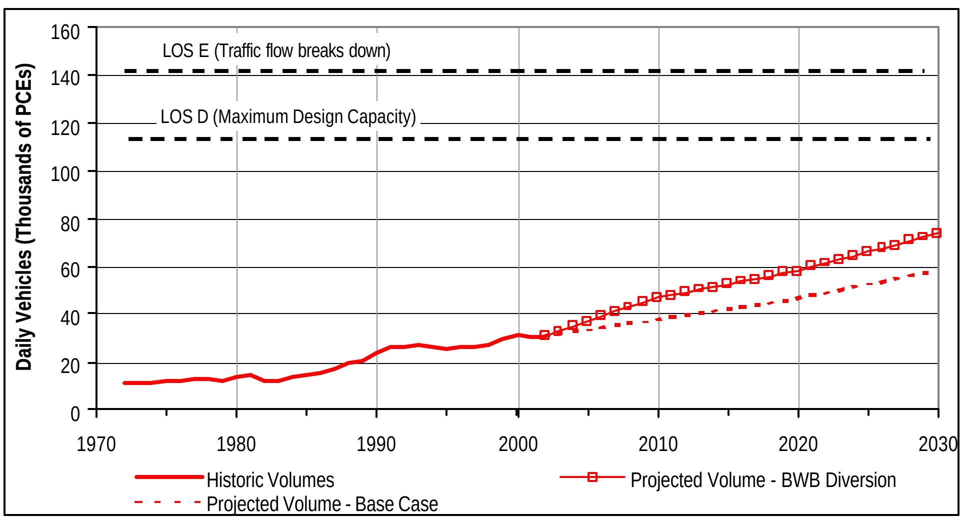
Exhibit 6.14 illustrates this crossing diversion scenario. The result is to postpone the capacity shortfall on the Ambassador Bridge by about five years. The additional volume loaded onto the Blue Water Bridge is still well below its physical capacity.

EXHIBIT 6.14: IMPACTS OF SARNIA-PORT HURON DIVERSION

AMBASSADOR BRIDGE



BLUE WATER BRIDGE



Diversion to Intermodal Rail and to Port Huron-Sarnia (Passenger and Freight)

The scenario presented here consists of a combination of the intermodal rail Base Diversion presented above for commercial vehicle traffic with diversion of both commercial vehicle and passenger car traffic from the Ambassador Bridge to the Blue Water Bridge.

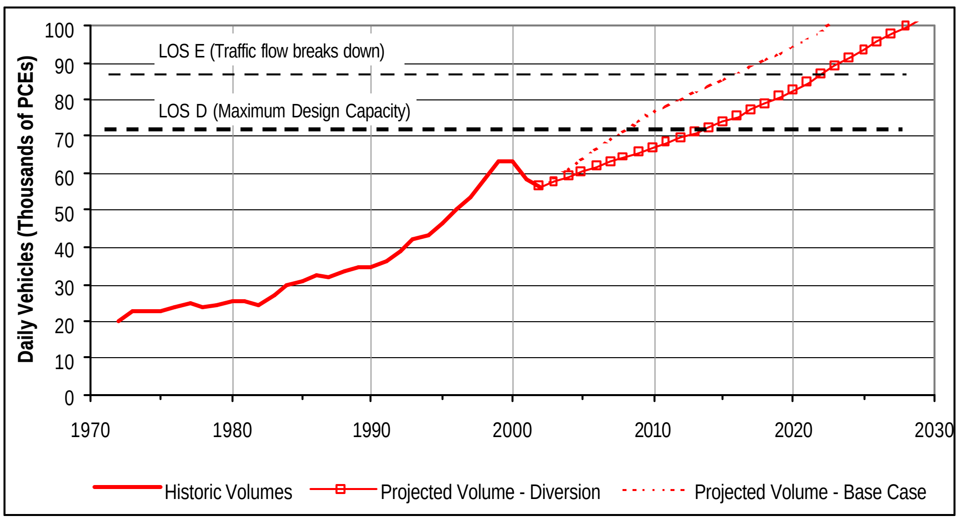
Under this scenario with diversion both to intermodal rail and to the Blue Water Bridge, about 3.5% of Ambassador Bridge passenger car traffic would be diverted to the Blue Water Bridge. For commercial vehicle traffic, the diversion of half of the in-scope trips to the Blue Water Bridge was first applied, with the remaining Ambassador Bridge commercial vehicle trips used to determine the number of trips that are potentially divertible to intermodal rail using the Base Diversion scenario. Combining these two diversion scenarios, it is estimated that about 22% of Ambassador Bridge commercial vehicle traffic could be diverted in 2030.

With intermodal rail diversions and shifting of commercial vehicles from the Ambassador Bridge to the Blue Water Bridge, the need for a new crossing can be moved back to a 15 to 20 year horizon.

Exhibit 6.15 presents the impact of this diversion scenario on traffic volumes over the study horizon. The initial drop in traffic volume in the first decade reflects the diversion of in-scope traffic to Sarnia-Port Huron, with the projected growth over time steadily increasing traffic volumes on the Ambassador Bridge. The exhibit also indicates that the Blue Water Bridge has the roadbed capacity to easily handle the diversions from the Ambassador Bridge.

EXHIBIT 6.15: IMPACTS OF INTERMODAL RAIL AND SARNIA-PORT HURON DIVERSION

AMBASSADOR BRIDGE



BLUE WATER BRIDGE

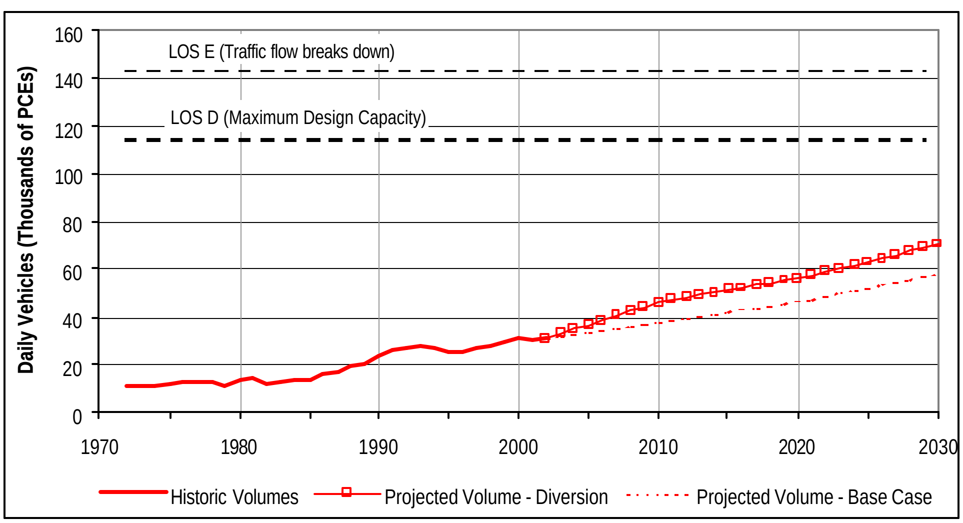
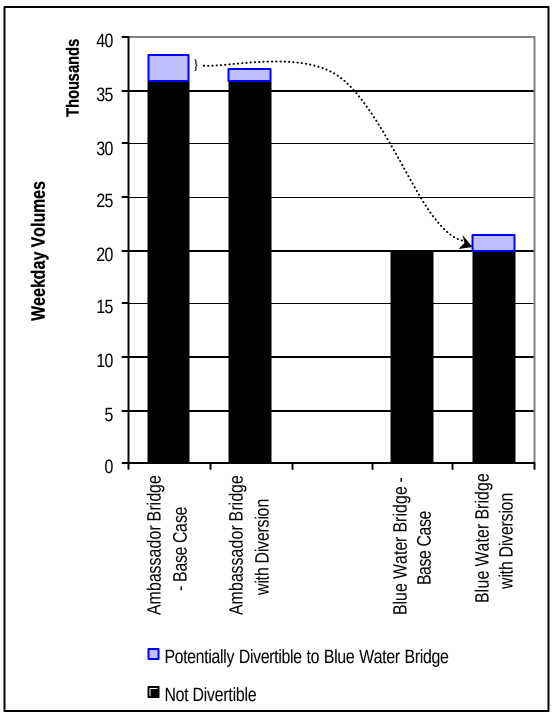


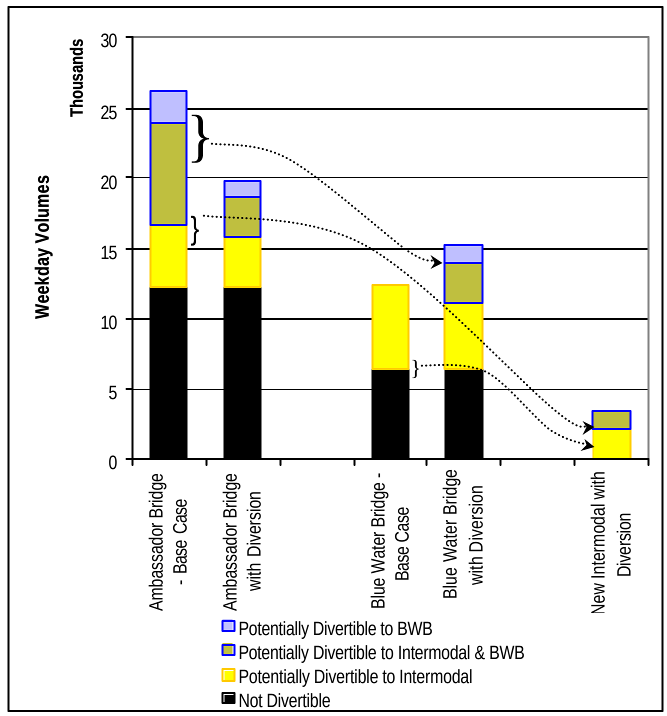
Exhibit 6.16 shows how volumes are diverted between the Base Case and this diversion scenario in 2030. The left sides of the charts show Ambassador Bridge volumes for both scenarios, and to the right are Blue Water Bridge volumes for both scenarios. Under the Base Case scenario, on a 2030 weekday the Ambassador Bridge would have some 26,200 commercial vehicle and 38,400 passenger car trips, while the Blue Water Bridge would have approximately 12,700 commercial vehicle and 20,000 passenger car trips.

EXHIBIT 6.16: WEEKDAY PASSENGER CAR AND COMMERCIAL VEHICLE TRAFFIC, BASE CASE VS. INTERMODAL RAIL AND SARNIA-PORT HURON DIVERSION SCENARIOS, 2030

PASSENGER CARS



COMMERCIAL VEHICLES



Under this diversion scenario, 1,300 passenger car trips and 4,800 commercial vehicle trips would be diverted from the Ambassador Bridge to the Blue Water Bridge, and a total of approximately 2,100 commercial vehicle trips would be diverted to intermodal rail.

The approximate 22% diversion of commercial vehicle traffic and 3.5% of passenger car traffic by 2030 would significantly move back the projected year where the Ambassador Bridge structure would reach capacity by about six years. This represents a combination of the two year postponement from the intermodal diversion and the five year postponement from the crossing diversion, minus the effect of overlapping divertible trips between the two. However, the crossing would still reach capacity during the study horizon period. It should be noted that allowances have been made for the diversion of trips from the Detroit-Windsor Tunnel to the Ambassador Bridge to utilize the available capacity, given the interaction between these two crossings.

Other Modes

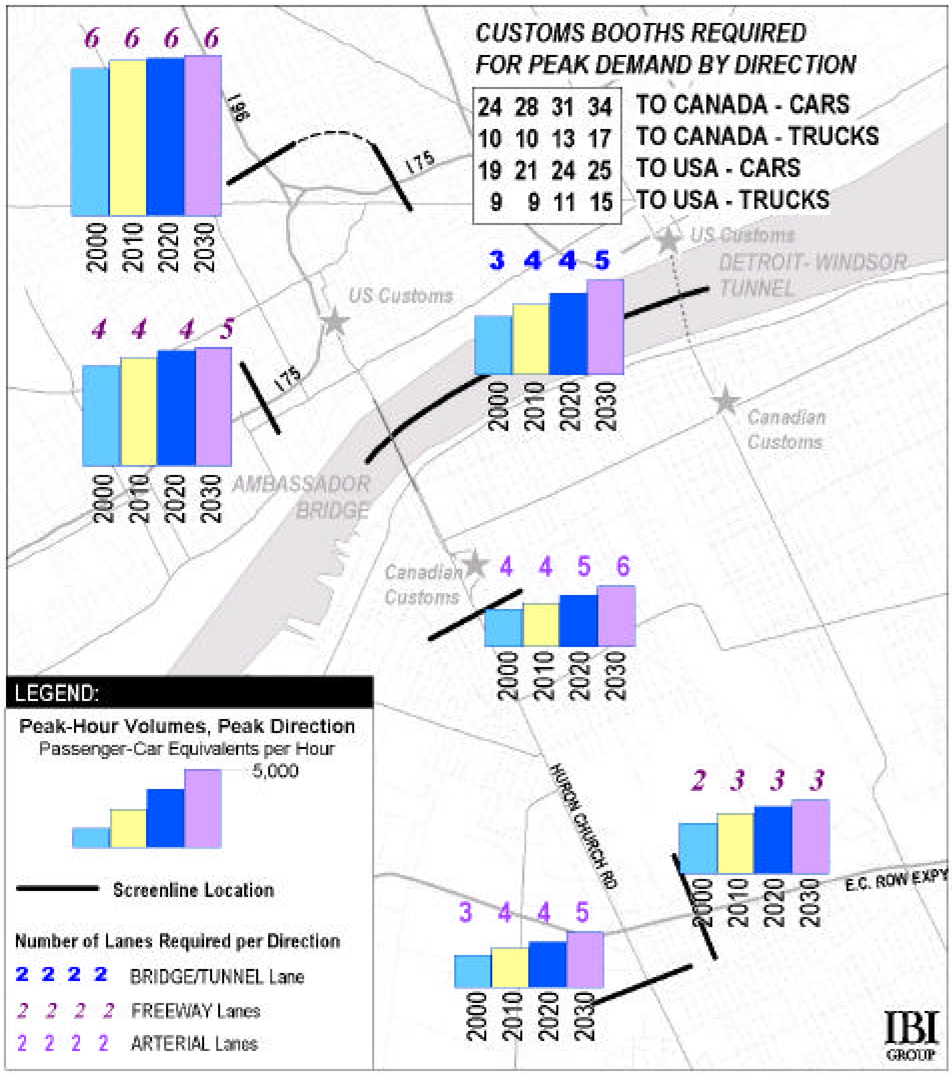
Other cross-border passenger modes are provided by passenger rail, intercity and local bus and ferry services that operate between Southeast Michigan and Southwest Ontario. Opportunities exist on these modes to increase services, given the existing and projected capacity deficiencies for road-based travel across the border. At present, local and intercity bus account for approximately 3.3% of cross-border person-travel, passenger train 0.2% and ferry is less than 0.1%. In total, these three modes represent approximately 3.5% of person-travel. Marine traffic's current market share of total trade traffic is less than 1%. Given the demand and the business justification, additional bus, ferry and passenger rail services could be increased by the individual operators. While these modes would not address the border capacity needs in the Windsor-Detroit area even under a very optimistic assumption of a five-fold increase, they would provide some short-term off-loading benefits and provide additional choice for travellers.

6.6. Future Capacity Needs

The previous sensitivity analyses have shown that capacity deficiencies will be encountered at the Detroit-Windsor crossings within the study horizon even under a pessimistic outlook in future US-Canada trade and even if optimistic shifts in traffic to less congested crossings (Blue Water Bridge or to other modes (intermodal rail) can be obtained. Capacity deficiencies the Detroit-Windsor crossings at will exist in terms of both the amount of physical roadway of the bridge and access/egress roads, as well as the number of border inspection booths. Exhibit 6.17 summarizes the time stream of future capacity needs for the Detroit-Windsor area. The needs are determined assuming that new facilities will have the same capacity characteristics as the existing facilities.

Based on the Base Case demand projections, there is a capacity need to increase roadbed capacity across the Detroit River by one lane in each direction by 2010 and by two lanes in each direction by 2030. Access road capacity increases to and from the crossings are also needed, with two additional lanes required in each direction on Huron Church Road corridor and one on the E.C. Row Expressway corridor by 2030 in Canada, and one additional lane in each direction needed on I-75 in the US. The number of inspection booths that are needed will also increase considerably, with as many as ten new booths needed to process passenger cars entering Canada by 2030.

EXHIBIT 6.17: DETROIT-WINDSOR ROAD AND BORDER PROCESSING CAPACITY NEEDS, 2000-2030



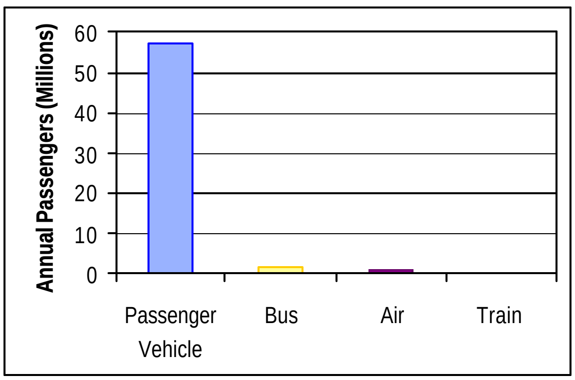
7. Summary

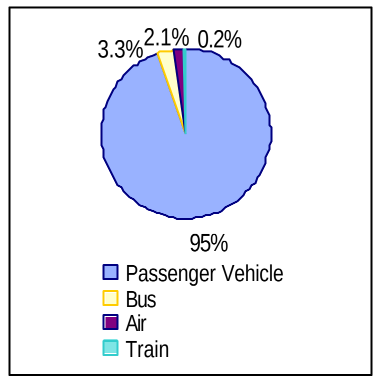
7.1. Travel and Trade Overview

Mode shares for the movement of people and goods through the Southeast Michigan/ Southwest Ontario gateway are shown in Exhibit 7.1. Passenger cars and commercial vehicles are the predominant travel modes between Southeast Michigan and Southwest Ontario, with 95% of person-trips across the border being made by passenger car, and 76% of the value of goods being carried by truck.

EXHIBIT 7.1: MODAL SHARE OF TOTAL PEOPLE AND GOODS

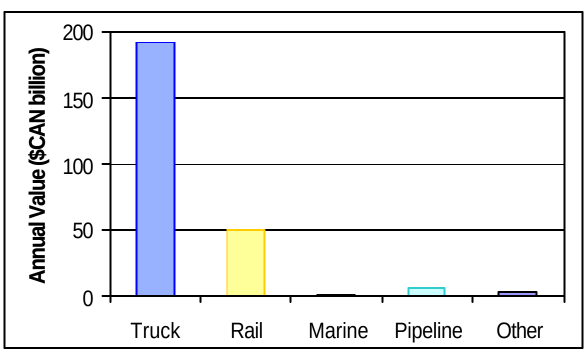
A. CROSS-BORDER PERSON TRIPS BY MODE (ANNUAL 2000)

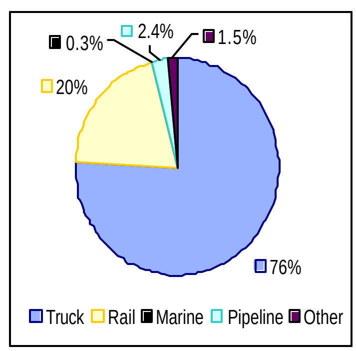




Source: Passenger Car, Bus Passenger, Train Passenger: US DOT, BTS, based on data from US Customs Service, Mission Support Services, Office of Field Operations, Operations Management Database – based on passengers incoming to US, multiplied by 2. Air: US DOT, based on flights between London/Toronto and Detroit/Lansing/Grand Rapids/Chicago.

B. CROSS-BORDER VALUE OF GOODS TRANSPORTED BY MODE (ANNUAL 2000)





Note: Other may include mail and/or air
Source: Canada Customs and Revenue Agency

7.2. Road-Based Travel

Travel Demand

With three of the top five busiest vehicle crossings among all Canada-US border crossings, the Southwest Ontario/Southeast Michigan border is one of the most significant corridors in the world. In the year 2000, the Ambassador Bridge, Detroit-Windsor Tunnel and Blue Water Bridge handled a total of 27 million vehicles, representing over 40% of the total vehicular traffic between Canada and the US. Together, the three crossings handled 38% of the total truck volumes between the two countries.

The significance of the Ontario-Michigan border crossings for passenger travel has been increasing over the last three decades and is expected to continue to increase in the foreseeable future. Between 1972 and 2000, passenger vehicle volumes increased by 126% for the Ambassador Bridge, 52% for the Detroit-Windsor Tunnel and 88% for the Blue Water Bridge. Although passenger traffic growth has slowed down in recent years, even prior to September 11, 2002, expectations are that passenger traffic will continue to grow substantially over the next 30 years.

The Base Case forecasts for this study project increases of 43%, 28% and 40% in passenger car traffic between 2000 and 2030 on the Ambassador Bridge, Detroit-Windsor Tunnel and Blue Water Bridge, respectively, as shown in Exhibit 7.2.

EXHIBIT 7.2: EXISTING AND PROJECTED ROAD-BASED ANNUAL TRAVEL DEMAND

Crossing	2000	2030	Absolute Increase	Percent Increase
Ambassador Bridge				
Passenger Cars	8,734,000	12,525,000	3,791,000	43%
Commercial Vehicles	3,486,000	7,593,000	4,107,000	118%
Detroit-Windsor Tunnel				
Passenger Cars	8,368,000	10,749,000	2,381,000	28%
Commercial Vehicles	182,000	394,000	212,000	116%
Blue Water Bridge				
Passenger Cars	4,390,000	6,130,000	1,740,000	40%
Commercial Vehicles	1,577,000	3,496,000	1,919,000	122%
Total				
Passenger Cars	21,491,000	29,403,000	7,912,000	37%
Commercial Vehicles	5,245,000	11,484,000	6,239,000	119%

The projected passenger car growth reflects the fact that much of the historic growth in passenger car travel was fuelled by two major phenomena. First, the cross-border shopping phenomenon in the late 1980s/early 1990s saw tremendous growth in same-day trips to the US. This was followed by the opening of the Windsor Casino in the late 1990s, which also resulted in a large increase in cross-border traffic. In each case, these types of movement have declined considerably from the original peaks and a return to these levels is not expected in the future. As such, future growth is expected to be more in line with the projected population and employment growth in the Windsor-Essex and SEMCOG areas.

In the last 30 years, commercial freight movements across the Ontario-Michigan border, in particular trucking movements, have increased at a very substantial rate. Between 1972 and 2000, the Ambassador Bridge experienced a five-fold increase in truck trips while Blue Water Bridge truck volumes increased by over six times. Commercial vehicle movements for the Detroit-Windsor Tunnel remained relatively stable; however, commercial vehicles represent a very small portion of the demand for this facility. In annual percentage terms, commercial vehicle traffic has increased by 5.7% per year on the Ambassador Bridge and 6.8% on the Blue Water Bridge. The Base Case forecasts developed for this study estimate future annual growth rates of 2.63%, 2.60% and 2.69% for the Ambassador Bridge, Detroit-Windsor Tunnel and Blue Water Bridge, respectively. This represents an absolute percentage increase of 118%, 116% and 122%, respectively, for the three facilities.

The commercial vehicle forecast assumes a continuation of sustained economic growth in the US and Canada, with trade between the two countries increasing at a higher rate than overall economic growth consistent with the globalization of the world economies as they become more integrated. However, trade relating to auto manufacturing, one of the key markets on both sides of the Ontario-Michigan border, is projected to occur at a much lower rate than overall Canada-US trade over the short and medium term, given increasing competition from the southern US and Mexico for auto manufacturing.

In terms of the patterns of travel demand, the vast majority of passenger movements between Southeast Michigan and Southwest Ontario are same-day trips, involving short distance trips for work, shopping and recreation purposes. For travel using Detroit-Windsor crossings, almost 80% of trips are local, starting and ending in the Detroit and Windsor areas. An additional 15% of passenger car trips start or end in the Detroit and Windsor areas for travel to/from other locations. The remaining 6% are long-distance passenger car trips that travel through Detroit-Windsor.

For truck movements, a large portion of the trips are longer distance trips, although there is also a substantial amount of shorter distance truck movements between Windsor and Detroit due to the high integration of the auto manufacturing centres in these areas. The majority of the truck movements in the Detroit-Windsor area are focused on the I-94 and I-75 corridors, which extend west and south from the Ambassador Bridge and Detroit-Windsor Tunnel. The large auto manufacturing presence in Southeast Michigan and Ohio is the primary reason for these movements.

Road-Based Border Crossing System

A border crossing is a system consisting of five components: access roads, toll collection, bridge/tunnel roadbed, customs and immigration and egress roads. Each component must function efficiently, as the component with the lowest throughput capacity will represent the bottleneck in the system and limit overall throughput across the border.

At present, there are frequent periods when travel demand exceeds border crossing capacity, although, in general, each crossing has infrastructure with sufficient capacity to process existing auto and truck demands. This conclusion appears counter to actual observations, as there are extensive queues extending back from border crossing facilities and significant delays experienced by cross-border travellers. Customs and immigration staffing shortages resulting in inspection booths at less than full staffing during peak periods have been responsible for much of the queuing and delays that have been experienced. The events of 9/11 have also resulted in increased customs and immigration inspection times. Increased staffing, implemented in September 2002, has had a very positive impact on queuing and delays.

Large increases in passenger car and commercial vehicle traffic are projected in the future, which will require infrastructure improvements to the border crossing systems at each of the three bridge/tunnel facilities. Exhibit 7.3 summarizes the expected life of each component of the border crossing system before capacity is reached.

EXHIBIT 7.3: FUTURE BORDER CROSSING LIMITATIONS

Crossing	Time Period Projected for Volumes to Reach Capacity				
	US Road Access	**US Border Processing**	**Bridge/Tunnel Roadbed**	**Can Border Processing**	**Can Road Access**
Ambassador Bridge	Beyond 30 years*	Within 5 years	10 to 15 years	Within 5 years	Within 5 years
Detroit-Windsor Tunnel	Within 5 years	Within 5 years	10 to 15 years	Within 5 years	Within 5 years
Blue Water Bridge	Beyond 30 years	5 to 10 years	Beyond 30 years	15 to 20 years	Beyond 30 years

*Assumes Ambassador Gateway project is completed.

The bridge/tunnel roadbed capacity for the Ambassador Bridge, Detroit-Windsor Tunnel and Blue Water Bridge is higher than the maximum throughput that can be presently processed to the bridge/tunnel by the local road system and by customs and immigration. As such, the full potential of the roadbed capacity cannot be realized. With sufficient improvements to access roads and border processing, the Ambassador Bridge roadbed is not projected to reach capacity for 10 to 15 years. The projected time until roadway capacity is reached for the Detroit-Windsor Tunnel is also projected at 10 to 15 years provided present access road and border processing constraints can be addressed. The twinning of the Blue Water Bridge in 1997 resulted in a six-lane facility, which is projected to provide sufficient capacity for more than the next thirty years.

At the Windsor-Detroit crossings, access road capacity will become a limitation to border crossing capacity in the short term within 5 years, particular on the Windsor side of the border. At the Detroit-Windsor Tunnel, both Goyeau Avenue and Ouellette Avenue are operating near capacity and experience some congestion in the peak hours. For access to the Ambassador Bridge, several intersections on Huron Church Road are also approaching capacity, with the high percentage of commercial seriously affecting vehicular operations. In Detroit, cross-border trips can access the freeway system within a short distance from the border crossings thereby reducing the traffic impacts of border crossing trips. The Ambassador Bridge Gateway Project is a committed project, which will effectively connect the Ambassador Bridge with the US Interstate system and is projected to provide adequate access road capacity for the next 30 years.

Border processing capacity is presently a limiting factor affecting the amount of traffic flowing across the border. Canada border processing is operating at capacity in the peak hour for passenger cars entering Canada at the Detroit-Windsor crossings. As well, border processing for commercial vehicles is operating at capacity at both the Ambassador Bridge and the Blue Water Bridge for travel to the US. The implementation of programs to expedite border processing (NEXUS and FAST) will increase border processing capacity at all crossings. With these improvements, border processing capacity is projected to be exceeded at both Detroit-Windsor crossings in the near-term (within 5 years). At the Blue Water Bridge, planned physical improvements to the border inspection plazas are expected to address border processing capacity needs.

Canada-US Trade

The traffic forecasts for road-based travel between Southeast Michigan and Southwestern Ontario are based on trade forecasts that assume a continuation of sustained economic growth in Canada and the US, with trade between the two countries increasing at a higher rate than overall economic growth, consistent with the world economies as they become more integrated. Given uncertainties in future levels of trade between US and Canada and the very high correlation with cross-border commercial vehicle traffic, sensitivity analyses based on high and low trade scenarios were performed.

The low trade forecast assumes no long-term recovery from the effects of the recent economic downturn and the events of 9/11 and reduced growth in trade extending to 2010. The resulting reduction in cross-border commercial vehicle traffic is estimated to defer the need for additional roadbed capacity in the Windsor-Detroit area by 5 to 10 years, resulting in the need for a new crossing in the next 20 to 25 years.

The high trade scenario assumes near-term recovery from the recent economic downturn and events of 9/11 and strong growth continuing to 2010, consistent with the growth of the past 15 years. This will move forward the timeframe when roadbed capacity is reached in the Windsor-Detroit area to the next 5 to 10 years.

Potential Diversion of Road-Based Traffic

The Base Case forecasts reflect a continuation of existing modal trends, with no major policy changes or major transportation improvements assumed, which could potentially divert traffic from crossings/modes that are projected to be over capacity in the Base Case to routings or modes where available cross-border capacity exists. Several possible scenarios were examined including the diversion of commercial vehicle traffic to intermodal rail in corridors where present intermodal facilities exist and where significant investments in intermodal rail are expected. It is estimated that approximately 9% of commercial vehicles could be diverted to intermodal rail.

A second diversion scenario examined the possibility of diverting long-distance passenger car and commercial vehicle trips that currently use the Ambassador Bridge to the Blue Water Bridge for trips that involved no significant travel time differences between the two crossings. It is estimated that approximately 7% of the passenger car traffic and 30% of commercial vehicle traffic that currently uses the Ambassador Bridge could divert to Sarnia-Port Huron without a significant change in travel time for the trip being made. The scenario considered that half of this traffic would be diverted, representing 3.5% of passenger car and 15% of commercial vehicle traffic.

The results of the sensitivity testing indicate that the above diversion scenarios will defer the timeframe of when capacity is reached at Windsor-Detroit crossings, but additional capacity will be required within the study horizon. Under the optimistic scenario that the intermodal rail and Sarnia-Port Huron diversions would both be realized, the capacity constraints of the Windsor-Detroit crossings would be deferred by approximately six years and roadbed capacity deferred to a timeframe of 15 to 20 years in the future.

7.3. Future Needs

Very significant growth in the movement of people and goods is projected for the Southeast Michigan and Southwest Ontario border crossing over the 30-year study horizon, which will require a significant increase in the capacity of the road-based cross-border transportation system in the Windsor-Detroit area. At present, delays and queuing are evident at Windsor-Detroit border crossings, with demand projected to increase by approximately 120% for commercial vehicles and by approximately 40% for passenger cars in the next 30 years. Increases in the role of marine, bus and rail modes can help address the capacity needs and may contribute to improving overall system performance, but these solutions cannot solve the capacity problem.

Based on the Base Case demand projections, there is a capacity need to increase roadbed capacity across the Detroit River by one lane in each direction by 2010 and by two lanes in each direction by 2030. Access road capacity increases to and from the crossings are also needed, with two additional lanes required in each direction on Huron Church Road corridor and one on the E.C. Row Expressway corridor by 2030 in Canada, and one additional lane in each direction needed on I-75 in the US. The number of inspection booths that are needed will also increase considerably, with as many as ten new booths needed to process passenger cars entering Canada by 2030.

The next stage of this study will analyze and evaluate various transportation alternatives to solve the cross-border capacity deficiency problem in Windsor-Detroit. It will involve the study of new/improved arterial/highway access to border crossings with new/improved international crossings, in combination with:

- Increased passenger car and commercial vehicle ferry services;

- Increased freight rail services;
- Diversion of some traffic from the Ambassador Bridge to the Blue Water Bridge;
- Travel demand management; and
- Traffic management, including NEXUS, FAST and Intelligent Transportation Systems.

The results of the evaluation/analysis of alternatives will be presented in the Feasible Transportation Alternatives Report.

Partnership of

APPENDIX A:

Detailed Matrices for Existing Passenger Car and Commercial Vehicle Travel

Prepared by IBI Group for URS Canada

Appendix A: Detailed Matrices for Existing Passenger Car and Commercial Vehicle Travel

Exhibits A.1 to A.6 show 24-hour cross-border passenger car travel origin-destination matrices by direction for each Southwest Ontario/Southeast Michigan border crossing. Exhibits A.7 to A.12 show the same for commercial vehicle travel. Each travel origin-destination matrix is based on a 40-superzone system.

EXHIBIT A.1: 24-HOUR PASSENGER CARS CROSSING AMBASSADOR BRIDGE TO CANADA

DESTINATION

	ORIGIN	SEMCOG									OTHER MI						OTHER USA, MEXICO										ESSEX					OTHER ON								CAN		TOTAL	
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40		
SEMCOG	1 Detroit + NE Wayne									5											10	9					1959	311	86	166	32	5	150	63	52	55	22	5		5		2945	11313
	2 Dearborn + NW Wayne				5																15	10					1871	235	71	171	38	9	82	75	64	102	48		3			2798	
	3 Wayne S	9																				3					1237	175	51	66	45		59	65	39	33	26					1807	
	4 Macomb																				3						551	123	38	63	8		44	5	31	28						895	
	5 Oakland																				6	9					1126	332	52	191	17		80	22	49	46	45	3	13			1991	
	6 Livingston																					14					49	5			9		10	9	10	18	5	9				138	
	7 Washtenaw																				14						284	22	3	11			14	9	70	77	19	9	5			537	
	8 Monroe																										138			10	3		5		9	8						173	
	9 Port Huron/St. Clair																										19	4	5	3												31	
OTHER MI	10 Huron Area																																										542
	11 North of SEMCOG - I-75																																										
	12 Northern MI																										135	12	17	22			13			5						204	
	13 SW MI / I-96																					10					58	15					8			14			4	3		112	
	14 SW MI / I-94																				9						71	5					5		40	18	13	5		5		171	
	15 Lenawee MI																										44			8				4								56	
OTHER USA, MEXICO	16 Ohio																										690	43	12	30	10	5	51	63	27	91	67	19	47	3		1156	2140
	17 Indiana																				3						31		3	8			12	5	22	44	9	18	8			164	
	18 Illinois																					5					23			8			8	26	67	175	48	8		8		376	
	19 Northwestern USA																					10					30	9		13			5		8	63	20	3	5	21		187	
	20 Erie and Niagara, NY																										9															9	
	21 Other Northeast USA																																										
	22 South and Middle Atlantic USA																										69	3		13			5	17	5	46	9	9	9			173	
	23 Eastern KY, TN																										8										8					16	
	24 MS, AL + Western TN, KY																											3								21	8		8			41	
	25 Southwest USA & Mexico																										13						5									18	
ESSEX	26 Windsor																										10				9											19	19
	27 Other WALTS																																										
	28 Amherstburg																																										
	29 Other Essex																																										
	30 Lakeshore (rest of)																																										
OTHER ON	31 Sarnia/Lambton																										40		5													45	78
	32 Kent County																																										
	33 Elgin + Middlesex Counties																																										
	34 Other SW Ont - SE																																										
	35 Greater Toronto Area																																										
	36 South Central ON																											8					5									13	
	37 Eastern ON																																										
	38 Northern ON																										16							5								20	
CAN	39 Eastern Canada																																										30
	40 Western Canada																										9							9		3	9					30	
TOTAL		9			5					5											59	70					8477	1305	352	781	171	19	560	375	493	849	357	89	101	46		14122	
										19																129					11098								2943		46		

EXHIBIT A.2: 24-HOUR PASSENGER CARS CROSSING AMBASSADOR BRIDGE TO US

DESTINATION

	ORIGIN	SEMCOG									OTHER MI						OTHER USA, MEXICO										ESSEX					OTHER ON								CAN		TOTAL	
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40		
SEMCOG	1 Detroit + NE Wayne																																										4
	2 Dearborn + NW Wayne																																										
	3 Wayne S																																										
	4 Macomb																																										
	5 Oakland																																										
	6 Livingston																																										
	7 Washtenaw																						4																			4	
	8 Monroe																																										
	9 Port Huron/St. Clair																																										
OTHER MI	10 Huron Area																																										
	11 North of SEMCOG - I-75																																										
	12 Northern MI																																										
	13 SW MI / I-96																																										
	14 SW MI / I-94																																										
	15 Lenawee MI																																										
OTHER USA, MEXICO	16 Ohio																																										237
	17 Indiana																																										
	18 Illinios																								3																	3	
	19 Northwestern USA																																										
	20 Erie and Niagara, NY	6	18	7		11	4	35						4	52	4	4																								4	147	
	21 Other Northeast USA	4	14	7		6		14					11	4	20				3	3																						83	
	22 South and Middle Atlantic USA		4																																							4	
	23 Eastern KY, TN																																										
	24 MS, AL + Western TN, KY																																										
	25 Southwest USA & Mexico																																										
ESSEX	26 Windsor	1695	1488	1122	313	1082	43	242	109	60	3		106	56	101	39	436	9	39	44		4	31			16						12				4			7			7040	9199
	27 Other WALTS	318	203	147	110	219	4	19	18	3	4		4	23	24		39	15	12	12				3								8							3			1187	
	28 Amherstburg	109	70	45	52	101		7	3	3			4	8	4		7															4							3			420	
	29 Other Essex	135	66	79	49	117	4	14					9	4	24	7	21	4					7			4															7	552	
	30 Lakeshore (rest of)	19	60	43	6	26								4			4																									163	
OTHER ON	31 Sarnia/Lambton														4					4																						9	2727
	32 Kent County	82	21	58	4	30		27	4					4	33		46		12	18			4	4																		345	
	33 Elgin + Middlesex Counties	7	22	23	4	15		4		4			8	4	47	9	51	4	7	13			27	4	10																	264	
	34 Other SW Ont - SE	30	68	42	7	30	8	17					9		92	6	72	11	69	44			8		4																	617	
	35 Greater Toronto Area	51	63	61	11	82	8	65					4	13	105	3	102	43	158	55			71	18	44	12															8	973	
	36 South Central ON	11	38	7		14		27							70		59	12	13	8			15		10							4									4	291	
	37 Eastern ON	12				4		8	4						9		36		8	6			11																			98	
	38 Northern ON	7	4	4					4						11		21	4	4	4						4																66	
CAN	39 Eastern Canada	4	4	3	4				4						9	4	4	4	12	10					4																	65	65
	40 Western Canada																																										
TOTAL		2480	2141	1650	559	1737	71	478	145	60	7		154	122	604	72	900	107	338	219		4	177	29	75	35						28				4			13		22	12230	
										9320						959										1886													44		22		

EXHIBIT A.3: 24-HOUR PASSENGER CARS CROSSING DETROIT-WINDSOR TUNNEL TO CANADA

	ORIGIN \ DESTINATION	SEMCOG 1	2	3	4	5	6	7	8	9	OTHER MI 10	11	12	13	14	15	OTHER USA, MEXICO 16	17	18	19	20	21	22	23	24	25	ESSEX 26	27	28	29	30	OTHER ON 31	32	33	34	35	36	37	38	CAN 39	40	TOTAL	
SEMCOG	1 Detroit + NE Wayne																				6	7					3730	369	37	134	49		123	24	46	112	5					4642	11864
	2 Dearborn + NW Wayne																										621	23	6	11	12		6	7	24	31						741	
	3 Wayne S																										420	7	7	7	5		6	6	5	13						476	
	4 Macomb																				7	8					1914	120	24	42	37	6	23		6	25	11					2220	
	5 Oakland					12															6	6					3857	175	48	36	37		84	13	45	89	5	18		6		3437	
	6 Livingston																										43															43	
	7 Washtenaw																										111															111	
	8 Monroe																										42									7						49	
	9 Port Huron/St. Clair																										127			7	12											145	
OTHER MI	10 Huron Area																										6															6	531
	11 North of SEMCOG - I-75																										25															25	
	12 Northern MI																										249	12		12	8		19		7	7						310	
	13 SW MI / I-96																										38	6														44	
	14 SW MI / I-94																										12	6			7		6			6		6				41	
	15 Lenawee MI																										93				5		6									106	
OTHER USA, MEXICO	16 Ohio																										120	19							7		11					166	332
	17 Indiana																					5					6							7				7				25	
	18 Illinois																											6		6			6		12	19						47	
	19 Northwestern USA																										34	13			5			6	5	13						68	
	20 Erie and Niagara, NY																																										
	21 Other Northeast USA																																										
	22 South and Middle Atlantic USA																										12						6									18	
	23 Eastern KY, TN																																			7						7	
	24 MS, AL + Western TN, KY																																					6				6	
	25 Southwest USA & Mexico																																			5						5	
ESSEX	26 Windsor																																										
	27 Other WALTS																																										
	28 Amherstburg																																										
	29 Other Essex																																										
	30 Lakeshore (rest of)																																										
OTHER ON	31 Sarnia/Lambton																										25															25	48
	32 Kent County																																										
	33 Elgin + Middlesex Counties																																										
	34 Other SW Ont - SE																																										
	35 Greater Toronto Area																																										
	36 South Central ON																																										
	37 Eastern ON																																										
	38 Northern ON																										11	6					6									23	
CAN	39 Eastern Canada																																										6
	40 Western Canada																																				6					6	
TOTAL						12															19	24					10486	760	122	254	176	6	280	62	157	332	39	36		6		12781	
										12																42					11798								922		6		

EXHIBIT A.4: 24-HOUR PASSENGER CARS CROSSING DETROIT-WINDSOR TUNNEL TO US

DESTINATION

		SEMCOG									OTHER MI						OTHER USA, MEXICO										ESSEX					OTHER ON								CAN			
	ORIGIN	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	TOTAL	
SEMCOG	1 Detroit + NE Wayne	4																																								4	4
	2 Dearborn + NW Wayne																																										
	3 Wayne S																																										
	4 Macomb																																										
	5 Oakland																																										
	6 Livingston																																										
	7 Washtenaw																																										
	8 Monroe																																										
	9 Port Huron/St. Clair																																										
OTHER MI	10 Huron Area																																										
	11 North of SEMCOG - I-75																																										
	12 Northern MI																																										
	13 SW MI / I-96																																										
	14 SW MI / I-94																																										
	15 Lenawee MI																																										
OTHER USA, MEXICO	16 Ohio																																										47
	17 Indiana																																										
	18 Illinois																																										
	19 Northwestern USA																																										
	20 Erie and Niagara, NY	10				4																																				14	
	21 Other Northeast USA	14	5			8		6																																		33	
	22 South and Middle Atlantic USA																																										
	23 Eastern KY, TN																																										
	24 MS, AL + Western TN, KY																																										
	25 Southwest USA & Mexico																																										
ESSEX	26 Windsor	3208	737	477	1982	3003	50	74	45	89	5	32	223	56	49	137	217	23	28	13			31			6	9					29		5			4		19			10544	11515
	27 Other WALTS	241	13	33	114	277	6	5					18	5											6							5							10			730	
	28 Amherstburg	37			19	14				5			4				5																						6			88	
	29 Other Essex	57			38	43							4				5			4																						152	
	30 Lakeshore (rest of)	90	13	10	28	41		5					6				6																									198	
OTHER ON	31 Sarnia/Lambton																															4										4	992
	32 Kent County	63		19	14	67		5					9		6								4																			186	
	33 Elgin + Middlesex Counties	10	4	6		33	4																																5			61	
	34 Other SW Ont - SE	17	13	12	4	36						4	4	9	13		4	9	6	5																						138	
	35 Greater Toronto Area	77	12	9	4	65	4	4					9	4	4		9		9	9																						221	
	36 South Central ON	9		4		12									4																										5	35	
	37 Eastern ON	13			5	9											4	5		4																						40	
	38 Northern ON	9	4		6										4																											23	
CAN	39 Eastern Canada																																										
	40 Western Canada																																										
TOTAL		3849	802	569	2212	3612	64	98	45	94	5	36	276	74	80	137	250	36	41	36			36		6	5	9					37		5			4		38		5	12458	
										11344						807										409					9								84		5		

EXHIBIT A.5: 24-HOUR PASSENGER CARS CROSSING BLUE WATER BRIDGE TO CANADA

DESTINATION

	ORIGIN	SEMCOG									OTHER MI						OTHER USA, MEXICO										ESSEX					OTHER ON								CAN			
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	TOTAL	
SEMCOG	1 Detroit + NE Wayne																					22										68		30		43	40		20			212	4872
	2 Dearborn + NW Wayne																				12											48		16	8	8	40		8			135	
	3 Wayne B																															46		15	6		28					95	
	4 Macomb																				20	31										350		87	82	59	81	12	16			698	
	5 Oakland																				41	57					6					222		38	100	222	184	13	5	15		882	
	6 Livingston																				8											34			15		24					78	
	7 Washtenaw																															27		19	6	6	10					68	
	8 Monroe																															8										8	
	9 Port Huron/St. Clair																					4	6								5	2288	21	187	75	33	41	16	6	5		2686	
OTHER MI	10 Huron Area																					8										103		8	5	6						126	1590
	11 North of SEMCOG - I-75																				5	17	6									128	6		6	9	17					194	
	12 Northern MI																				30	51										195		83	78	138	90	10	8	12		690	
	13 SW MI/I-96																				24	86										74		38	67	53	85		9			436	
	14 SW MI/I-94																				12						8					8			29	8	12			8		75	
	15 Lenawee MI																					6										36		13	9		6					69	
OTHER USA, MEXICO	16 Ohio																															45		21	5		18					89	387
	17 Indiana																															6		6		4	18			6		41	
	18 Illinios																																		15	22	31			9		77	
	19 Northwestern USA																					17										22	12	9	27	10	21			6		123	
	20 Erie and Niagara, NY																																										
	21 Other Northeast USA																															6					6					12	
	22 South and Middle Atlantic USA																				8											12		8			8					30	
	23 Eastern KY, TN																																										
	24 MS, AL + Western TN, KY																																										
	25 Southwest USA & Mexico																															11					4					15	
ESSEX	26 Windsor																															50					15					65	90
	27 Other WALTS																															19					6					25	
	28 Amherstburg																																										
	29 Other Essex																																										
	30 Lakeshore (rest of)																																										
OTHER ON	31 Sarnia/Lambton																																										47
	32 Kent County																																										
	33 Elgin + Middlesex Counties																																										
	34 Other SW Ont - SE																																										
	35 Greater Toronto Area																																										
	36 South Central ON																																										
	37 Eastern ON																																										
	38 Northern ON																															15		21	6		6					47	
CAN	39 Eastern Canada																																										41
	40 Western Canada																															16	6	4	8	9						41	
TOTAL																					155	287	12				12				5	3832	44	546	523	638	789	48	68	59		7028	
																										463					17								6499		59		

EXHIBIT A.6: 24-HOUR PASSENGER CARS CROSSING BLUE WATER BRIDGE TO US

DESTINATION

		SEMCOG									OTHER MI						OTHER USA, MEXICO										ESSEX					OTHER ON								CAN			
	ORIGIN	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	TOTAL	
SEMCOG	1 Detroit + NE Wayne																																										
	2 Dearborn + NW Wayne																																										
	3 Wayne S																																										
	4 Macomb																																										
	5 Oakland																																										
	6 Livingston																																										
	7 Washtenaw																																										
	8 Monroe																																										
	9 Port Huron/St. Clair																																										
OTHER MI	10 Huron Area																																										
	11 North of SEMCOG - I-75																																										
	12 Northern MI																																										
	13 SW MI / I-96																																										
	14 SW MI / I-94																																										
	15 Lenawee MI																																										
OTHER USA, MEXICO	16 Ohio																																										388
	17 Indiana																																										
	18 Illinois																																										
	19 Northwestern USA																																										
	20 Erie and Niagara, NY	9			12	26	9					11	58	35		11			9																							180	
	21 Other Northeast USA	11			32	64				3	3		37	26						11						11																199	
	22 South and Middle Atlantic USA												9																													9	
	23 Eastern KY, TN																																										
	24 MS, AL + Western TN, KY																																										
	25 Southwest USA & Mexico																																										
ESSEX	26 Windsor										9																															9	9
	27 Other WALTS																																										
	28 Amherstburg																																										
	29 Other Essex																																										
	30 Lakeshore (rest of)									5																																5	
OTHER ON	31 Sarnia/Lambton	67	28	61	484	163		9		2474	69	59	277	52	21	28	36	9	5	22	9						52	17	27			3							14			3987	6635
	32 Kent County					11				87		23	9	11																									10			152	
	33 Elgin + Middlesex Counties	36	9	17	68	59		20		228	11	9	68	17			14	17	29	17						9	11												75		39	753	
	34 Other SW Ont - SE	9		9	32	43	9	20		46		20	65	67	9			11	9	63																			20		5	437	
	35 Greater Toronto Area	17			34	153	18			23			153	63	37	9	14	11	56	45					9														20		3	666	
	36 South Central ON	49		17	9	131		27		93			40	32	20		19		3	23			17	3															39		22	539	
	37 Eastern ON	11		9						9			12	3	9																											52	
	38 Northern ON				9	19							17																													44	
CAN	39 Eastern Canada		3							5				29																												37	37
	40 Western Canada																																										
TOTAL		210	40	113	679	668	35	76		2963	93	132	752	334	95	49	82	49	111	182	9		17	3	9	20	64	17	27			3							179		70	7069	
										4793						1445										482					107								182		70		

EXHIBIT A.7: 24-HOUR COMMERCIAL VEHICLES CROSSING AMBASSADOR BRIDGE TO CANADA

DESTINATION

		SEMCOG									OTHER MI						OTHER USA, MEXICO									
	ORIGIN	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
SEMCOG	1 Detroit + NE Wayne																1				14	8				
	2 Dearborn + NW Wayne																				48	4				
	3 Wayne S																			2	9	2				
	4 Macomb																				3					
	5 Oakland																					1				
	6 Livingston																									
	7 Washtenaw																					5				
	8 Monroe																									
	9 Port Huron/St. Clair																				2					
OTHER MI	10 Huron Area																									
	11 North of SEMCOG - I-75																									
	12 Northern MI																				3					
	13 SW MI / I-96																				1					
	14 SW MI / I-94																				2	4				
	15 Lenawee MI																									
OTHER USA, MEXICO	16 Ohio																				10					
	17 Indiana																				3					
	18 Illinois																				5					
	19 Northwestern USA																									
	20 Erie and Niagara, NY																									
	21 Other Northeast USA																									
	22 South and Middle Atlantic USA																					3				
	23 Eastern KY, TN																									
	24 MS, AL + Western TN, KY																									
	25 Southwest USA & Mexico																									
ESSEX	26 Windsor																									
	27 Other WALTS																									
	28 Amherstburg																									
	29 Other Essex																									
	30 Lakeshore (rest of)																									
OTHER ON	31 Sarnia/Lambton																									
	32 Kent County																									
	33 Elgin + Middlesex Counties																									
	34 Other SW Ont - SE																									
	35 Greater Toronto Area																									
	36 South Central ON																									
	37 Eastern ON																									
	38 Northern ON																									
CAN	39 Eastern Canada																									
	40 Western Canada																									
TOTAL																	1			2	101	26				
																										130

	ESSEX					OTHER ON								CAN			
ORIGIN	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	TOTAL	
1 Detroit + NE Wayne	279			15			16	14	53	167	43	4		13	2	627	2141
2 Dearborn + NW Wayne	204			17			12	12	23	54	18		8	3		401	
3 Wayne S	409			29			10	29	17	120	23	9	4	17		679	
4 Macomb	63		19				8	2		16	3					104	
5 Oakland	103		23	15			5	3	18	19	11		4	4		204	
6 Livingston				32				2		3			1			38	
7 Washtenaw								2	10	19	2					38	
8 Monroe										16	1	1				17	
9 Port Huron/St. Clair	31															33	
10 Huron Area																	346
11 North of SEMCOG - I-75														1		1	
12 Northern MI	10				13		5		8	17	9	5		2		72	
13 SW MI / I-96	51			22			6	4	1	12	3		2	2		105	
14 SW MI / I-94	49							2	4	29	26			10		126	
15 Lenawee MI	18							6	3	6	3		4			42	
16 Ohio	207					3	50	33	68	230	157	22	10	78		869	3432
17 Indiana	88	11					6	3	27	169	29	4	5	64		411	
18 Illinois	30	4	8				1	3	29	200	44	9		109		445	
19 Northwestern USA	69						12	14	49	272	67	26	7	235	1	730	
20 Erie and Niagara, NY																	
21 Other Northeast USA																	
22 South and Middle Atlantic USA	61	5					3	3	7	120	18			17		238	
23 Eastern KY, TN						2	6	8	11	42	21	11		28		130	
24 MS, AL + Western TN, KY	33					1	9	5	16	169	25	20	2	85	2	337	
25 Southwest USA & Mexico	22						2	4	12	101	32	18	3	80		273	
26 Windsor																	
27 Other WALTS																	
28 Amherstburg																	
29 Other Essex																	
30 Lakeshore (rest of)																	
31 Sarnia/Lambton																	1
32 Kent County																	
33 Elgin + Middlesex Counties																	
34 Other SW Ont - SE																	
35 Greater Toronto Area																	
36 South Central ON																	
37 Eastern ON																	
38 Northern ON										1						1	
39 Eastern Canada																	68
40 Western Canada	66			8										3		68	
TOTAL	1763	20	49	139	13	6	150	147	357	1772	527	129	50	732	6	5988	
					1983								3138		737		

EXHIBIT A.8: 24-HOUR COMMERCIAL VEHICLES CROSSING AMBASSADOR BRIDGE TO US

	DESTINATION																																										
		SEMCOG									OTHER MI						OTHER USA, MEXICO										ESSEX					OTHER ON								CAN			
	ORIGIN	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	TOTAL	
SEMCOG	1 Detroit + NE Wayne																																										
	2 Dearborn + NW Wayne																																										
	3 Wayne S																																										
	4 Macomb																																										
	5 Oakland																																										
	6 Livingston																																										
	7 Washtenaw																																										
	8 Monroe																																										
	9 Port Huron/St. Clair																																										
OTHER MI	10 Huron Area																																										
	11 North of SEMCOG - I-75																																										
	12 Northern MI																																										
	13 SW MI / I-96																																										
	14 SW MI / I-94																																										
	15 Lenawee MI																																										
OTHER USA, MEXICO	16 Ohio																																										209
	17 Indiana																																										
	18 Illinios																																										
	19 Northwestern USA																																										
	20 Erie and Niagara, NY	47	26	3	4	8	3	6		2			2	9	2				17																							129	
	21 Other Northeast USA	11	7	15	6	6								8	4				3	9			1																			72	
	22 South and Middle Atlantic USA																		4																							4	
	23 Eastern KY, TN			4																																						4	
	24 MS, AL + Western TN, KY																																										
	25 Southwest USA & Mexico		1																																							1	
ESSEX	26 Windsor	531	181	115	81	104		98	60				60	53	32		264	84	61	10			50	25	31	12															83	1937	2237
	27 Other WALTS	26			26								7				21								45																	126	
	28 Amherstburg																19	15																							8	42	
	29 Other Essex		12														21		53				21		16																9	132	
	30 Lakeshore (rest of)			19									21				7									4																60	
OTHER ON	31 Sarnia/Lambton			0									5		2							2																				9	2809
	32 Kent County	18	2	18	4	1		2					11	2			42	12	5	2				5	5	10																138	
	33 Elgin + Middlesex Counties	18	16	26	2	2	2		2					6	3		58	14	1	28			13	6	9	4																208	
	34 Other SW Ont - SE	36	24	41	3	6		5					15			3	45	30	31	52			15	7	14	23																350	
	35 Greater Toronto Area	121	70	95	21	18	4	9	24				13	15	17	10	171	114	119	125			49	46	80	69																1179	
	36 South Central ON	55	18	45	0	3	3	2	12				5	5	10	9	166	45	22	57			17	34	42	23															10	584	
	37 Eastern ON	22	3	2		6							2				31	19	32	49			4	11	14	34																231	
	38 Northern ON	4			2				7						2		19		3	5			5		5	9																61	
CAN	39 Eastern Canada	23	38	20		28	4	7					3	10	6		60	69	111	214			16	33	77	77																797	800
	40 Western Canada																			4																						4	
TOTAL		912	401	402	150	191	16	129	104	2			145	109	77	22	923	402	463	558		2	191	186	340	264															111	8066	
										2296						353										3295															111		

EXHIBIT A.9: 24-HOUR COMMERCIAL VEHICLES CROSSING DETROIT-WINDSOR TUNNEL TO CANADA

DESTINATION

		SEMCOG									OTHER MI						OTHER USA, MEXICO										ESSEX					OTHER ON								CAN			
	ORIGIN	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	TOTAL	
SEMCOG	1 Detroit + NE Wayne																				3						86	2	6	13			2	1	10	3	1	1	0			129	321
	2 Dearborn + NW Wayne																				3						11	10		0						1						26	
	3 Wayne S																				2						61	9		2						9	3					74	
	4 Macomb																										39	2		4					3		2					60	
	5 Oakland																										30			1			3		2							36	
	6 Livingston																																										
	7 Washtenaw																																										
	8 Monroe																				3									4				1								8	
	9 Port Huron/St. Clair																																										
OTHER MI	10 Huron Area																										4															4	36
	11 North of SEMCOG - I-75																																										
	12 Northern MI																										7			10					2	1						20	
	13 SW MI / I-96																										4	5					1									10	
	14 SW MI / I-94																										2									1						3	
	15 Lenawee MI																																										
OTHER USA, MEXICO	16 Ohio																										4								0		0			3		8	16
	17 Indiana																																0		1					3		4	
	18 Illinois																																										
	19 Northwestern USA																																				3	0				3	
	20 Erie and Niagara, NY																																										
	21 Other Northeast USA																																										
	22 South and Middle Atlantic USA																																										
	23 Eastern KY, TN																																				1					1	
	24 MS, AL + Western TN, KY																																										
	25 Southwest USA & Mexico																																					0				0	
ESSEX	26 Windsor																																										
	27 Other WALTS																																										
	28 Amherstburg																																										
	29 Other Essex																																										
	30 Lakeshore (rest of)																																										
OTHER ON	31 Sarnia/Lambton																																										
	32 Kent County																																										
	33 Elgin + Middlesex Counties																																										
	34 Other SW Ont - SE																																										
	35 Greater Toronto Area																																										
	36 South Central ON																																										
	37 Eastern ON																																										
	38 Northern ON																																										
CAN	39 Eastern Canada																																										
	40 Western Canada																																										
TOTAL																					11						237	27	6	35			6	2	18	13	10	1	0	6		373	
																										11					305								51		6		

EXHIBIT A.10: 24-HOUR COMMERCIAL VEHICLES CROSSING DETROIT-WINDSOR TUNNEL TO US

		DESTINATION																																								
		SEMCOG									OTHER MI						OTHER USA, MEXICO										ESSEX					OTHER ON								CAN			
	ORIGIN	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	TOTAL	
SEMCOG	1 Detroit + NE Wayne																																										
	2 Dearborn + NW Wayne																																										
	3 Wayne S																																										
	4 Macomb																																										
	5 Oakland																																										
	6 Livingston																																										
	7 Washtenaw																																										
	8 Monroe																																										
	9 Port Huron/St. Clair																																										
OTHER MI	10 Huron Area																																										
	11 North of SEMCOG - I-75																																										
	12 Northern MI																																										
	13 SW MI / I-96																																										
	14 SW MI / I-94																																										
	15 Lenawee MI																																										
OTHER USA, MEXICO	16 Ohio																																										9
	17 Indiana																																										
	18 Illinois																																										
	19 Northwestern USA																																										
	20 Erie and Niagara, NY	2						6										1																								9	
	21 Other Northeast USA																0																									0	
	22 South and Middle Atlantic USA																																										
	23 Eastern KY, TN																																										
	24 MS, AL + Western TN, KY																																										
	25 Southwest USA & Mexico																																										
ESSEX	26 Windsor	104	21	19	25	12		5		1		4	28		1		11																									231	261
	27 Other WALTS	13			5		3																																			22	
	28 Amherstburg																																										
	29 Other Essex		4										4																													8	
	30 Lakeshore (rest of)		1		3																																					5	
OTHER ON	31 Sarnia/Lambton																0																									0	74
	32 Kent County				1			2	1	3																																6	
	33 Elgin + Middlesex Counties	3		1					1								1																									5	
	34 Other SW Ont - SE	6	2	10		1				1									0																							20	
	35 Greater Toronto Area	3	1	2	1	12			5								1	0	0				0																			26	
	36 South Central ON												1				1																									2	
	37 Eastern ON						1										1	0		2			1		5	0																10	
	38 Northern ON																0																									0	
CAN	39 Eastern Canada	0			5												1	1	0	0					0	0																8	8
	40 Western Canada																																										
TOTAL		130	29	32	40	26	5	12	7	5		4	32		1		16	2	1	2			1		5	1																361	
										286						37										29																	

EXHIBIT A.11: 24-HOUR COMMERCIAL VEHICLES CROSSING BLUE WATER BRIDGE TO CANADA

DESTINATION

		SEMCOG									OTHER MI						OTHER USA, MEXICO										ESSEX					OTHER ON								CAN			
	ORIGIN	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	TOTAL	
SEMCOG	1 Detroit + NE Wayne																		2		13	10	3									6		14	4	49	12		1	2		117	700
	2 Dearborn + NW Wayne																				1	2										2		4	3	13	6					31	
	3 Wayne S																				4											2	6	3	1	15	5	2				39	
	4 Macomb					2															8	3										4		42	32	60	19	1	6	2		180	
	5 Oakland																				49	22										4	1	10	8	49	26	4		5		176	
	6 Livingston																				1													1	5	8				2		18	
	7 Washtenaw																																						1			1	
	8 Monroe																																										
	9 Port Huron/St. Clair																				17	22										9		14	12	31	9	5	2	15		135	
OTHER MI	10 Huron Area																						1				2					2	1			2		1				9	811
	11 North of SEMCOG - I-75																				8	4										5	4	14	5	14	7	3		2		66	
	12 Northern MI																				71	25										7		15	42	118	38	10	4	12		342	
	13 SW MI/I-96																				24	38					2			1		6	3	14	27	113	57	13	1	28		328	
	14 SW MI/I-94																					3	1									3		6	9	16	15		2	9		63	
	15 Lenawee MI																															2				1						3	
OTHER USA, MEXICO	16 Ohio																															17		7	8	34	28	6		9		109	1058
	17 Indiana																				2	2										5		9	6	43	29	7	2	22		129	
	18 Illinois																				3	11							2			10		7	22	164	26	14	2	49		310	
	19 Northwestern USA																					2					2					5	1	10	24	115	42	16	4	75		295	
	20 Erie and Niagara, NY																															2				1						3	
	21 Other Northeast USA																																										
	22 South and Middle Atlantic USA																					1										12	3	1	1	9	3	1		2	1	35	
	23 Eastern KY, TN																															7				8	6			2		22	
	24 MS, AL + Western TN, KY																															3		2		33	10	2	1	9	1	62	
	25 Southwest USA & Mexico																					1										4		2	3	40	15	2		26		93	
ESSEX	26 Windsor																																										
	27 Other WALTS																																										
	28 Amherstburg																																										
	29 Other Essex																																										
	30 Lakeshore (rest of)																																										
OTHER ON	31 Sarnia/Lambton																																										5
	32 Kent County																																										
	33 Elgin + Middlesex Counties																																										
	34 Other SW Ont - SE																																										
	35 Greater Toronto Area																																										
	36 South Central ON																																										
	37 Eastern ON																																										
	38 Northern ON																															2		3								5	
CAN	39 Eastern Canada																																										14
	40 Western Canada																																	3	2	4				5		14	
TOTAL						2													2		201	148	6				6		2	1		118	20	183	214	940	353	90	27	274	2	2588	
										2																358					8								1945		276		

EXHIBIT A.12: 24-HOUR COMMERCIAL VEHICLES CROSSING BLUE WATER BRIDGE TO US

		DESTINATION																																									
		SEMCOG									OTHER MI						OTHER USA, MEXICO										ESSEX					OTHER ON								CAN			
	ORIGIN	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	TOTAL	
SEMCOG	1 Detroit + NE Wayne																																										2
	2 Dearborn + NW Wayne																																										
	3 Wayne S																																										
	4 Macomb																																										
	5 Oakland																																	1								1	
	6 Livingston																																										
	7 Washtenaw																																										
	8 Monroe																																										
	9 Port Huron/St. Clair																																			1						1	
OTHER MI	10 Huron Area																																										
	11 North of SEMCOG - I-75																																										
	12 Northern MI																																										
	13 SW MI / I-96																																										
	14 SW MI / I-94																																										
	15 Lenawee MI																																										
OTHER USA, MEXICO	16 Ohio																																										478
	17 Indiana																																										
	18 Illinios																																										
	19 Northwestern USA																																										
	20 Erie and Niagara, NY	19	10		19	65		2		20		6	67	31	8			7	6	3												2										266	
	21 Other Northeast USA	21	4	12	23	28			2	10		2	33	35	2		1		10	17																						202	
	22 South and Middle Atlantic USA									11																																11	
	23 Eastern KY, TN																																										
	24 MS, AL + Western TN, KY																																										
	25 Southwest USA & Mexico																																										
ESSEX	26 Windsor					1				9										1																						11	11
	27 Other WALTS																																										
	28 Amherstburg																																										
	29 Other Essex																																										
	30 Lakeshore (rest of)																																										
OTHER ON	31 Sarnia/Lambton	10		5	9	6		1	2	13	5		14	7	2	1	25	2	6	5			8	1	7	4																134	2186
	32 Kent County									2	5		4			2			2	2			1																			18	
	33 Elgin + Middlesex Counties	14	2	12	50	23		2		24	2	2	16	41	2		5	8	14	14					3	1																236	
	34 Other SW Ont - SE	8	10		30	24		1	2	11	3	3	27	50	8	1	12	15	18	39			6		8	1															1	278	
	35 Greater Toronto Area	47	9	10	78	66	10	4	3	39	5	10	102	123	19	1	17	71	150	93			9	11	13	14													0		9	908	
	36 South Central ON	15	4		29	35		3		10	4	7	39	43	6	4	30	36	29	51			4	5	13	20															15	400	
	37 Eastern ON	1			9	29				2			11	11	4		9	10	26	31			1		11	1																158	
	38 Northern ON	5			3	5		4					4	2	3		7	3	8	7				1		1																52	
CAN	39 Eastern Canada	2	1	5	17	12	6	2		14		3	40	40	14	2	13	32	87	136			1	4	19	26																476	476
	40 Western Canada																																										
TOTAL		143	40	44	265	296	17	19	9	164	24	33	357	393	69	11	120	184	356	399			30	22	74	70						2		1		1			0		23	3153	
										997						876										1254													4		23		

Partnership of

APPENDIX B:
Literature Review of Existing Models and Forecasts

Prepared by IBI Group for URS Canada

Forecasts for the Ontario-Michigan Border Crossings

Following is a review of the relevant literature on cross-border travel from both a macro-level (i.e. regional travel demand models) and micro-level perspective (i.e. crossing simulations and studies). This includes discussions of the studies and travel demand models that have focused in and around the Ontario-Michigan border as well as other relevant investigations of cross–border activities from within North America.

The EBTC's *Trade And Traffic Across The Eastern U.S.-Canada Border* (1997) studied flows across the eastern US-Canada border in general. The objectives of the study were to:

- Provide a descriptive analysis of past and present trade and traffic flows across eastern border;
- Project future demand;
- Consider the roles of Federal inspection agencies as they affect border crossings;
- Identify short- and long-term infrastructure needs;
- Evaluate alternative criteria for defining international trade and transportation corridors; and
- Identify deficiencies in the data and recommend ways to resolve them.

Low and high trade and traffic forecasts were made for four regions to year 2015 using two autoregressive time-series techniques. The first was a mixed time series-regression model that linked trade growth to forecasted changes in Canadian GDP with robust autoregression, also known as median regression. It included a logarithmic trend model to explain the residual element from the regression. This technique is derived from the autoregressive-integrated-moving average (ARIMA) family of models, typically used by economists to forecast time series data. It provides a conservative estimate of trade growth, as it is relatively insensitive to the effects of outliers, which, in this case, represent periods of high and low trade growth.

The second model forecasted growth rates by commodity group, region and flow direction using moving average autoregression. Thus, each region grew at a rate determined by the composition of its commodities. These growth rates were then constrained to ensure overall growth did not exceed 4%, which is the highest growth forecast for Canadian GDP. This model resulted in optimistic overall growth and was considered to represent the upper limit of forecasts.

Both sets of forecasts assumed that (i) the direction, not the rate, of trends would continue as in the past decade; (ii) the amount of trade between the two countries would be dictated by the Canadian economy; (iii) there would be no major economic shocks; and (iv) the mixture of commodity flows would remain unchanged.

Annual trade flow growth for the Ontario-Michigan region ranged from a low of 3.7% from the US to Canada to a high of 8.7% from Canada to the U.S, with transport equipment, machinery and electronics the principal commodity. Growth forecasts for passenger and truck traffic were not determined explicitly by the models, but rather indirectly as increasing at the same rate as the overall trends observed in the trade forecasts. They ranged by region from 2.0% to 2.5% for passenger vehicles and 4.1% to 7.5% for commercial trucks.

Due to limitations with the data this methodology was not extended to the individual crossing level. Furthermore, the addition of an assignment component to analyse competing crossings was considered beyond the scope of the data available. Instead, historical trends for each crossing were extrapolated, within the constraints of the regional forecasts. This mostly resulted in the continuation of current trends, sometimes to unrealistic levels where recent growth has been high.

The lack of an assignment element to the model leaves it insensitive to policy actions and inactions, particularly regarding infrastructure improvements. The model is also unable to incorporate new trends in the transportation industry, such as the increasing market for inter-modal rail. The study recognizes that the inclusion of these uncertainties would require a high number of alternative model scenarios.

It was concluded that congestion was not an immediate problem due to a recent decrease in auto volumes as well as infrastructure and inspection procedure improvements. However, projected growth would affect cross-border activities in the near future, requiring improved crossing procedures. A series of investment proposals were also defined for immediate, short- and long-term implementation. Specific proposals suggested for the Ontario-Michigan border crossings included:

- Highway crossing projects for both sides, consisting of re-decking the Blue Water Bridge and adding a second span, as well as improving access to the Ambassador Bridge;
- Highway corridor projects for both sides, consisting of physical improvements to I-69, I-75, I-94, 401, 403, 407 and QEW as well as implementation of ITS technologies;
- Rail crossing projects for both sides, consisting of a double-stack tunnel between Detroit and Windsor;
- Rail corridor projects for the Michigan side, consisting of a Detroit freight inter-modal terminal, Detroit-Chicago high speed rail, CN/CP corridor improvements; and
- Marine projects for the Michigan side, consisting of a new lock.

Total costs of implementing these recommendations are estimated at over US$5 billion over the horizon period.

The MTO's *Southwestern Ontario Frontier International Gateway Study* (1998) encompassed the surrounding freeway system and the three main crossings at Sarnia-Port Huron and Windsor-Detroit. The objectives of this study were to:

- Identify the importance of trade and tourism;
- Examine the existing traffic characteristics of the freeways and border crossings in terms of volume and level-of-service;
- Forecast future traffic demand;
- Identify current and future problem areas; and
- Identify possible mitigation/improvement alternatives to satisfy future demand.

A 1997 base year was developed initially from 1993 traffic counts, which were factored up by road section to 1997 levels. Using the findings of the EBTC and other sources, growth forecasts were then developed separately for passenger and commercial vehicles, with commercial vehicles further split into local and international trips. Commercial and passenger vehicles were forecast separately with horizon years 2011 and 2021. Passenger vehicle traffic growth was linked to an increase in tourism, forecast to increase at 2% per annum. Local and inter-provincial commercial vehicles were assumed to grow in line with Canadian and Ontario GDP as well as South-western Ontario population, also at 2% per annum. International commercial traffic, however, was linked to more rapidly growing Canadian exports and imports. Growth for these trips was forecast at a robust 5% per annum.

The 1995 Commercial Vehicle Survey provided respective proportions of trucks in each trip type (i.e. intra- and inter-provincial, international), enabling an average truck growth rate to be developed for each highway. Truck growth on Highway 402 was estimated at 4.25% per annum, and on Highway 401 forecast at 3.65% per annum.

Specific freeway and crossing problem areas were identified in terms of standard level-of-service indicators. These indicated that the Windsor-Detroit gateway, which combines the Ambassador Bridge and Windsor-Detroit Tunnel, would reach capacity around year 2012 and that the Blue Water bridge has adequate capacity to beyond year 2021 following capacity improvements already completed. Short- and long-term recommendations are proposed comprising implementation of ITS technologies and infrastructure improvements consisting mainly of corridor widening. Rail transport is discussed in a historical perspective only.

Concurrently in 1998, the MTO undertook another study of trade issues of both the South-western Ontario and Niagara Gateways. This study incorporated the findings of the EBTC to forecast traffic and commodity flows at each gateway to year 2015. The biggest issue raised concerned accessibility to the Ambassador Bridge, for which there was very little infrastructure on the Michigan side. Thus, the report called for a direct access ramp from I-75 to the Bridge as well as improvements to the I-75 and I-94 corridors close by.

Both of the MTO studies rely heavily on the findings and methodology of the EBTC report. As such, they suffer from the same deficiencies and shortcomings of the data (as identified by the EBTC) as well as the methodology, which is not sensitive to the physical infrastructure supporting the gateway. Furthermore, as aggregate forecasts should only be applied at the aggregate level, it is dangerous to make crossing-specific forecasts and recommendations with such data.

To further the work done in 1997, the EBTC in 2002 acquired new data that allowed for forecasts of truck flows at 22 major truck border crossings. The *Truck Freight Crossing the Canada-U.S. Border* study set up 40 data collection sites located at the US-Canada border crossings attaining 97% of cross-border truck flows. The information in the report examined origin and destination, major Canada-US truck freight routes, commodity classification, weight and value and truck volumes by state/province and major border crossing.

The study discovered that trade was growing at a faster rate compared to truck volumes suggesting that alternative modes such as rail and intermodal traffic was increasing at a higher rate than trucking. Therefore, rather than using trade forecasts, the *Truck Freight Crossing the Canada-U.S. Border* study used a method, which forecasted truck volumes directly at major crossings. This was accomplished by fitting linear regressions to the time series 3 to 5 year moving average. The models fit the data well, in most cases meeting or exceeding the original time series analysis of trade by commodity.

Findings show that although growth will be greatest in the Pacific Northwest in terms of rate, the absolute truck volumes will be highest in the Niagara and South-western Gateways. The crossing between Ontario to New York and Michigan will increase by 60% or by 5.5 million trucks per year over 20 years.

Truck traffic is expected to almost double in the next 20 years between Maine and New Brunswick crossings. The St. Stephen-Calais crossing is expected to increase from 239,508 trucks in 2000 to 482,000 trucks in 2020. This represents an annual average growth rate of 5.5%.

The slowest growth rate is expected in the crossings connecting Quebec to Vermont and Northern New York where annual growth rates will average from 1% to 2.4% per year.

The study concluded that the six highest volume truck crossings in descending order are the Ambassador Bridge, Blue Water Bridge, Peace Bridge, Queenston-Lewiston Bridge, Douglas-Blaine, and the Lacolle-Champlain Bridge. These crossings were reported to handle three quarters of the truck trips.

In 1999, the Ambassador Bridge was the busiest crossing carrying over 3.4 million truck trips with the commodity group, electronics, vehicles, and precision goods representing 23% of the flows entering the US and 24% of the flows entering Canada. Michigan, Ohio, Illinois and Indiana accounted for three-quarters of the truck trips entering Canada with 42% of the truck trips originating in Michigan. The forecasted annual growth rate at the Ambassador Bridge is 2.2% with truck volumes increasing from 3,486,110 in 2000 to 5,051,000 in 2020.

The Detroit-Windsor Tunnel serves local traffic between Detroit and Windsor with a majority or 93% of the truck trips destined to Michigan. The metal products and machinery represented the highest commodity group with 21% of the truck flows entering the US and 34% of the truck flows entering Canada. As a result of the large decline in truck traffic from 1950, the forecasted volumes for the Detroit-Windsor Tunnel were based on the operator projection. A 0.5% annual growth rate was used increasing the truck traffic to 187,000 in 2020.

In 1999, the Blue Water Bridge was the second busiest truck crossing carrying 1.5 million trucks. Approximately 21% of the flows entering the U.S and 24% of the flows entering Canada were related to the electronics, vehicles, and precision goods commodity group. For the 90% of trucks originating in Ontario, 50% were destined to Michigan, 12% to Illinois, 5% to Texas and California and the remaining were destined to other Midwest states. The 2000 truck volume of 1,576,839 is forecasted to grow at an annual growth rate of 4.3%, which would increase the truck volume to 2,944,000 in 2020.

The study also notes that the forecasts are still more accurate at the state/provincial level than by crossing, as the method still neglects to capture all of the factors unique to each crossing that will affect their future truck volumes. In some instances data was limited to 9 and 10 years versus 21 to 32 years and therefore for the crossings with fewer than 20 years of data the forecasts are not as reliable. Such is not the case for the Ontario-Michigan crossings where 22 years of data was available.

Forecasts for Other Eastern US-Canada Border Crossings

The NYSDOT's *Northern New York Border Crossing Study* (1998) investigated current and future performance at several New York State-Ontario/Quebec border crossings. The objectives consisted of the following:

- Determining travel patterns and growth around the crossings;
- Determining the causes and degree of congestion and delays;
- Forecasting the short- and long-term effects of growth;
- Quantifying the economic importance to the State and the nation; and
- Identifying short- and long-term mitigation measures and strategies to accommodate the growth.

High and low demand forecasts of passenger and commercial vehicles for each crossing were made to year 2021 using time series techniques. These forecasts were used to assess the capacity needs for each corridor, also considering vehicle processing times. From these needs a series of recommendations were made. One of the key recommendations was that customs and immigration could be improved with pre-clearance technology and the sharing of border facilities. It was also believed processing times could be reduced, considering the large variation in processing time currently between crossings. Where toll collection is a constraint, transponder technology could ease congestion.

The study also indicated that existing capacity could be used more efficiently. The diversion of truck to rail would achieve this, although its contribution was not considered significant due to the low proportion of long trips. However, a more equitable distribution of traffic among the four crossings and bridge geometric improvements were believed to be more effective.

The Economic Importance of the Peace Bridge (O'Dell 2000) considered truck volumes on the bridge in terms of current and future capacity. The economic growth in trade was the driver, defined as increases in Ontario's exports as a percent share of Ontario's GDP to year 2021. The forecasts assume that:

- The bridge's share of imports/exports remains unchanged;
- The bridge's capacity is that of the current volume;
- Auto growth will be absorbed by increases in capacity and processing technologies; and
- There will be no effects from other crossings.

Three scenarios were developed, assuming a one-third, two-thirds and equal growth relative to that occurring from 1981 to 1998, resulting in annual traffic growth rates of 3.6%, 4.4% and 5.0%, respectively. Findings indicated that the bridge is already over capacity and that level-of-service is expected to deteriorate until a proposed twin bridge is completed.

The International Bridge Authority of Michigan in their *International Bridge at Sault Ste. Marie: Traffic and Revenue Forecasts* (1994) undertook a study of the Sault Ste. Marie crossing to determine traffic and revenue forecasts to year 2014. Traffic volume was forecasted for six vehicle types based on relationships with the growth of factors including population and employment, gas prices, the exchange rate and Ontario GDP. Rail and shipping's contribution was also included. Given an increasingly unified North American economy and a more balanced pricing of goods, overall annual growth to year 2014 was projected to grow more slowly than in the recent past at rates of 0.44% for passenger vehicles and 3.0% for commercial vehicles.

Travel Demand Models of Areas Adjacent to the Ontario-Michigan Border

The MTO's *Value of Goods Transported by Truck in Ontario* (1997) used their 1995 Commercial Vehicle Survey to assign truck travel in Ontario. The survey contains information about the vehicle, driver, carrier and commodity characteristics as well as detailed trip data. As the surveys were mostly carried out between urban nodes, rather than at the customs staging areas, trips terminating at locations near to the border were not captured. Canada customs and bridge authority counts were used to recalibrate these trips.

Flows were developed for the 5,000 links of the provincial highway system using standard route assignment techniques and background passenger volumes. Following the assignment, the economic importance of each link and corridor was then determined by assigning a value to the commodity being transported by each truck. The importance of border crossings was also identified in the same manner. The model was then used to forecast year 2021 commodity flows using industrial sector output projections.

Michigan's Statewide Travel Demand Model (MDOT, 1998) incorporates urban area models into their four-stage model. It is comprised of 2,307 internal and 85 external zones (representing other states, Canada and Mexico) and simulates the highway system using over 13,000 links.

Trip generation is developed using a cross-classification model with 5 trip purposes. The number of trips is dependent on household size and income. The gravity model used for distribution is calibrated from the National Personal Travel Survey. Mode share is incorporated as a cross-classification model, although a network-based mode share model incorporating comparative costs of modes is under development.

Truck flows are determined separately from customs data, surveys, US input-output accounting and the 1993 National Commodity Survey. This model develops international and domestic data and outputs the flow of commodities in terms of tons, dollars and trucks.

Passenger and commercial vehicle flows are then combined for the network assignment. This uses an all-or-nothing assignment method, as congestion is not considered significant in route choice in rural areas.

The City of Windsor's *Windsor Area Long Range Transportation Study* (1999) prepared a transportation model that included the effects of cross-border traffic. The model was calibrated using 1997 household survey data with forecasts made to year 2016.

The household survey data was augmented by two further surveys, a cordon survey and a border crossing survey. These allowed through traffic to be accurately described, and provide good linkage with nearby models such as that of SEMCOG.

The model predicts PM peak-hour traffic volumes through a traditional four-stage process that utilizes 464 internal and 43 external zones, including 30 US zones. Three trip purpose trip rates were developed for internal zones, based on population and employment. While trip rates were developed for external areas, several explicit vehicle growth scenarios were developed to determine the performance of the road network. Problem links were identified under the heavier scenarios, involving the supporting roads and the border crossings themselves.

The study produced a transportation master plan developed through public consultation and the model's forecasts. Improvements are focused on the local area, but they also recognize the importance of the City as a throughway for truck traffic. Thus, additional attention is given to improving connections from the crossings to the highway infrastructure.

The SEMCOG's *Structure And Implementation Of The Regional Travel Forecasting Model For Southeast Michigan* (2000) developed a model for southeast Michigan and the Detroit metropolitan area using their 1994 Household-Based Person Trip Survey.

This is also a four-stage complete model, although external trips are added exogenously. Trips are generated for 6 trip purposes using cross-classification, and distributed according to friction factors from the 1994 survey. Modal split factors are partly derived from the survey, but also include transit observations. Although the model was calibrated using 24-hour observations, a PM peak-hour model has also been developed using factors derived from the 1994 survey.

The focus is on passenger travel, although a simple cross-classification truck model is included. Unlike Michigan's statewide and Windsor's municipal model, however, there is no consideration of international cross-border travel effects.

Other Relevant Studies of Cross-Border Activities

In the wake of free trade, the development of international cross-border trade and travel demand forecasting methods has become more important. As a result, several other studies have looked at various topics and techniques in an attempt to capture the unique aspects of border crossings. Below is discussion of a wide range of studies relevant to this study's objective.

Paselk and Mannering (1993) used hazard-duration models to estimate traffic delays at four US-Canada crossings. This approach was utilised to account for stated inadequacies of standard queuing analysis techniques, which do not capture the "duration dependence" of waiting in a queue. Wait time was chosen as the dependent variable, as opposed to the total delay from wait and service times. Independent variables consisted of various crossing attributes such as the number of open lanes and average service time. These were chosen so as to be measurable by standard vehicle detection technology. A range of model formulations was tested with results varying by model formulation and the input variables used.

Fang *et al.* (1996) developed an aggregate logit model of simultaneous mode and destination choice for truck and rail shipments of machinery, electronics and automobiles from the US to Mexico. Models incorporating both discrete and pooled origins (i.e. representative cities and the country as a whole) were tested. Explanatory variables included measures of distance and value of the shipment by mode as well as destination characteristics of population, employment and the number of firms. Results showed that the discrete origin models predicted better, with rho-square values of around 0.5.

Christie (2000) modelled regional and international flows of combined passenger and truck traffic based on origin/destination count data from 1979. He used a gravity model with population as an attractor and travel time as an impedance. Although the model predicted well for base year data, forecasts to year 1997 revealed some shortcomings. Plans to improve model performance include incorporating more socio-demographic factors, disaggregating the zone system and separating the two traffic types.

Figliozzi *et al.* (2001) estimated truck flows across the Texas-Mexico border resulting from international trade. The authors took two different approaches. The first modified actual truck counts based on correction factors that accounted for empty and local trucks as well as inter-modal travel to determine volumes using a standardized value called the Equivalent Trade Truck (ETT). The second approach calculated the same as a direct result of trade commodity densities and volumes, rather than extrapolating past truck flow rates as is commonly practiced. That is, the physical characteristics of each commodity type as well as standard truck capacities (i.e. of maximum volume and weight) were used to calculate the number of trucks required for transport. In this way, it was shown that trade forecasts can be used directly for the estimation of truck traffic.

Ashur *et al.* (2001) developed a microsimulation model of a crossing from El Paso, Texas into Mexico. Their objectives were to: estimate queue lengths and crossing times; analyse the efficiency of operations; identify bottlenecks; quantify traffic impacts on adjacent infrastructure; and make recommendations for more efficient operations. The main inputs to the model consisted of inter-arrival and service times in addition to traffic counts and the percentage of trucks. The times were fitted to exponential distributions for use in the simulator. Once validated, the model was used to test scenarios that varied in vehicle processing characteristics and traffic volume. Some of these revealed possible future facility deficiencies in terms of an estimated maximum queue length capacity.

Finally, Lin and Lin (2001) modelled traffic delays at three New York border crossings. The model was developed using a microsimulation of the crossings as a guide. The dependent variable is average approach delay, which is equal to the actual travel time through the crossing minus the free flow travel time to a point just after the plaza booth. The acceleration of the vehicle after the booth is determined separately and can be combined with the approach delay to evaluate the total delay. Independent variables include the vehicle processing rate, analysis time period, volume to capacity ratio, number of available gates and calibration factors. Estimated values from the model were compared to those of the simulator and were usually within 10 percent.

Summary

In reviewing the preceding studies, a common theme is apparent. All conclude that although the physical infrastructure in place at crossings throughout the eastern US-Canada border (and, indeed, all of North America) is currently sufficient, it will not be within the 20-year planning horizons typically investigated in each. In fact, many predict capacity problems to arise within much shorter time periods. This is generally the consequence of forecasted annual average growth rates of 1 to 3 percent for passenger traffic and 2 to 5 percent for truck traffic, which themselves are the result of forecasted increases to population, employment, trade and tourism on both sides of the border. The problem is compounded when considering that traffic from commercial trucks, which places a much greater burden on crossing infrastructure and processing procedures than passenger vehicles, has and will be increasing its share of the total volume at crossings as indicated by the recent trends and growth forecasts. By and large, all recommendations call for improvements to the capacity of these crossings through the construction or rehabilitation of the physical infrastructure as well as through the implementation of faster processing procedures and technology. The latter has gained an increased importance given recent events.

The techniques employed by these studies have tended to focus on a single or limited number of transport modes as well as on only one side of the border. All models treat the other side of the border as 'external'; thus, there is no comprehensive cross-border travel model for the south-western gateway that considers the physical infrastructure of both sides in addition to that of the connecting crossings to determine the auto, bus, commercial truck and rail (freight and passenger) traffic flows. The historical trend and extrapolation analyses consider multiple modes while failing to capture large-scale infrastructure effects, apart, perhaps, from those of the specific crossings. Even then, consideration of crossing infrastructure effects are crude and appear to be handled much better by the microsimulations. Also, while these methods are probably appropriate for short-range forecasting, in which the observed trend being used can be expected to hold barring major disruptions, they are likely inappropriate for long-range forecasting. Here, forecasts should be made incorporating the direct determinants of growth. For passenger travel, population and employment growth is the commonly accepted determinant. Likewise, commercial traffic should be forecast as a direct function of forecasted economic and trade growth, rather than indirectly from assumed rates based on these analyses, as appears to be the common approach. On the other hand, the travel demand models forecast down to the transportation link level, but only on one side of the border and only for passenger vehicle and commercial truck modes of transport. It must be acknowledged, however, that data on commercial truck travel are sparse and that for rail practically non-existent. This recognition leads many to also recommend investment in data gathering for these modes.

Thus, there exists the requirement for a comprehensive model that captures socio-economic and physical infrastructure effects on both sides of the border. The 1997 EBTC report proposes that such a model would incorporate:

- Sensitivity to changes in investment in infrastructure serving travel between the countries, as well as changes to government policies and technological advancements;
- The ability to model both person and commercial travel across the border over a 20-year horizon;
- The ability to express freight movement in dollar, weight and truckload values;
- The ability to express person movements in person and vehicle equivalents;
- The ability to model changes in mode share; and
- The ability to model person and commercial travel by port of entry and, if possible, individual crossing.

The preceding studies have each considered at least one of these components with varying success, but none have managed all. The opportunity exists to merge some of the newer concepts into a combined micro- and macro-level model so as to capture as many of these factors as possible.

References

Ashur, S., J. Weissmann, S. Perez and A. Weissmann (2001). *Traffic Simulation at International Ports of Entry*. Transportation Research Record (1763), pp. 48-56.

Christie, J. (2000). *Regional and Extra-Regional Highway Traffic in Atlantic Canada: A Review and Preliminary Model*. In CTRF 2000 Proceedings, Vol. 2, Proceedings of the 35th Annual CTRF Conference, Charlottetown, PEI, June 4-7, 2000.

City of Windsor (1999). *Windsor Area Long Range Transportation Study: Final Report*. Prepared by Stantec Consulting Limited.

EBTC (1997). *Trade and Traffic Across the Eastern US-Canada Border*. Prepared by Parsons Brinckerhoff Quade & Douglas Incorporated.

EBTC (2002). *Truck Freight Crossing the Canada-U.S. Border*. Prepared by Parsons Brinckerhoff Quade & Douglas Incorporated.

Fang, Y., R. Harrison and H. Mahmassani (1996). *Forecasting Freight Traffic Between the U.S. and Mexico*. Research Report CTR 1319-2, Federal Highway Administration.

Figliozzi, M., R. Harrison and J.P. McCray (2001). *Estimating Texas-Mexico North American Free Trade Agreement Truck Volumes*. Transportation Research Record (1763), pp. 42-47.

International Bridge Authority of Michigan (1994). *International Bridge at Sault Ste. Marie: Traffic and Revenue Forecasts*. Prepared by URS Consultants Incorporated.

Lin and Lin (2001). *Modelling Traffic Delays at Northern New York Border Crossings*. Journal of Transportation Engineering, Vol. 127(6), pp. 540-545.

MDOT (1998). *Michigan's Statewide Travel Demand Model*.

MTO (1998a). *Southwestern Ontario Frontier Gateway Study*. Prepared by McCormick Rankin Corporation.

MTO (1998b). *Trade Issues at Ontario's International Gateways*. Prepared by Parsons Brinckerhoff Quade & Douglas Incorporated.

MTO (1997). *Value of Goods Transported by Truck in Ontario*.

NYSDOT (1998). *Northern New York Border Crossing Study*. Prepared by The Sear-Brown Group Incorporated.

Paselk, T. and F. Mannering (1993). *Use of Duration Models for Predicting Vehicular Delay at U.S./Canadian Border Crossings*. Paper presented at the 72nd Annual Meeting of the Transportation Research Board, Washington, D.C., January 10-14, 1993.

Robert O'Dell Management and Strategic Projections Incorporated (2000). *The Economic Importance of the Peace Bridge*.

SEMCOG (2000). Structure and Implementation of the Regional Travel Forecasting Model for Southeast Michigan. Prepared by Parsons Brinckerhoff Quade & Douglas Incorporated.

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APPENDIX C:

Multivariate Regression Analysis and Time Series Trend Analysis

Prepared by IBI Group for URS Canada

Introduction

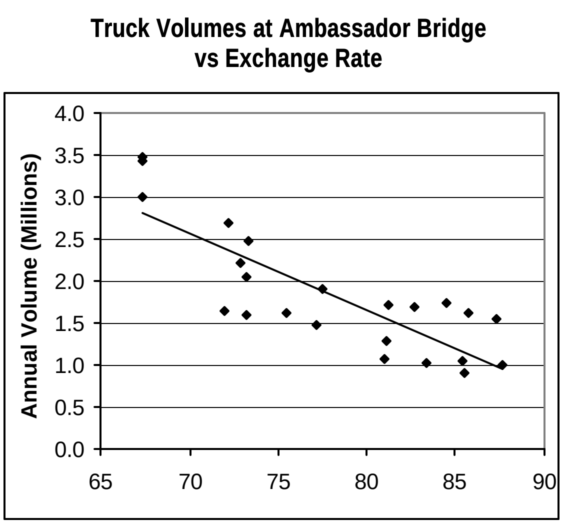
In addition to the Base Case forecast methods used for the final cross-border demand forecasts, two other forecasting methods were applied to the data in order to develop comparisons. Both of these were regression analyses, one a multivariate regression analysis and the other a time series trend analysis. The general approach and results are presented below.

Multivariate Regression Analysis

Multivariate regression analysis relates the dependent variable to a set of independent, or explanatory, variables. The first step in this type of analysis is hypothesizing what variables will explain the behaviour observed in the data; that is, there should be some logical explanation as to why and how an independent variable will affect the dependent variable. These hypotheses are most commonly tested using scatter plots. Exhibit C1 shows the relationship between annual crossing volumes and various explanatory variables thought to affect same-day and overnight passenger cars as well as trucks.

The relationships are clear in most cases. All relationships are as expected except overnight trips on the Detroit-Windsor Tunnel, for which trips have been steadily declining.

EXHIBIT C.1: SCATTER PLOTS OF VEHICLE VOLUMES VERSUS EXPLANATORY VARIABLES



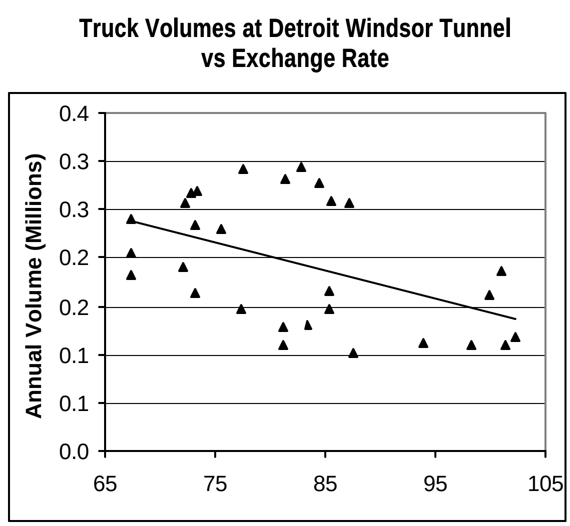
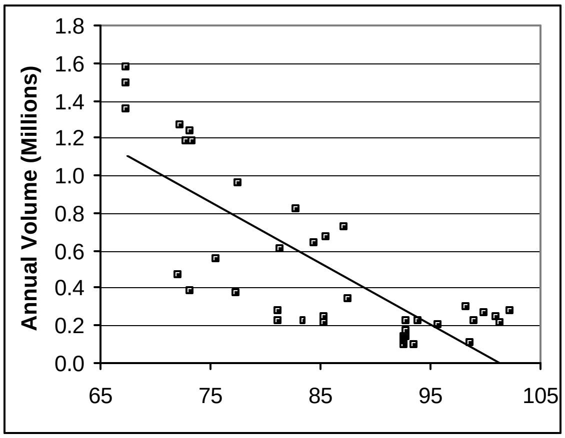
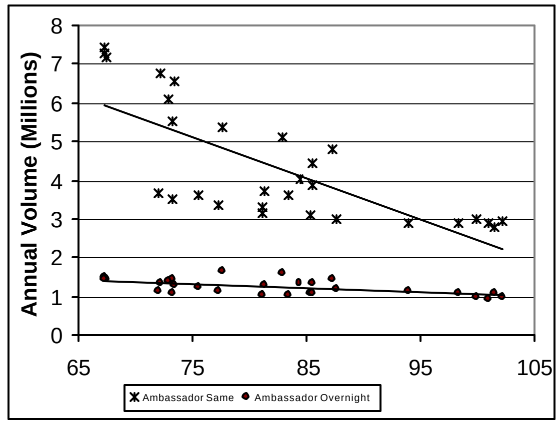


EXHIBIT C.1: SCATTER PLOTS OF VEHICLE VOLUMES VERSUS EXPLANATORY VARIABLES (CONT.)

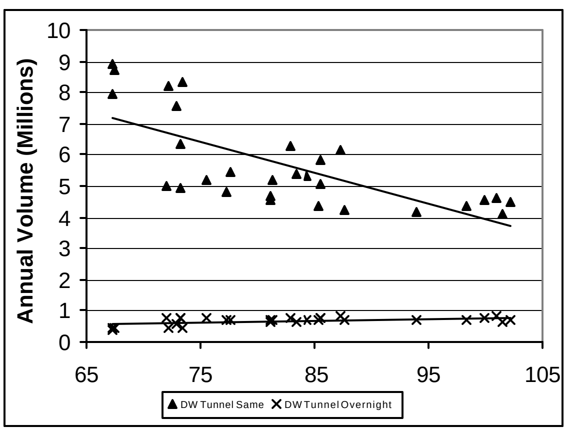
Truck Volumes at Blue Water Bridge vs Exchange Rate



Passenger Car Volumes at Ambassador Bridge vs Exchange Rate



Passenger Car Volumes at Detroit Windsor Tunnel vs Exchange Rate



Passenger Car Volumes at Blue Water Bridge vs Exchange Rate

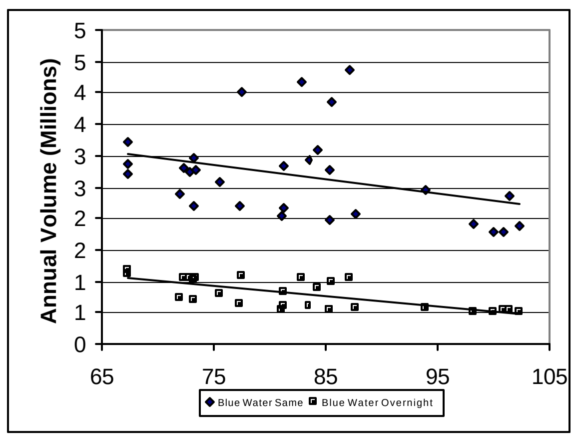
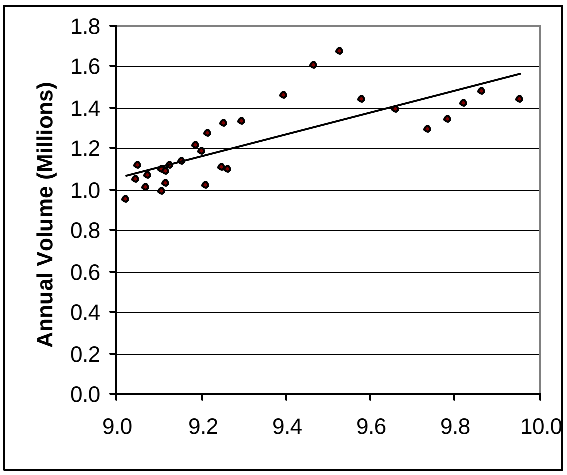
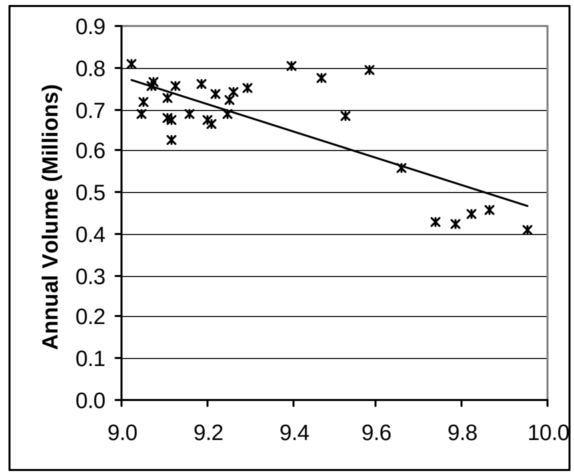


EXHIBIT C.1: SCATTER PLOTS OF VEHICLE VOLUMES VERSUS EXPLANATORY VARIABLES (CONT.)

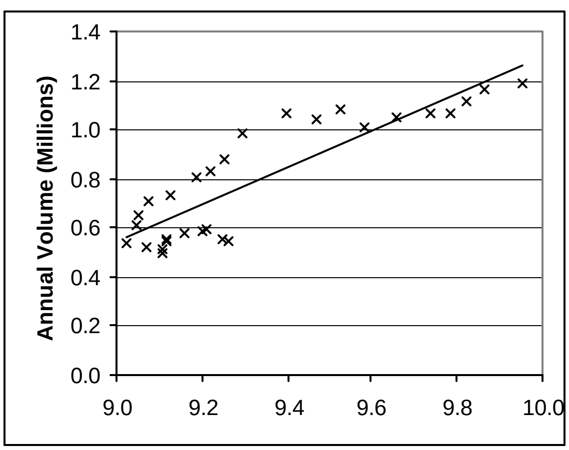
Passenger Car Volumes at Ambassador Bridge vs Michigan Population



Passenger Car Volumes at Detroit Windsor Tunnel vs Michigan Population



Passenger Car Volumes at Blue Water Bridge vs Michigan Population



Passenger Car Volumes at Ambassador Bridge vs Michigan Employment

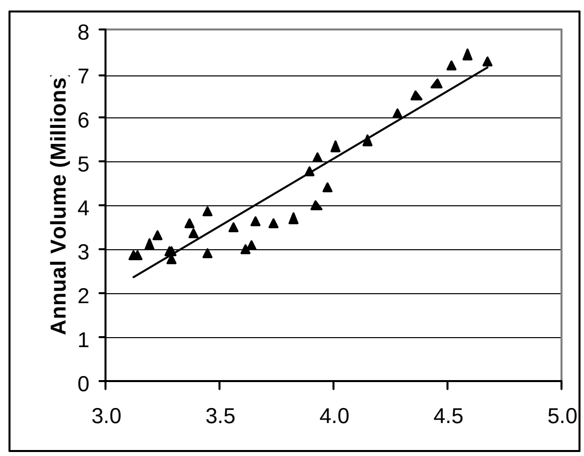
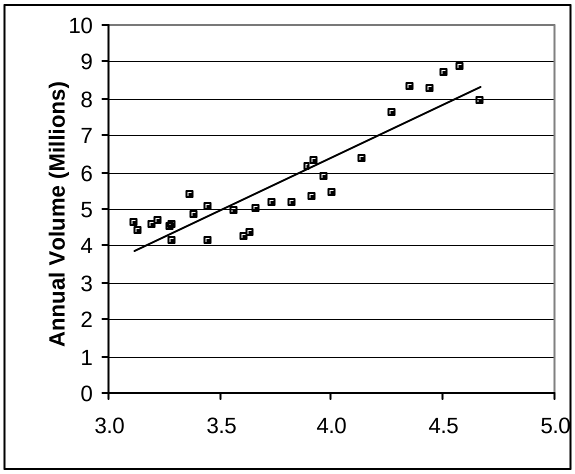
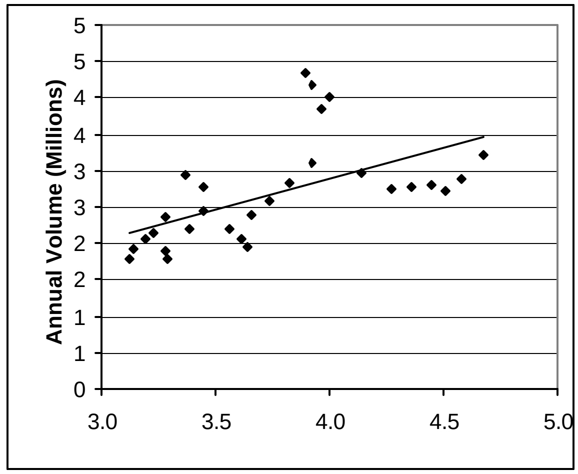


EXHIBIT C.1: SCATTER PLOTS OF VEHICLE VOLUMES VERSUS EXPLANATORY VARIABLES (CONT.)

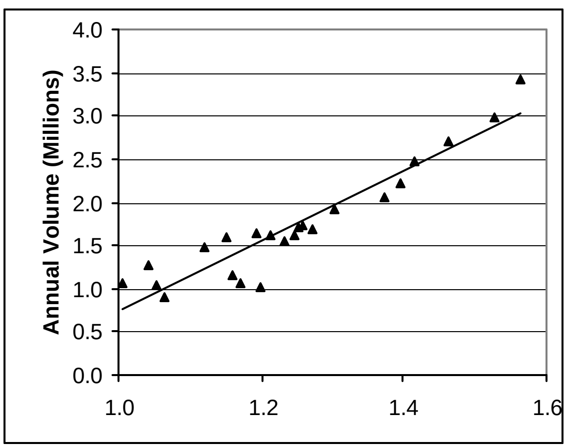
Passenger Car Volumes at Detroit Windsor Tunnel vs Michigan Employment



Passenger Car Volumes at Blue Water Bridge vs Michigan Employment



Truck Volumes at Ambassador Bridge vs Great Lakes GDP



Truck Volumes at Detroit Windsor Tunnel vs Great Lakes GDP

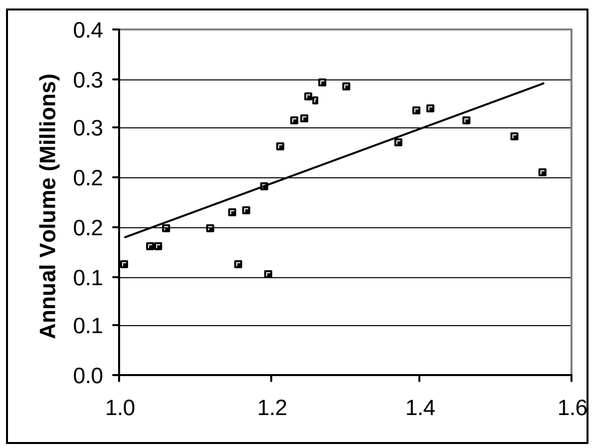
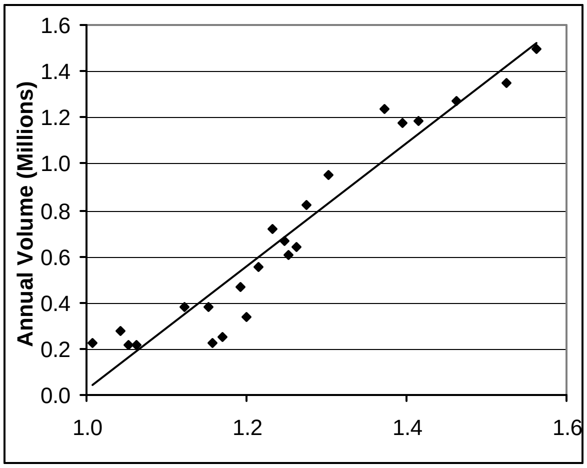
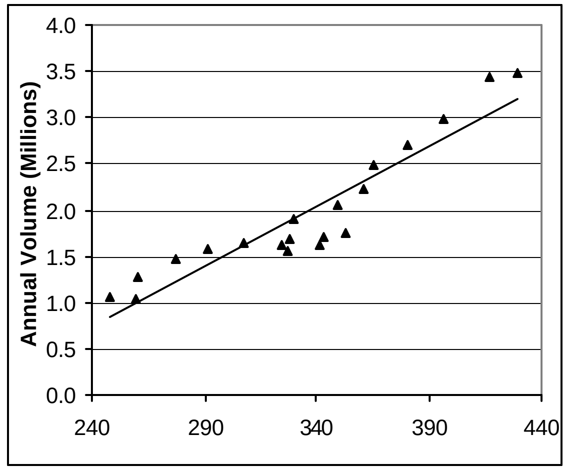


EXHIBIT C.1: SCATTER PLOTS OF VEHICLE VOLUMES VERSUS EXPLANATORY VARIABLES (CONT.)

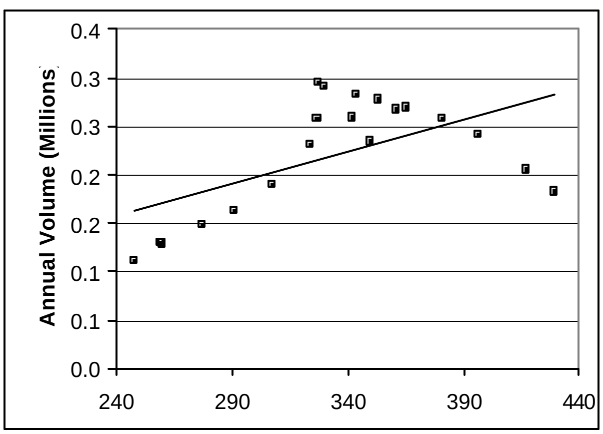
Truck Volumes at Blue Water Bridge vs Great Lakes GDP



Truck Volumes at Ambassador Bridge vs Ontario GDP



Truck Volumes at Detroit Windsor Tunnel vs Ontario GDP



Truck Volumes at Blue Water Bridge vs Ontario GDP

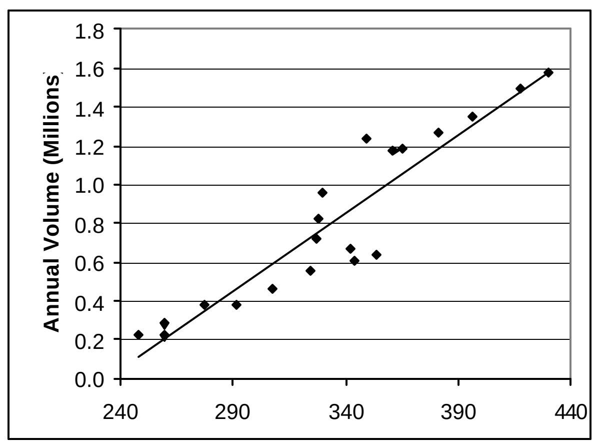
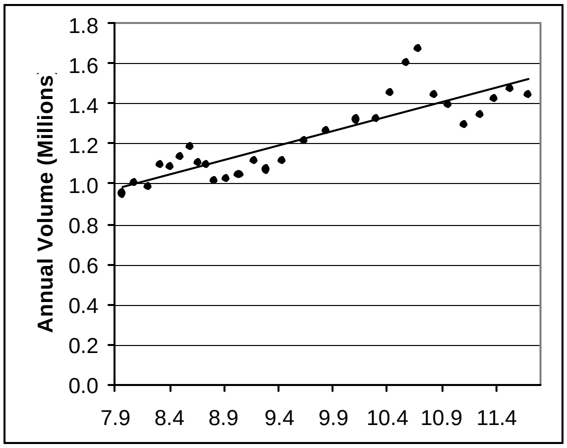
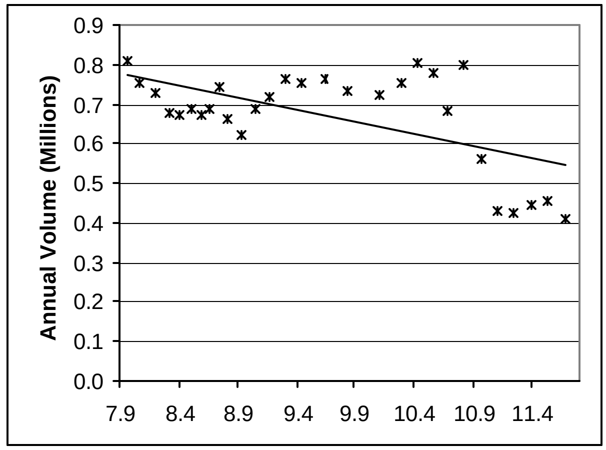


EXHIBIT C.1: SCATTER PLOTS OF VEHICLE VOLUMES VERSUS EXPLANATORY VARIABLES (CONT.)

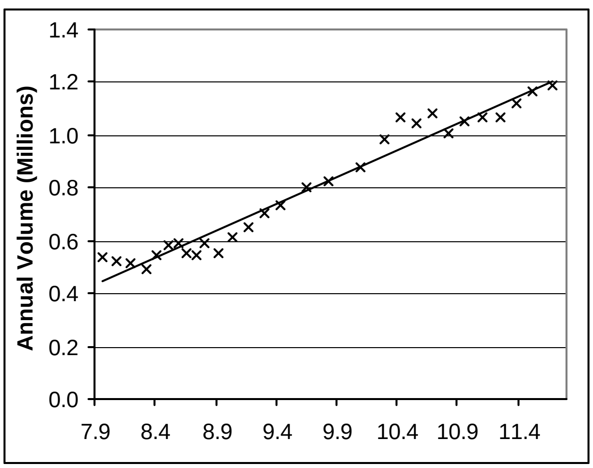
Passenger Car Volumes at Ambassador Bridge vs Ontario Population



Passenger Car Volumes at Detroit Windsor Bridge vs Ontario Population



Passenger Car Volumes at Blue Water Bridge vs Ontario Population



Once these relationships have been established, regression models can be developed based on the forecasted values and behaviour of the explanatory variables. If these were not available, they were developed from Ordinary Least Squares time series regressions (see next section). Exhibit C2 shows the estimated coefficients for each model. All explanatory variable coefficients are statistically significant (i.e. pass a one-tailed t-test). A suitable model was not developed for overnight passenger cars on the Detroit-Windsor Tunnel.

The models consist of various combinations of independent variables including a constant, the exchange rate, the sum of the populations of Michigan and Ontario, Michigan employment, the sum of the GDP's of the Great Lakes States (Michigan, Ohio, Indiana, Illinois and Wisconsin) and Ontario and a dummy variable (equal to 0 or 1) indicating whether the Windsor Casino was open in that year or not. The dependent variable is the annual volume.

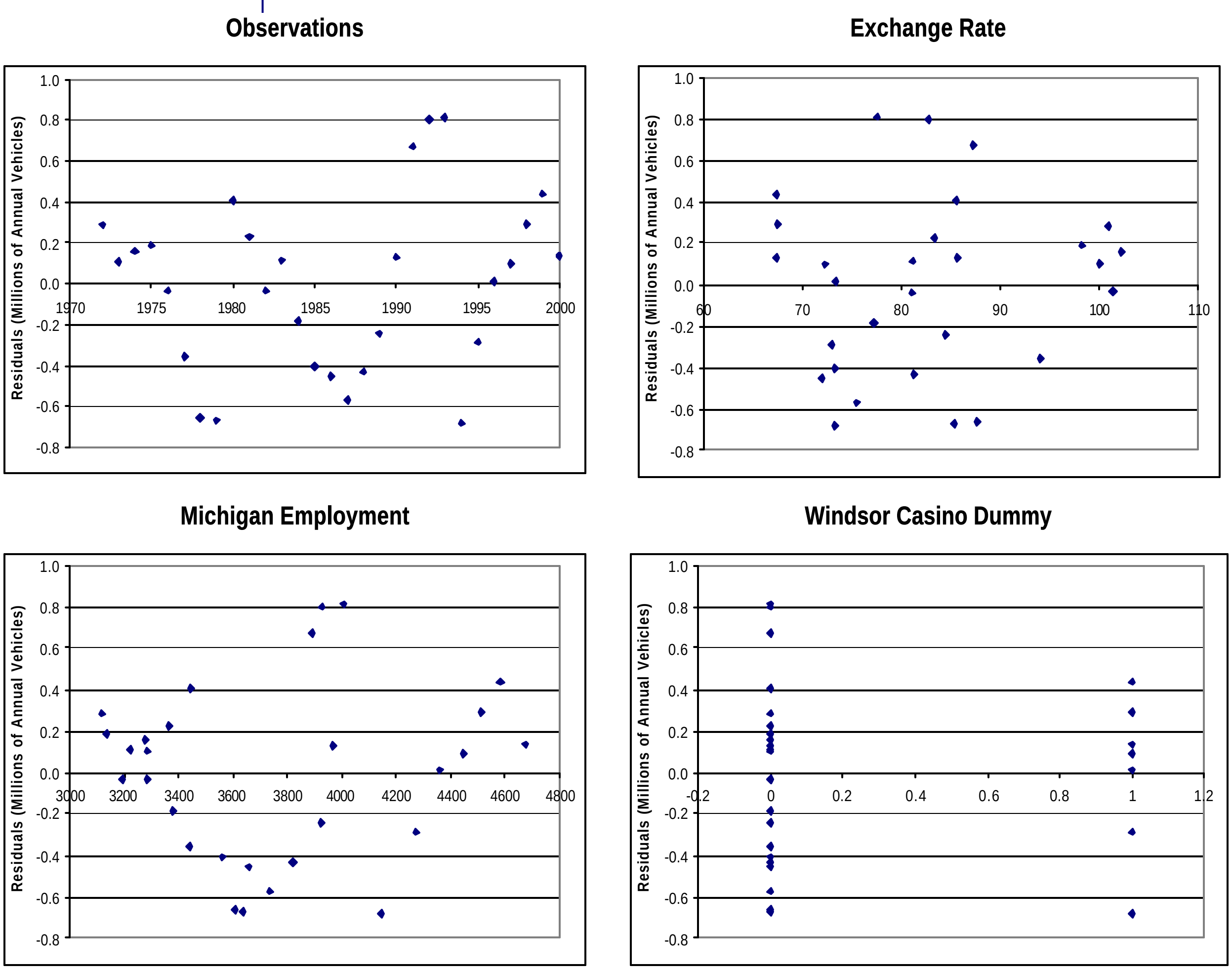
In general, same-day trips, geared towards commuting and shopping purposes, are hypothesized to be related to the exchange rate, Michigan employment (given the relatively large amount of commuting from Windsor into Detroit) and the Windsor Casino. Overnight trips, geared towards vacation trips, are hypothesized to be affected by the exchange rate and the population of Ontario and Michigan. Truck trips are affected by the exchange rate and the GDP's of Ontario and the Great Lakes.

EXHIBIT C.2: ESTIMATED EXPLANATORY VARIABLE COEFFICIENTS FOR MULTIVARIATE REGRESSIONS

Crossing	Vehicle Type	Constant	Exchange Rate (US cents)	Sum of MI/ON Pop (1000s)	Michigan Emp (1000s)	Sum of GL/ON GDP's (2000 $CAN/US x 10^6)	Windsor Casino Dummy	Adjusted R^2
Ambassador	Car Same-day		-23355		1312		1317639	92%
	Car Overnight		-3249	78.98				64%
	Truck		-25684			2.500		95%
D-W Tunnel	Car Same-day				1158		1801493	89%
	Car Overnight							n/a
	Truck	-76484				0.194		40%
Blue Water	Car Same-day	-452964			691.8			28%
	Car Overnight		-9471	83.10				81%
	Truck		-19225			1.461		89%

The models range in goodness-of-fit but the majority exhibit good measures of adjusted R^2, particularly for multivariate regression models. As another model validation, regression residual analyses were also completed. None of the explanatory variables were transformed and all relationships were assumed linear. Plots of the residuals (i.e. the difference between actual and predicted values of the dependent variable) help to determine whether this specification is appropriate. This is confirmed if the residuals are evenly distributed about the x-axis across all observations and explanatory variables (i.e. the residual variance is constant, or homoskedastic) . Exhibit C3 presents residual plots for same-day volumes on the Ambassador Bridge across observations and for the three explanatory variables used in this model. As can be seen, the residual variances are reasonably even in all cases. Thus, the model specification produces homoskedastic results and is therefore acceptable.

EXHIBIT C.3: REGRESSION RESIDUALS FOR AMBASSADOR BRIDGE SAME-DAY PASSENGER CARS



The forecasted annual volumes are presented in Exhibit C4. As a multivariate model was not developed for overnight trips on the Detroit-Windsor Tunnel, time series results for these were used to obtain total passenger car forecasts.

EXHIBIT C.4: MULTIVARIATE REGRESSION ANALYSIS RESULTS (1000S)

Crossing	Vehicle Type	2000	2010	2020	2030	Overall Growth (2000-2030)	Avg. Ann. Growth (2000-2030)
Ambassador	Pass. Cars	8,734	9,294	9,548	9,691	11.0%	0.35%
	Trucks	3,486	4,652	5,989	7,416	112.7%	2.55%
	Total	12,220	13,946	15,537	17,107	40.0%	1.13%
D-W Tunnel	Pass. Cars	8,368	9,427	9,699	9,788	17.0%	0.52%
	Trucks	182	424	545	667	266.3%	4.42%
	Total	8,550	9,850	10,244	10,455	22.3%	0.67%
Ambassador & D-W Tunnel	Pass. Cars	17,102	18,721	19,248	19,479	13.9%	0.43%
	Trucks	3,668	5,076	6,534	8,083	120.4%	2.67%
	Total	20,770	23,796	25,782	27,562	32.7%	0.95%
Blue Water	Pass. Cars	4,390	5,035	5,275	5,440	23.9%	0.72%
	Trucks	1,577	2,421	3,164	3,974	152.0%	3.13%
	Total	5,967	7,456	8,439	9,415	57.8%	1.53%
Gateway Total	Pass. Cars	21,492	23,756	24,523	24,919	15.9%	0.49%
	Trucks	5,245	7,497	9,698	12,057	129.9%	2.81%
	Total	26,737	31,252	34,221	36,976	38.3%	1.09%

Time Series Trend Analysis

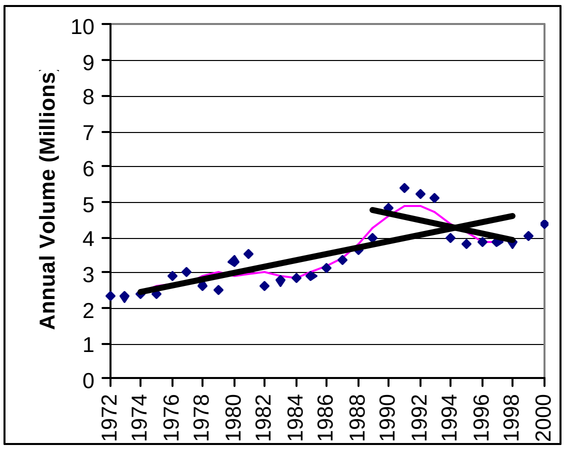
Time series regression analysis involves the regression of data against time rather than against a set of explanatory variables; in effect, time is the sole independent variable, explaining the trend that is exhibited by the data. Forecasting of the data by this method involves fitting a line (or other shape, depending on the theorized behaviour of the variable) to it and extending it forward to the forecast year. This is most commonly accomplished using Ordinary Least Squares regression. More sophisticated methods, however, can also be applied. A moving average is commonly applied to the data to reduce the effect of outlying data points that represent extreme events in the behaviour of the variable, the effects of which should not be imposed on the overall trend.

Five-year moving averages were applied to the data and a regression line fitted to these. This approach resembles that taken by the EBTC in their forecasts of trucks crossing the Canada-US border, however longer time series were available for this analysis so the results are somewhat different. Two forecasts were made based on trends observed in data spanning the 1972 to 2000 time period. These consist of a 25-year trend and a 10-year trend.

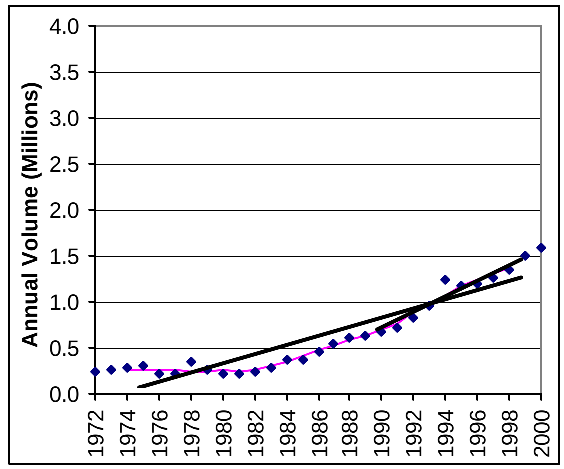
The results of these analyses are presented in Exhibit C5. The regression parameters of the lines fitted to the data (as $y = ax + b$) are shown in Exhibit C6. Again, all explanatory variable parameters are statistically significant. Here, the independent variable (x) is the year and the dependent variable (y) is the number of annual vehicles, in thousands. As can be seen, the goodness-of-fit is quite high for most of the models.

EXHIBIT C.5: 10-YEAR AND 25-YEAR TIME SERIES TREND ANALYSIS OF PASSENGER CAR AND TRUCK VOLUMES BY CROSSING

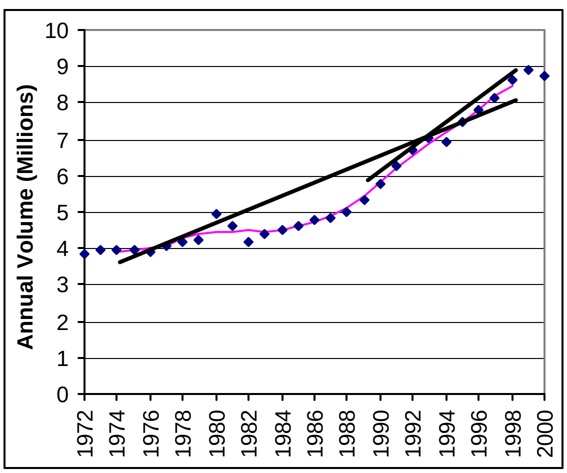
Blue Water Bridge, Passenger Car



Blue Water Bridge, Truck



Ambassador Bridge, Passenger Car



Ambassador Bridge, Truck

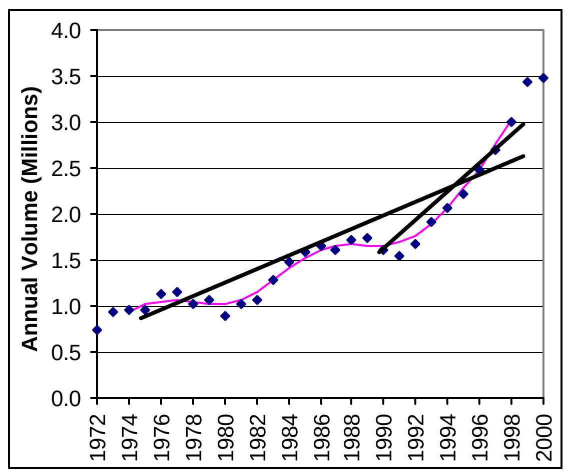
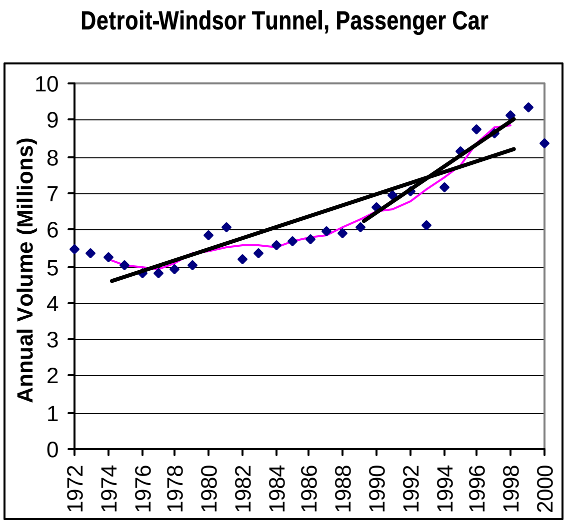


EXHIBIT C.5: 10-YEAR AND 25-YEAR TIME SERIES TREND ANALYSIS OF PASSENGER CAR AND TRUCK VOLUMES BY CROSSING (CONT.)



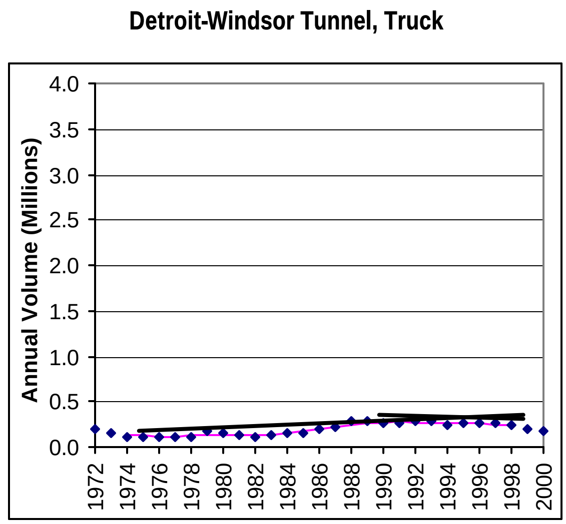


EXHIBIT C.6: 10-YEAR AND 25-YEAR TIME SERIES TREND ANALYSIS REGRESSION EQUATIONS

Crossing	Vehicle Type	25-Year Trend			10-Year Trend		
		a	b	R^2	a	b	R^2
Blue Water	Passenger Car	88.8	-172760	69%	-93.1	189900	49%
	Truck	49.3	-97404	88%	86.1	-170662	99%
Ambassador	Passenger Car	185.6	-363212	89%	333	-656784	100%
	Truck	73.1	-143523	88%	155.7	-308313	92%
Detroit-Windsor Tunnel	Passenger Car	151.3	-294314	87%	311.6	-613712	96%
	Truck	7.8	-15211	80%	-3.4	7120	57%

Again, as a check of the linear-linear model specification, analyses of regression residuals were completed. Exhibit C7 shows the residual plot for Ambassador Bridge passenger cars. As is the case with time series residual plots, the errors form the shape of the trend line and are not evenly distributed about the x-axis that represents time. However, as the number of positive and negative error values are reasonably evenly distributed about the x-axis, the model exhibits homoskedastic properties and is therefore appropriate.

The forecasted annual volumes are shown in Exhibit C8. In general, the 25-year trend forecasts are considerably more conservative (and realistic) than the 10-year trend forecasts. This is due to the relatively extreme behaviour observed during the 1990s.

EXHIBIT C.7: REGRESSION RESIDUALS FOR AMBASSADOR BRIDGE PASSENGER CARS

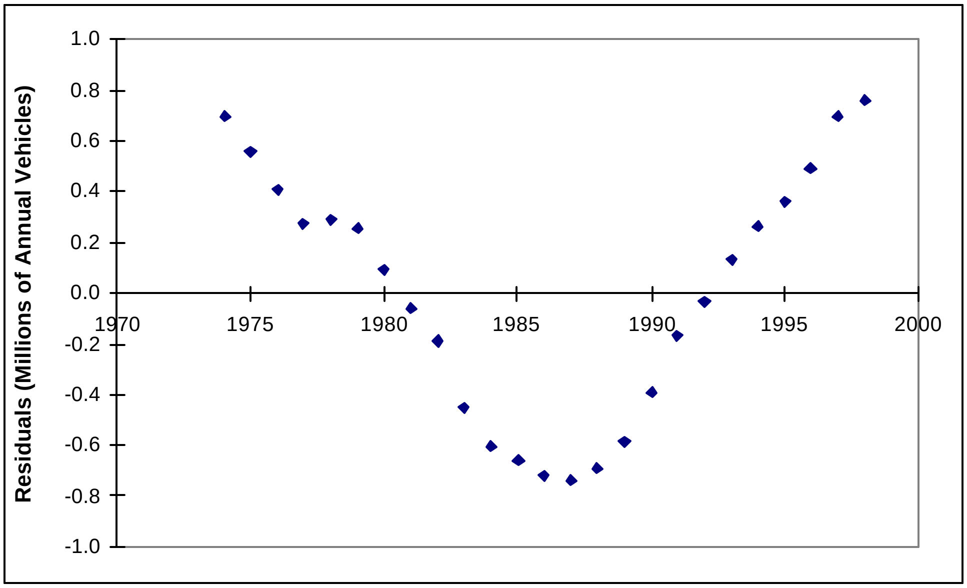


EXHIBIT C.8: TIME SERIES TREND ANALYSIS RESULTS (1000S)

A. 25-YEAR TREND

Crossing	Vehicle Type	2000	2010	2020	2030	Overall Growth (2000-2030)	Avg. Ann. Growth (2000-2030)
Ambassador	Pass. Cars	8,734	9,913	11,770	13,626	56.0%	1.49%
	Trucks	3,486	3,344	4,074	4,805	37.8%	1.08%
	Total	12,220	13,257	15,844	18,431	50.8%	1.38%
D-W Tunnel	Pass. Cars	8,368	9,868	11,381	12,895	54.1%	1.45%
	Trucks	182	382	460	537	195.1%	3.67%
	Total	8,550	10,250	11,841	13,432	57.1%	1.52%
Ambassador & D-W Tunnel	Pass. Cars	17,102	19,781	23,151	26,521	55.1%	1.47%
	Trucks	3,668	3,726	4,534	5,342	45.6%	1.26%
	Total	20,770	23,507	27,685	31,863	53.4%	1.44%
Blue Water	Pass. Cars	4,390	5,653	6,540	7,428	69.2%	1.77%
	Trucks	1,577	1,787	2,281	2,774	75.9%	1.90%
	Total	5,967	7,440	8,821	10,202	71.0%	1.80%
Gateway Total	Pass. Cars	21,492	25,434	29,691	33,949	58.0%	1.54%
	Trucks	5,245	5,513	6,815	8,117	54.8%	1.47%
	Total	26,737	30,947	36,506	42,066	57.3%	1.52%

EXHIBIT C.8: TIME SERIES TREND ANALYSIS RESULTS (1000S) (CONT.)

B. 10-YEAR TREND

Crossing	Vehicle Type	2000	2010	2020	2030	Overall Growth (2000-2030)	Avg. Ann. Growth (2000-2030)
Ambassador	Pass. Cars	8,734	12,546	15,876	19,206	119.9%	2.66%
	Trucks	3,486	4,704	6,262	7,819	124.3%	2.73%
	Total	12,220	17,250	22,138	27,025	121.2%	2.68%
D-W Tunnel	Pass. Cars	8,368	12,584	15,700	18,816	124.9%	2.74%
	Trucks	182	204	169	135	-26.0%	-1.00%
	Total	8,550	12,787	15,869	18,950	121.6%	2.69%
Ambassador & D-W Tunnel	Pass. Cars	17,102	25,130	31,576	38,022	122.3%	2.70%
	Trucks	3,668	4,908	6,431	7,954	116.8%	2.61%
	Total	20,770	30,038	38,007	45,975	121.4%	2.68%
Blue Water	Pass. Cars	4,390	2,829	1,899	968	-78.0%	-4.91%
	Trucks	1,577	2,439	3,300	4,162	163.9%	3.29%
	Total	5,967	5,269	5,199	5,130	-14.0%	-0.50%
Gateway Total	Pass. Cars	21,492	27,959	33,474	38,990	81.4%	2.01%
	Trucks	5,245	7,347	9,731	12,115	131.0%	2.83%
	Total	26,737	35,306	43,206	51,105	91.1%	2.18%

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APPENDIX D:
Committed Future Road Improvements

Prepared by IBI Group for URS Canada

Future Road Improvements

The following outlines transportation improvement projects in Southeast Michigan and Southwest Ontario that are considered to have a direct relevant impact on the Ontario-Michigan border crossing.

Windsor Area

Relevant projects for the Windsor area were identified from the Windsor Area Long Range Transportation Study (WALTS) 1999. WALTS identifies several future transportation network alternatives, and recommends an alternative that contains structural improvements to the road network in combination with transportation demand management (TDM) to increase transit ridership and reduce home-work trips. The recommended road improvements are shown in Exhibit D1, along with the assumed date that the improvement will be in place in terms of the traffic forecasts for the Ontario-Michigan Border Crossing Study. The improvements were assumed to be in place by 2016 in the WALTS report.

EXHIBIT D.1: ROAD IMPROVEMENTS IN THE WINDSOR AREA

Improvement	Date Assumed Complete
McDougall capacity improvements (Wyandotte to Howard)	2010
Wyandotte Street East capacity improvements (Ouellette to Lauzon)	2010
Tecumseh Road East capacity improvements (Banwell to Lesperance)	2010
Walker Road capacity improvements (Riverside to Division)	2010
Howard Avenue capacity improvements (Tecumseh to Memorial)	2010
Extend Edinborough Street between Howard and Dougall	2020
Widen Matchette Road (Tecumseh to Laurier)	2010
Todd Lane capacity improvements (Malden to Huron Church)	2010
Partial diamond interchange at Highway 401/Sixth Concession	2020
Lauzon Parkway widening and improvements (EC Row to Division)	2020
Dougall Avenue operational improvements (Eugenie to Norfolk)	2010
Widen Highway 401 (Highway 3 to Essex County Road 42)	2020

Of the above projects, McDougall Street capacity improvements from Wyandotte Street to Howard Avenue will provide additional capacity for one of the key routes from the Detroit-Windsor Tunnel to Highway 401. Trucks use McDougall Street between Giles Boulevard and Tecumseh Road to access the secondary Customs inspection facility on Hanna Street.

Improvements to Howard Avenue and Walker Road will provide additional capacity on parallel routes to the main route between the Detroit-Windsor Tunnel and Highway 401, with Walker Road in particular providing access to several industrial facilities.

Operational improvements to Dougall Avenue between Eugenie Street and Norfolk Street will impact directly on the main route between Highway 401 and the Detroit-Windsor Tunnel, and the link to the E C Row Expressway.

In addition to local roads, the Ministry of Transportation is undergoing a preliminary design study, which will be completed by the end of 2002 where they are recommending that Highway 401 be widened to six lanes from 0.5 km east of Highway 3 to 1.0 km east of Essex County Road 42.

Generally, projects such as structure replacement and resurfacing are not considered to have a significant impact on traffic capacity and travel patterns to and from the border. However, changes may result where improved surfacing attracts more trips to a route, or where structural strengthening permits heavier trucks to use a particular route, or results in fewer closures due to maintenance.

Sarnia Area

Improvements to the Highway 402 interchange east of the Blue Water Bridge in Point Edward is under investigation. One improvement alternative includes a separate truck on-ramp from the customs and agricultural inspection plaza to Highway 402, removal of the existing on and off-ramps at Marina Street and Bridge Street, and reconfiguration of the existing interchange at Front Street. This improvement will provide direct access for Canada-bound trucks to Highway 402 and reduce conflict between trucks and cars on Marina Road.

Highway 402 reconstruction east of Sarnia, including bridge rehabilitation is currently underway. This project will not directly provide any additional capacity, but will provide a more robust pavement that will accommodate the needs of increased heavy vehicles, and reduce the frequency of disruption of traffic for pavement maintenance.

The Blue Water Bridge Authority Plaza Study is currently underway to improve traffic flow through toll booths and customs inspections. This project would be expected to simplify the existing movements, particularly for trucks travelling from Canada to the US, which currently have to cross from the right hand lane to the left hand lane to pass through the US Customs and Immigration inspection. The study is moving forward and recommending that improvements be made to four interchanges and possible widening of Highway 402 to six lanes from the Blue Water Bridge Authority plaza to Airport Road.

Southeast Michigan

The relevant projects in Southeast Michigan were identified from the SEMCOG Transportation Improvement Program (TIP) list for Wayne County as approved by the Executive Committee July 19, 2002. The TIP is a list of projects developed from the goals, objectives, and projects found in the 2025 Regional Transportation Plan. SEMCOG's TIP currently contains projects for the fiscal years 2002-2004, including 645 projects with a total cost of US$1.9 billion. Projects found in the TIP include major road resurfacings, road widening, bus replacements, safety improvements, operation of transit and traffic operation centres, non-motorized pathways, and other studies.

The TIP projects shown in Exhibit D2 are considered directly relevant to the border crossing study.

EXHIBIT D.2: ROAD IMPROVEMENTS IN THE DETROIT AREA

Improvement	Date Assumed Complete
Ambassador Bridge Gateway Project	2010
Detroit Intermodal Freight Terminal	2010
I-375 and Jefferson Avenue interchange improvements	2010
Jefferson Avenue improvements (M-10 to I-375)	2010
Jefferson Avenue/Randolph Street intersection pedestrian bridge	2010
I-75 widening at M-59 junction	2010
I-94 at Black River west of the Blue Water Bridge (four-lane bridge to be replaced with a six-lane bridge)	2010
I-75 four laning (I-696 to M-59)	2010
I-75 corridor ITS integration (Oakland County)	2010

The Ambassador Bridge Gateway Project is currently in the engineering design phase and will have a significant impact on the operation of traffic using the Ambassador Bridge. The project will improve connections to and from the United States side of the Ambassador Bridge plaza by modifications to the I-75 and I-96 between Clark Street and Vernor Highway to provide direct ramp connections for most movements, and construction of new toll plazas for cars and trucks. Significant changes include:

- Construction of an at-grade toll plaza west of the existing plaza, and south of Lafayette Boulevard, to support all toll facilities for Canada-bound traffic. The plaza will segregate cars from trucks and will ensure that trucks will be in the curb lane after the toll plaza in preparation for using the curb lane on the Ambassador Bridge. The existing toll plaza on the bridge deck would only serve traffic entering the United States;
- Removal of the Porter Street bridge over the I-75 and provision of a direct ramp connection to the Southbound I-75 for traffic arriving in the United States from the Bridge;
- Providing direct ramp connections for trucks leaving the Ambassador Bridge customs plaza and travelling to the I-75 and I-96, removing the need for interstate-bound truck traffic to use Fort Street;
- Lengthening the ramp tapers for the ramps from the Ambassador Bridge north to the I-75 and I-96; and
- Providing improved connections for local traffic, and separation of local traffic from freeway traffic.

A pedestrian bridge over Randolph Street at the intersection of Jefferson Avenue, adjacent to the Detroit-Windsor Tunnel access is scheduled for construction in 2003 and 2004. This project could be expected to improve the capacity of the Jefferson Avenue/Randolph Street intersection by reducing the adverse impacts of crossing pedestrians on right turning traffic.

Improvements to the interchange between the I-375 and Jefferson Avenue are to go through the engineering design phase for construction in 2003. Jefferson Avenue is also being improved from the M-10 to the I-375, which will provide increased capacity for traffic travelling to and from the Detroit-Windsor Tunnel.

The I-94 interchange with Schaefer Road is to be reconstructed in 2003 with improved geometry to meet modern standards and facilitate the movement of heavy trucks.

Funds have been approved for the Detroit Intermodal Freight Terminal, which will develop a regional freight complex for Southeast Michigan by consolidating existing intermodal facilities into one location. Land acquisition and development of rail connections will take place in 2003, with access road improvements likely to begin in 2004. This project is designed to facilitate the movement of freight and will have an impact on the number of trucks crossing between Ontario and Michigan.

Elsewhere in Wayne County, funding has been approved for a passenger terminal project on West Jefferson Avenue in Detroit, with construction funds allocated for 2002. Construction of a terminal and improvements to passenger service may result in fewer cross-border trips by road.

In Oakland County, an engineering study into ITS integration on the I-75 corridor, and investigation into the expansion of a carpool lot northwest of Pontiac is included for 2002. Investigation and right of way acquisition for improvements at the junction of the I-75 and M-59 east of Pontiac are also included. This project will add two lanes from the Chrysler Drive Interchange to the M-24 connector. Furthermore, a feasibility study of the I-75 in Oakland County determined the need for a uniform four lane directional cross section between the I-696 and the M-59, and environmental clearance activities were scheduled for 2002.

In St Clair County, the existing two-lane bridges over the Black River on the I-94 west of the Blue Water Bridge are to be replaced with a six lane bridge, with construction scheduled for 2006 to avoid conflict with construction of the Ambassador Bridge Gateway Project. This improvement will remove a bottleneck and allow for improved connections in the area between the Water Street interchange and the Blue Water Bridge plaza.

Peripheral TIP Projects

In Macomb County, widening of major roads from two or four lanes to five lanes is scheduled for construction in 2002, and upgrades to the M-53 highway in 2003 and 2004.

In Oakland County, sections of Grand River Avenue parallel to the I-96 are to be widened from two to five lanes, and widening of a section of the M-59 east of the I-75 from four to six lanes is to be studied and designed from 2002 to 2004.

In Washtenaw County, a new eastbound on-ramp to the I-94 at Zeeb Road, west of Ann Arbor, is planned for engineering design in 2002. A project to widen the US-23 from four lanes to six lanes from M-14 to I-96 is to commence preliminary engineering in 2004.

Other Projects

At the Detroit-Windsor Tunnel, the Detroit and Canada Tunnel Corporation is studying improvements to the toll and customs plazas on the Detroit and the Windsor sides of the tunnel. Improvements under investigation include a policy to reduce the number of large commercial vehicles using the tunnel, and to investigate provision of reverse inspections to clear vehicles before they reach the border crossing. Reduction in the number of large commercial vehicles using the tunnel will free up space for passenger cars at inspection facilities, allowing the entry and exit plazas to process an increased number of passenger cars.