Partnership of

Canada-United States-Ontario-Michigan
Border Transportation Partnership

DETROIT RIVER INTERNATIONAL CROSSING STUDY
TRAVEL DEMAND FORECASTS

WORKING PAPER

SEPTEMBER 2005

Prepared by IBI Group for URS Canada

PREFACE

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

The purpose of this Travel Demand Forecasts Working Paper is to prepare passenger car and commercial vehicle forecasts for Detroit River Crossings and to present the border infrastructure needs and implications associated with the projected demand. This Working Paper and companion Travel Demand Model Update Working Paper were prepared by IBI Group with the assistance of The Corradino Group, which was responsible for the US-side model validation and assessment of traffic conditions on US approach roads.

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1. INTRODUCTION

The Ambassador Bridge and Detroit-Windsor Tunnel are the two highest-volume border crossings between Canada and the US, with combined traffic of 3.53 million annual commercial vehicles and 12.10 annual passenger car trips in 2004 (Exhibit 1.1). In 2004, total Canada-US trade totalled $407.3 US billion ($530.1 CAN billion), with the Detroit River crossings handling 28% of this trade (Exhibit 1.2), or $113.3 US billion ($158.7 CAN billion).

The purpose of this Working Paper is to present preliminary commercial vehicle and passenger car demand estimates for crossings of the Detroit River at Windsor-Detroit and to present the border infrastructure needs associated with the projected demand. The travel demand forecasts represent an update of the forecasts prepared for the ***Planning/Need and Feasibility (P/N&F) Study***, which had a 2000 base year. The update of the forecasts reflects the need to review key assumptions, given that the previous forecasts were based on pre-9/11 data that did not include the impacts of 9/11, the War in Iraq and SARS, all extreme events that have significantly affected recent cross-border traffic and trade and may have resulted in structural or long term changes in cross-border trade patterns and travel behaviours. This update of forecasts incorporates the most current knowledge on the impacts of these extreme events, and considers recent trends in socio-economic (e.g. Canada-US exchange rate, fuel prices) conditions and attitudes on cross-border travel behaviour and more recent traffic and trade data and forecasts.

The forecasting process and methodology used to develop cross-border forecasts consider specific passenger car and freight/commercial vehicle markets, with segmentation by trip purpose and commodity types to reflect their different characteristics and growth outlooks. A 2004 Base Year has been developed based on an update of the previous 2000 travel data to reflect current origin-destination patterns, and temporal characteristics. Forecasts are prepared for 2015, 2025 and 2035 horizon years.

1.1 Analysis Area

The development of travel demand forecasts for Windsor-Detroit considers the total flow of people and goods between Southeast Michigan and Southwestern Ontario, given the interactions between Detroit River and St. Clair River crossings in accommodating international travel flows. The analysis area for forecasting purposes is shown in Exhibit 1.3. The areas is defined to be sufficiently large to capture key decision points on the road system where motorists must determine if they are to use a Detroit River (i.e. Windsor-Detroit) or St. Clair River (i.e. Sarnia-Port Huron) crossing. For many longer distance cross-border trips, the travel time and distance are very similar.

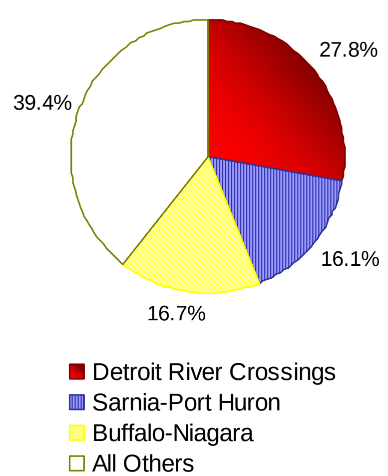
Exhibit 1.1: 2004 Volume & Rank of Ontario-US Border Crossings

Crossing	Passenger cars[1]		Commercial Vehicles	
	Volume (Millions)	Rank	Volume (Millions)	Rank
Ambassador Bridge	6.26	1	3.37	1
Detroit-Windsor Tunnel	5.84	2	0.16	6
Blue Water Bridge	3.77	4	1.80	2
Peace Bridge	5.66	3	1.30	3
Lewiston-Queenston Bridge	2.92	6	1.01	4
Whirlpool Rapids Bridge	0.17	11	n/a	n/a
Rainbow Bridge	3.46	5	n/a	n/a
Sault St. Marie Bridge	1.72	8	0.13	8
Ogdensburg Bridge	0.42	10	0.10	9
Seaway International Bridge	2.39	7	0.16	7
Thousand Islands Bridge	1.63	9	0.48	5
TOTAL	34.21	-	8.51	-
Share for Detroit River Crossings	35.4%	-	41.5%	-
Total Detroit River Crossings	12.10	2	3.53	1
Total St. Clair River Crossings	3.77	4	1.80	3
Total Niagara River Crossings	12.21	1	2.31	2
Total St. Lawrence River Crossings	4.44	3	0.74	4

[1] Includes passenger cars, buses, taxis, motorcycles, etc.

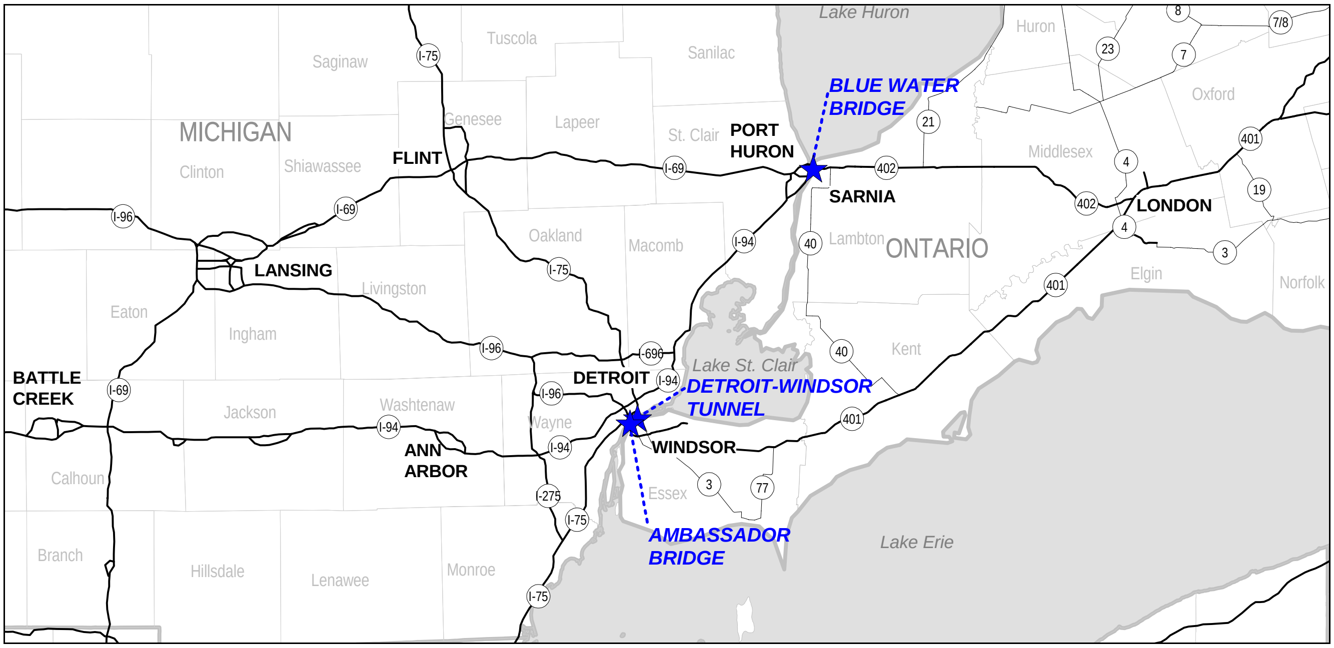
Source: BTOA

Exhibit 1.2: Detroit River Share of 2004 Total Canada-US Trade by Value



Source: Bureau of Transportation Statistics (BTS) Transborder Freight Database

Exhibit 1.3: Analysis Area



1.2 Organisation of Working Paper

This Working Paper is organised into six chapters. Following this introduction,:

- Chapter 2 describes the existing travel infrastructure, including a description of the border crossings, the road and highway network, railways, and marine services;
- Chapter 3 describes existing travel demand trends for commercial vehicle and passenger car traffic at Detroit River crossings and in relation to other Ontario-US crossings. Rail, marine and bus modes are also examined;
- Chapter 4 describes the development of the commercial vehicle and passenger car forecasts and explains the economic, social and transportation assumptions used to develop the forecasts;
- Chapter 5 presents forecast year traffic estimates for Detroit River crossings;
- Chapter 6 examines the impacts of the traffic forecasts with respect to the capacity and identifies future border crossing system needs; and
- Chapter 7 provides a summary of findings.

2. EXISTING TRANSPORTATION SYSTEM

This chapter provides an overview of the existing transportation system, comprising the road, rail and marine border crossing facilities and the supporting transportation infrastructure for the Detroit River and St. Clair River crossings.

2.1 Bridge & Tunnel Crossings

There are three road crossings between Southeast Michigan and Southwestern Ontario, consisting of the Ambassador Bridge and Detroit Windsor Tunnel crossing the Detroit River in Windsor-Detroit and the Blue Water Bridge crossing the St. Clair River in Sarnia-Port Huron.

2.1.1 AMBASSADOR BRIDGE

The Ambassador Bridge was opened in 1929 and connects the local road network in west Windsor with the US interstate system in southwest Detroit. From entrance to exit, the suspension bridge is 2.8 kilometres (9,200 feet) long, and rises as high as (46 m (152 feet) 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 on the approach to the bridge.

For entry to the US, Department of Homeland Security (DHS) operates separate border processing facilities for commercial vehicles and for passenger cars. Commercial vehicles are routed via a ramp from the bridge to a processing area below and to the east of the bridge with thirteen primary inspection booths. Passenger cars continue straight ahead from the Bridge to twelve primary inspection booths. Toll booths are provided after primary inspection for cars and commercial vehicles.

For entry to Canada, Canada Border Services Agency (CBSA) operates ten passenger car and ten truck primary inspection lanes. Secondary inspection for cars occurs beyond the primary inspection booths. Secondary inspection for commercial vehicles is located off-site at Malden Road, approximately two kilometres south off of Huron Church Road, although there is a small area for secondary commercial inspection at the plaza.

2.1.2 DETROIT-WINDSOR TUNNEL

The Detroit-Windsor Tunnel was opened in 1930 and connects downtown Windsor and downtown Detroit. The tunnel is approximately 1.6 kilometres (1 mile) long and extends 23 metres (75 feet) 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 4.0 metres (13’2”) and a 330-degree bend in the tunnel, which restricts the types of commercial vehicles that can use the tunnel.

Primary 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.

There are twelve primary inspection lanes on the US side, including three booths available for use by commercial vehicles. Secondary inspection for cars is carried out immediately adjacent to the primary inspection with twenty-three spaces available. In Canada, there are twelve primary inspection lanes, with commercial vehicle primary inspection lanes to the east of the tunnel exit portal and leading onto Goyeau Street. Primary inspection lanes 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 kilometres south of the tunnel plaza, although there is a small area for secondary commercial inspection on the plaza itself.

2.1.3 BLUE WATER BRIDGE

The Blue Water Bridge was opened in 1938. The original three-lane, 6,200-foot (1.88-km) cantilever truss bridge over the St. Clair River connects Sarnia and Port Huron. A second three-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.

2.2 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 (see Exhibit 2.1).

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 long distance travel flows being I-75 for travel to south US and I-94 for travel west to Chicago and beyond.

For travel via Sarnia-Port Huron, 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. For trips from Highway 401 to points west via I-94 or south via I-69, the routes using the Ambassador Bridge and the Blue Water Bridge are almost equal in length.

2.3 Road System

Exhibit 2.2 shows the road system and access roads in the vicinity of the Ambassador Bridge and the Detroit-Windsor Tunnel in Detroit/Windsor.

Exhibit 2.1: Southeast Michigan/Southwestern Ontario Highway System

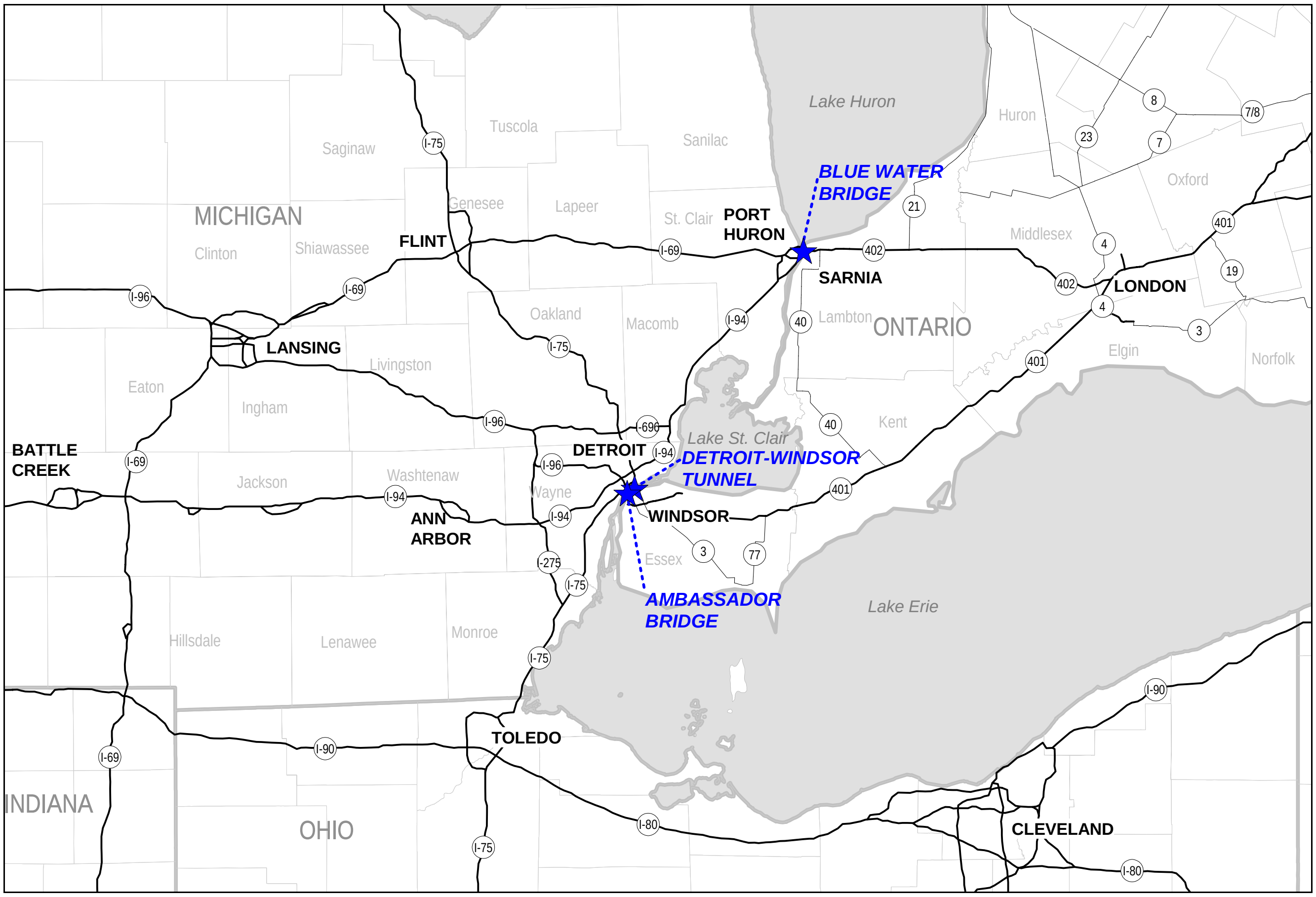
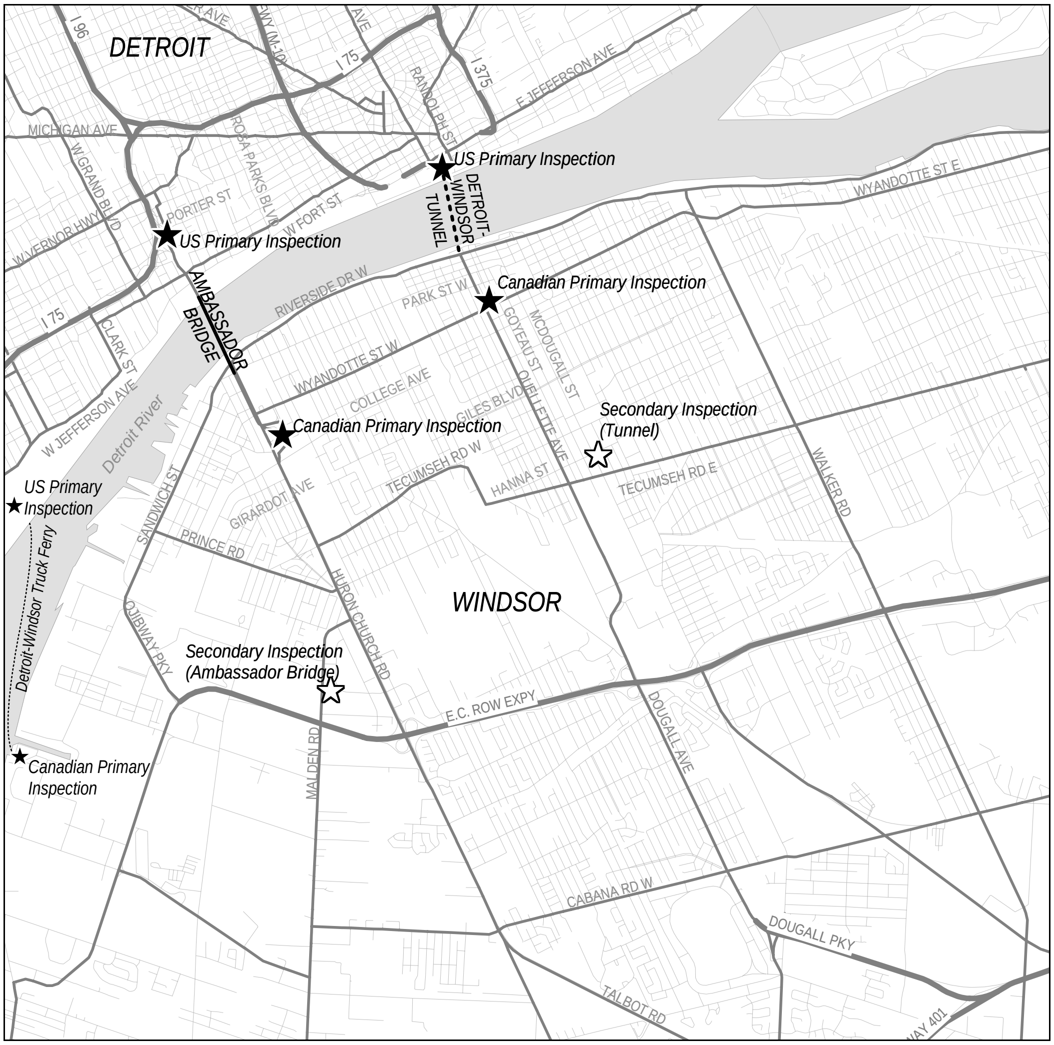


Exhibit 2.2: Access Road System



2.3.1 CANADIAN ACCESS ROADS

Huron Church Road is the main access road to the Ambassador Bridge on the Canadian side, extending as a 6-lane urban arterial road linking Highway 401 to the Ambassador Bridge via **Highway 3/Talbot Road**. The posted speed limit on Huron Church Road is 80 km/h from Highway 3/Talbot Road to Pulford Street (south of the E.C. Row Expressway), and 60 km/h from Pulford Street to College Avenue, near the bridge plaza. There are 17 signalized intersections on Huron Church Road and Highway 3/Talbot Road between Highway 401 and the Ambassador Bridge.

Given the high commercial vehicle volumes, 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, the University of Windsor at College Avenue, Assumption High School at Wyandotte Street, the University Mall at Tecumseh Road, and, further south on the Highway 401/Huron Church corridor, St. Clair College on Talbot Road.

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.

2.3.2 US ACCESS ROADS

For traffic using the Ambassador Bridge, cars and commercial vehicles have many route options, given the proximity to several Interstate freeways. 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 for 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.

2.4 Rail System

The rail network serving the study area roughly parallels the US interstate/Ontario provincial road system. Exhibit 2.3 is a map of the rail network and operators.

A Canadian National Railway (CN) line runs from London to Sarnia parallel to 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 although the one through train was discontinued in 2004. Another CN line roughly follows the Highway 401 corridor from London to Windsor, carrying VIA passenger service. The line continues through Detroit, northwest toward Flint. Amtrak passenger 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 (via trackage rights) and beyond. A CN line connects Detroit and Port Huron on the Michigan side.

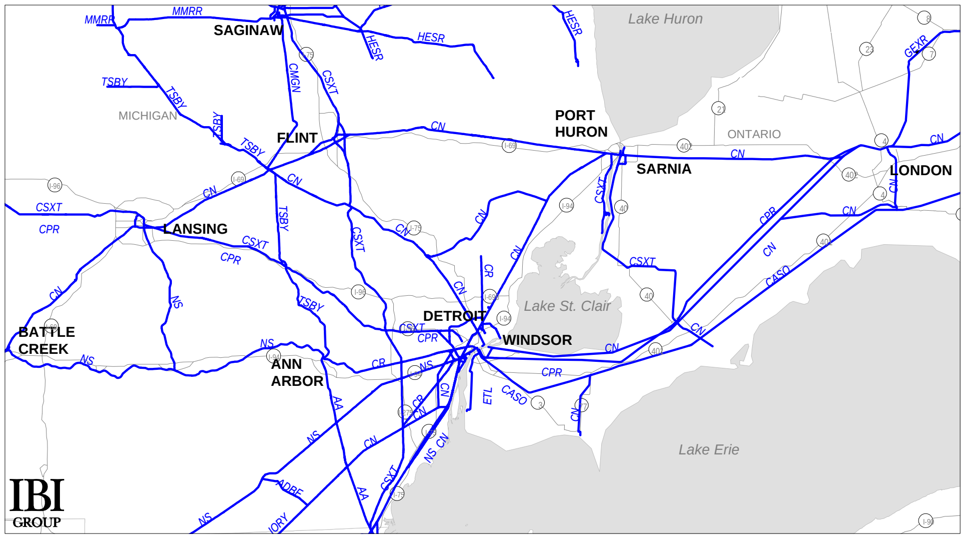
Other rail operators have connections in Detroit. A Norfolk Southern (NS) line, used by Amtrak, runs between Detroit and Chicago roughly along I-94. Another NS runs south toward Toledo then branches east and west. An Indiana & Ohio Railway (IORY) line runs south toward Cincinnati. CSX Transportation (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.

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 also shown in Exhibits 2.3.

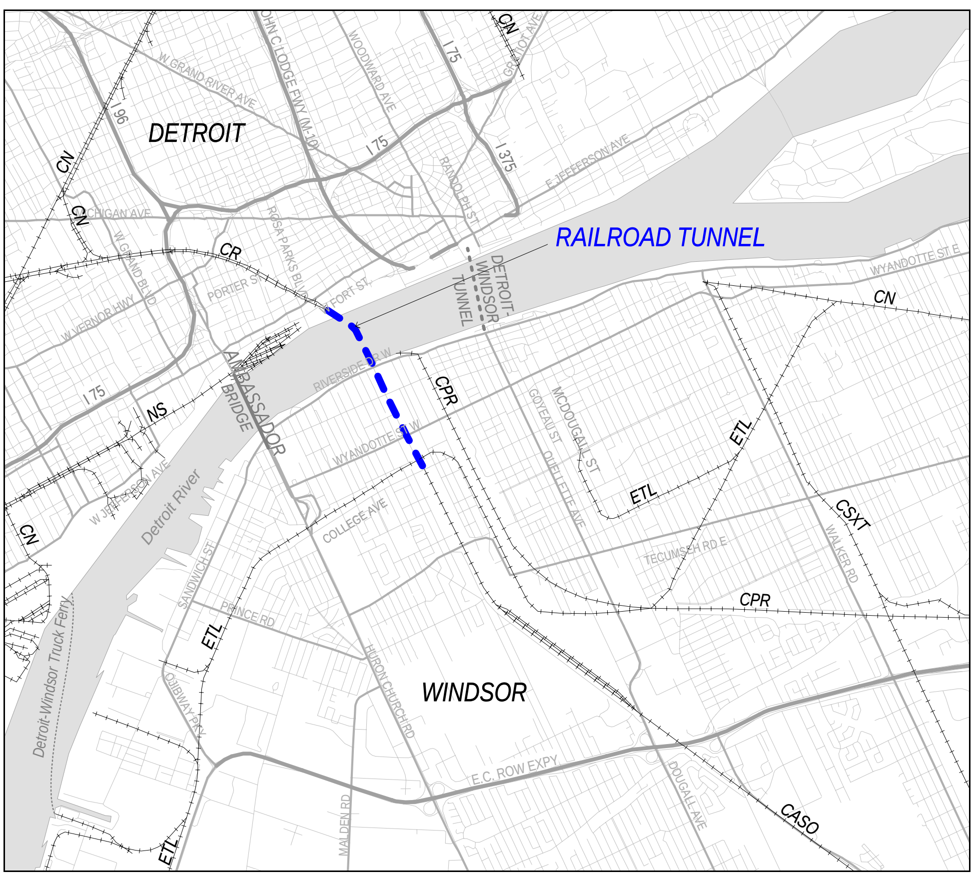
During the 1990s, both crossings were expanded to accommodate larger vehicles. The CN tunnel at Sarnia accommodates the largest vehicles that operate across the North American railway system. CPR expanded one of the two existing tunnels between Detroit and Windsor to the maximum dimensions structurally 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 2.3: Rail System

A. Southeast Michigan/Southwestern Ontario



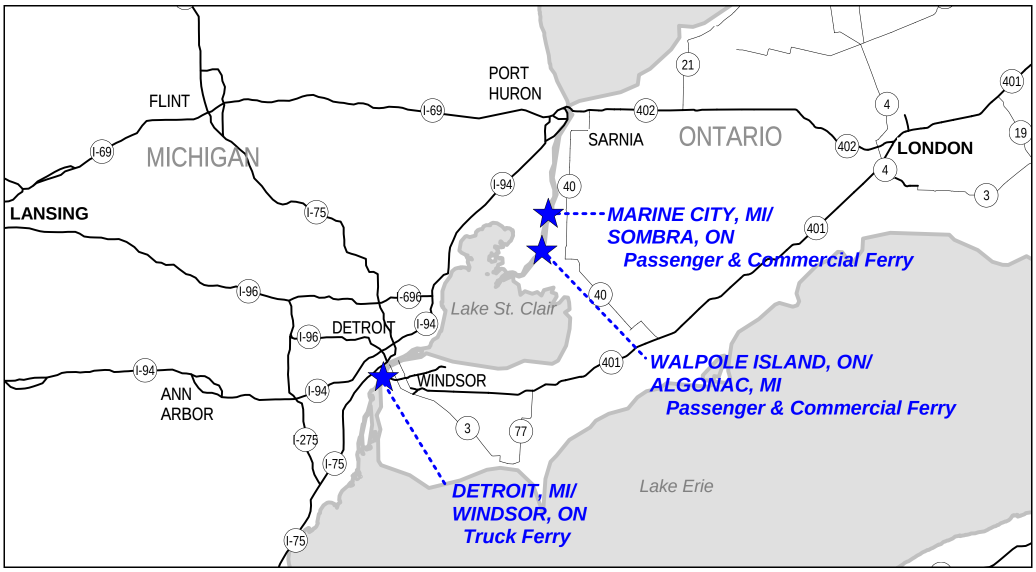
B. Windsor-Detroit



2.5 Marine Services

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 2.4. Each service has relatively limited vehicle capacity.

Exhibit 2.4: Marine Services



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 a.m. to 9:45 p.m., and return from Marine City from 6:50 a.m. to 10:00 p.m. The one-way cost is approximately $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 cars each, but will also take commercial vehicles. The larger of the two ferries can hold up to two tractor trailers or larger vehicles up to 80,000 pounds gross weight each. The service runs approximately every 15 minutes, 7 days a week year round at a cost of $5 US per car each way and $2 for foot passengers. Ferries leave Sombra from 6:40 a.m. to 10:15 p.m., and return from Marine City from 7:00 a.m. to 10:30 p.m. 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 its use is not restricted to these two markets. The ferry operates hourly 10 hours per day and can accommodate 8 trucks per crossing.

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 trips using the ferry crossing 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.

3. PERSON & GOODS MOVEMENT CHARACTERISTICS

This chapter examines trends in person and goods movement at Detroit River, St. Clair River and Ontario-US crossings. The analysis includes an examination of trends over the past several decades, as well as a closer examination of more recent trends since 2000 given the major events and changes that have occurred. The focus of the analysis is passenger car and commercial vehicle demand with an overview of travel trends for local and inter-city bus, passenger and freight rail and marine transportation.

3.1 Total Movement of Persons & Goods

3.1.1 PERSON MOVEMENT

Person movement between Canada and the US at the Detroit River and St. Clair River crossings is provided by passenger car and local and intercity bus. The number of annual person trips and modal share is shown in Exhibit 3.1. Passenger car travel is expressed in person trips, reflecting the auto occupancy of the trip. The bus mode includes charter, inter-city motor coach and local public transit vehicles providing services between Windsor and Detroit. Passenger rail service is not provided at Windsor-Detroit. A VIA/Amtrak through rail passenger service was previously provided at Sarnia-Port Huron, but this service was discontinued in 2004.

Person movements at Detroit River crossings are significantly higher than at St. Clair River crossings, owing to the much larger population and economic integration of Windsor-Detroit compared to Sarnia-Port Huron. Between 2000 and 2003, with Detroit River cross-border bus passenger levels remaining steady (2.0 million) and passenger car person trip levels at 70% of what they were in 2000, the passenger mode share for buses has increased from 4% in 2000 to 8% in 2003. However, in terms of vehicle traffic, buses represented only 0.6% of Detroit River passenger vehicle volumes in 2003. This indicates the dominance of the passenger car mode for person travel at the Detroit River crossings.

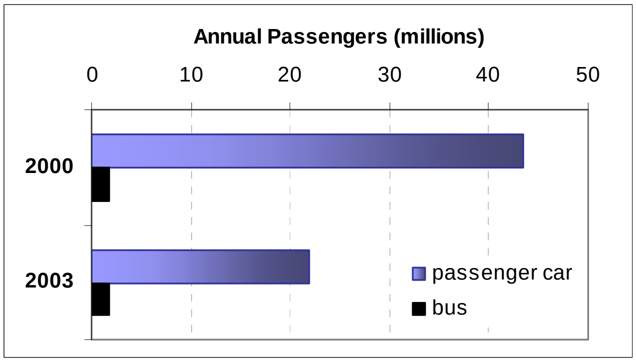
At the St. Clair River crossings, a significant, but lower, decrease in passenger car traffic from 8.3 million person-trips in 2000 to 7.2 million person-trips in 2003 was matched by a similar drop in bus passenger traffic over the same period from 0.24 million to 0.20 million passengers. Passenger car is by far the dominant mode at the St. Clair River crossing, representing over 97% of passenger travel for both 2000 and 2003.

For both crossings, there were a total of 2.1 million bus passenger trips, representing less than 7% of total person trips in 2003.

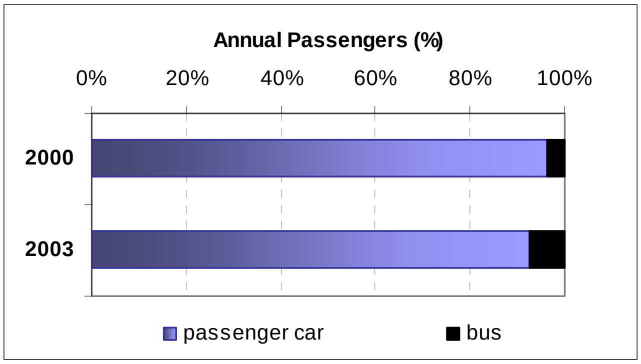
Exhibit 3.1: Person Volumes & Mode Share at Detroit River & St. Clair River Crossings, 2000 & 2003

A. Detroit River Crossings

Volume

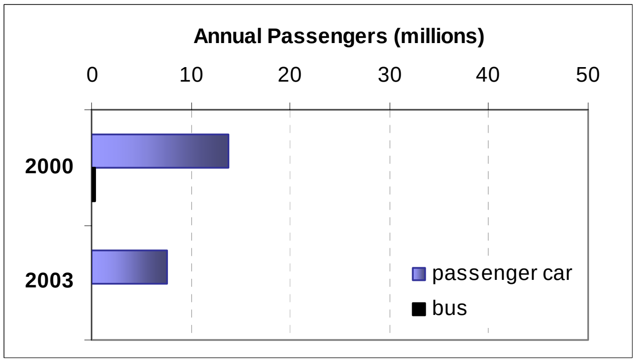


Modal Share

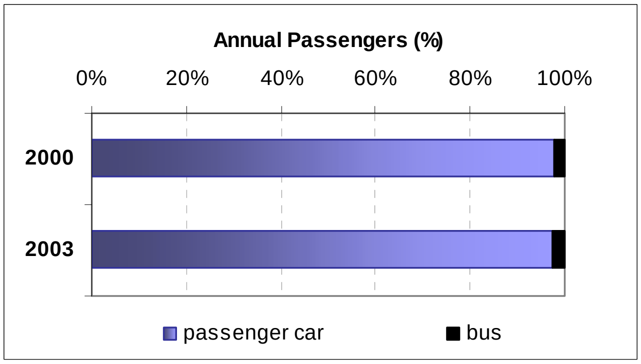


B. St. Clair River Crossing

Volume



Modal Share



Source: Based on BTS border crossing counts and assumed vehicle occupancies (1.9 for passenger cars and 25 for buses).

3.1.2 GOODS MOVEMENT

The movement of goods is provided by commercial vehicles, rail freight, pipeline and marine modes. The modal shares by value for the movement of goods at the Canada-US border as a whole are shown in Exhibit 3.2. The truck mode continues to dominate Canada-US trade, although the percentage of goods moved by truck has decreased from 75% in 1998 to 66% in 2004 due largely to significant increases in the value of goods shipped by pipeline and other modes (e.g. air, marine, power, mail). The rail share increased from 16.6% to 18.3% over this time period.

The Detroit River crossings continue to carry the largest percentage of Canada-US trade compared to all border crossings. In 2004, 28% of the value of trade used the Detroit-Windsor crossings, with approximately 16% of the value using St. Clair River crossings. The Detroit River and St. Clair River crossings operate together as a system and combined, these crossings have increased their share in overall trade, growing from approximately 41% in 1998 to approximately 44% in 2004, although the majority of the growth was experienced at St. Clair River crossings. However, Detroit River crossings are much higher in trade volume, exceeding trade at St. Clair River crossings by approximately 75%. Overall, these statistics indicates the importance of the Detroit River and St. Clair River crossings in the transport of trade between Canada and the US.

Exhibit 3.3 shows the relative importance of the rail and truck transport modes to Canada-US trade across the Detroit River and across the St. Clair River in terms of the value of trade. The truck mode continues to dominate across the Detroit River. The value of truck trade across the Detroit River has seen a slight increase since 2000, although its share by trade value has dropped from 91% in 1998 to 83% in 2004, given a doubling in rail trade by value across the Detroit River since 2000. (The increase in rail trade across the Detroit and St. Clair Rivers combined is only 18%, as part of this increase can be attributed to a shifting of a portion of rail goods movement from the St. Clair River to the Detroit River.) In 2004, trucks carried 77% of the value of Canadian freight exports to the US ($US 43 billion) and 89% of the value of US freight exports to Canada ($US 51 billion) across the Detroit River.

The St. Clair River crossings have historically had higher rail proportions. Rail has carried over half of the US-bound freight in terms of value, and almost 20% of Canada-bound freight. Rail freight across the St. Clair River has not grown as quickly as at the Detroit River, such that the Detroit River now carries more rail freight from the US to Canada than the St Clair River, and 80% of the total value of Canada-US trade compared to the St. Clair River.

Information on the weight of shipments is available from the Bureau of Transportation Statistics (BTS) Transborder Surface Freight database only for Canadian exports to the US. The mode shares for the Detroit River and St. Clair River crossings are shown based on weight in Exhibit 3.4. It shows a similar trend as the above modal share data expressed in trade value, with growth in the rail mode but with absolute rail volume very small compared to the truck mode. Based on weight at Detroit River crossings, truck modal shares have dropped to a lesser extent, from 79% to 75%, than as expressed in term of value (85% to 77%) between 2000 and 2004, respectively. In 2004, the St. Clair US-bound truck mode share was 49% by value, and 26% by weight.

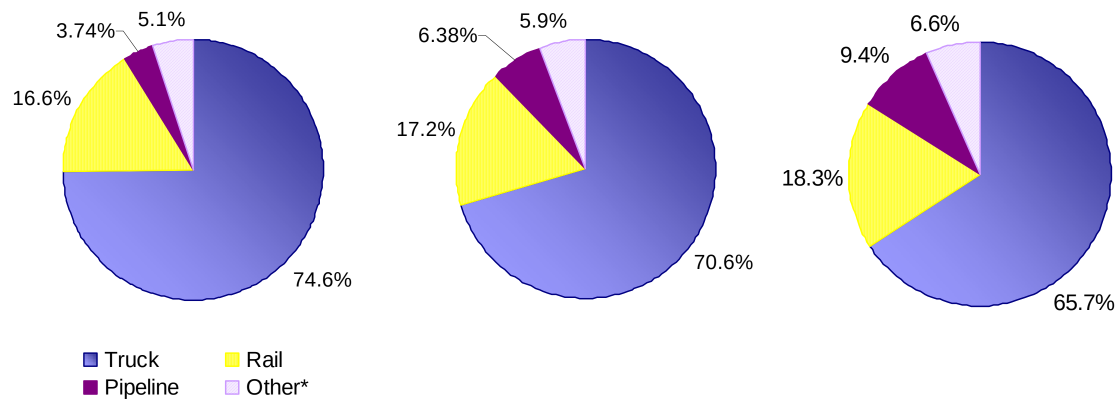
Exhibit 3.2: Value of Canada-US Trade at All Crossings, 1998 to 2004

A. Value by Mode

1998: $299.9 US billion ($444.9 CAN billion)

2000: $365.1 US billion ($542.5 CAN billion)

2004: $407.3 US billion ($530.1 CAN billion)



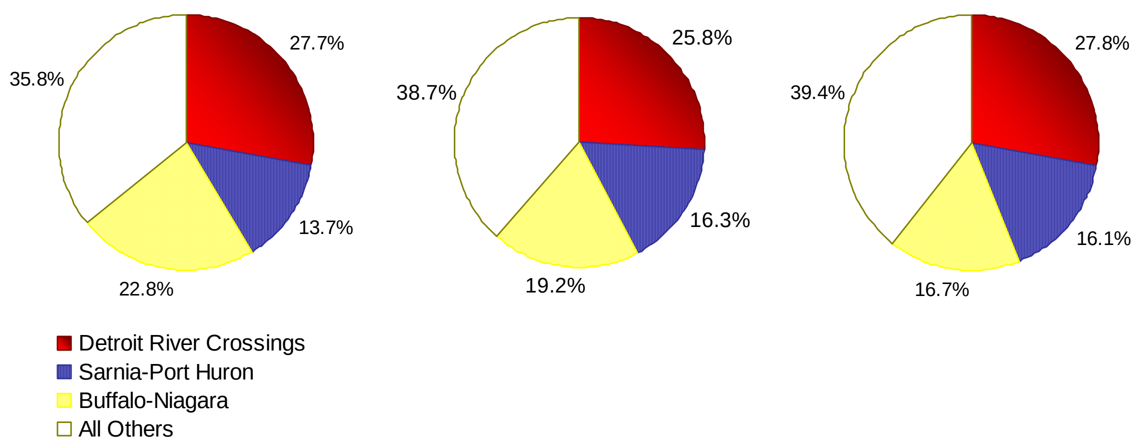
* Other includes air, marine, powerhouse (electricity), mail (where cannot be subdivided into rail or truck), Foreign Trade Zones, unknown and miscellaneous other.
Source: BTS Transborder Freight Database

B. Value at Major Crossings

1998: $299.9 US billion ($444.9 CAN billion)

2000: $365.1 US billion ($542.5 CAN billion)

2004: $407.3 US billion ($530.1 CAN billion)

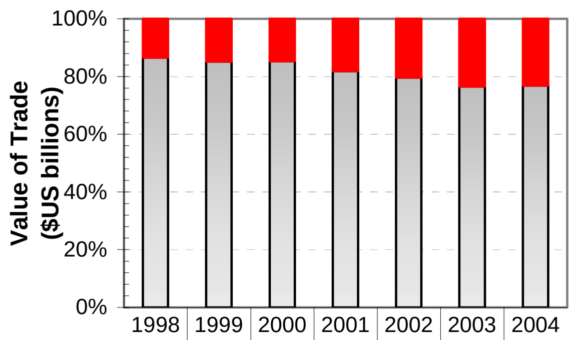


Source: BTS Transborder Surface Freight Database

Exhibit 3.3: Value of Trade by Mode for Detroit & St. Clair River Crossings, 1998 to 2004

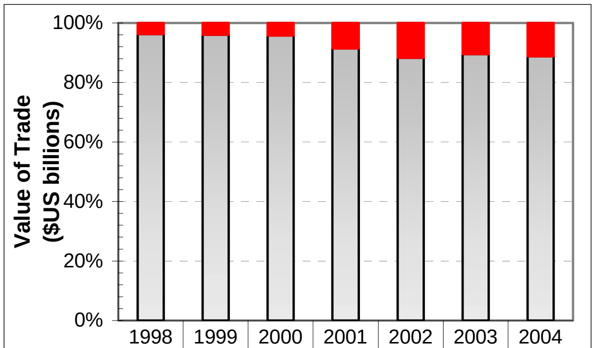
DETROIT RIVER

Canada to US



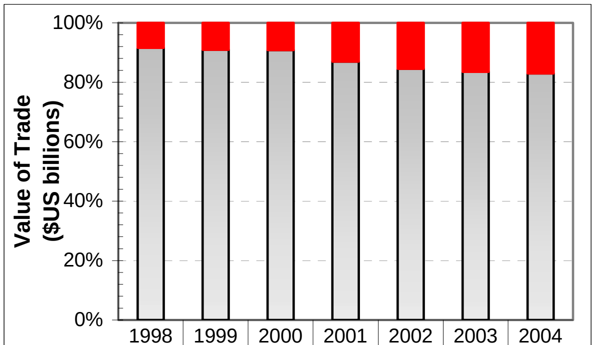
	1998	1999	2000	2001	2002	2003	2004
Rail	5.3	6.5	6.5	7.7	9.1	11.0	12.8
Truck	34.0	37.2	38.0	34.9	35.4	36.1	42.5

US to Canada



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

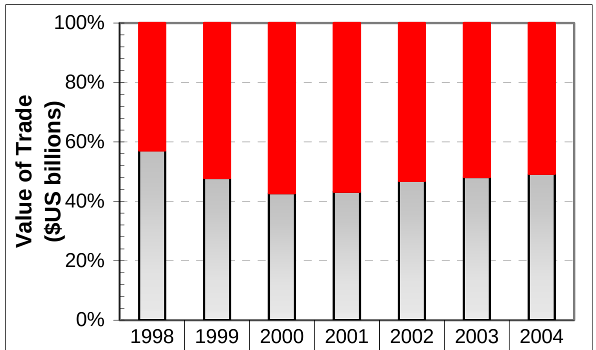
Total Two-Way Trade



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

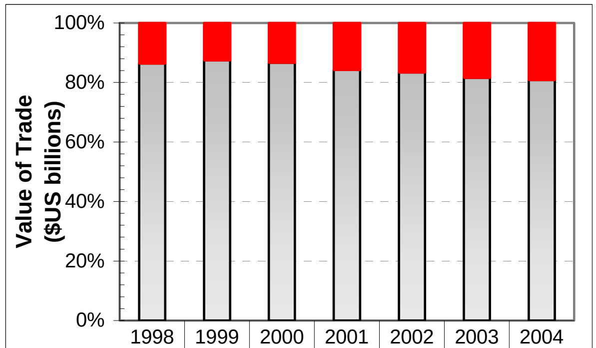
ST CLAIR RIVER

Canada to US



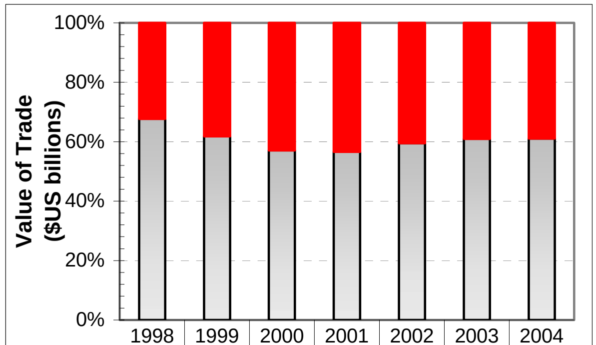
	1998	1999	2000	2001	2002	2003	2004
Rail	10.9	16.4	22.2	20.2	19.2	18.8	19.5
Truck	14.6	15.1	16.6	15.4	17.0	17.5	19.0

US to Canada



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

Total Two-Way Trade

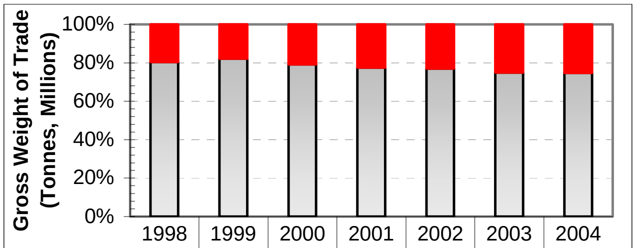


	1998	1999	2000	2001	2002	2003	2004
Rail	12.9	18.6	24.6	22.9	22.4	22.9	23.9
Truck	26.9	30.2	32.7	29.8	32.8	35.7	37.6

Source: BTS Transborder Surface Freight Database

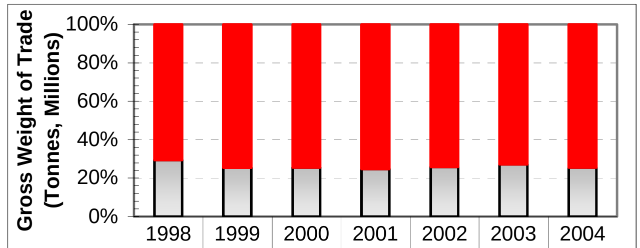
Exhibit 3.4: Gross Shipping Weight of Trade by Mode for Detroit & St. Clair River Crossings, 1998 to 2004, Canada to US

DETROIT RIVER



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

ST CLAIR RIVER



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

Source: BTS Transborder Surface Freight Database

The BTS Transborder Surface Freight database includes only shipments whose ultimate origins/destinations are Canada and the United States. Data on transhipments – freight that originates in Canada and is shipped to another country via the United States, or vice versa – is not included in the BTS database. Other sources, however, provide insight on how transhipments have affected border crossing volumes between 2000 and 2004. Cross-border freight data provided by the CCRA for 2000 and 2001 show that transhipments made up 13% by value of freight crossing the border from the US to Canada at the Detroit River crossings in 2000 and 14% in 2001. The proportions were similar at the Blue Water Bridge. The reported values for exports to the US were much lower at 1.2 to 1.5%, but may be underreported.

The largest source of imports transhipments via the Detroit River crossings is Mexico, providing 6.1 to 6.3% of total freight value to Canada via the US via the Detroit River crossings. The types of goods shipped from Mexico to Canada via the US are mostly machinery/equipment and auto-industry related, while exports are mostly auto-industry goods to be assembled in Mexico. Trade between Canada and Mexico more than doubled between 1995 and 2000, although growth has not been nearly as aggressive since then as Canada looks to other countries for outsourcing auto-assembly tasks. Total imports from Mexico have increased only 11% between 2000 and 2004, while exports to Mexico, a much smaller percentage of total freight, have increased 46%.[1]

[1] International Trade Canada, Merchandise Trade by Country

3.2 Passenger Car Travel

3.2.1 TRAFFIC TRENDS

The Detroit River Crossings ranked first and second among all Ontario-US crossings in terms of passenger car crossings in 2000 and 2004, as shown in Exhibit 3.5 (this includes passenger cars, buses, trucks, motorcycles, etc.). Passenger car crossings have declined dramatically at virtually all Canada-US border crossings since then, owing to 9/11, SARS, the War in Iraq and border inconveniences. Detroit River crossings were particularly affected, owing to the high proportion of same-day discretionary travel that occurs between Windsor and Detroit. Passenger car traffic at Detroit River crossings decreased from 17.25 annual vehicles in 2000 to 12.10 million in 2004, representing 30% decrease. Preliminary 2005 data indicates that decline in passenger car traffic is still a continuing trend that has yet to level off.

Exhibit 3.5: Passenger Car Volumes at Ontario-US Crossings, 2000 to 2004

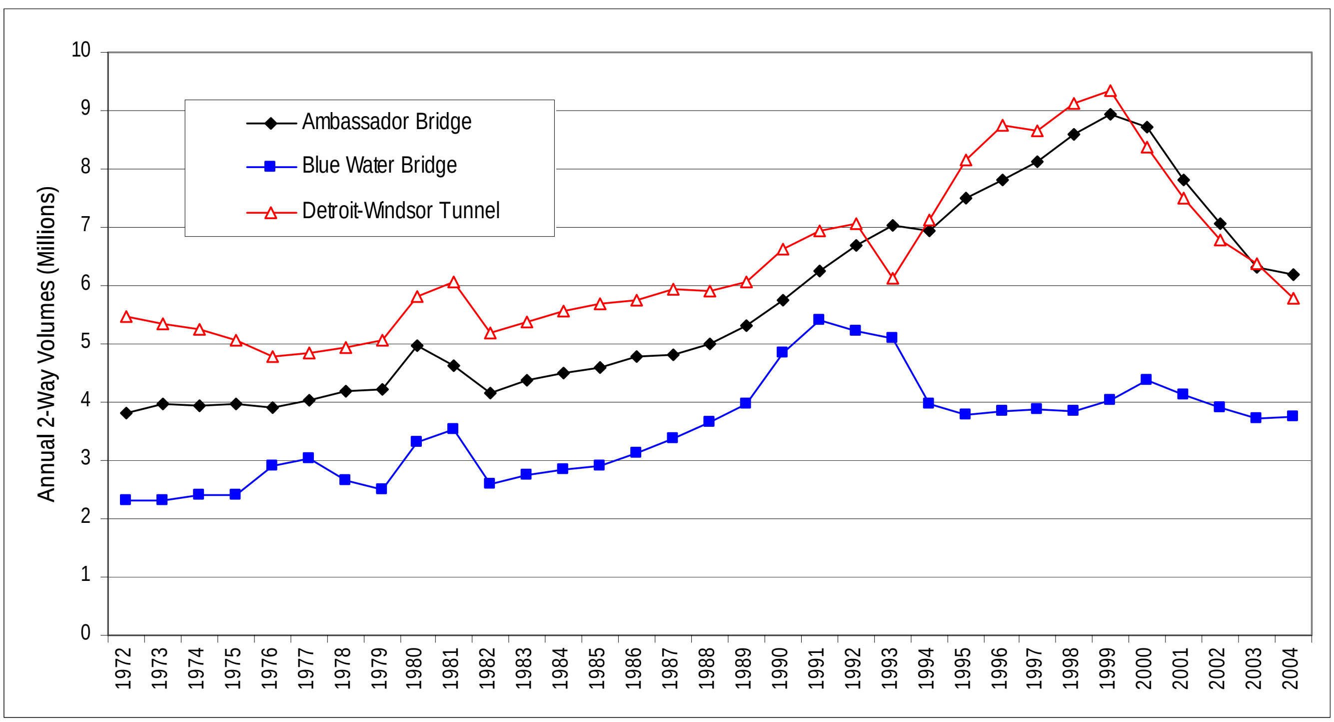
Crossing	2000 Volume (Millions)	2004 Volume (Millions)	Absolute Increase (Millions)	Percent Change
Ambassador Bridge	8.81	6.26	(2.55)	(29%)
Detroit-Windsor Tunnel	8.44	5.84	(2.60)	(31%)
Blue Water Bridge	4.40	3.77	(0.63)	(14%)
Peace Bridge	6.95	5.66	(1.29)	(19%)
Lewiston-Queenston Bridge	3.49	2.92	(0.57)	(16%)
Whirlpool Rapids Bridge	0.76	0.17	(0.59)	(78%)
Rainbow Bridge	4.24	3.46	(0.78)	(18%)
Sault St. Marie Bridge	2.55	1.72	(0.83)	(33%)
Ogdensburg Bridge	0.48	0.42	(0.06)	(13%)
Seaway International Bridge	2.27	2.39	+0.12	+5%
Thousand Islands Bridge	1.67	1.63	(0.04)	(2%)
TOTAL	44.07	34.21	(9.86)	(22%)
Share of Detroit River Crossings	39.2%	35.4%	-	-
Total Detroit River Crossings	17.25	12.10	(5.15)	(30%)
Total St. Clair River Crossings	4.40	3.77	(0.63)	(14%)
Total Niagara River Crossings	11.95	9.29	(2.66)	(22%)
Total St. Lawrence River Crossings	4.42	4.44	0.02	0.0%

Note: Annual volumes in millions.
Source: Bridge and Tunnel Operators Association

Annual passenger car crossing volumes from 1972 to 2004 for the Detroit River crossings are shown in Exhibit 3.6, together with data for Blue Water Bridge. The Detroit and St. Clair River 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, and a drop in volume since 2000, all indicative of national trends. The national trends in visitation between the US and Canada by country of residence is shown in Exhibit 3.7 from 1986 to 2004 indicates the historic variation in same-day and overnight trips. The largest variation occurs with same day trips related to the large peaks that have occurred with overnight travel being more consistent over time.

The Iran-Iraq war in the early 1980s led to a 150% price rise in crude oil in the US, which resulted in a short-term 20% increase in 1980/81 for travel to Canada to take advantage of the availability and lower gasoline prices in Canada. At that time, Canada's National Energy Program was in place to control increases in domestic oil prices, with reliance on oil from Western Canada. A falling Canadian dollar, valued at approximately $0.85 US in the early 1980s after being on par with the US dollar for much of the 1970s (see Exhibit 3.8 for historic Canada-US exchange rates), contributed to increased cross-border travel by Americans.

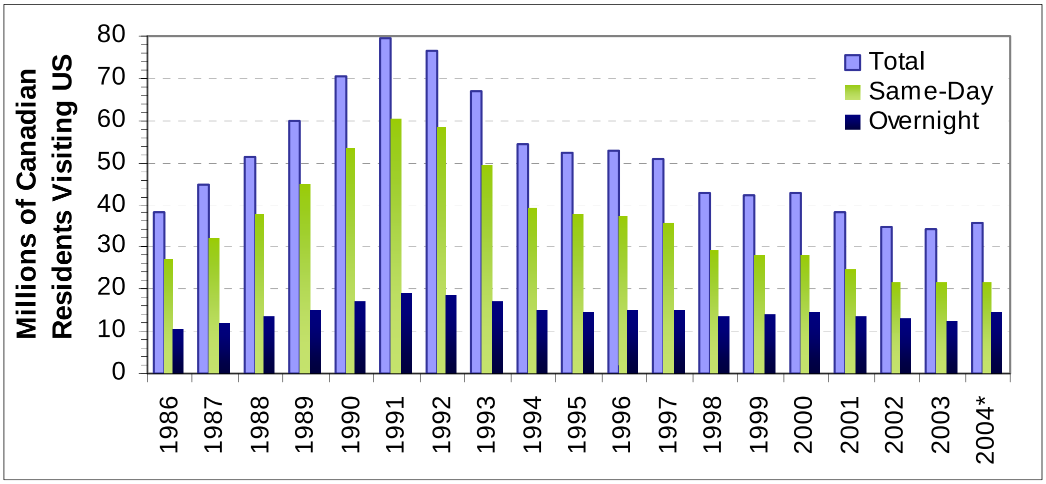
Exhibit 3.6: Annual Passenger Car Volumes, 1972 to 2004



Source: Bridge and Tunnel Operators Association

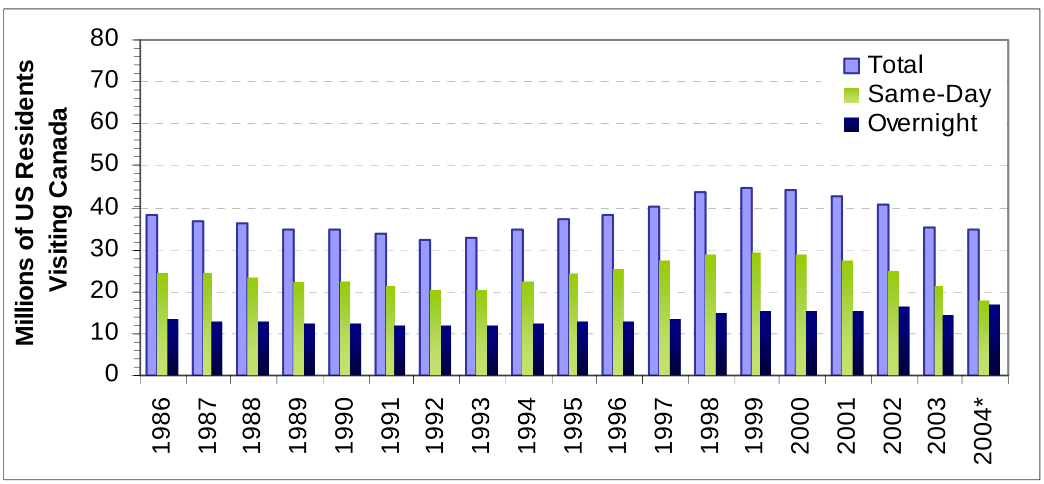
Exhibit 3.7: Visitation between Canada-US at Detroit-Windsor, All Modes

A. Number of Canadian Residents Visiting US, All Modes



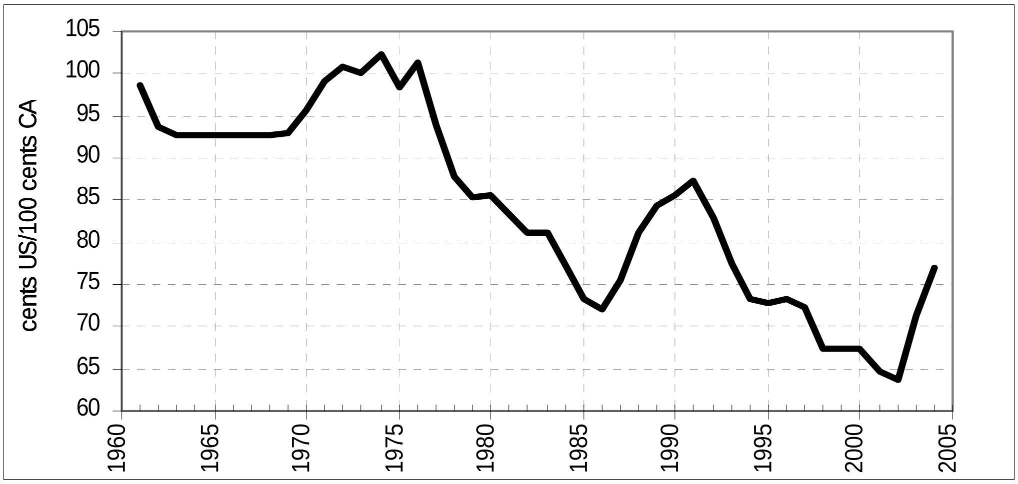
* First 11 months, annualized.
Source: Statistics Canada International Travel Survey, Table 387-0004

B. Number of US Residents Visiting Canada, All Modes



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

Exhibit 3.8: Canada-US Exchange Rate, 1960 to 2004



Source: Statistics Canada

During the late 1980s, an increase in the Canada-to-US currency exchange rates, differences in prices and taxes on many goods, Sunday closing laws in Canada, and the introduction of the Canadian Goods and Services Tax (GST) in January 1991 led to the cross-border shopping phenomenon, with Canadian residents shopping in the US to 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.

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

Average annual growth rates by crossing between 1972 and 2000 were 3.0% for the Ambassador Bridge, 2.3% for the Detroit-Windsor Tunnel, and 1.5% for the Blue Water Bridge. For 2000 to 2004, average annual growth has been -8.3% for the Ambassador Bridge, -8.8% for the Detroit-Windsor Tunnel, and -3.8% for the Blue Water Bridge.

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

3.2.2 TRIP PURPOSE TRENDS

The Ontario-Michigan Border Crossing Traffic Study, carried out in August 2000, provided a rich source of cross-border passenger car travel characteristics. The completed dataset consists of trip characteristics obtained from 22,310 roadside surveys of passenger-vehicles crossing the Ambassador, Blue Water and International (Sault Ste. Marie) Bridges as well as the Detroit-Windsor Tunnel, coded and expanded to represent the total auto volumes at each crossing. This information, together with comparisons of hourly and seasonal travel profiles, information on Detroit River and national border-crossing trends by length of stay, provide a basis for providing an updated estimate of trip purpose characteristics for 2004. This is described in detail in the ***2004 Travel Demand Model Update Report.***

National data on length of stay by travellers between the US and Canada is available from the Statistics Canada International Travel Survey, and were presented previously in Exhibits 3.7. For US residents visiting Canada, information on length of stay is available for travel specific to the Detroit River crossings[2]. These figures are shown in Exhibit 3.9 for same-day, overnight, and total crossings.

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

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

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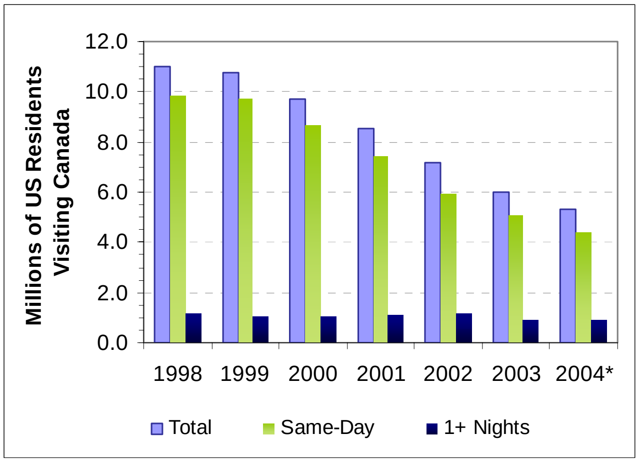
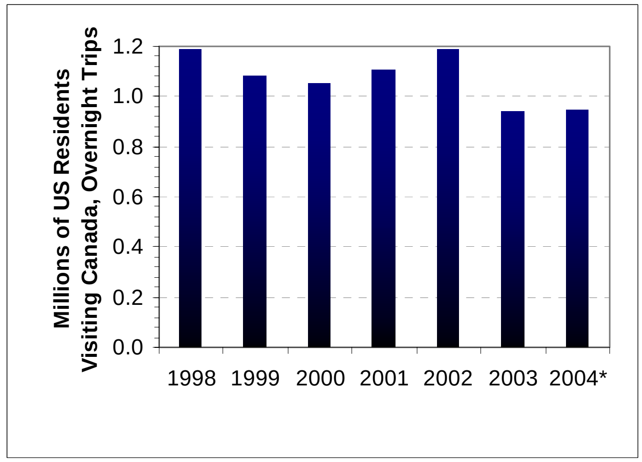
[2] Data for the Ambassador Bridge and Detroit-Windsor Tunnel could not be provided separately for privacy reasons.

Exhibit 3.9: Number of US Residents Visiting Canada by Automobile via Detroit River Crossings by Duration of Stay

A. Total, Same-Day, Overnight



B. Overnight Only (change of scale)

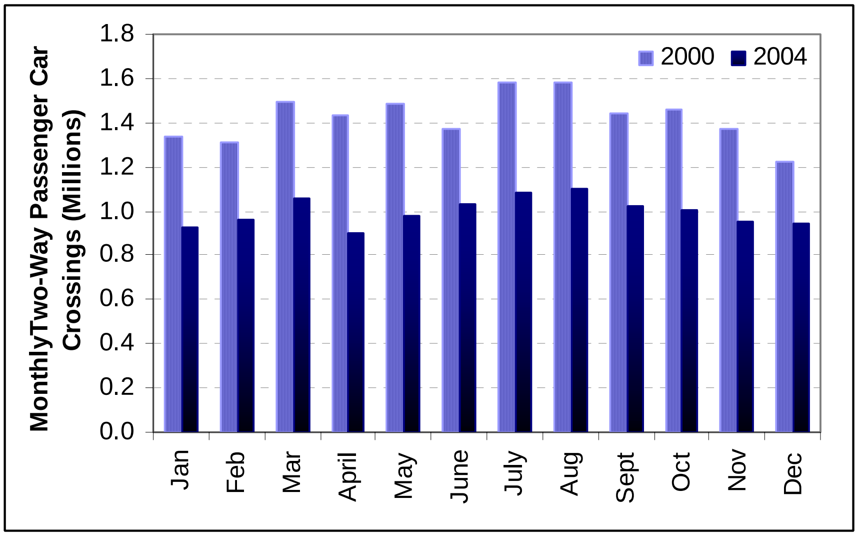


* First 11 months, annualized.
Source: Statistics Canada International Travel Survey

3.2.3 SEASONAL TRENDS

Exhibit 3.10 shows seasonal trends for passenger car traffic via plots of monthly traffic for the years 2000 and 2004. In both years, July and August had the highest levels of passenger-car volumes, followed by March, corresponding to peak travel/vacation periods. With lower proportions of discretionary travel in 2004 compared to 2000, monthly variation is less in 2004 (22%) than in 2000 (29%). This decrease in monthly variation reflects the lower number of same day discretionary and vacation trips that are being made post 9/11.

Exhibit 3.10: Monthly Variation in Detroit River Passenger Car Crossings, 2000 & 2004



Source: Bridge and Tunnel Operators Association

3.2.4 COMMUTE TRIPS

Work/business trips represented approximately 16,000 to 18,000 weekday trips in 2004, representing almost half of the traffic using the Detroit River crossings on a typical Fall weekday. Canadian residents employed in the US are the dominant proportion, representing almost 80% of the cross-border work/business travel.

The number of Windsor-area residents who work in the United States increased from 2,500 to 7,000 between 1991 and 2001, corresponding to an absolute increase of 170% over this ten-year period or 10.6% per year annually, as can be seen in Exhibit 3.11. The majority of these cross-border jobs are in manufacturing (23%), professional services (21%) and in health care (20%). The Canada-US Free Trade Agreement of 1988 and the North American Free Trade Agreement of 1994 has facilitated work travel between the two countries. It is supported by NEXUS and predecessor voluntary programs established by Canada and US border inspection agencies to provide frequent, low-risk travellers with reduced inspection times and priority treatments.

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

Exhibit 3.11: Place of Work for City of Windsor & Windsor Census Metropolitan Area Workers

A. Windsor Workers Employed in the US, 1981 to 2001

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

Source: Statistics Canada Census Place-of-Work

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

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

Source: Statistics Canada Census Place-of-Work

3.2.5 VACATION TRIPS

In 2004, it is estimated that there were approximately 2,000 Fall weekday and 4,000 Summer weekday vacation trips using the Detroit River crossings. It represents 5% of the international passenger car traffic on a typical Fall weekday. Vacation travel has been much less affected by 9/11, SARS, the Iraq War and overall heightened security levels at the border as compared to same-day discretionary trips, as the border delay represents a much smaller proportion of the travel time for longer-distance overnight trips.

Updating passenger travel vacation trends was based largely on the Statistics Canada International Travel Survey data for overnight trip trends, a large proportion of which are vacation trips. Between 2000 and 2004, overnight trips by US residents to Canada via the Detroit River decreased by 10%. In the same time, overnight trips by Canadian residents to the US nationally decreased a net 1% overall, although a 5% drop resulted in a better fit for the updated 2004 Detroit River traffic profile.

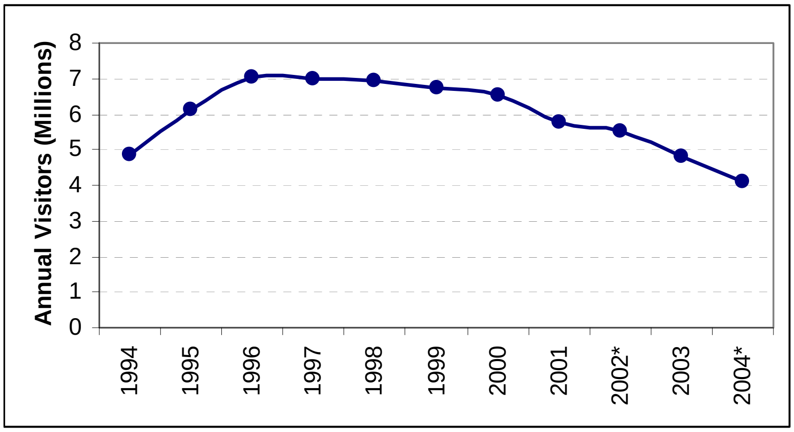
3.2.6 RECREATION/ENTERTAINMENT/SHOPPING TRIPS

There were approximately 15,000 same-day recreation, entertainment, and shopping trips using the Detroit River crossings on a Summer weekday and 14,000 on a Fall weekday in 2004. This represents 40% of cross-border travel on a Summer 2004 weekday, but is a dramatic decrease from 27,000 trips and 49% of Summer 2000 weekday trips.

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

Major attractions for Americans in the Windsor area include Casino Windsor, Windsor Racetrack, bingo and the many restaurants, bars and entertainment venues in the downtown area. Between 2000 and 2004, Casino Windsor attendance has declined by approximately 38% (see Exhibit 3.12), with Americans assumed to represent approximately 80% of Windsor Casino attendance. Three new casinos have opened in Detroit since 1999 and the Windsor Casino strike in 2004 contributed to further Casino Windsor declines. Significant declines at local hotels, restaurants and entertainment venues have also been experienced in the Windsor area.

Exhibit 3.12: Casino Windsor Patronage



* 2004 values are annualized from 9 months' data
Source: 1994-2001 – Previous Windsor Casino website; 2002-2004 – Ontario Lottery and Gaming Corp.

The recent rapid rise in the Canadian dollar relative to the US dollar has also influenced same-day discretionary travel, although to a much lesser extent. Americans still generally feel that good value is obtained for travel to Canada based on an exchange rate in the low-US$0.80 range. Changes in the exchange rate are considered to have only a marginal impact on US travel to Canada compared to the overall passenger car decline.

Among Canadians, a stronger Canadian dollar typically translates to higher levels of discretionary travel to the US, but this has not occurred with the recent large increase the Canadian dollar based on a recent Statistics Canada report[3]. The lack of responsiveness may be due to real/perceived border crossing inconvenience, as described above, and/or that the incentive for cross-border travel is limited or does not exist for Canadians. The latter may be due to increased economic integration of retail/shopping industries in both countries, which has greatly reduced or eliminated potential price savings after exchange and/or the need to travel for a variety of selection, with common stores in both countries. This is a very different situation from the late 1980s when the cross-border shopping phenomenon was occurring due to significant cost savings to Canadian shoppers in a pre-NAFTA era, a wider selection of stores in the US, and significantly lower taxes on gasoline and tobacco products, among other reasons.

3.2.7 SPATIAL TRAVEL PATTERNS

Exhibit 3.13 presents a summary of the origin-destination patterns for passenger car traffic at Detroit and St. Clair River Crossings. On a Fall Weekday, there were approximately 35,850 passenger car trips at Detroit River crossings, comprising the Ambassador Bridge and Detroit-Windsor Tunnel. Almost 80% of these trips were local in nature between greater Windsor and greater Detroit. Approximately 15% of the trips started or ended in the greater Windsor-Detroit area, but involved long-distance travel to other parts of the US or Canada. Only a small proportion of the passenger car trips (6%) represented long distance travel that passed through the Windsor-Detroit area. The Detroit-Windsor Tunnel serves a higher proportion of local Windsor-Detroit travel compared to the Ambassador Bridge (88% vs. 71%), but less long distance to long distance traffic travelling through Windsor-Detroit (0.9% vs. 10%). This reflects the highly localized nature of passenger car travel using the Detroit River crossings, with limited ability for these trips to use other international crossings (i.e. Blue Water Bridge).

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

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

Exhibit 3.13: Weekday Passenger Car Trips Trip Patterns at Detroit River & St. Clair River Crossings, 2004

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

[1]The local trip area for Blue Water Bridge crossings is Sarnia and area (Lambton County) in Canada.
[2] This includes unexpected/atypical trips where the shortest route is not taken.
Source: Ontario-Michigan Border Crossing Traffic Study

3.3 Travel by Other Passenger Modes

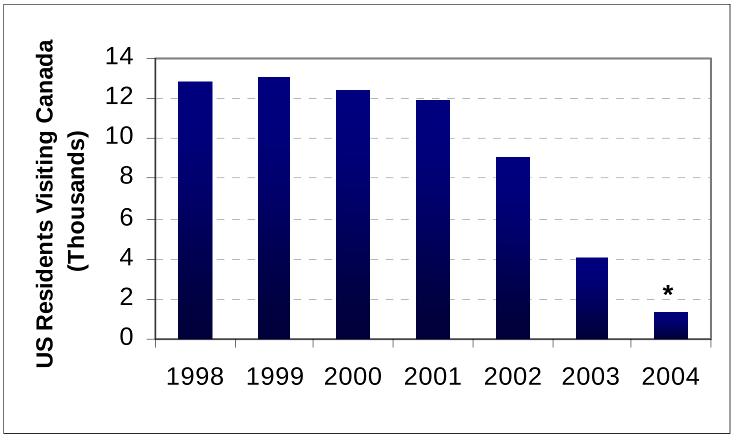
3.3.1 BUS

As noted above, there were 2.1 million bus passenger trips at the Detroit River and St. Clair River crossings, representing less than 7% of total person trips. At Detroit River crossings, there were 1.8 million bus passenger trips in 2004, representing a passenger modal share of 8%. The estimated 78,000 buses represent only 0.6% of total Detroit River cross-border passenger car volumes. These volumes include intercity motor coaches and public transit services operated by Windsor Transit. The Windsor Transit Tunnel bus operates seven days a week at regular headways (generally 20 minutes in peak periods and 30 minutes off-peak on weekdays, and 30 to 40 minute headways on weekends). This service operates from the Windsor downtown bus terminal to the Detroit downtown bus terminal, serving the Renaissance Centre, Cobo Hall/Joe Lois Arena and the downtown area in Detroit, as well as Casino Windsor. Special services are provided to Detroit Lion (Ford Field) and Detroit Tiger (Comerica Park) home games.

3.3.2 PASSENGER RAIL

No passenger rail service exists between Detroit and Windsor. Until April 25, 2004, Amtrak and VIA provided international train service between Chicago and Toronto, with stops in Port Huron and Sarnia. Given declining ridership (see Exhibit 3.14) and schedule disruptions due to customs delays, Amtrak has decided to better serve its Michigan market and end service at Port Huron, instead of continuing easterly to Toronto. (In May 2004, Amtrak's new Blue Water service between Port Huron and Chicago saw a 20% increase in ridership compared to the previous International service in May 2003.) VIA Rail Canada provides service between Sarnia and Toronto and between Windsor and Toronto, and Amtrak has a Chicago-Detroit-Pontiac service, but neither VIA nor Amtrak provides shuttle service across the border.

Exhibit 3.14: Cross-Border Rail Trips at Sarnia-Port Huron



* Amtrak cross-border service ended April 25, 2004
Source: Statistics Canada International Travel Survey

3.3.3 PASSENGER FERRY

Alternative but very low-volume border-crossing mode in the vicinity of the study area is the Blue Water Ferry and Walpole Island Ferry, as noted in Section 2.5. The Blue Water Ferry provides international ferry service across the St. Clair River between Marine City, Michigan and Sombra, Ontario, approximately 32 kilometres south of Sarnia-Port Huron, or about a 130-kilometres trip from Windsor. The ferry operates daily at twenty-minute headways from 6:40 AM to 10:30 PM year-round, weather permitting. The Walpole Island Ferry provides daily service between Algonac, Michigan and Walpole Island, Ontario, operating on a twenty-minute headway with a six-minute travel time. The one-way cost is approximately $4 US.

3.4 Commercial Vehicle Demand

3.4.1 TRAFFIC TRENDS

Exhibit 3.15 presents annual commercial vehicle volumes for Ontario-US crossings for 2000 and 2004. The Ambassador Bridge is the dominant commercial vehicle crossing and carried 3.37 million commercial vehicles in 2004. The Detroit-Windsor Tunnel serves a small number of commercial vehicles (0.16 million in 2004), with geometric constraints of the tunnel precluding most large trucks from using this facility. These two Detroit River crossings represented 41.5% of Ontario-US commercial vehicle traffic.

Exhibit 3.15: Commercial Vehicle Volumes at Ontario-US Crossings, 2000 to 2004

Crossing	2000 Volume (Millions)	2004 Volume (Millions)	Absolute Increase	Percent Change
Ambassador Bridge	3.49	3.37	(0.12)	(3.4%)
Detroit-Windsor Tunnel	0.18	0.16	(0.02)	(11.1%)
Blue Water Bridge	1.48	1.80	+0.32	+21.6%
Lewiston-Queenston Bridge	1.04	1.01	(0.03)	(2.9%)
Ogdensburg Bridge	0.06	0.10	+0.04	+66.6%
Peace Bridge	1.45	1.30	(0.15)	(10.3%)
Sault St. Marie Bridge	0.13	0.13	0.00	0.0%
Seaway International Bridge	0.13	0.16	+0.03	+23.1%
Thousand Islands Bridge	0.54	0.48	(0.06)	(11.1%)
TOTAL	8.50	8.51	+0.01	0.1%
Share of Detroit River Crossings	43.2%	41.5%	-	-
Total Detroit River Crossings	3.67	3.53	(0.14)	(3.8%)
Total St. Clair River Crossings	1.48	1.80	+0.32	+21.6%
Total Niagara River Crossings	2.49	2.31	(0.18)	(7.2%)
Total St. Lawrence River Crossings	0.73	0.74	+0.01	(1.3%)

Source: Bridge and Tunnel Operators Association

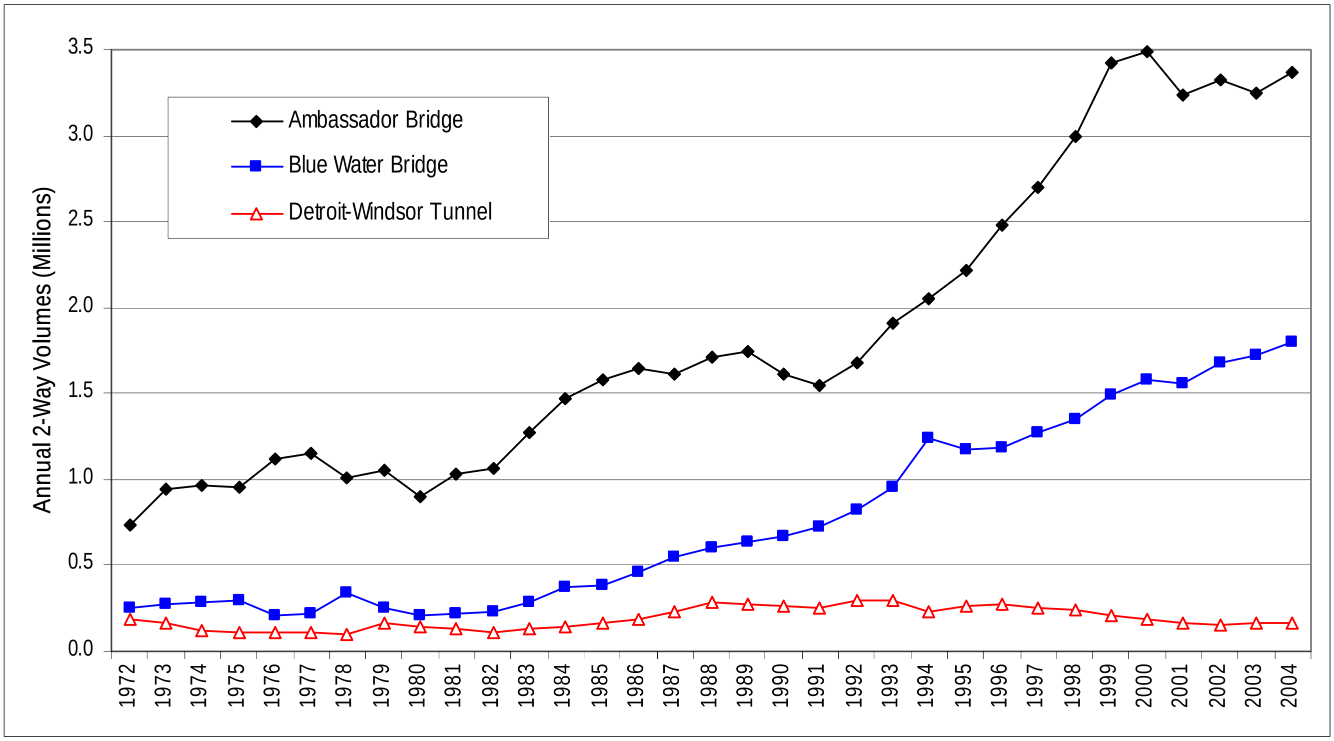
Since 2000, total commercial vehicle traffic at Ontario-US crossings has been constant at approximately 8.5 million vehicles, with growth impeded by a downturn in the US economy that started in 2000, the events of 9/11 and the associated border delays and more rigorous security procedures. Annual commercial vehicle traffic at the Ambassador Bridge decreased by 0.12 million vehicles or by 3.4% between 2000 and 2004. The Blue Water Bridge increased by 0.32 million vehicles over this same time period, representing a 21.6% increase. The Ambassador Bridge and Blue Water Bridge operate as a system, as many long distance trips can use either crossing and the combined Detroit and St. Clair River crossings experienced a net growth of 0.18 million vehicles. A proportion of Ambassador Bridge trips have diverted to the Blue Water Bridge, owing to actual and perceived delays at border inspection in Windsor-Detroit, as well as a small shift in travel patterns between 2000 and 2004, with a slightly higher proportion of trade to mid-western states that are more easily accessed via the Blue Water Bridge.

In combination, the Detroit and St. Clair River crossings have increased their share of commercial vehicle among Ontario-US crossings. The Niagara River commercial vehicle crossings, consisting of the Lewiston-Queenston and Peace Bridges experienced a decline in commercial vehicle traffic from 2.49 million in 2000 to 2.31 million in 2004, representing a 7.2% decrease.

Exhibit 3.16 shows annual commercial vehicle volumes for the three crossings from 1972 to 2004. Previous to 2000, commercial vehicle volumes had increased very rapidly in the 1990s and more than doubled at Ambassador Bridge and Blue Water Bridge, to 3.49 million commercial vehicles at Ambassador Bridge in 2000 and 1.58 million at Blue Water Bridge. Volumes at the Detroit-Windsor Tunnel, however, steadily decreased over the same period to 182,000 commercial vehicles in 2000, about half of the volume in 1990. Volumes at all crossings are lower in 2001 than in 2000 by 6% due to the effects of 9/11: 7.1% lower at the Ambassador Bridge, 6.8% lower at the Detroit–Windsor Tunnel and 1.3% lower at the Blue Water Bridge.

In total, since 1994, growth in commercial vehicle volumes exhibited at the Detroit River crossings has been much stronger than that of other Canada-US border regions. Overall, the rate of growth has been strong and almost continuous over the past 30-year period, owing to increases in industrial production in both Canada and the US. Growth in the auto sector and increases in Canadian assembly plant activity have particularly influenced the growth in commercial vehicle traffic between Southeast Michigan and Southwestern 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 Detroit and St. Clair River crossings.

Exhibit 3.16: Annual Commercial Vehicle Volumes, 1972 to 2004



Source: Bridge and Tunnel Operators Association

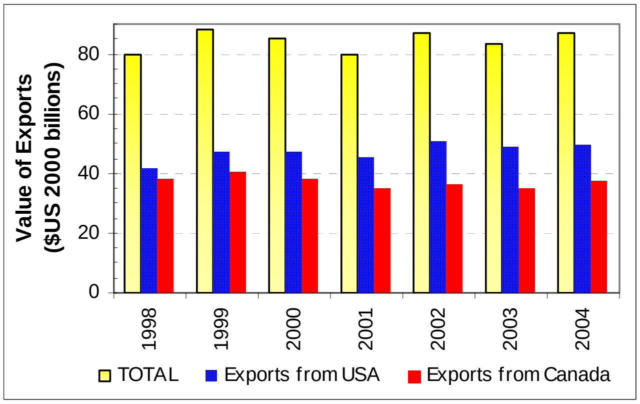
As well, the North American Free Trade Agreement (NAFTA) between the US, Canada and Mexico came into effect in January of 1994. Prior to NAFTA, Mexico had highly restrictive trade barrier and entrance into its market place was difficult; commercial vehicles are now able to drive across North America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

3.4.2 TRADE TRENDS

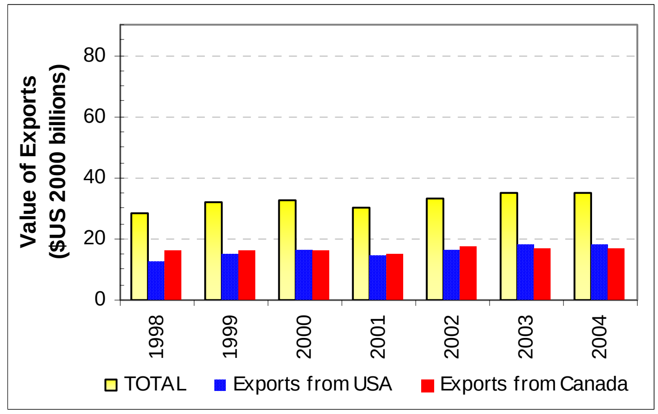
Exhibit 3.17 shows the value of truck trade transported from 1998 to 2004. The total value of trade carried by truck at Detroit-Windsor over the last few years has been somewhat steady but has not quite returned to 1999 values. Meanwhile, the value of trade transported by the Blue Water Bridge has been steadily increasing, the only deviation from the trend being in 2001. In 2004, the total value of truck trade at Blue Water Bridge was 42% compared to Detroit- Windsor, although commercial vehicle volumes are 53% compared to Detroit-Windsor. This suggests that trucks passing Detroit-Windsor have significantly higher freight value per truck than the Blue Water Bridge. Canadian exports to the US exceed imports at both Detroit River and St. Clair River crossings, although flows are much more balanced at the St. Clair River crossings.

Exhibit 3.17: Value of Annual Canada-US Trade Transported by Truck

A. Detroit River



B. St. Clair River



Source: BTS Transborder Surface Freight Database

Exhibit 3.18 presents the value of trade by commodity type transported by truck from 1998 to 2004. For truck trade crossing the Detroit and St. Clair Rivers, the main travel movements are between Ontario and the Central States of Michigan, Ohio, Indiana, Illinois and Wisconsin. These five states account for approximately 75% of the value of truck trade to the US crossing at Detroit River and St. Clair River crossings. Exhibit 3.18 also shows truck trade between Ontario and the US, which also includes traffic crossing at Niagara and St. Lawrence River crossings. The commodity trade trends indicate the importance of the auto industry to Canada-US trade, with approximately 35% of the value trade crossing at Detroit/St. Clair River crossings related to that industry. The metal sector is also highly related to the auto industry, with combined auto/metal sectors representing some 43% of the value.

Exhibit 3.19 graphically shows the amount of trade by value by state of origin and state of destination for truck traffic crossing at Detroit River and St. Clair River crossings. The geographic distribution indicates a strong focus in Michigan and the Interstate-75 and Interstate-69 corridors, extending south to Texas, Mexico and southern US states. There is also high interaction with California.

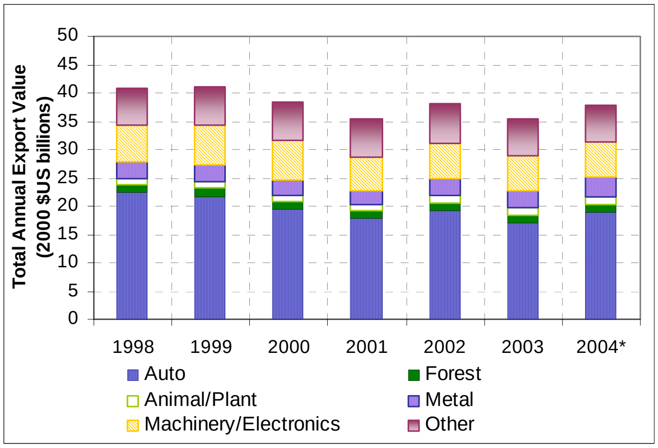
The examination of origin-destination patterns of truck movements between 1998 and 2004 did not indicate any significant change in travel patterns, or structural changes in the manner in which goods were being manufactured and/or shipped. Overall origin-destination patterns of truck movements by commodity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

In recent years, there have been structural changes in the auto industry with new plants being constructed in the southern US and Mexico. This has resulted in intra-US truck and Mexico-US truck movements that are not reflected in the Canada-US trade volumes that are presented. While affected in overall magnitude by these changes, the auto related truck movements that continue to cross the Canada-US border have maintained the same general origin-destination patterns.

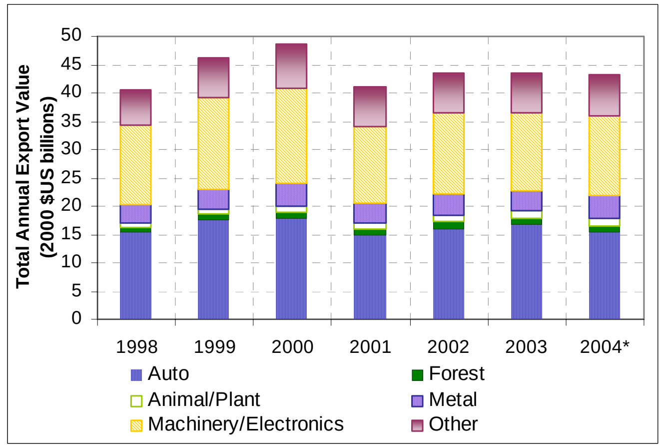
Exhibit 3.18: Value of Commodity Trade by Truck, 1998-2004

A. Between Ontario and East North Central States

ON to MI/OH/IN/IL/WI



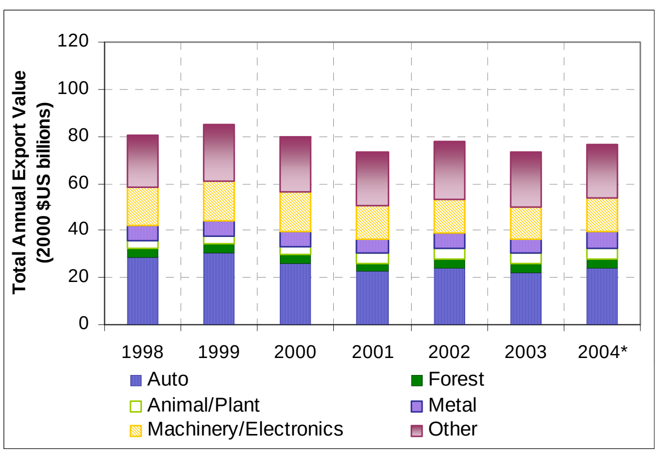
MI/OH/IN/IL/WI to ON



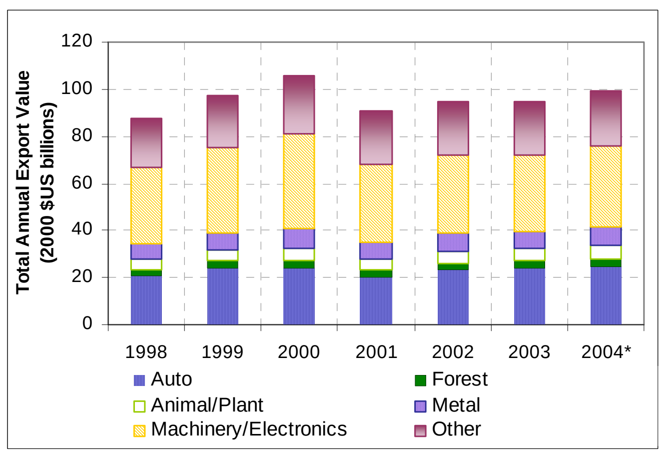
Source: Bureau of Transportation Statistics Transborder Freight Data

B. Between ON and US

ON to US



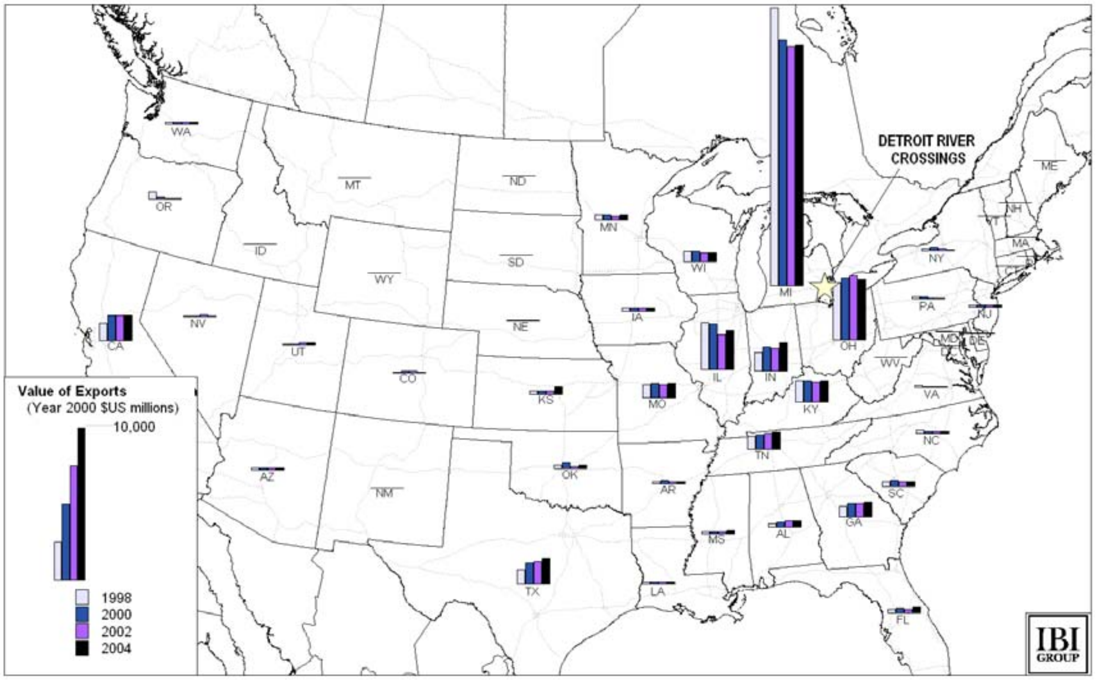
US to ON



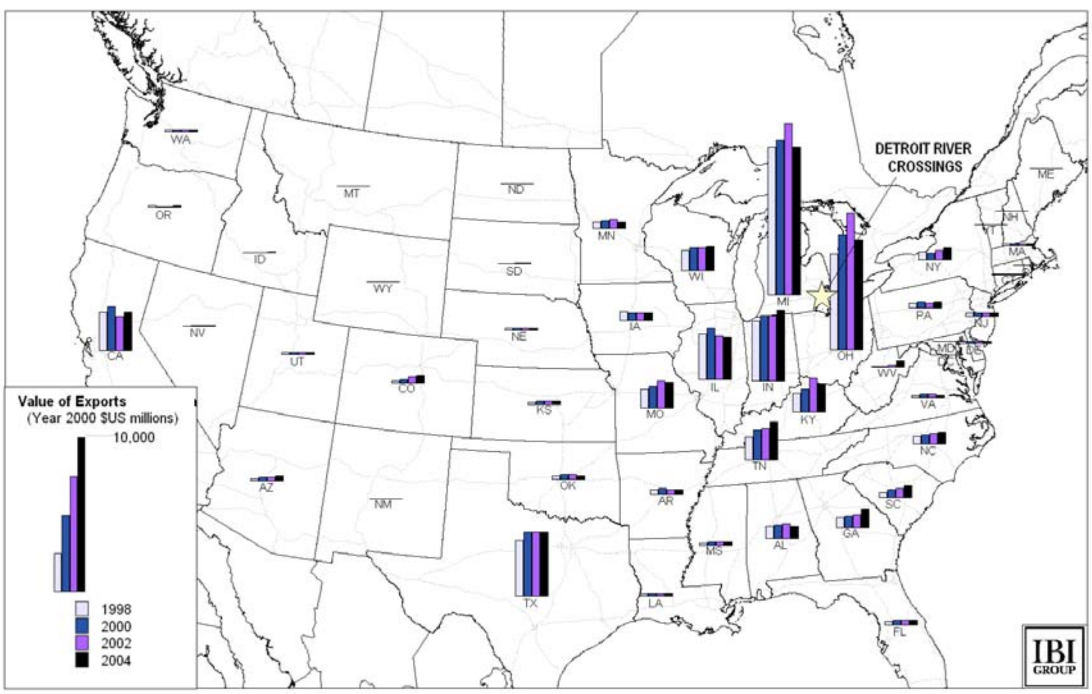
* First 11 months, annualized
Source: Bureau of Transportation Statistics Transborder Freight Data

Exhibit 3.19: Value of Trade between Canada & US at Detroit River Crossings, Truck Mode, 1998 to 2004

A. Canada to US



B. US to Canada



Source: BTS Transborder Surface Freight database

3.4.3 COMMODITY FLOWS

The primary source of data for developing cross-border commercial vehicle trip matrices is the 2000 Commercial Vehicle Survey database provided by the MTO, which has been updated in this study to 2004 based on BTS data, as described in detail in the ***2004 Travel Model Update Report***. This database provides an extremely rich sample of more than 13,500 trip records collected for trucks crossing the border between Ontario and Michigan, and is based on the 1999 National Roadside Survey (NRS), combined with results from the 2000/2001 MTO Commercial Vehicle Survey (CVS). Exhibit 3.20 maps the Detroit River commercial vehicles flows by state/province of origin/destination by commodity. The exhibit reveals different travel patterns for each commodity type.

The **Auto/Metal** category represents the highest volume of commercial vehicles crossing the Detroit River compared to other categories, at 36% of Canada-bound trucks and 42% of US-bound trucks. Compared to other commodities, trade patterns for auto/metal transport are more locally-oriented. Some 87% of trucks travel to/from Ontario, and the majority of trade (77 to 79%) is with the East North Central states (Michigan, Ohio, Indiana, Illinois, and Wisconsin). There is also some trade activity with the southern states, such that much Auto/Metal commercial vehicle travel is likely to use the I-75 corridor. Approximately 180 (7%) auto/metal Canada-bound trucks are in-transit trips from the East North Central states to New York State.

Commercial vehicles transporting **Forest** goods represent 4% of Canada-bound trucks and 12% of US-bound trucks at the Detroit River crossings. US-bound trucks travel the farthest distances within Canada, with some 40% of trips originating in Quebec and the Atlantic provinces. Two-thirds of these are destined for the East North Central states. More than a quarter of trips are to/from the Southern states, for which I-75 would likely be travelled.

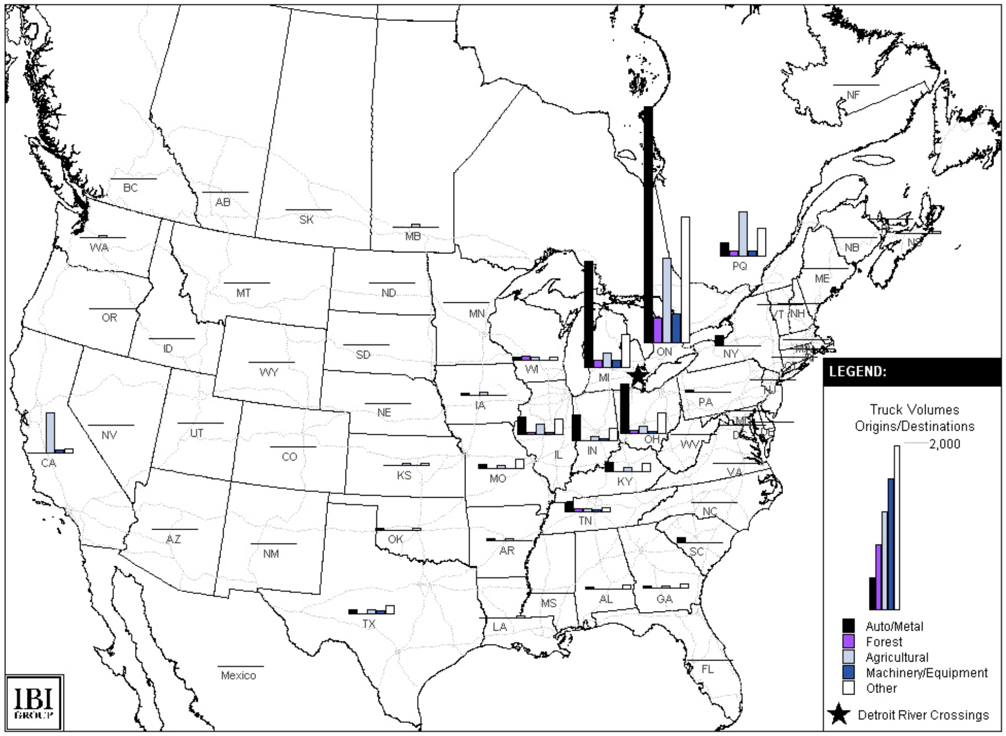
Commercial vehicles transporting **Agricultural** goods represent 18% of Canada-bound trucks and 10% of US-bound trucks at the Detroit River crossings. Canada-bound trucks travel the longest distances on average, with only one-third of trucks originating in the East North Central States. One-third of Canada-bound trucks come from California, and one-third travel as far as Quebec. (Some 40 trucks, or 3%, represent in-transit trips from Western Canada.) The majority of these trips could use the I-94 corridor to access the Detroit River crossings. US-bound trips are somewhat more local, with just over half of trips destined for the East North Central.

Although the **Machinery/Equipment** category represents a large portion of the value of trade crossing at the Detroit River, the proportion of trucks is quite small due to the large value of goods carried per truck. Commercial vehicles transporting Machinery/ Equipment represent only 5% of Canada-bound trucks and 3% of US-bound trucks at the Detroit River. Approximately 77% of trips are to/from Ontario. A slightly higher proportion of these trips are to/from the I-94 corridor than the I-75 corridor in the US.

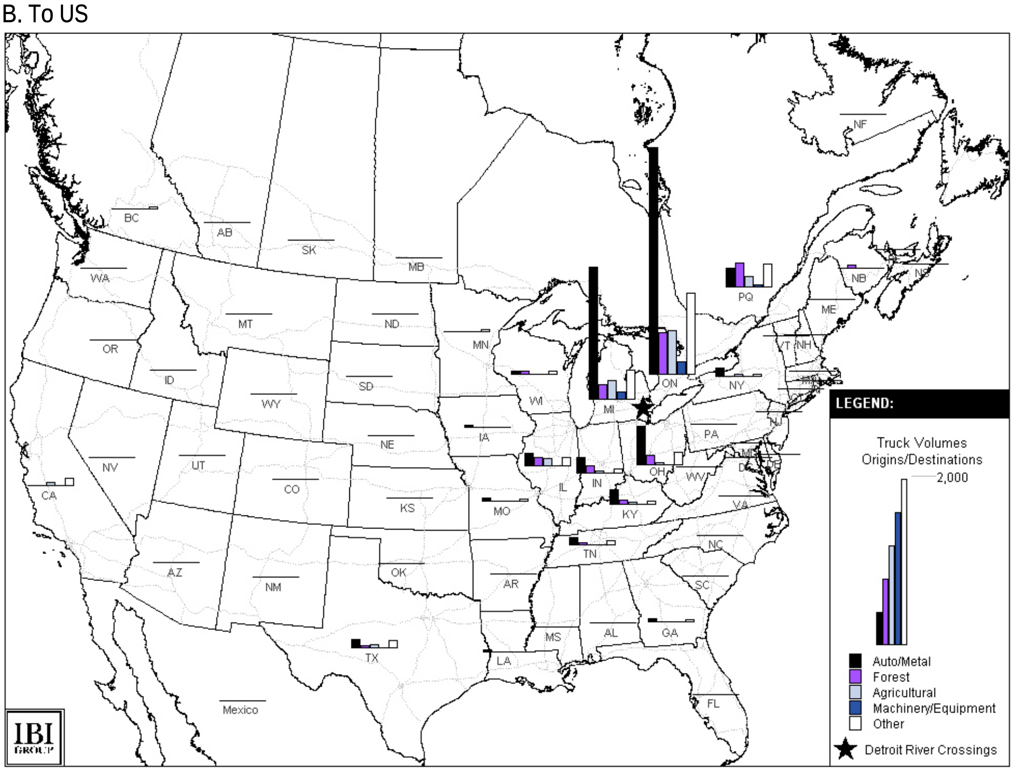
The **Other** commodity category represents over 1,000 commercial vehicles per direction on a given weekday at the Detroit River crossings, or 14% of Canada-bound trucks and 18% of US-bound trucks. These are slightly longer-distance on average, with roughly three-quarters of trips to/from Ontario, approximately 55% to/from the East North Central states, and roughly one-quarter to/from the Southern states, indicating a slightly higher likelihood of using I-75.

Exhibit 3.20: 2004 Commercial Vehicle Flows by Commodity

A. To Canada



B. To US



3.4.4 SPATIAL TRAVEL PATTERNS

Exhibit 3.21 presents an overview of the aggregate trip pattern characteristics for commercial vehicle traffic at Detroit River and St. Clair River crossings. The characteristics are much different than the passenger car travel patterns (see Section 3.2.7), with much longer distance travel and a much lower proportion of local travel between the Windsor and Detroit areas. In 2004, there were approximately 13,000 Fall weekday commercial vehicle trips at Detroit River crossings, with over 95% of the commercial vehicle traffic using the Ambassador Bridge.

While 37% of the commercial vehicle traffic at Detroit River crossings involves travel between Ontario and Michigan, less than 20% of the traffic is local to local, involving short distance travel between Windsor and Detroit. However, approximately 30% of the commercial vehicle travel involves long distance to local trips, which are long distance trips that have a trip start or end point in the Windsor-Detroit area. Approximately 50% of the commercial vehicle traffic at Detroit River crossings involve long distance to long distance travel and travel through Windsor-Detroit.

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

Exhibit 3.21: Weekday Commercial Vehicle Trips Patterns at Detroit River & St. Clair River Crossings, 2004

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

[1]The local trip area for Blue Water Bridge crossings is Sarnia and area (Lambton County) in Canada.
[2] This includes unexpected/atypical trips where the shortest route is not taken.
Source: 1999/2000 NRS/MTO Commercial Vehicle Survey

3.5 Other Freight Modes

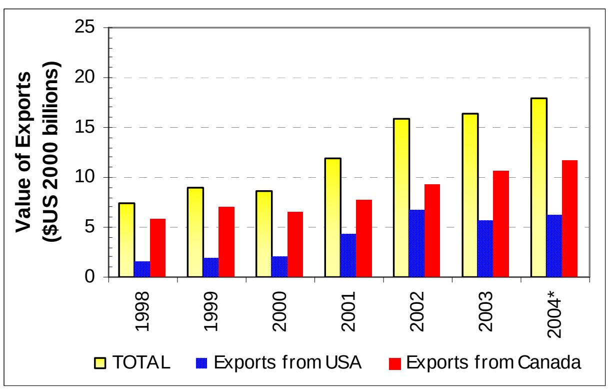
3.5.1 RAIL

Exhibit 3.22 shows the value of freight transported by rail across the Detroit River crossing. The value of rail trade transported via this crossing has been steadily increasing and has more than doubled since 1998. It now carries more rail freight from the US to Canada than the St. Clair River crossing, and 80% of the total value of Canada-US trade compared to the St. Clair River. Exhibit 3.23, which presents the monthly variation in rail trade via the Detroit River crossing, shows that the acceleration in rail freight began in early 2001 and therefore does not represent mode shifts in response to 9/11.

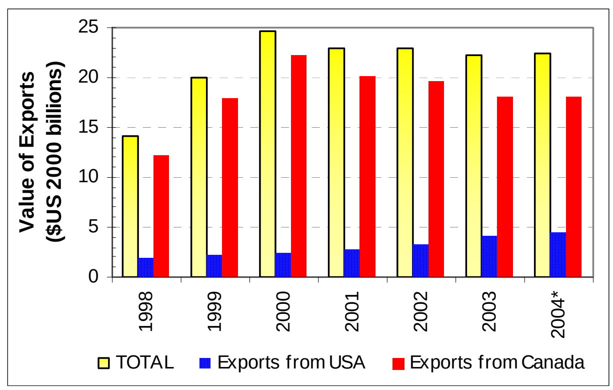
There have been operational changes that have affected the use of rail. The St. Clair Rail Tunnel is owned and controlled by Canadian National (CN); the Detroit-Windsor Rail Tunnel is controlled by Canadian Pacific Railway (CPR). The two railways have made a number of agreements to allow them to use each other's routings. For example, much of CN's traffic destined to Detroit used to go via the Sarnia tunnel but now goes through the Windsor tunnel. This accounts for some of the increase in usage of the Detroit-Windsor Rail Tunnel.

Exhibit 3.22: Value of Annual Import/Export Transported by Rail at Detroit River & St. Clair River Crossings

A. Detroit River

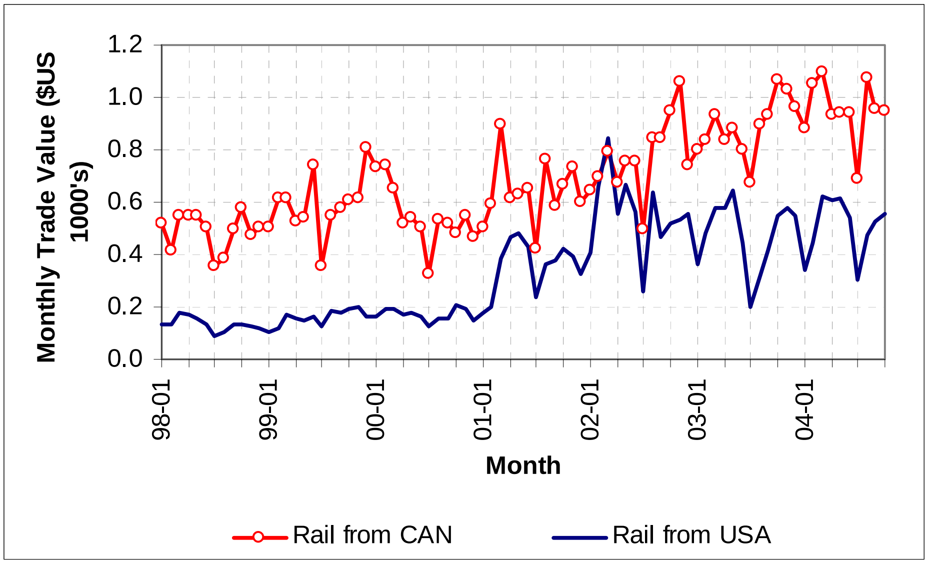


B. St. Clair River



* November and December 2004 values are estimated based on growth for January-October 2004 over January-October 2003.
Source: BTS Transborder Surface Freight Data, Indexed to Monthly Import/Export Price Indices

Exhibit 3.23: Monthly Variation in Rail Trade at Detroit River Crossing, 1998-2004



Source: BTS Transborder Surface Freight database

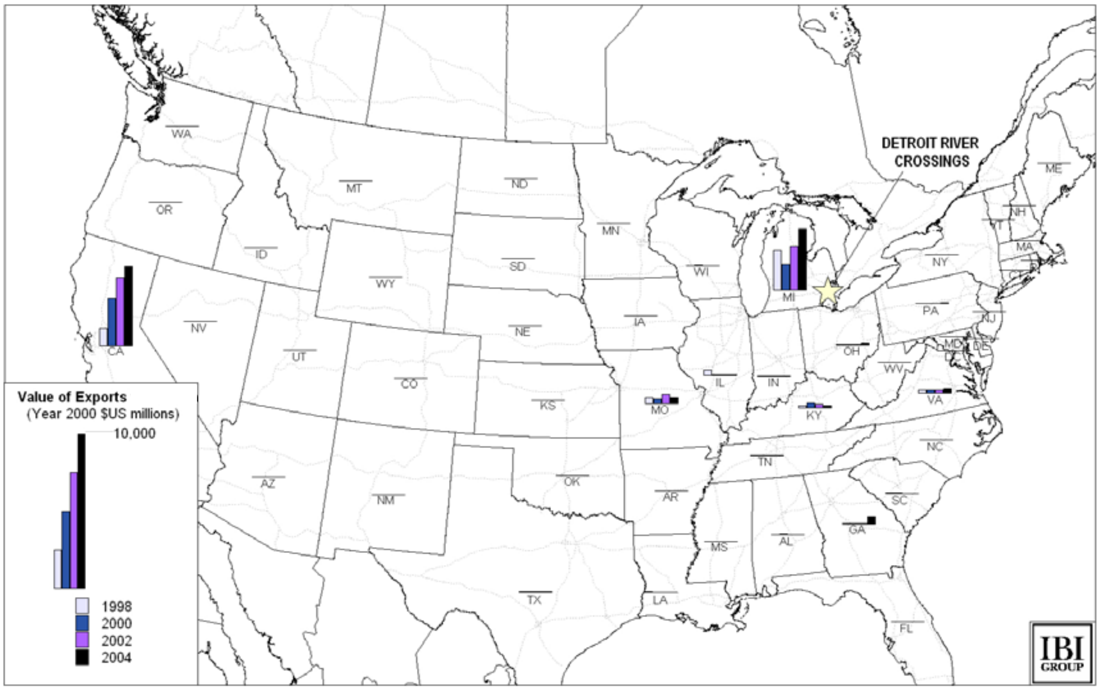
Exhibit 3.24 shows the distribution of Canada-US trade via the Detroit River by rail from 1998 to 2004. Most rail shipments are to/from Ontario. Most rail shipments from Canada are to California and Michigan. These are mostly auto-industry-related goods. Shipments to California have seen tremendous growth since 1998. Shipments from the US to Canada have been increasing from Michigan, Ohio, Indiana, Kentucky and Georgia. Where there have been increases in rail shipments, corresponding decreases are not evident in the trucking mode. Therefore, much of the increase in rail shipments is seen to have captured new markets, as newly-developing auto industry locations in the US are developing rather than diverting from existing trucking movements, as well as diversion from the St. Clair Tunnel as noted above.

The two major Canadian railways have traditionally done very well at attracting intermodal traffic. Much of the long-distance traffic in Canada has been moved to intermodal rail haulage either using piggyback trains with trailers on flat cars or domestic container movements. They have not been as successful in attracting cross-border intermodal traffic. In recent years, however, the railways have used innovative technology to attempt to make inroads into the market of relatively short-distance trips (500 km or less). For example, CPR started an intermodal service between Montreal/Toronto and Detroit using its Xpressway technology. However, after operating for several years, this service was discontinued in the Fall of 2004. Reasons given for the discontinuance include the following:

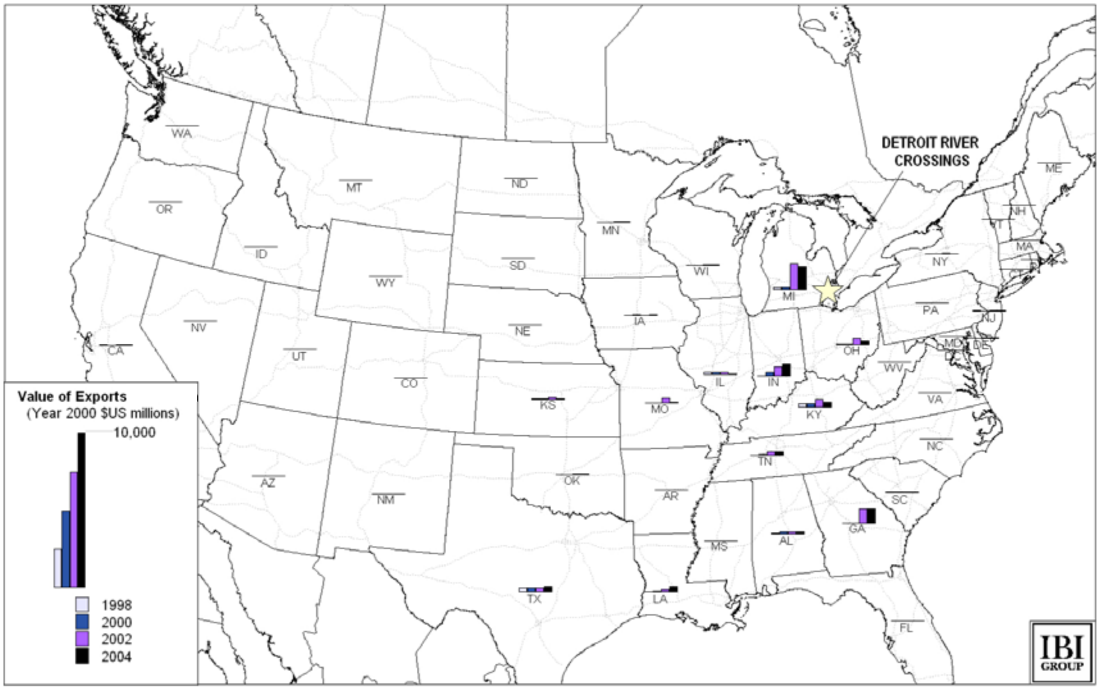
- Low margins;
- A lack of capacity on the mainline through Southwestern Ontario (a single track line); and
- Problems with US immigration with respect to Canadian drivers delivering trailers from the Detroit yard.

Exhibit 3.24: Rail Freight Trade at the Detroit River Crossing by State of Origin/Destination

A. Canada to US



B. US To Canada



Source: BTS Transborder Surface Freight database

3.5.2 MARINE

The Detroit-Windsor Truck Ferry provides vehicular service between Detroit and Windsor, specializing in the hazardous goods market and over-sized vehicles. It operates at one-hour headways over 10-hour days and can shuttle 8 trucks per crossing. The ferry currently handles about 50 trucks per day on average. This represents less than 0.5% of the total commercial vehicle traffic at Detroit River Crossings. 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 to cross by land between Minnesota and Ontario.

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, respectively. Detroit handled 17.0 million metric tonnes in 2001 (4.7 million metric tonnes in foreign trade). Windsor handled 5.3 million tonnes in 2004. In both cases, much 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. A plan to expand the Detroit Marine Terminal, south of Ambassador Bridge, is currently being considered.

3.6 Temporal Patterns of Vehicular Travel

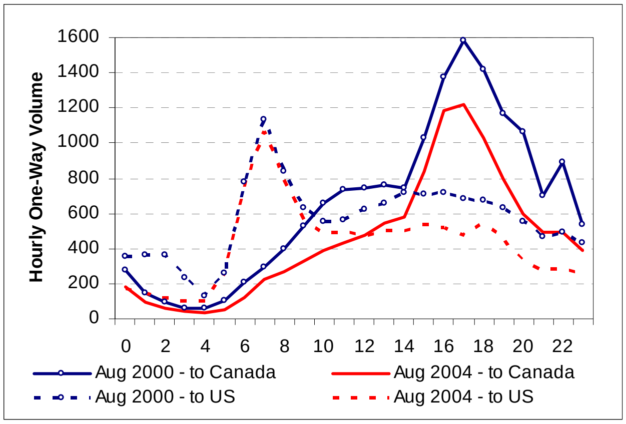
Hourly vehicle traffic profiles for the Detroit River crossings can be seen in Exhibit 3.25. These plots show travel by direction for two months, August and September, for both 2000 and 2004. In all cases, the peak in US-bound passenger car traffic occurs in the early morning, 6 to 9 a.m.; a high proportion of this travel includes Canadian residents commuting to US work locations. The peak in Canada-bound traffic occurs in the late afternoon, 4 to 7 p.m., with many Canadian commuters returning home. The morning and afternoon peaks are higher in September, while the mid-day volumes and total daily volumes are higher in August. This is due to increased discretionary travel (e.g. vacation/recreation travel) and a corresponding decrease in commuter travel while workers are on vacation in the summer months.

Exhibit 3.25: Hourly Detroit River Cross-Border Traffic Profiles, August & September Weekdays, 2000 & 2004

A. Passenger Cars

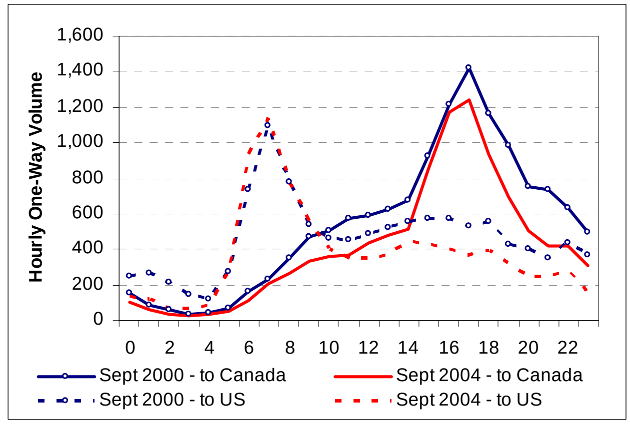
AUGUST 2000 and 2004

Ambassador Bridge

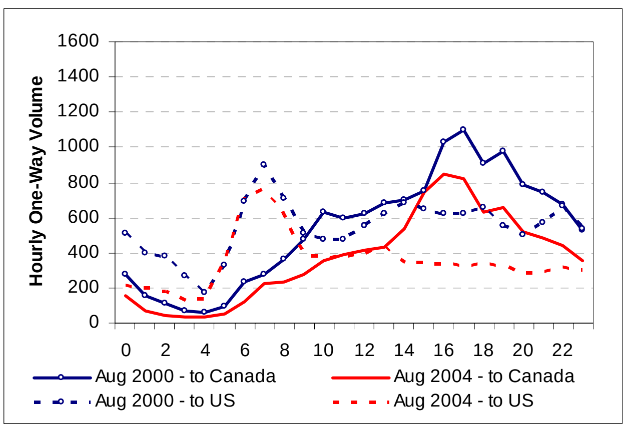


SEPTEMBER 2000 and 2004

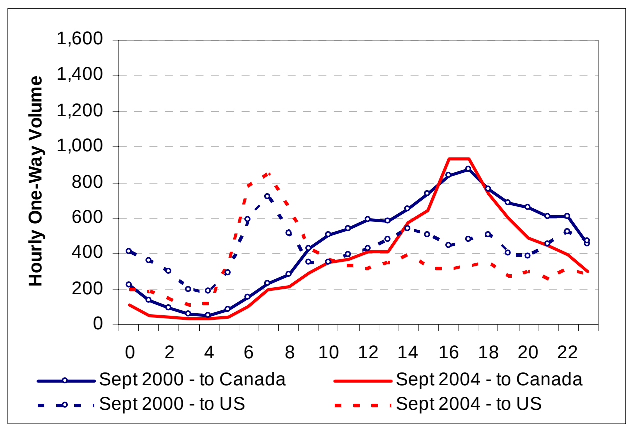
Ambassador Bridge



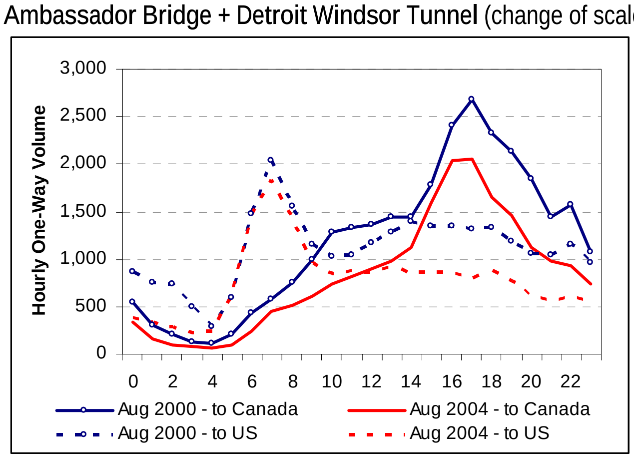
Detroit Windsor Tunnel



Detroit Windsor Tunnel



Ambassador Bridge + Detroit Windsor Tunnel (change of scale)



Ambassador Bridge + Detroit Windsor Tunnel (change of scale)

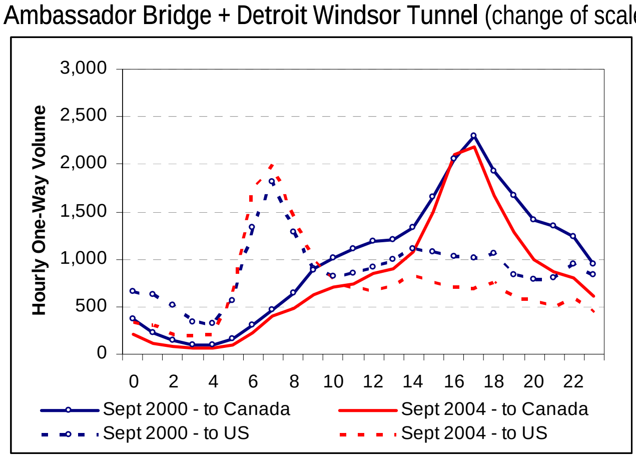
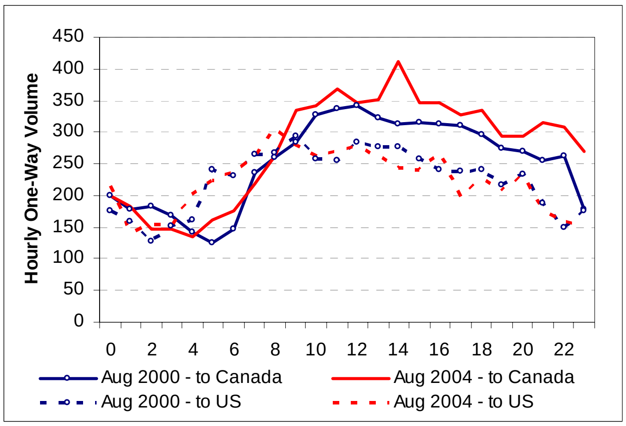


Exhibit 3.25 (Cont.): Hourly Detroit River Cross-Border Traffic Profiles, August & September Weekdays, 2000 & 2004

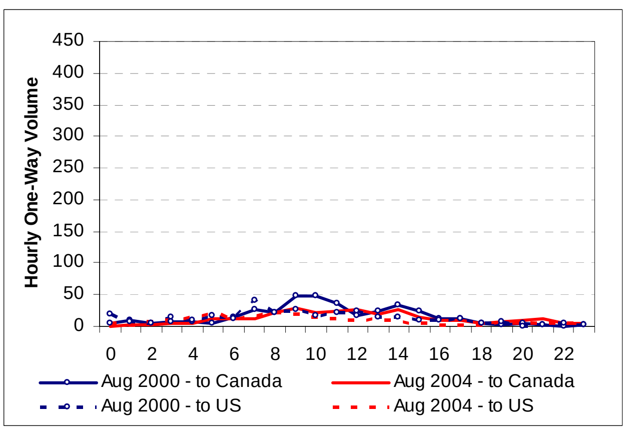
B. Commercial Vehicles

AUGUST 2000 and 2004

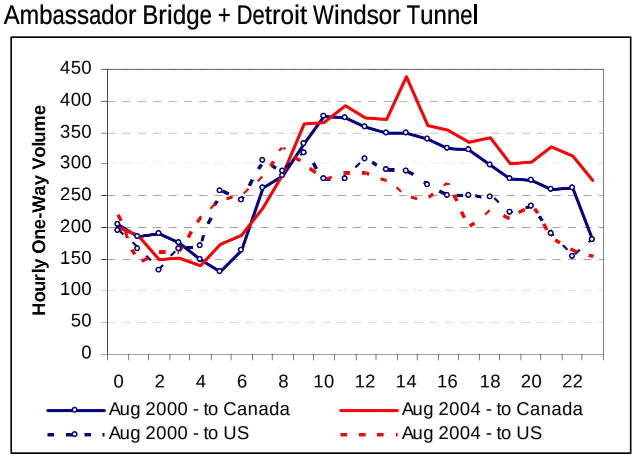
Ambassador Bridge



Detroit Windsor Tunnel

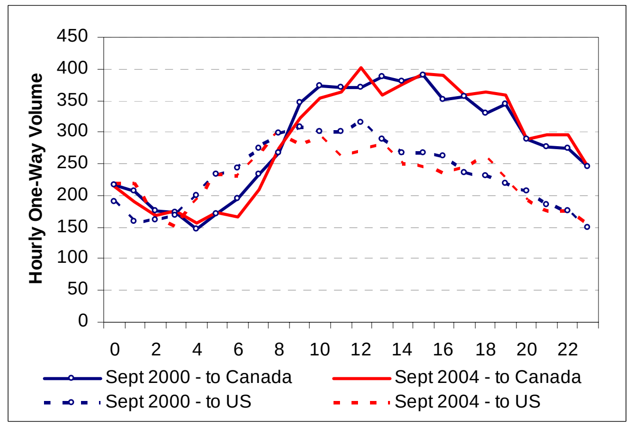


Ambassador Bridge + Detroit Windsor Tunnel

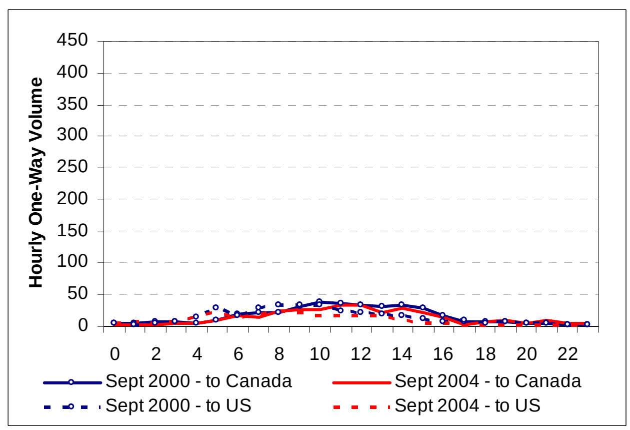


SEPTEMBER 2000 and 2004

Ambassador Bridge



Detroit Windsor Tunnel



Ambassador Bridge + Detroit Windsor Tunnel

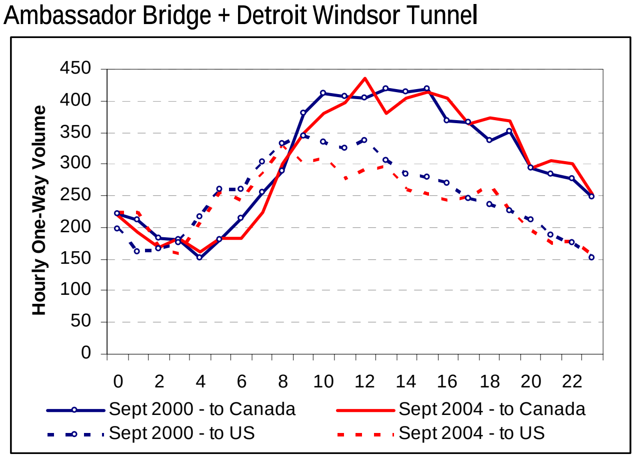
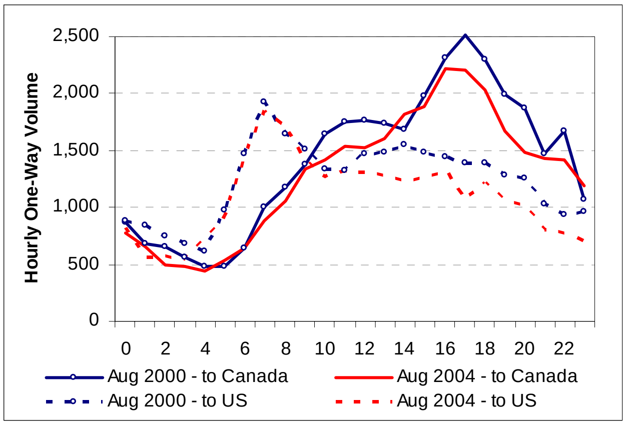


Exhibit 3.25 (Cont.): Hourly Detroit River Cross-Border Traffic Profiles, August & September Weekdays, 2000 & 2004

C. Passenger Car Equivalents (PCEs)

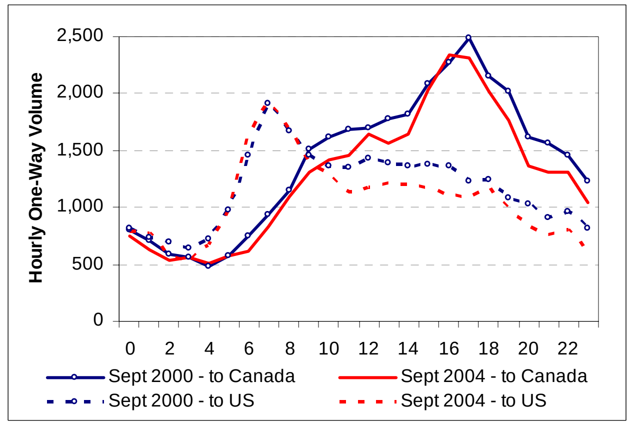
AUGUST 2000 and 2004

Ambassador Bridge

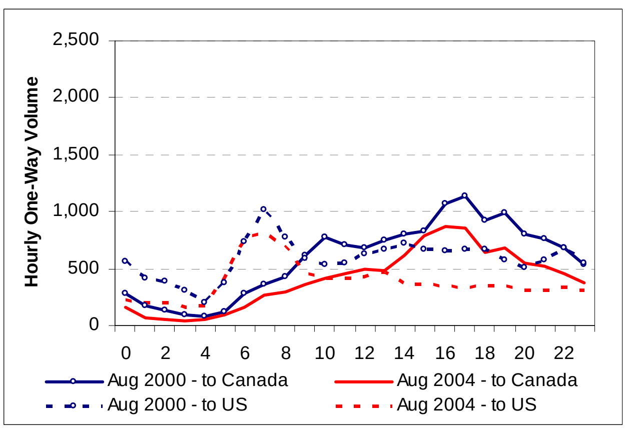


SEPTEMBER 2000 and 2004

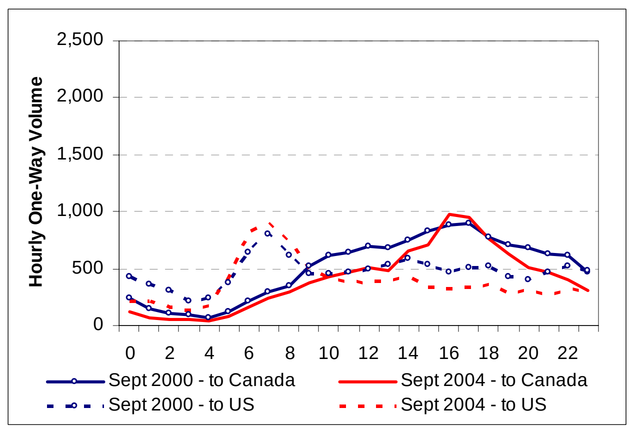
Ambassador Bridge



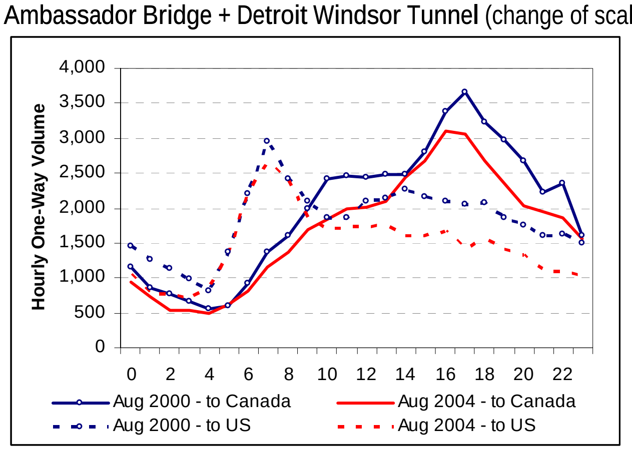
Detroit Windsor Tunnel



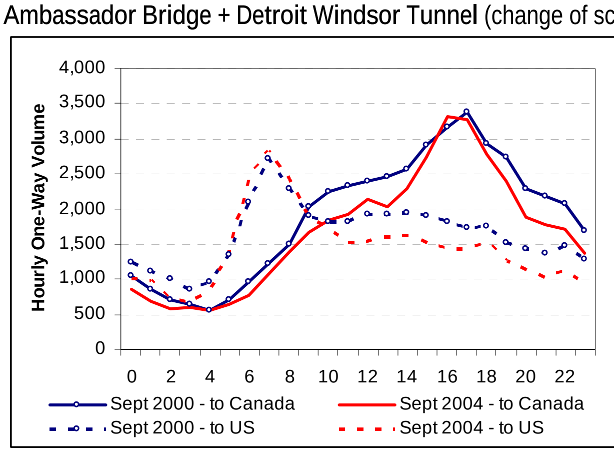
Detroit Windsor Tunnel



Ambassador Bridge + Detroit Windsor Tunnel (change of scale)



Ambassador Bridge + Detroit Windsor Tunnel (change of scale)



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

The plot of the passenger car equivalent (PCE) distribution of travel by hour of day combines the passenger car and commercial vehicle flows by representing one commercial vehicle as the equivalent of 3.0 passenger cars. PCE traffic flows are shown for a typical Summer/Fall weekday and over four consecutive August and September days in Exhibit 3.26. As indicated in the graphs, the peak hours expressed in PCE terms still occur during the traditional morning and afternoon peak periods, given the heavy peaking of passenger cars, while commercial vehicles are more uniformly distributed throughout the day. The magnitude of the peak hours is very similar with 2004 PCE peak hour volumes only approximately 3% lower than the comparable peaks in 2000.

The peak hour and peak period PCE traffic volumes by direction, represented by the traffic distributions shown in Exhibit 3.26, are shown for August and September, 2000 and 2004 weekdays in numeric terms in Exhibit 3.27. In the morning period, the September 2004 peak hour is 2,864 PCEs per hour (Thursday) for Canada to US travel. The August 2004 morning peak hour is marginally lower at 2,678 PCEs per hour (Thursday). Traffic is higher during the PM peak period, and the 2004 peak hour, peak direction volume is for US to Canada travel in September (Friday) at 3,614 PCEs per hour. This compares to the September 2000 afternoon peak hour of 3,409 PCEs per hour (Friday) and the August 2000 afternoon peak of 3,752 PCEs per hour (Thursday).

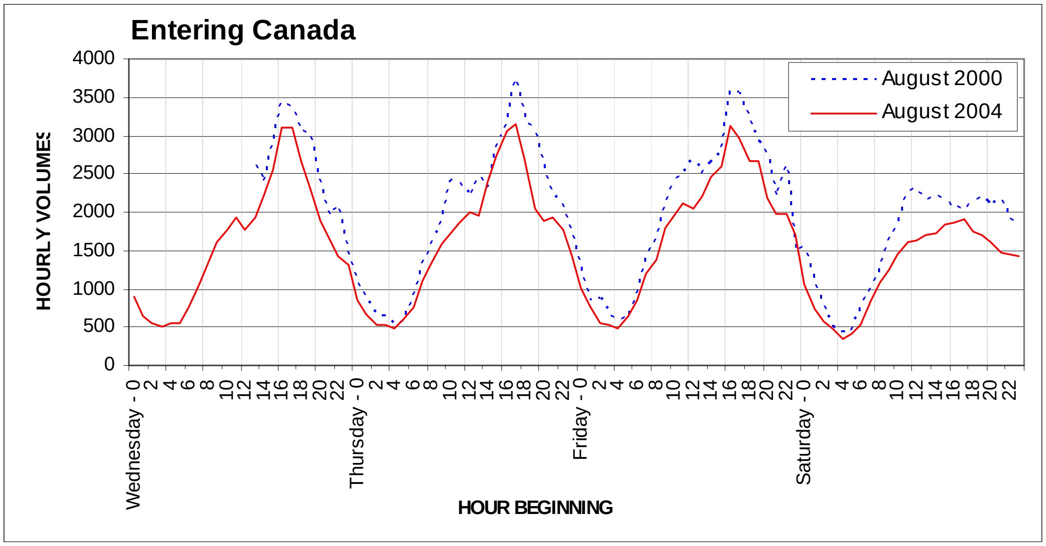
September 2004 is therefore the basis of modelling and analysis for this study. Peak traffic volumes for a Thursday-Friday average weekday are as follows:

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

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

Exhibit 3.26: Hourly PCE Traffic Distribution at Detroit River Crossings, 2000 & 2004

A. August 2000 and August 2004



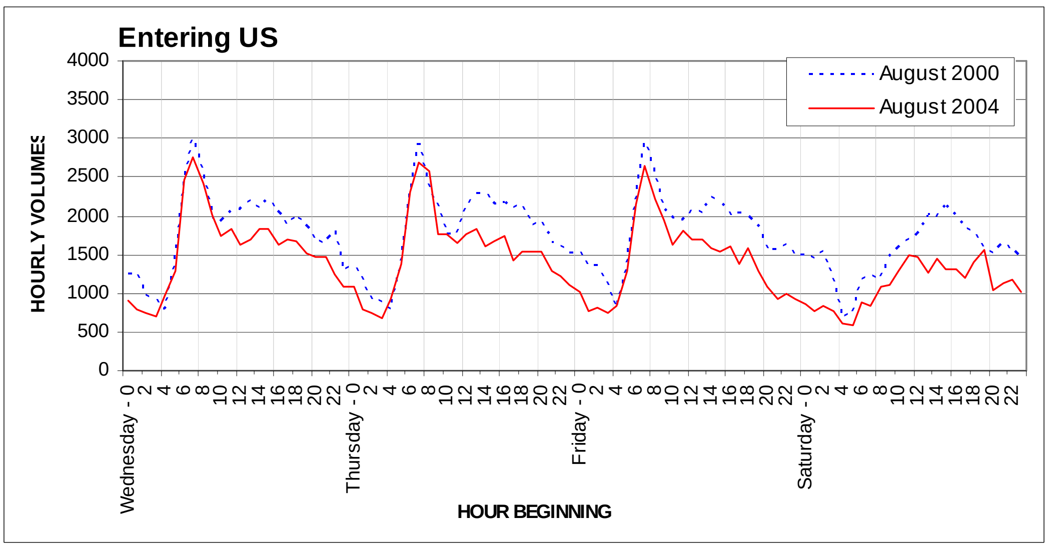
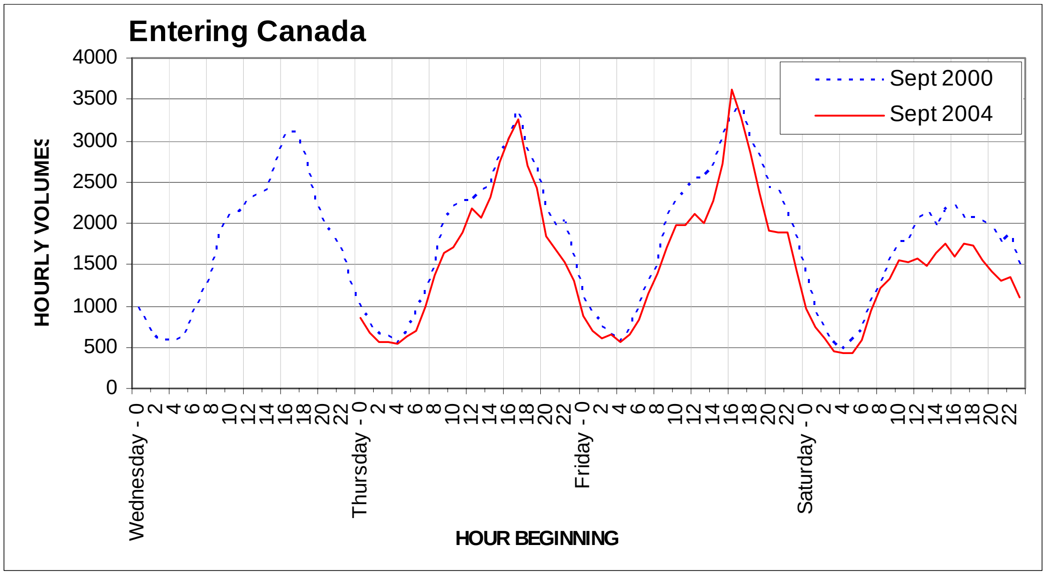


Exhibit 3.26 (Cont.): Hourly PCE Traffic Distribution at Detroit River Crossings, 2000 and 2004

B. September 2000 and September 2004



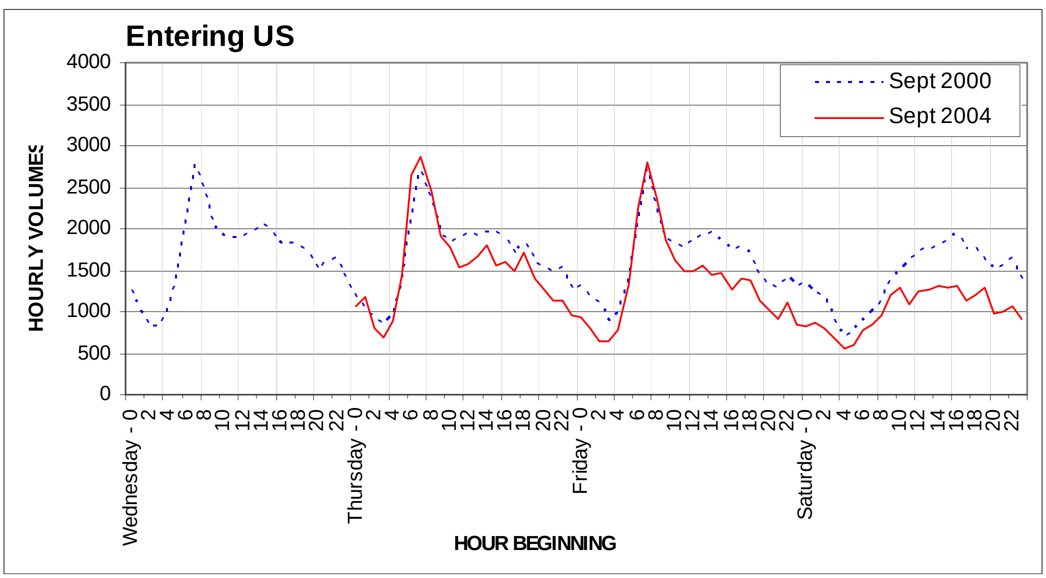


Exhibit 3.27: 2000 & 2004 PCE Peak Hour at Detroit River Crossings

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

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

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

3.7 Crossing Choice Characteristics

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

3.7.1 BORDER CROSSING TIME

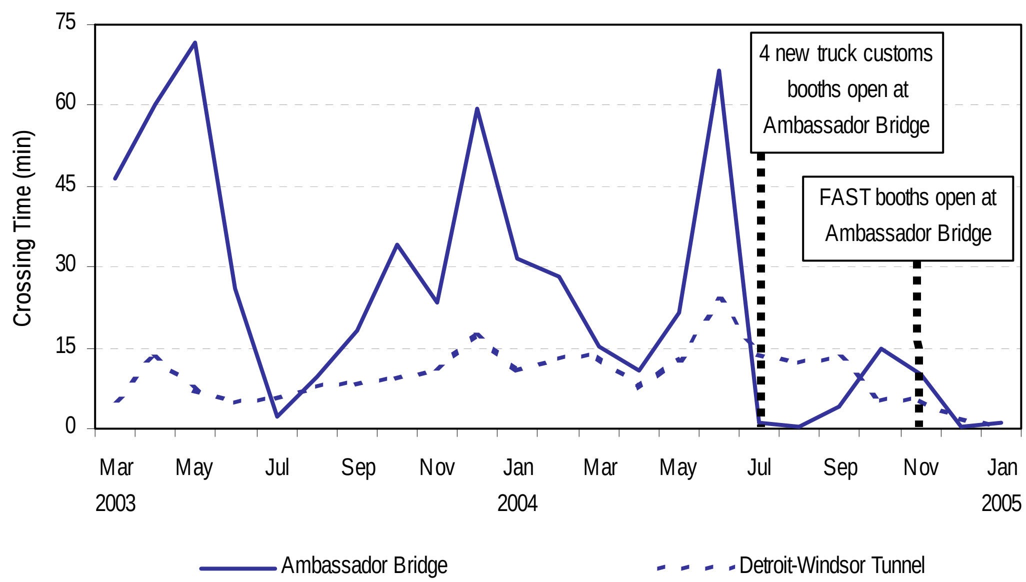
This section provides a discussion of the delays experienced by both commercial vehicles and passenger cars observed at the Detroit River crossings.

3.7.1.1 Commercial Vehicles

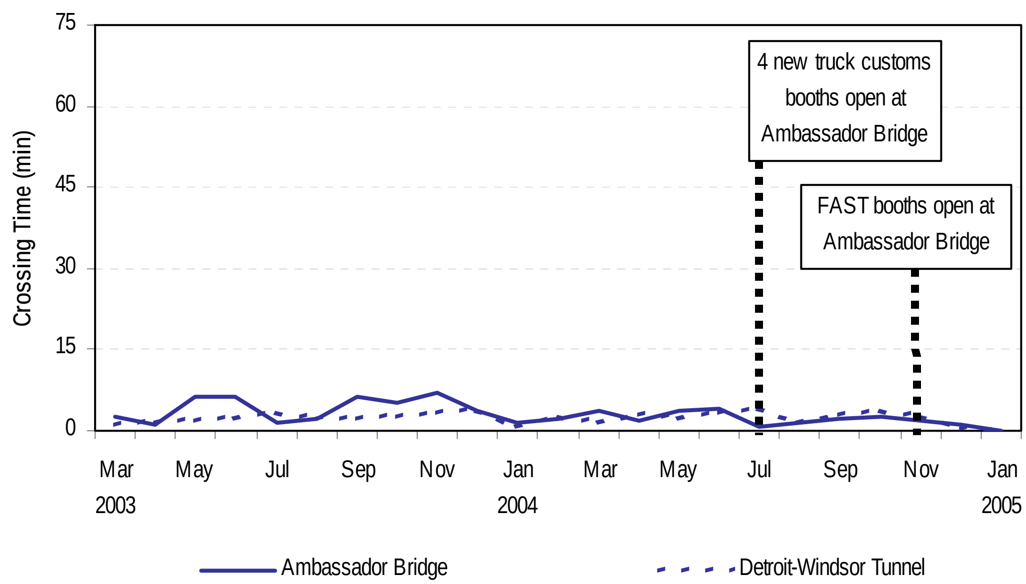
Exhibit 3.28 plots the mean border crossing times for the Ambassador Bridge and the Detroit-Windsor Tunnel from March, 2003 to January, 2005 for the US-bound and Canada-bound directions, respectively. The most significant delays are observed for the US-bound Ambassador Bridge crossing. One immediate observation from the plot is the large amount of seasonal variation of delays. The largest observed delays are found in the winter and late spring months, while the summer months have the smallest delays. The low summer delays can be attributed to a reduction in commercial vehicle traffic common in the summer months. The only other crossing that showed significant delays was the US-bound Detroit-Windsor Tunnel. The same approximate seasonal variations were also observed for this crossing. There were no significant delays observed in the Canada-bound directions at both crossings, with average delays of only two to three minutes reported. The average and maximum border crossing times at the two Detroit River crossings for commercial vehicles are:

Exhibit 3.28: Mean Commercial Vehicle Border Crossing Times

A. Canada to US



B. US to Canada



- **Ambassador Bridge to US –** 24-minute average, 72-minute maximum (May, 2003);
- **Ambassador Bridge to Canada** – 3-minute average, 7-minute maximum (Nov., 2003);
- **Detroit-Windsor Tunnel to US –** 10-minute average, 24-minute maximum (June, 2004); and
- **Detroit-Windsor Tunnel to Canada –** 2-minute average, 4-minute maximum (multiple).

While significant delays have been observed in the March, 2003 to January, 2005 time period, border crossing capacity improvements were implemented in 2004 that have eliminated most of the significant delays at the Detroit River crossings. The improvements include four new truck customs booths at the Ambassador Bridge that opened on June 28, 2004 as well as new FAST booths that were opened at the Ambassador Bridge on November 1, 2004. The impact of the additional border capacity can be seen in Exhibit 3.28 when comparing the delays after the implementation of the new capacity to the equivalent delays from 2003. This same comparison is made quantitatively in Exhibit 3.29. Significant delay reductions have been observed for all crossings, with the most significant reductions being on the busier US-bound crossings where the delay times were initially highest. For example, the delay times on the critical US-bound Ambassador Bridge crossing have been reduced by 80% from a mean value of 25.5 minutes to 4.6 minutes.

Exhibit 3.29: Mean Commercial Vehicle Travel Times

Crossing & Direction	July 2003 to Jan. 2004		July 2004 to Jan. 2005		Percent Reduction	
	Mean (min.)	Max. (min.)	Mean (min.)	Max. (min.)	Mean	Max.
Ambassador Bridge - to US	25.5	59.5	4.6	14.8	82%	75%
Ambassador Bridge - to Canada	3.9	7.1	1.4	2.4	64%	66%
Detroit-Windsor Tunnel - to US	10.0	17.9	7.4	13.6	26%	24%
Detroit-Windsor Tunnel - to Canada	2.7	3.9	2.2	4.1	17%	-5%

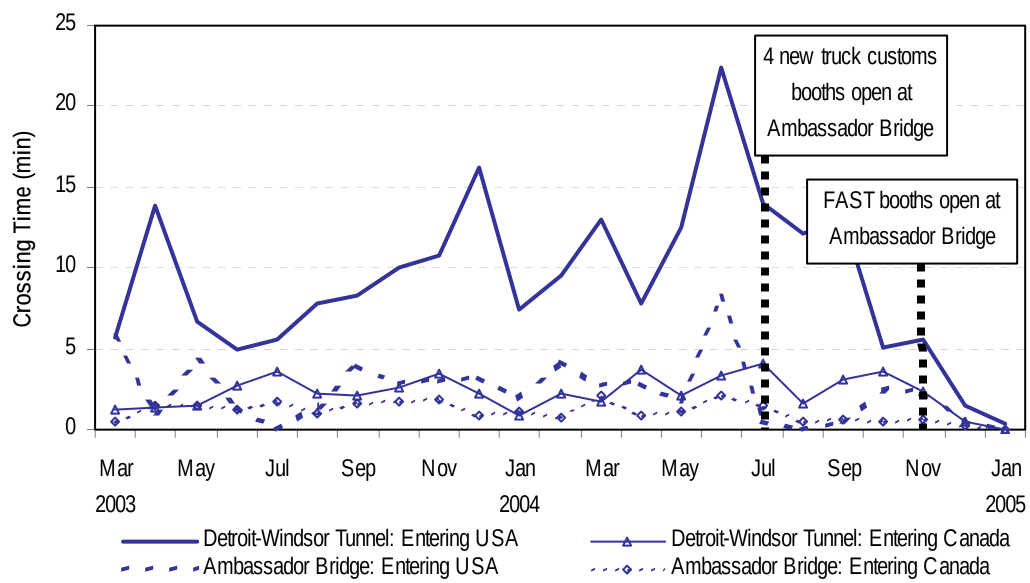
While the capacity improvements were all made to the Ambassador Bridge crossing, the improvements have also reduced delay times at the Detroit-Windsor Tunnel with 26% reductions in delay witnessed for the US-bound crossing. Overall, average delays at both Detroit River crossings have been reduced extensively, with the longest average delay now 7.4 minutes for the US-bound tunnel. As a whole, the delay times were addressed in 2004 with increased commercial vehicle capacity, and the border crossing performance is now satisfactory.

All of the border delay data used in this section have been compiled from various government websites (Canada Customs, MTO and US Customs). The delays are recorded three times daily and averaged over each month. The delays have also been compared to average annual delays compiled using GPS data recorders on commercial vehicles. The GPS methods are significantly more accurate and reliable and act as an effective validation for the results presented in this section. In general, the GPS wait times are slightly lower when compared to the website data when traveling to the US, with average delays of 16 minutes and 8 minutes for the Ambassador Bridge and Detroit-Windsor Tunnel, respectively, and higher when traveling to Canada, at 9 minutes and 5 minutes. These variations can easily be attributed to differences in study periods and other factors, but the most important result is that all of the trends in delay times that have been observed using the website data are confirmed by the GPS data.

3.7.1.2 Passenger Cars

Exhibit 3.30 presents the mean passenger car border crossing times at each of the Detroit River crossings. The delays are quite small at all crossings with the US-bound Detroit-Windsor Tunnel being the only crossing with any significant delay. Like the commercial vehicle traffic, the passenger car traffic has also experienced reductions in average delay since increases were made to commercial vehicle capacity. In general, the passenger car delays are not a major concern as they average below ten minutes at all crossings

Exhibit 3.30: Mean Passenger Car Border Crossing Times



3.7.2 BORDER CROSSING FEES

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

Ambassador Bridge	$4.00 ($2.75 US)
Detroit-Windsor Tunnel	$3.50 to US, $4.75 to Canada ($2.50 US, $3.50 US)
Blue Water Bridge	$2.50 ($2.00 US)

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

Ambassador Bridge	$0.03335 per 100 lbs gross weight for 2 to 7 axles ($0.0230 US) $0.03698 per 100 lbs gross weight 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 to US ($2.25 plus $0.025 US) $4.50 plus $0.045 per 100 lbs gross weight to Canada ($3.25 plus $0.030 US)
Blue Water Bridge	$2.75 per axle ($2.25 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, assuming a value of time of $15/h, a 50 cent difference in toll rates would equate to about two 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 five-axle truck weighing 40,000 gross pounds and the second an eight-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.

3.7.3 DRIVING DISTANCES

For several major trip origin-destination pairs between Ontario and Michigan, trip distances via a Highway 402 routing through the St. Clair River crossing are similar to those via a Highway 401 routing through the Detroit River crossing. To illustrate the differences, trip distances have been calculated for several representative origin-destination pairs by major highway routings, as shown in Exhibit 3.31, with the travel distances shown in Exhibit 3.32. 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 US. A trip from London, Ontario to Detroit would only be 13 km 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 difference between the two routes.

Exhibit 3.31: Routing Choices for Selected Trips

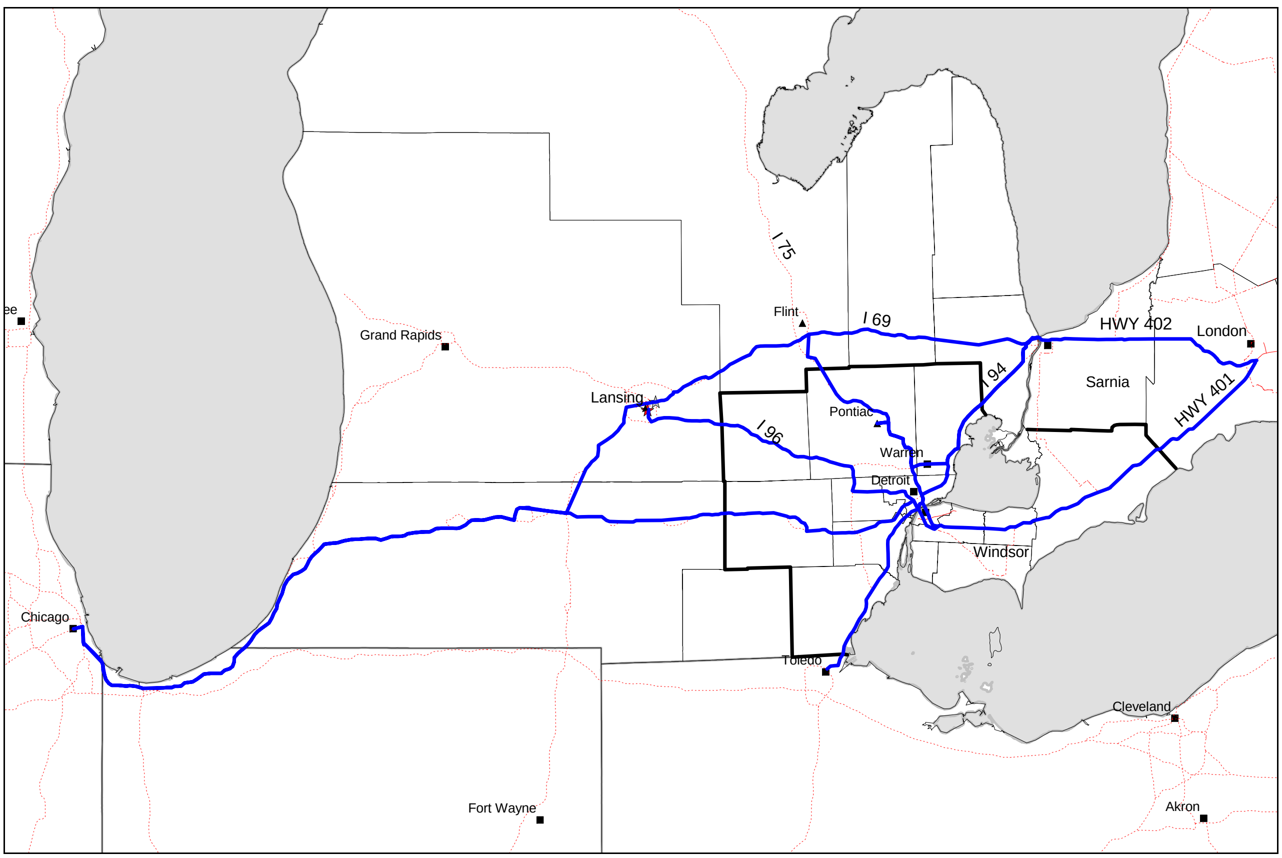


Exhibit 3.32: Comparison of Driving Distances for Selected Trips

Trip Interchange	Via Detroit River (Hwy 401)	Via St. Clair River (Hwy 402)	Difference
London / Detroit	190 km	203 km	+13 km
London / Pontiac	229 km	222 km	-6 km
London / Flint	296 km	210 km	-86 km
London / Lansing	328 km	285 km	-43 km
London / Toledo	269 km	290 km	21 km
London / Chicago	629 km	632 km	3 km

The results of the travel distance comparison indicates that the St. Clair River crossing provides competitive travel times for many of the longer-distance border crossing trips between Ontario and Michigan. There is an inherent preference towards the Detroit River crossings among travellers, as the calculated travel distance would suggest greater use of the St. Clair River 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 the Detroit River crossings. For commercial vehicles, there are lower toll rates at the Ambassador Bridge for lighter vehicles as compared to the Blue Water Bridge, while heavier vehicles tend to favour the Blue Water Bridge.

3.7.4 ADDITIONAL FACTORS FOR COMMERCIAL VEHICLES

Other intangible factors that may affect route/crossing choice for commercial vehicles include:

- 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;

- An aggressive voucher redemption program and marketing by the Ambassador Bridge;

- A convenient rest stop at the Ambassador Bridge;

- 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

- A perception of a shorter distance via the Ambassador Bridge for more of the total trips between Ontario and Michigan.

4. FORECASTING APPROACH & MODELLING ASSUMPTIONS

The forecasting approach builds on the previous P/N&F Study, but with a review and update of key assumptions given that the previous work utilised a 2000 base year and had to rely on pre-9/11 data. The updated forecasts capture recent knowledge of the impact of recent major events on cross-border travel and the most current trade projections for goods movement between Canada and the US. Improved methods to determine the crossing choice of commercial vehicle and passenger cars with the potential to use either of the Detroit River or St. Clair River crossings have also been developed.

The impact of 9/11 and other major events on cross-border travel, the update of the 2000 cross-border travel data to reflect 2004 conditions and the development of algorithms to predict the flow and implications of cross-border passenger car and commercial traffic are provided in the ***Travel Demand Model Update Report***.

4.1 Forecasting Approach

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. The large influence and uncertainty associated with many key factors including international trade (e.g. NAFTA, Auto Pact), policies (e.g. tariffs, tobacco taxes), the US and Canada economies (e.g. exchange rate, trade, GDP growth) and others (e.g. casinos, border processing times) have overwhelmed the predictive ability of any strictly mathematical model. Future estimates must also consider the complex dynamics and on-going structural changes in the Canadian and US economies that dramatically influence cross-border traffic and trade and which cannot be captured within a mathematical model.

Recognising these uncertainties, the cross-border forecasting approach is based on developing an understanding of past trends and causal relations influencing cross-border traffic for each passenger car trip purpose and commercial vehicle commodity group. Passenger car traffic growth is estimated based on consensus on future growth rates by trip purpose while commercial vehicle growth is based on Government of Canada US-Canada trade projections by commodity group.

The products of the travel demand forecasting process are ten-, twenty- and thirty-year horizon traffic forecasts of annual and peak hour cross-border traffic by mode. Traffic growth rates for the Base Forecast were developed for total traffic at the Detroit and St. Clair River crossings, comprising the Ambassador Bridge, Detroit-Windsor Tunnel and Blue Water Bridge, which serve a similar, interdependent population/market. Base year traffic demand was then projected to future years based on growth rates that were developed for various trip purposes (for passenger cars) and commodity types (for commercial vehicles). These growth rates were then applied to the annual traffic volumes and the peak hour trip matrices developed for the travel demand model, representing travel within and across Southeastern Michigan and Southwest Ontario. Of the total, traffic at the Detroit River crossings was then determined and assigned to specific facilities using a crossing choice model based on projected level-of-service at the crossings, as described further below.

4.1.1 BASE YEAR

Year 2004 is used to describe existing conditions and as a base year for the preparation of forecasts. The 2004 base year reflects an update of the travel survey data[1] collected in 2000 to capture cross-border commercial vehicle and passenger car travel between Southeastern Michigan and Southwest Ontario. The 2000 surveys provide comprehensive origin-destination and travel characteristic information for travel across the border on a trip purpose (passenger cars) and commodity group (commercial vehicles) basis. The update of the 2000 data to a 2004 base year is based on detailed analysis of travel data and statistics to determine the impact of 9/11, SARS, the Iraq War and other major events on cross-border traffic levels and characteristics.

4.1.2 CROSS-BORDER PASSENGER CAR DEMAND

For passenger travel, forecasts were established for three categories of passenger demand, by country of destination activity:

- Same-day work/business trips;
- Same-day discretionary/recreation trips; and
- Overnight/vacation trips.

The above breakdown of passenger car travel is made possible through the use of travel survey data gathered in the Ontario-Michigan Border Crossing Traffic Study of August 2000, updated in this study to 2004. This survey provides comprehensive travel information for over 23,000 passenger car trips and data on cross-border travel characteristic and origin-destination pattern information.

The approach to estimate passenger car traffic is based on forecasts of the key explanatory variables or causal factors affecting the behaviour of travel by trip purpose. The analysis examined relationships between cross-border travel and various factors (e.g. GDP, population, employment, exchange rate, etc.) and determined the best indicators of future demand, recognising that many of the relationships have changed over time, given changes in the US and Canada economies and retail sectors and changes in general attitudes and preferences. Given consensus on the factors considered to be the best predictors of future growth for each trip purpose, growth rates are determined from official projections of each factor. The growth rates for each of the 2015, 2025 and 2035 horizon years are applied directly to the base year demand, resulting in cross-border passenger car volumes by trip purpose for each horizon year.

Within the travel demand model, the growth in passenger car trips are allocated geographically based on population growth projections by traffic superzones at the home-end or trip production end of the trip. The passenger car demand is assigned to

[1] 2000 Ontario-Michigan Border Crossing Traffic Study and 1999/2000 MTO National Roadside Survey/ Commercial Vehicle Survey.

the network, with the proportion using each major crossing or port determined with a discrete choice logit model based on travel time and generalised cost. This provides future year passenger car traffic using Detroit River and St. Clair River crossings.

4.1.3 CROSS-BORDER COMMERCIAL VEHICLE DEMAND

For goods movement forecasts, five commodity groups were defined based on the main commodities that are presently being transported at Windsor-Detroit:

- Automotive/metal industry products (combined);
- Forest products;
- Machinery and equipment;
- Agriculture; and
- Other (including chemical and petroleum products, rubber and plastics, textiles, minerals and stone/ceramic/glass, etc.).

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 MTO National Roadside Survey/Commercial Vehicle Survey (NRS/CVS) and forecasts of trade data by commodity type prepared for the Government of Canada by Informetrica Limited. The update of the NRS/CVS to reflect 2004 conditions was based on data from the 2004 Bureau of Transportation Statistics (BTS) Transborder Surface Freight Database. The commercial vehicle survey, like the above passenger car survey, provides truck characteristic, commodity and origin-destination information for cross-border truck trips that is unprecedented in its comprehensiveness.

The approach for estimating commercial vehicle traffic is based on forecasts of Canadian trade by commodity type. Growth rates are determined from national projections of trade expressed in value, as prepared by Informetrica Limited in November 2004 and presented below by commodity group. The commodity trade growth rates for each of the 2015, 2025 and 2035 horizon years are applied directly to the number of commercial vehicles estimated to be carrying each commodity and to the weight of goods transported by truck and rail. The assumptions that are made or that are implicit to this method include the following:

- A constant 2004 truck/rail mode share by commodity type and direction is maintained over the study horizon (discussed further in Section 4.2.3.2). The impact of the diversion of freight to this mode is investigated as a sensitivity test in the next chapter;
- The value-to-weight/truck relationships by commodity type remain constant over the study horizon. BTS data from 1998 to 2004 show these relationships to be quite stable across all commodities, with, for example, the overall cost per tonne value having a mean of CAN$3,059/tonne and a 95% confidence interval of plus/minus CAN$250/tonne (i.e. +/- 8%); and

- The proportion of trucks with no load (i.e. empties) is a measure of the "efficiency" of the goods movement industry that is dependent on such factors as logistics, trade imbalances, commodity truck-type requirements, etc. As the distribution of empties by commodity type is unknown, the current Canada-to-US proportion of empties is assumed to represent the maximum attainable efficiency as this has been the dominant direction of trade for some time. The US-to-Canada proportion of empties is directly dependent on the trade imbalance, with the efficiency increasing linearly to this maximum level as the imbalance decreases.

As discussed previously, the same growth rates are used to develop the future peak hour truck trip matrices for the travel demand model. The rates are applied to each commodity- and direction-specific trip matrix, which are then summed to create a single truck trip matrix. This assumes that the origin-destination travel patterns will remain constant by commodity and direction (but, consequently, not in total). This assumption is based on an analysis of origin-destination flows by commodity and direction between 1998 and 2004, which showed the travel patterns remained relatively stable. There are also many uncertainties that will affect how travel patterns may evolve in the future and to assume changes would involve speculation, which is not appropriate at this time. On this basis, the resulting commercial vehicle trip matrix is assigned to the network, with the proportion using each port determined with a discrete choice logit model based on travel time and cost. As the choice of port is determined within the travel demand model, feedback is made to the annual forecasts.

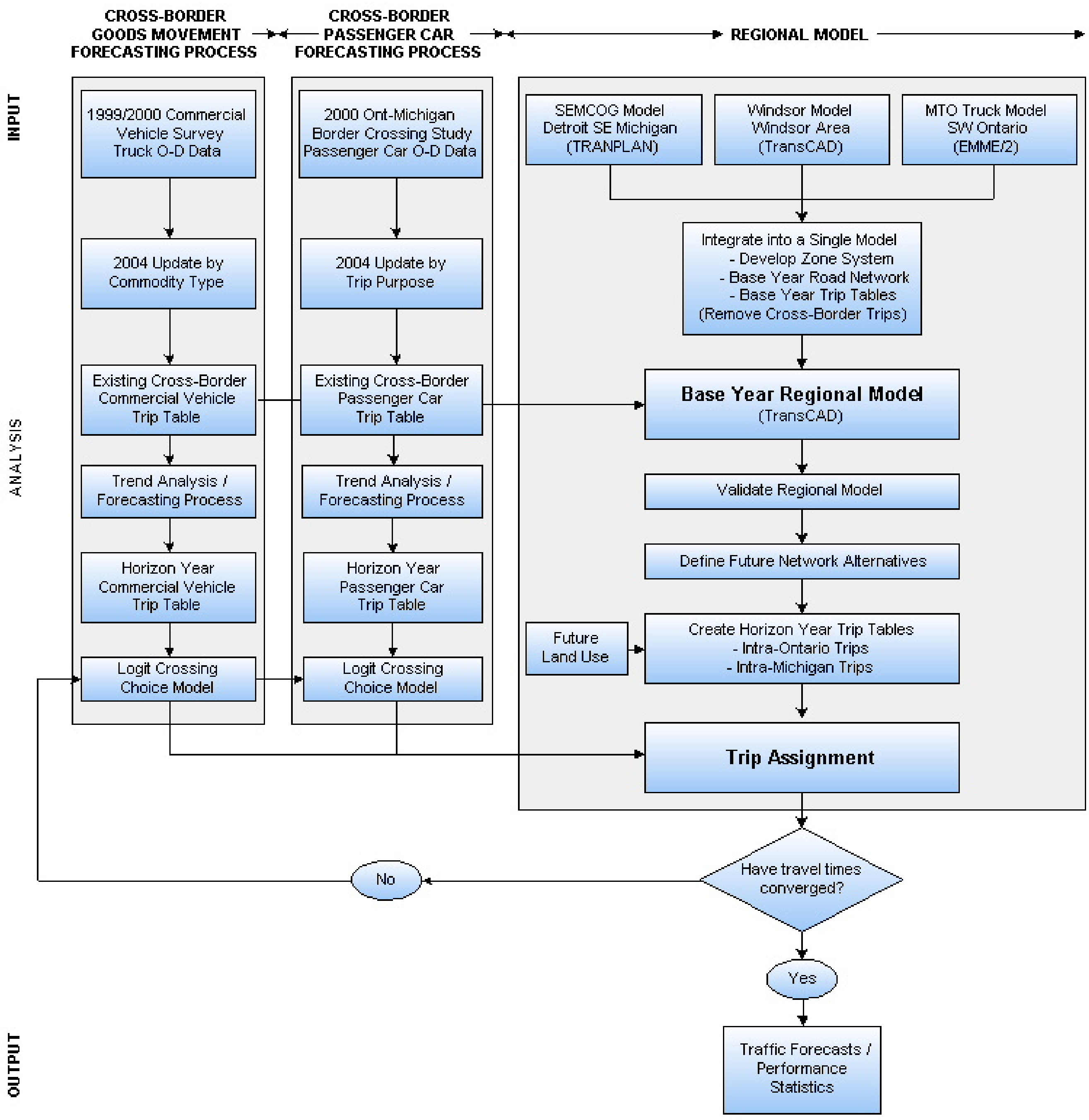
Finally, due to the physical dimensions restricting the use of the Detroit-Windsor Tunnel by large tractor-trailer configurations, half of the estimated unconstrained demand at this facility is shifted to the Ambassador Bridge. This assumes that there will not be a continued growth in the use of specialised low-height equipment by local business. This is consistent with recent trends with Detroit-Windsor Tunnel commercial vehicle traffic remaining relatively stable with significant growth in traffic using the Ambassador Bridge.

4.1.4 DRIC TRAVEL DEMAND MODEL

Cross-border commercial vehicle and passenger car forecasts provide estimates of future demand to determine infrastructure needs in the immediate area of the crossing, including bridge/tunnel roadbed capacity and border processing requirements. To assess level-of-service and roadway infrastructure needs on roadway facilities leading to and from international crossings, the DRIC Travel Demand Model is used to determine travel paths and utilisation of road facilities for a study area encompassing Southeastern Michigan and Southwestern Ontario, which includes the Detroit River and St. Clair River international crossings. The model combines cross-border traffic with domestic US and domestic Canada travel within the study area to determine total traffic flows, with algorithms to determine travel routing of trips based on travel times and costs and which reflect congestion effects through a deterministic user equilibrium assignment process.

A flowchart of the model process is provided in Exhibit 4.1. As can be seen, the model loops between the trip assignment and logit model stages until the travel times have converged to within a reasonable level.

Exhibit 4-1: DRIC Travel Demand Model Process Flowchart



4.1.4.1 Zone System & Modelled Area

The DRIC Travel Demand Model consists of approximately 1,500 traffic zones, which allows precision in the identification of trip origin and trip destination locations and more accurate determination of travel time trade-offs between different travel routing options available to the traveller leading to more realistic travel paths, both for international traffic and domestic traffic in the vicinity of the crossings. The model builds on the SEMCOG and Essex-Windsor Travel Demand Models by combining the two models into a single comprehensive model with expansion of the modelled areas to include the St. Clair River crossings, given that many trips can use either Detroit River or St. Clair River crossings when making the trip.

4.1.4.2 Analysis Time Periods

The DRIC Travel Demand Model has been developed for a 2004 base year, with forecast years of 2015, 2025 and 2035. The modelled time periods include:

- **Morning peak hour** – Capturing the peak Canada to US total (passenger car and commercial vehicle) traffic flows;
- **Mid-day peak hour** – Capturing the peak commercial vehicle volumes; and
- **Afternoon peak hour** – Capturing the peak US to Canada total traffic flows.

The above were determined based on an analysis of the temporal distribution of vehicular traffic, as presented in Section 3.6. It was assumed that the future temporal distribution of passenger car trips by trip purpose would remain constant in the future. Similarly, it was assumed that the temporal distribution of commercial vehicle trips would remain constant in the future given that there was very limited potential for peak spreading to occur beyond its present state.

The a.m. and p.m. peak hours represent the heaviest overall travel period for both international and domestic travel. Commercial vehicle travel demand is marginally higher during the mid-day compared to the a.m. and p.m. peak hours and thus a mid-day model is used to estimate border crossing infrastructure requirements to ensure that commercial vehicle needs are addressed.

4.1.4.3 Modelling of Domestic Traffic

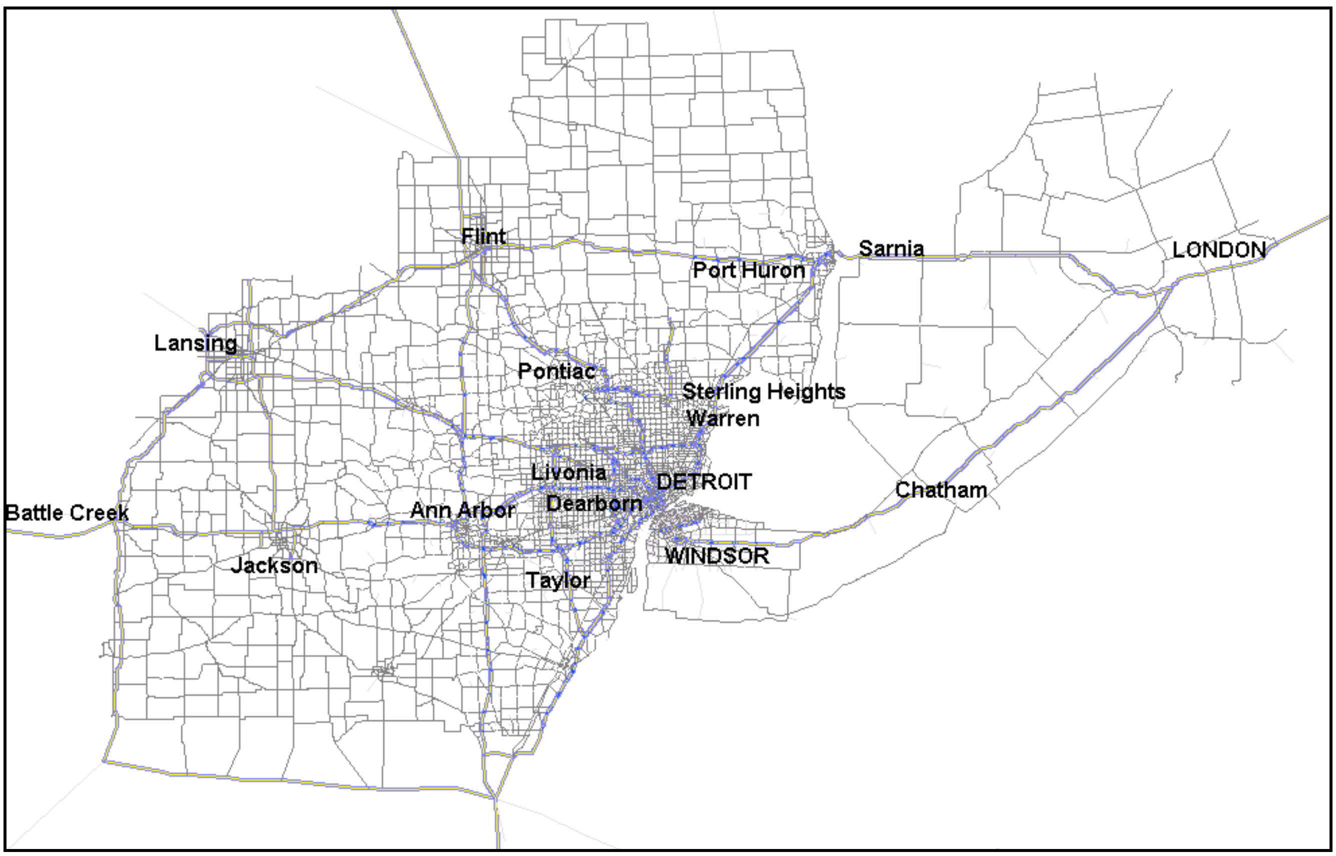
The international traffic component of the demand is described in detail in this report. Domestic traffic components are based on the SEMCOG and City of Windsor Model, which were developed by the respective metropolitan/city planning organizations using comprehensive four-stage transportation demand modelling techniques that are considered state-of-practice in the transportation planning industry. A TransCAD model platform is used.

A plot of the TransCAD network indicating the modelled area and roads and highways included in the DRIC Travel Demand Model is shown in Exhibit 4.2. The network was developed from the SEMCOG and Windsor Models, described above, and from the MTO Truck Model for the rest of Southwestern Ontario. A description of the development of the Model, including calibration and validation statistics, is provided in the ***Travel Demand Model Update Report***.

4.1.5 CROSSING CHOICE

As noted previously, the DRIC Travel Demand Model and the development of travel demand forecasts consider flows at both Detroit River and St. Clair River crossings given the interaction between them in accommodating cross-border travel. A crossing choice model has been developed within the DRIC Travel Demand Model to estimate the relative proportion of passenger cars and commercial vehicles using Detroit River and St. Clair River crossings based on travel time and cost and reflecting the current bias, or preference, that exists towards the Detroit River crossings. This is an important aspect to capture, given that travel through Southeastern Michigan/Southwestern Ontario for many longer-distance trips is often similar in nature in terms of travel time and cost between the two major crossings. For future years, the choice of crossing is determined using two discrete choice logit models calibrated to the passenger car and commercial vehicle survey data. This method is supplementary to the conventional route choice algorithms (i.e. deterministic user equilibrium) used within the model, which are unable to effectively capture this bias for trips with similar origins and destinations.

Exhibit 4-2: DRIC Travel Demand Model Road Network



Discrete choice logit models are based on the economic consumer choice behaviour principle of utility maximisation, which assumes that rational consumers will choose one good over another so as to maximise the utility, or benefit, they receive from the good, with the benefit expressed by certain attributes of the good. Some attributes can be measured while others cannot. In extending this concept to the choice of international crossing (i.e. the good), measurable attributes include travel time and cost. Intangible attributes, such as local amenities and familiarity with the crossing, are captured by a bias constant. A discrete choice logit model is considered to be a superior technique compared to conventional route choice methods in this border crossing application, better capturing existing preferences and behaviour and providing a more robust tool for future forecasting.

The resulting route choice models, based on travel time (considering congestion effects) and cost, were applied to passenger car and commercial vehicle cross-border travel demand to determine use of Detroit River crossings relative to St. Clair River crossings in the presentation of the demand forecasts in Chapter 5.

4.1.6 SUPPLEMENTAL CROSS-BORDER FORECASTS

To supplement the above forecasting approach, the following two statistical methods are also presented to confirm the reasonableness of cross-border forecasts prepared using the primary methodology described above and to identify the reasonable range of future passenger car and commercial forecasts. The two statistical approaches are based on total passenger car and commercial vehicle trends and therefore do not provide the trip purpose/commodity type breakdown level of detail, as provided above:

- **Multivariate regression analysis** – This relates cross-border traffic (the dependent variable) to independent or explanatory variables using mathematical relationships established using historical data. Forecasts are then developed by substituting expected future values for the explanatory variables; and

- **Time-series regression analysis** – This involves the linear, non-linear and autoregressive extrapolation of past trends into the future. This analysis does not take into account possible changes in the underlying factors of cross-border traffic and is typically not recommended for long-term forecasting. However, it represents a straightforward method for assessing the reasonableness and implications of the other forecasts. Three time-series analysis techniques are employed.

These supplementary forecasts are intended to provide perspective and bounds to the Base Forecast. A description of the regression and statistical methods used to develop the supplementary forecasts is provided in Appendix A.

4.2 Social, Economic & Transportation Assumptions

The following describes trends and outlines the various assumptions that are used as a basis for the estimation of future travel demand presented in the next chapter, representing the Base Forecast.

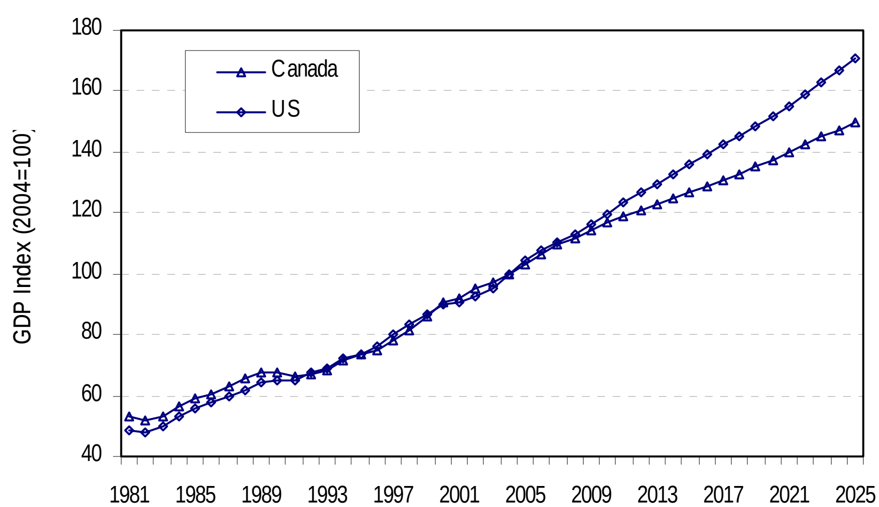
4.2.1 MACRO-ECONOMIC & TRADE FORECASTS

Macro-economic and trade forecasts are based on long-range projections prepared by Informetrica Limited for the Government of Canada. The Informetrica projections were prepared in November 2004 and extend to the year 2025. To provide 2035 trade forecasts as input to the traffic forecasts for a 2035 horizon year, the trade forecasts were extrapolated to 2035 based on 2015 to 2025 growth trends. The following describes the forecasts of US and Canadian Gross Domestic Product, the currency exchange rate and trade, as each relates to the estimation of future travel demand in the study area.

4.2.1.1 Gross Domestic Product

Exhibit 4.3 presents an index of historic and forecast Gross Domestic Product (GDP) for Canada and the US. US production is expected to outpace Canadian production over the 2004 to 2035 period, growing at 2.6% annually in real terms relative to 1.9% annually for Canada.

Exhibit 4-3: Historic & Forecast Canada & US Gross Domestic Product

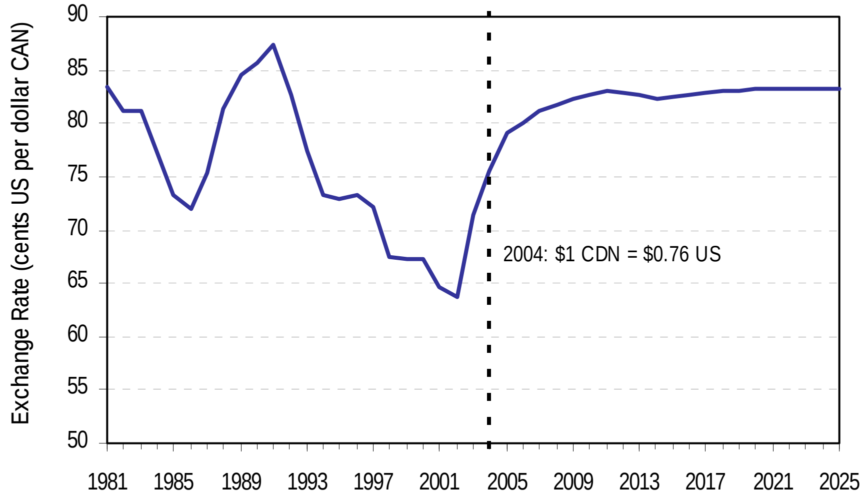


Source: Informetrica Limited

4.2.1.2 Currency Exchange Rate

Exhibit 4.4 illustrates the historic and forecast Canadian currency exchange rate as it has an influence on cross-border trade and travel. There have been significant fluctuations in the past, with the Canadian dollar ranging from the high 80-cent (US) to mid 60-cent level in the past twenty years. Recently, the Canadian dollar has increased significantly to a low 80-cent range. The dollar is projected to stabilize at a value of about 83 cents over the longer term future.

Exhibit 4-4: Historic & Forecast Canadian Currency Exchange Rate



Source: Informetrica Limited

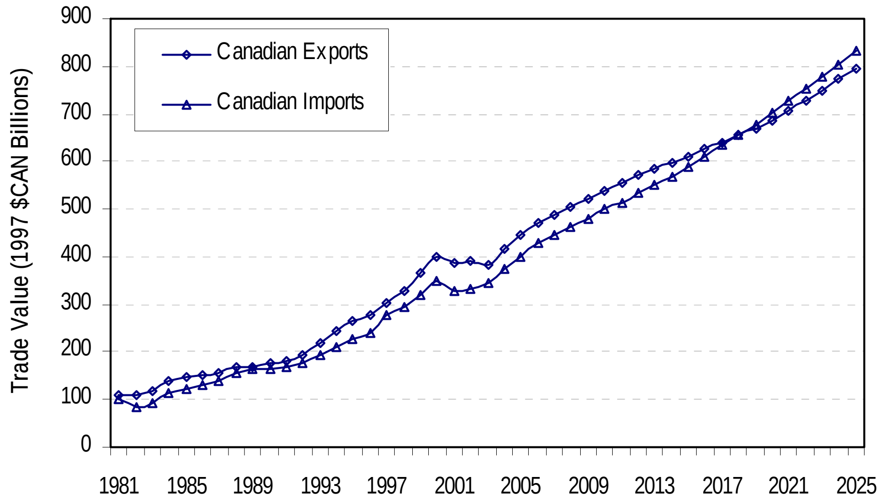
4.2.1.3 Commodity Trade

Informetrica Limited has prepared forecasts of Canadian trade for the Government of Canada to 2025, which provide the basis for estimating future cross border commercial vehicle flows between Canada and the US at the Detroit River crossings. The forecasts are inherently tied to the forecasts of GDP and currency exchange rate presented above. As this study has a horizon year of 2035, it was necessary to extend the Informetrica forecasts to this horizon year. To do so, it was assumed that the GDP, currency exchange rate and commodity trade trends forecast for the 2015 to 2025 period would continue over the next ten years. As such, these trends have been linearly extrapolated to 2035 for use within this study. This assumption was made independently by the study team and does not necessarily represent the opinions of Informetrica Limited.

Total Canadian exports (i.e. merchandise and services) are projected to grow by 3.5% annually, while imports of merchandise alone are projected to increase at 3.1% annually. Higher growth in exports is projected in the near term (4.4% annually from 2004 to 2010) with slower growth over the longer term (2.5% annually from 2010 to 2030). Strong growth in automotive exports to the US is also projected in the near term (4.4% annually), with sustained growth over the study horizon.

Total Canadian imports are projected to increase by 3.8% annually, with imports of merchandise alone increasing at a slightly higher rate of 4.0% annually. A stronger growth in imports from the US is expected (5% annually) than exports to the US (4.4% annually) in the near term. The historical and forecast Canadian merchandise exports and imports are illustrated in Exhibit 4.5. As can be seen, on a national level in terms of value, Canada is expected to become a net importer of goods from the US by approximately 2018.

Exhibit 4-5: Historic & Forecast Canadian Trade



Source: Informetrica Limited

As noted previously, commercial vehicle demand is estimated based on five commodity groups. The Government of Canada trade forecast for this breakdown is presented in Exhibit 4.6. A discussion of the resulting commercial vehicle demand derived through the use of the trade forecast by commodity group is presented in Section 5.2.2.

Exhibit 4-6: Merchandise Trade Forecast by Commodity Group

A. Decade Average Annual Growth Rates

Commodity Group	Period and Direction					
	2004 to 2015		2015 to 2025		2025 to 2035	
	Canada to US	US to Canada	Canada to US	US to Canada	Canada to US	US to Canada
Agriculture	2.3%	3.8%	3.0%	3.9%	2.3%	2.8%
Auto/Metal	3.5%	3.3%	2.5%	2.7%	2.0%	2.1%
Forest	1.3%	2.9%	1.0%	2.2%	0.9%	1.8%
Machinery/Equipment	4.6%	6.2%	3.3%	4.7%	2.4%	3.1%
Other	3.7%	3.3%	2.6%	2.9%	2.0%	2.3%

Source: Analysis of Informetrica Limited trade forecasts

B. Total Growth From Base Year

Commodity Group	Period and Direction					
	2004 to 2015		2004 to 2025		2004 to 2035	
	Canada to US	US to Canada	Canada to US	US to Canada	Canada to US	US to Canada
Agriculture	28%	51%	73%	121%	117%	192%
Auto/Metal	46%	44%	87%	88%	128%	132%
Forest	15%	37%	27%	70%	39%	103%
Machinery/Equipment	65%	93%	127%	205%	189%	315%
Other	48%	43%	92%	91%	134%	139%

Source: Analysis of Informetrica Limited trade forecasts

4.2.2 POPULATION & EMPLOYMENT FORECASTS

The projections of population and employment within the study area are provided in Exhibit 4.7, corresponding to the estimates provided as base input to the Essex-Windsor Regional Transportation Master Plan (EWRTMP) and Southeastern Michigan Council of Governments (SEMCOG) travel demand models. The EWRTMP Study provided forecasts to a 2021 horizon year with the 2025 and 2035 forecasts used in this study based on an extrapolation of the EWRTMP projections based on Ontario Ministry of Finance projections for Windsor and Essex County. The SEMCOG travel demand model has a 2030 horizon year, with 2035 forecasts developed for use in this study by extrapolating the SEMCOG 2020 to 2030 projections to 2035.

Exhibit 4-7: Study Area Population & Employment Growth

A. Population

Area	Year				2004 to 2035 Growth	
	2004	2015	2025	2035	Absolute	CAGR[1]
Windsor/Essex County	385,600	436,200	482,100	528,100	37%	1.0%
Ontario	12,400,000	14,200,000	15,700,000	17,000,000	37%	1.0%
SEMCOG Area	4,920,100	5,126,100	5,313,500	5,500,800	12%	0.4%
Michigan	10,000,000	10,600,000	10,700,000	10,800,000	8%	0.2%

[1] Compound annual growth rate.
Source: EWRTMP Model, SEMCOG Model, Ontario Ministry of Finance, US Census Bureau
Note: Values interpolated and extrapolated from original data for comparison.

B. Employment

Area	Year				2004 to 2035 Growth	
	2004	2015	2025	2035	Absolute	CAGR[1]
Windsor/Essex County	167,700	196,600	222,800	249,100	49%	1.3%
SEMCOG Area	2,272,400	2,380,700	2,479,100	2,577,500	13%	0.4%

[1] Compound annual growth rate.
Source: EWRTMP Model, SEMCOG Model, Ontario Ministry of Finance, US Census Bureau
Note: Values interpolated and extrapolated from original data for comparison.

4.2.3 FUTURE MODAL SHARE BY MODE

4.2.3.1 Person Movement

In 2004, about 23 million persons crossed the Detroit River in passenger cars, representing 92% of cross-border travel. This corresponds to almost 99% of road-based vehicles and an average auto occupancy of about 1.9. For the Base Forecast, it is assumed that passenger car person-trips and vehicle mode shares will remain constant. As discussed in Section 3.1.1, the bus mode share increase between 2000 and 2003 occurred as a result of a decrease in passenger car travel while the volume of bus passengers remained constant. As such, bus service and passenger levels are anticipated to increase, but are not expected to dramatically change the passenger car modal share and volumes. Passenger rail could provide an additional travel option, although there is no passenger rail service at present at the Detroit River or St. Clair River crossings. The previous VIA/Amtrak service through Sarnia-Port Huron attracted low ridership before its discontinuation.

4.2.3.2 Goods Movement

The modest shift of freight transport from truck to intermodal rail observed over the past five years at Detroit River and St. Clair River crossings has been supported by significant investment in intermodal facilities and infrastructure. Although the existing rail crossing facilities have sufficient capacity, further growth will require continued investment, notably to mainline capacity in Canada, which is currently restricting cross-border intermodal rail growth. CP cancelled its Toronto-Detroit Xpressway service in 2004.

Given the present dominance of the truck mode in transporting freight at the Detroit River and St. Clair River crossings, the truck mode share of the value/weight of goods is assumed to remain constant over the study horizon for the purposes of the Base Forecast. This reflects that the auto industry use of intermodal rail is relatively mature and the significant proportion of the machinery and equipment goods that are transported at the border crossing are not conducive to intermodal rail.

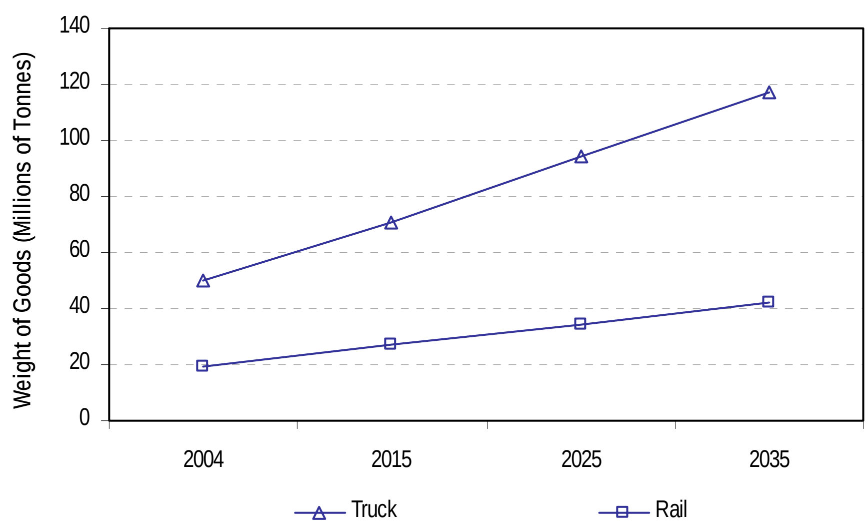
It is anticipated that intermodal rail traffic will grow over the study horizon, although any increase or shift from the truck mode is not expected to dramatically change the truck modal share. The Base Forecast assumes that intermodal rail will increase by approximately 2.5% per year in terms of the weight of goods transported, which will maintain its freight value/weight share by commodity type and direction. The Base Forecast also assumes continued on-going investment in rail over the study horizon to accommodate the assumed growth. A significant diversion of freight to intermodal rail through major investments and transportation policies is considered as a sensitivity test in Section 6.2.2.

The estimated existing and Base Forecast weight of goods traded across the Detroit and St. Clair River crossings by both truck and rail modes is presented in Exhibit 4.8. Again, the forecasts assume that the rail mode share by commodity type and direction is maintained throughout the study period, which results in a slightly different total growth.

Exhibit 4-8: Existing & Projected Annual Weight of Goods Traded Via Detroit River & St. Clair River Crossings, Millions of Tonnes

Year / Period	Measure	Mode		Total
		Truck	Rail	
2004	Weight	50	19	69
2015	Weight	71	27	98
2004 to 2015	Growth	44%	39%	43%
	CAGR[1]	3.4%	3.1%	3.3%
2025	Weight	94	34	128
2015 to 2025	Growth	32%	28%	31%
	CAGR[1]	2.8%	2.5%	2.7%
2035	Weight	117	42	158
2025 to 2035	Growth	24%	22%	24%
	CAGR[1]	2.2%	2.0%	2.1%
2004 to 2035	Growth	136%	118%	131%
	CAGR[1]	2.8%	2.5%	2.7%

[1] Compound annual growth rate.
Note: Application of forecast trade growth to estimation of weight by commodity.
Note: Estimated from 2004 value-to-weight relationships.
Source: BTS, CCRA and analysis of Informetrica Limited trade forecasts



4.2.4 TRANSPORTATION SYSTEM IMPROVEMENTS

The 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 construction. Improvements include:

- **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. The most significant road improvements in terms of impact on future cross-border vehicle traffic flow are as follows:

  – **Ambassador Bridge Gateway Project** – New connection between the Ambassador Bridge and interstates I-96 and I-75 on the US side of the facility, significantly improving access to the US 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 second 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** – Widened from four to six 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 twenty-kilometre stretch of the highway approaching the 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;

  – **Huron Church Road** – Near-term operational improvements to address current traffic demands, including vehicle detection upgrading, incident management video system, LED traffic signals, variable message signs and data collection systems;

  – **EC Row Expressway** – Widened from four to six lanes between Huron Church Road and Lauzon Parkway;

  – **Lauzon Parkway** – four lane arterial road from Highway 401 to EC Row Expressway;

  - **Essex County Road 22** – Widened to six through lanes from Banwell Road to Manning Road and to four lanes from Manning Road to West River Road;

  - **Highway 3** – Widened to four lanes from Highway 401 to CR 34 near Leamington;

  - **Cabana/Division Road** – Widened to four lanes from Huron Church to Puce Road;

  - **Manning Road** – Widened to four lanes from Jamesyl Drive to Highway 3; and

- **Passenger Rail** – No cross-border rail service is assumed at the Detroit River;

- **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** – Continued investments in intermodal facilities by the railways are assumed, including the Detroit Intermodal Freight Terminal and technology; and

- **Marine** – No new service improvements to the current operation of existing ferry services are assumed, 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.

5. FUTURE TRAVEL DEMAND

This chapter describes the development of travel demand forecasts for the movement of people and goods across the Detroit River and St. Clair River crossings between Southeastern Michigan and Southwestern Ontario and the proportion of this travel using the Detroit River crossings. The traffic forecasts are developed for passenger car and commercial vehicle modes for 2015, 2025 and 2035 horizon years. The forecasts presented are not constrained by the physical capacity of the crossing facilities (in terms of the number of vehicles that could realistically physically utilise the facilities), but are sensitive to the transportation system performance (in terms of travel time) and the manner in which the Detroit River and St. Clair River crossings operate together as a system to serve cross-border travel.

This chapter provides a qualitative and quantitative analysis of the key factors influencing cross-border travel and their outlooks, separately for each mode. Annual demand forecasts for passenger cars and commercial vehicles are then developed and presented for the three time horizons. These form the Base Forecast, representing business-as-usual conditions.

5.1 Passenger Car Demand

The following describes the passenger car forecasts by trip purpose and for total passenger car demand.

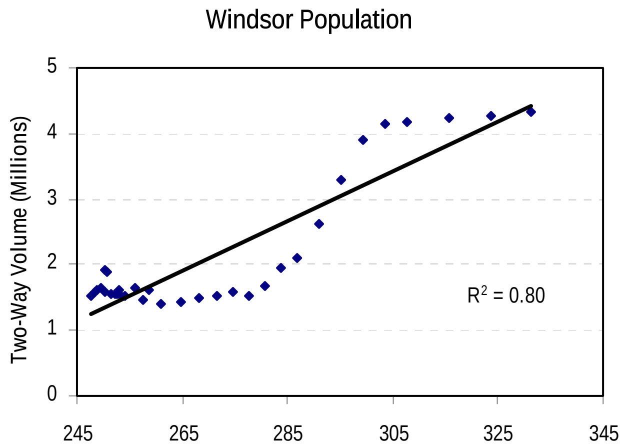
5.1.1 TRIP PURPOSE FORECASTS

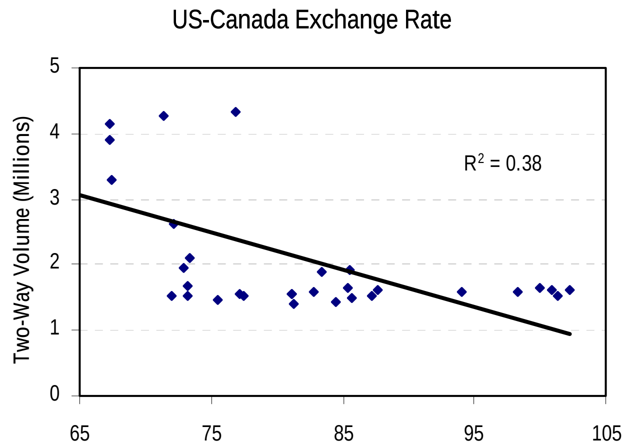
5.1.1.1 Same-Day Work/Business

In the future, growth in cross-border commuting is expected to continue given the continued effects of NAFTA. However, the growth will be dampened somewhat by the continued rise in value of the Canadian dollar, which is expected to reach the low- to mid-US$0.80 level based on the economic forecast used in this study (see Section 3.1.2), and as NAFTA effects reach maturity.

The historic relationships between cross-border work/business traffic and various key indicators are shown in Exhibit 5.1. For forecasting purposes, it is felt that Essex-Windsor labour force is the best indicator of future growth in cross-border commuting, with future commuting growth increasing in the same relation as Essex-Windsor labour force. This assumes that the proportion of the Essex-Windsor labour force working in the US will remain constant in the future at its 2001 level of 4.7%, compared to the pre-2001 historic range of 2.2% to 3.1%. This reflects a conservative assumption given that the local Windsor/Detroit economies could become more integrated through the ongoing effects of NAFTA and other influences, as shown by the significant increase in cross-border commuters over the 1996 to 2001 period. However, this growth could also be suppressed due to future border delays/inconveniences and the exchange rate.

Exhibit 5-1: Factors Influencing Same-Day Work/Business Travel at Detroit River Crossings





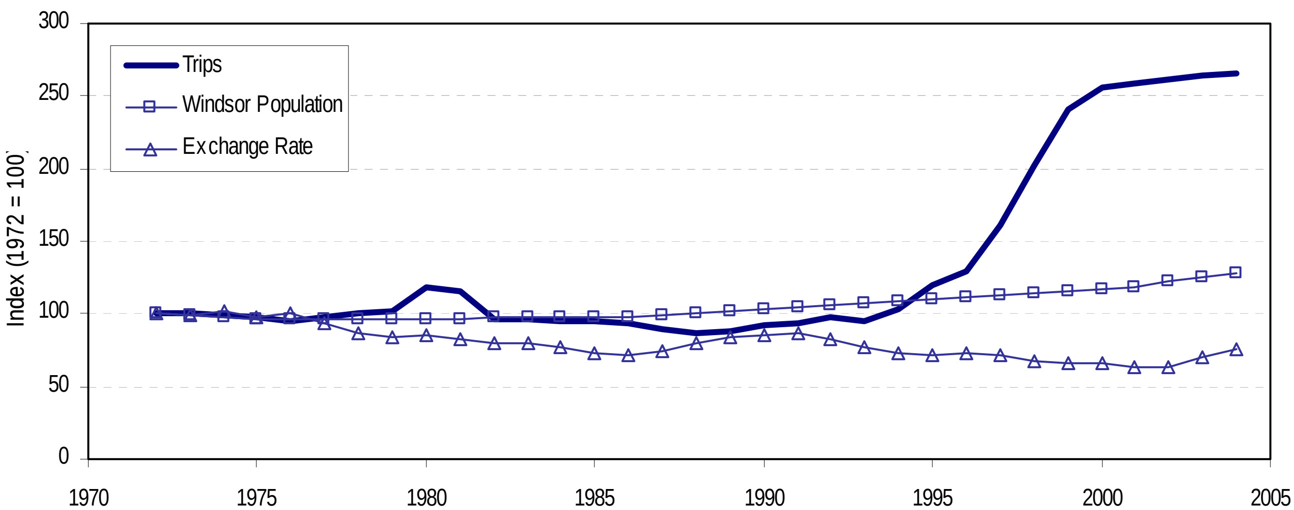
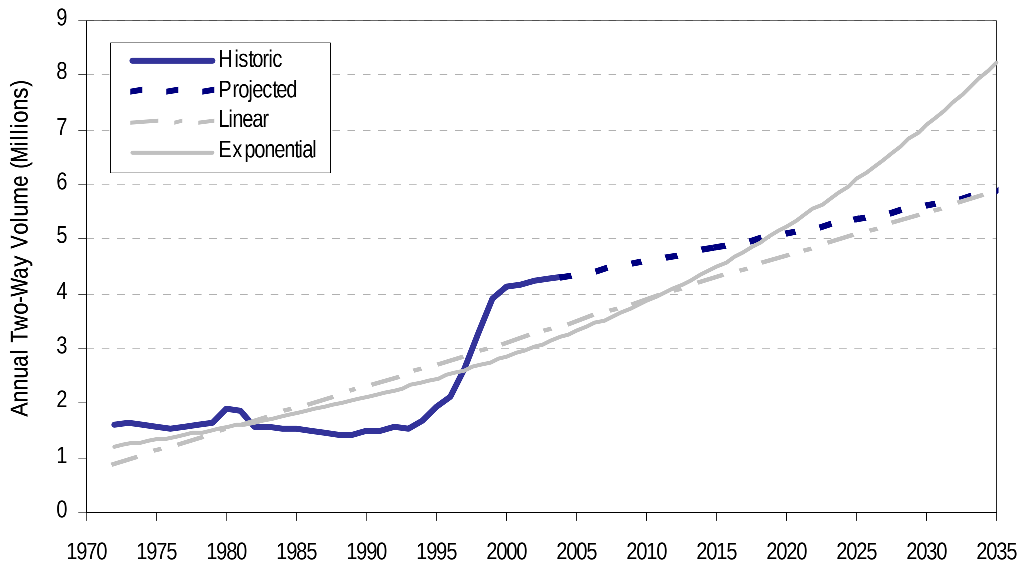


Exhibit 5.2 presents past cross-border work/business traffic trends and the projected future growth at Windsor-Detroit. The forecast calls for a 36% absolute increase in cross-border work/business trips and an annual growth of 1.0% per year. While this growth rate is larger than the projected rate of SEMCOG-area employment growth of 0.4% per year, it is felt that the additional workers could be absorbed into the SEMCOG-area economy given the very small proportion that Canadian workers would represent and their specialised areas of employment. American residents working in greater Windsor is also assumed to increase in the same relation as Canadians working in the US, given that this travel is predominantly related to the auto industry and should therefore grow accordingly.

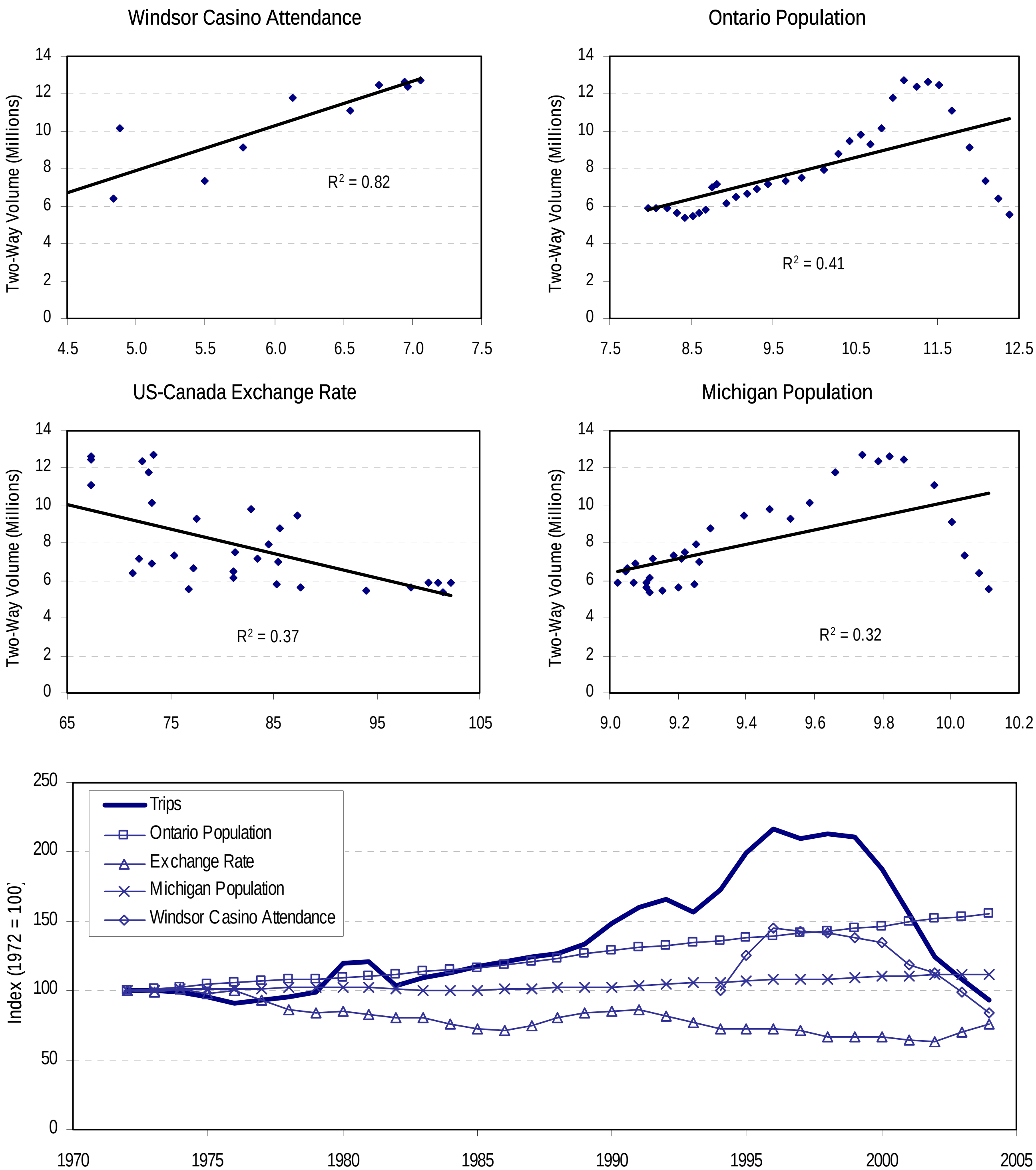
Exhibit 5-2: Historic and Projected Same-Day Work/Business Passenger Car Travel at Detroit River Crossings



5.1.1.2 Same-Day Discretionary/Recreation

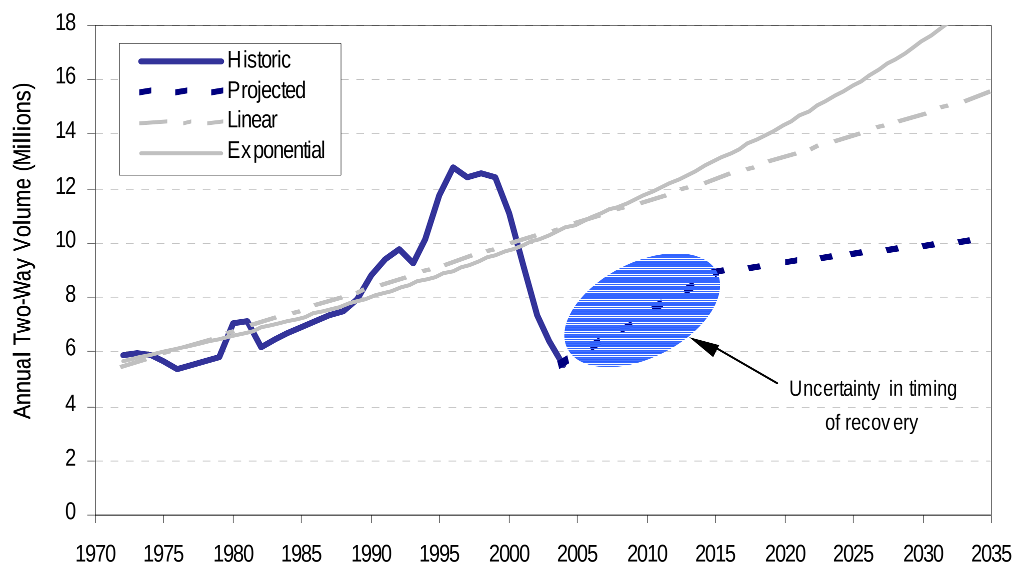
The historic relationship between cross-border same day discretionary traffic and various key indicators is shown in Exhibit 5.3. The future outlook for same-day discretionary travel is highly uncertain, given that the long-term effects of 9/11and the other deterrents mentioned above are difficult to anticipate. Historically, there have been no other extreme events of such magnitude to be able to gauge the timing and extent of a potential recovery of discretionary travel at a border crossing. While discretionary trips have declined by approximately 50% since 2000, a reasonable estimate would be to assume that one-half of these trips would be recovered over the next ten years. Given the extreme recent volatility of this travel, however, it is unclear as to when in this period that this recovery might begin.

Exhibit 5-3: Factors Influencing Same-Day Discretionary/Recreation Travel at Detroit River Crossings



Beyond 2015, growth in discretionary traffic is assumed to increase in relation to population over the period to 2035, with Canadian same-day discretionary travel increasing in relation to Essex-Windsor population and American traffic increasing in relation to SEMCOG-area population. Between 2004 and 2035, the same-day discretionary travel is projected to increase by 84%, or an annual growth of 2.0% per year. The past and projected trends in same-day discretionary/recreation trips using the Detroit River crossings are shown in Exhibit 5.4.

Exhibit 5-4: Historic and Projected Same-Day Discretionary/Recreation Travel at Detroit River Crossings

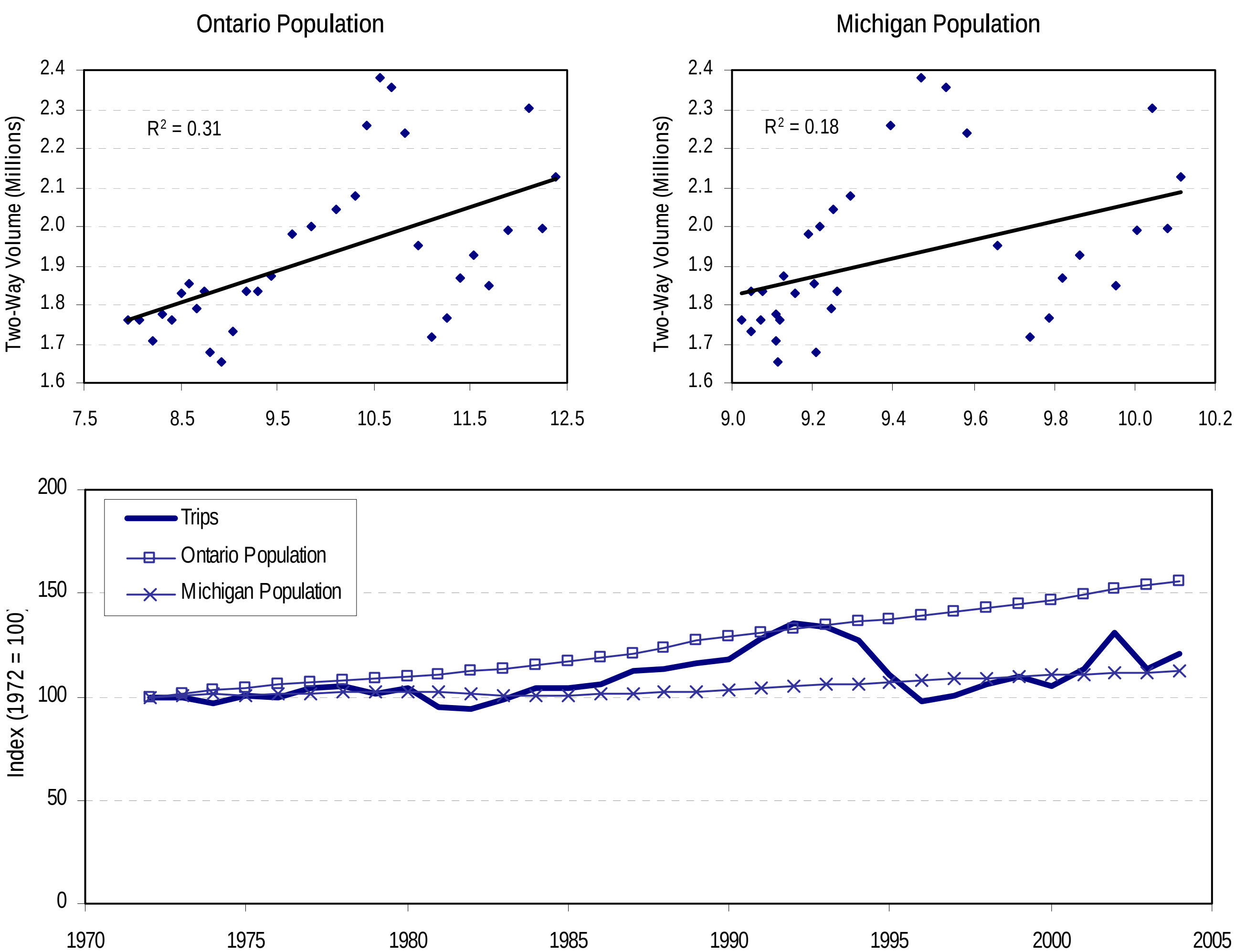


This future growth in same-day discretionary travel is also based on the expectation that the economy, exchange rate, entertainment/recreation venues and other factors will continue to provide an incentive for same-day discretionary travel by both Americans and Canadians. Marketing to promote Windsor-Detroit as a destination and building on the 2006 Super Bowl in Detroit is expected to help in the recovery. Drinking age laws, taxation on casino winnings, a favourable exchange rate, and the quality of entertainment venues and safety in the downtown area will attract Americans to the Windsor area over the long term. However, the rate of growth would be lower than experienced over the past thirty years, which was distorted by the cross-border shopping and Windsor Casino phenomena, which have since run their course.

5.1.1.3 Overnight/Vacation

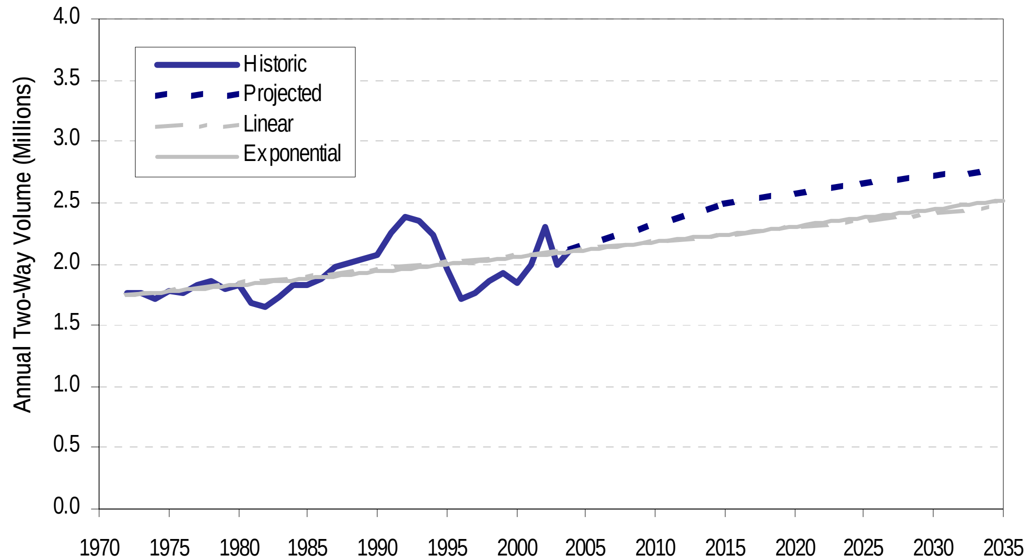
The historic relationship between cross-border overnight/vacation trips and various key indicators is shown in Exhibit 5.5. As discussed previously, overnight/vacation travel has been much less affected by 9/11, SARS, the Iraq War and overall heightened security levels at the border as compared to same-day discretionary trips, as the border delay represents a much smaller proportion of the travel time for longer-distance overnight trips. It is estimated that overnight/vacation trips have only decreased by less than 10% between 2002 and 2004. This decline is attributable to Toronto's SARS crisis in 2003, which had a devastating effect on Toronto tourism, with significant impacts throughout Southern Ontario. Surprisingly, the events of 9/11 did not appear to significantly effect tourism in Ontario, with 2002 visitation higher than 2001 for trips using the Detroit River crossings.

Exhibit 5-5: Factors Influencing Overnight/Vacation Travel at Detroit River Crossings



For forecasting purposes, it is assumed that the approximate 10% decrease in overnight/vacation travel due to SARS will be fully recovered by 2008. Beyond 2008, it is assumed that the future growth will be in the same relation as Ontario population for trips by Canadian residents to the US, with Michigan/Ohio population growth used to estimate the growth in trips by American residents to Canada. Over the study horizon to 2035, overnight/vacation trips at the Detroit River crossings are projected to increase by 30%, or 0.8% per year. The past and projected trends in overnight/vacation trips using the Detroit River crossings are shown in Exhibit 5.6.

Exhibit 5-6: Historic and Projected Overnight/Vacation Passenger Car Travel at Detroit River Crossings



5.1.2 TOTAL PASSENGER CAR DEMAND FORECAST

The total projected passenger car traffic volumes at the Detroit River and St. Clair River crossings are presented in Exhibit 5.7. In total, annual two-way passenger car demand is projected to increase from 15.7 million in 2004 to 27.7 million in 2035, representing a 1.5% annual increase.

Exhibit 5.8 shows the Detroit River and St. Clair River crossing choice proportions, as determined by the logit crossing choice model, reflecting changes in travel time from congestion effects and the future distribution of passenger car travel. As can be seen, there are no expected significant changes in future proportions of total trips, although the increasing congestion in the Windsor-Detroit area does affect long distance trips. The relatively small proportion of total passenger car traffic that is long distance, for which there is a realistic choice based on travel time, results in the overall proportions remaining largely unchanged.

Exhibit 5-7: Existing & Projected Annual Passenger Car Demand at Detroit River & St. Clair River Crossings

Trip Purpose	Volumes and Growth Rates						
	2004	2004 to 2015 Growth Rate	2015	20015 to 2025 Growth Rate	2025	2025 to 2035 Growth Rate	2035
Same-Day Work/Business	4,948,200	1.1%	5,580,900	1.0%	6,164,800	0.9%	6,742,700
Same-Day Discretionary/Recreation	7,134,800	4.5%	11,578,700	0.7%	12,415,200	0.6%	13,180,500
Overnight/Vacation	3,633,600	1.5%	4,280,200	0.6%	4,544,000	0.4%	4,729,100
Total	15,716,500	2.9%	21,439,800	0.7%	23,124,000	0.6%	24,652,300

Exhibit 5-8: Summary of Base Forecast Passenger Car Crossing Choice

Year	Crossing Share			
	All Trips		Long Distance Trips[1]	
	Detroit River	St. Clair River	Detroit River	St. Clair River
2004	76%	24%	49%	51%
2015	76%	24%	47%	53%
2025	76%	24%	46%	54%
2035	76%	24%	44%	56%

[1] Long distance trips have neither trip end in the SEMCOG, Sarnia or Essex area.

Derived from the projected total Detroit River and St. Clair River demand and crossing shares from the crossing choice model, Exhibit 5.9 shows the estimated passenger car demand for the Detroit River crossings. Exhibit 5.10 illustrates past and projected traffic at the crossings along with several time-series trend extrapolations and multivariate regression model forecasts. The multivariate regression models have been developed using forecasts of the exchange rate and Ontario population and are presented for comparison purposes. The passenger car forecast derived above for Detroit River crossings is lower than the statistical methods presented, which do not compensate for the recent structural changes affecting cross-border passenger car traffic.

Over the 2004 to 2035 horizon, total passenger car trips are projected to increase from 12.0 million to 18.7 million annual trips, representing an absolute growth of 57% and an annual growth of 1.5%. Overall, the projected total passenger car traffic represents modest growth at a significantly lower rate than the thirty-year trends for the Detroit River crossings. Even with the assumed levels of recovery from 9/11 and SARS, the projected 2035 traffic level is only somewhat higher than the 1999 level.

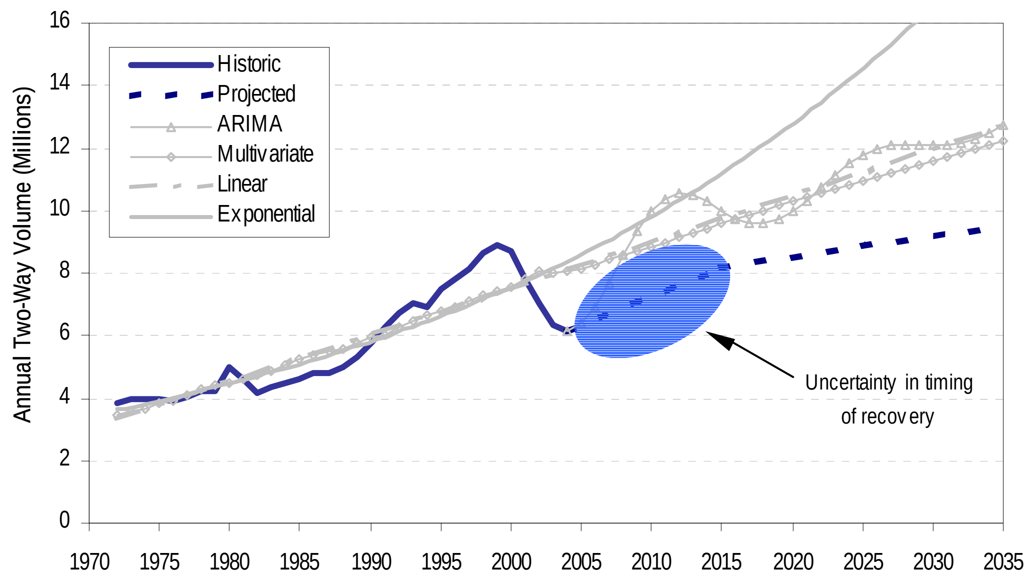
Exhibit 5-9: Existing & Projected Annual Passenger Car Demand at Detroit River Crossings

Year / Period	Measure	Crossing		Total
		Ambassador Bridge	Detroit-Windsor Tunnel	
2004	Volume	6,170,000	5,780,000	11,950,000
2015	Volume	8,180,000	8,100,000	16,280,000
2004 to 2015	Growth	33%	40%	36%
	CAGR[1]	2.6%	3.1%	2.8%
2025	Volume	8,820,000	8,750,000	17,570,000
2015 to 2025	Growth	8%	8%	8%
	CAGR[1]	0.8%	0.8%	0.8%
2035	Volume	9,380,000	9,360,000	18,740,000
2025 to 2035	Growth	6%	7%	7%
	CAGR[1]	0.6%	0.7%	0.6%
2004 to 2035	Growth	52%	62%	57%
	CAGR[1]	1.4%	1.6%	1.5%

[1] Compound annual growth rate.
Note: Includes Windsor-Detroit/Sarnia-Port Huron crossing choice effects.

Exhibit 5-10: Historic and Projected Passenger Car Traffic at Detroit River Crossings

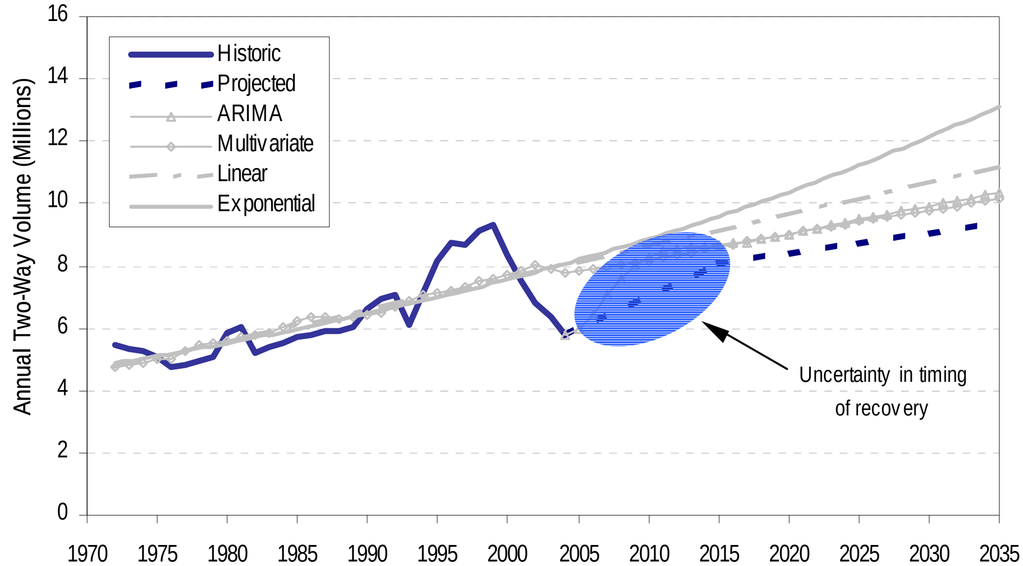
A. Ambassador Bridge



Note: Multivariate forecasts based on projections of Canadian dollar value and Ontario population (see Appendix A).

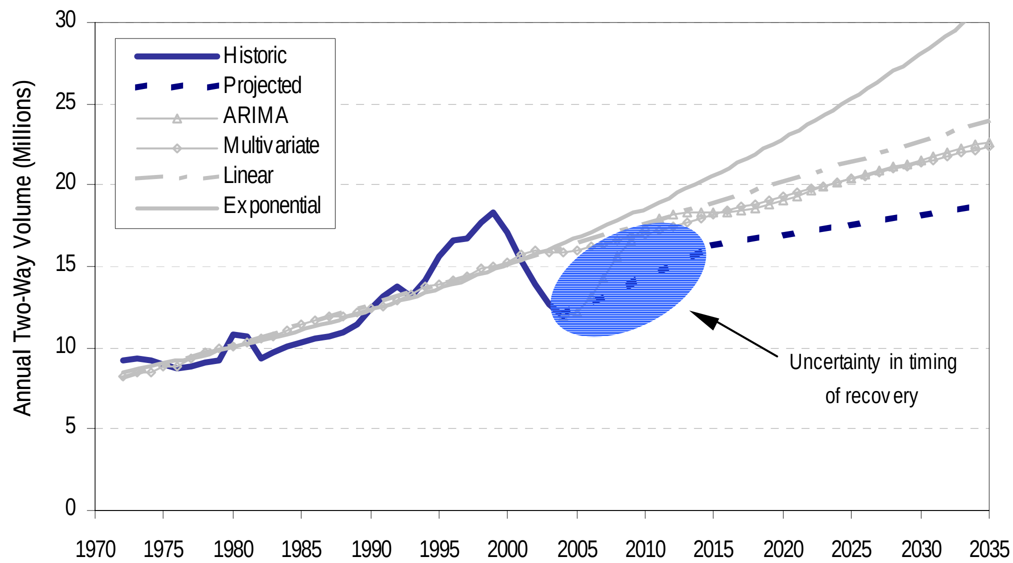
Exhibit 5.10 (Cont.): Historic and Projected Passenger Car Travel at Detroit River Crossings

B. Detroit-Windsor Tunnel



Note: Multivariate forecasts based on projections of Canadian dollar value and Ontario population (see Appendix A).

C. Total Detroit River Crossings



Note: Multivariate forecasts based on projections of Canadian dollar value and Ontario population (see Appendix A).

5.2 Goods Movement Demand

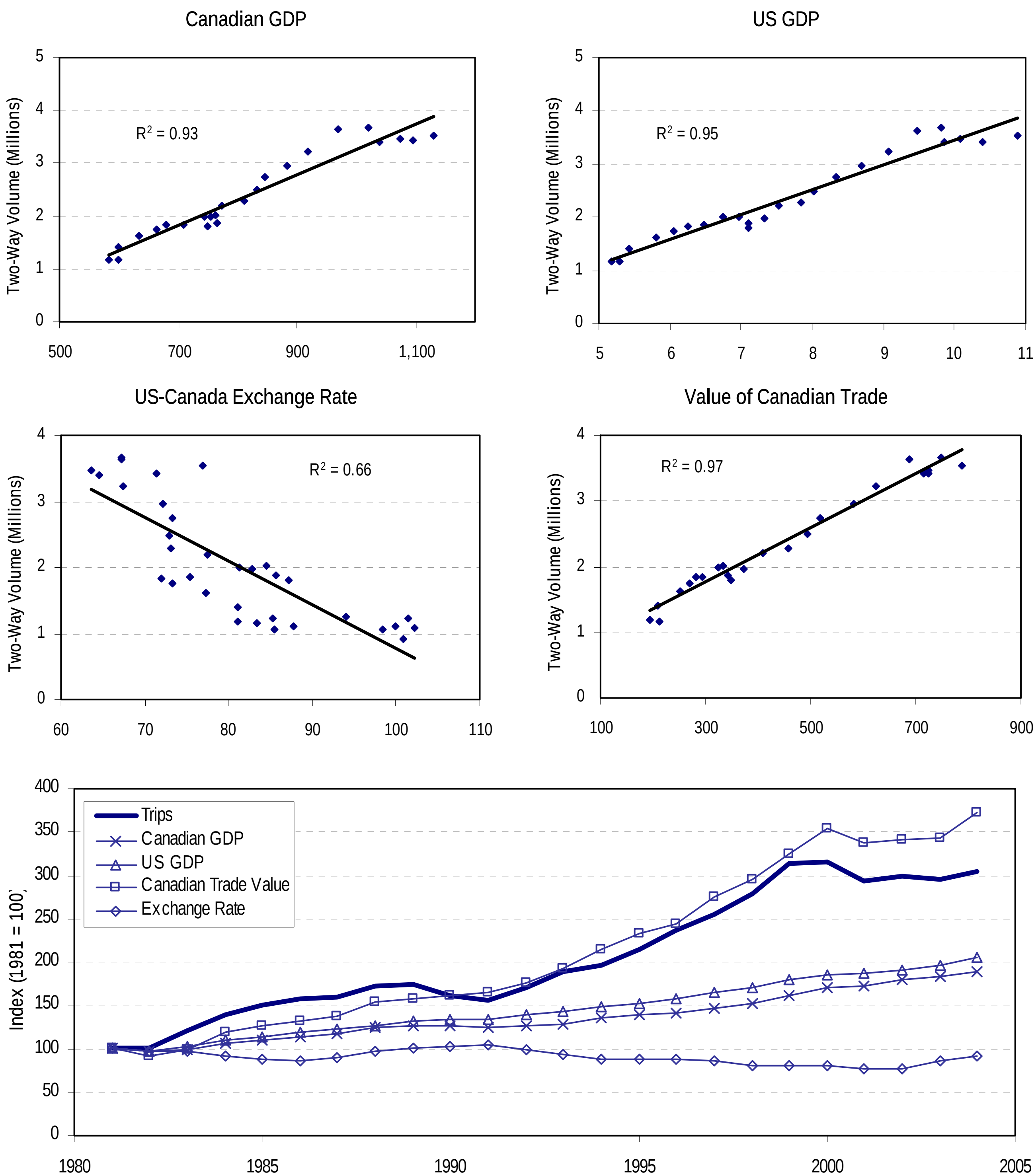
The following discusses the commodity trade forecasts and the resulting total commercial vehicle demand forecasts for cross-border traffic.

5.2.1 COMMODITY TRADE FORECASTS

The relationships between commercial vehicle traffic and various key indicators are shown in Exhibit 5.11. There are very strong relationships with Canadian and US GDP, the value of Canadian trade and the exchange rate. The strongest relationship is between cross-border commercial vehicle demand and trade. Government of Canada forecasts of merchandise trade, as described in Section 4.2.1 are therefore used as the primary basis for projecting future cross-border commercial vehicle demand.

Data regarding historical commodity trade across Detroit River and St. Clair River crossings by direction were available from Industry Canada. The following describes the historical trade trends of the commodity types in terms of the value traded via all modes between Ontario and Michigan, Ohio, Indiana, Illinois and Wisconsin between 1992 and 2004. As historical data by both crossing and commodity were not available, the historical trade values shown here between Ontario and Michigan, Ohio, Indiana, Illinois and Wisconsin are used as a proxy. This is a reasonable proxy for the trade trends through these crossings, typically accounting for about two-thirds of the total value of trade. Projected growth rates, as developed from the Government of Canada forecasts by Informetrica Limited, are also presented for all commodity groups.

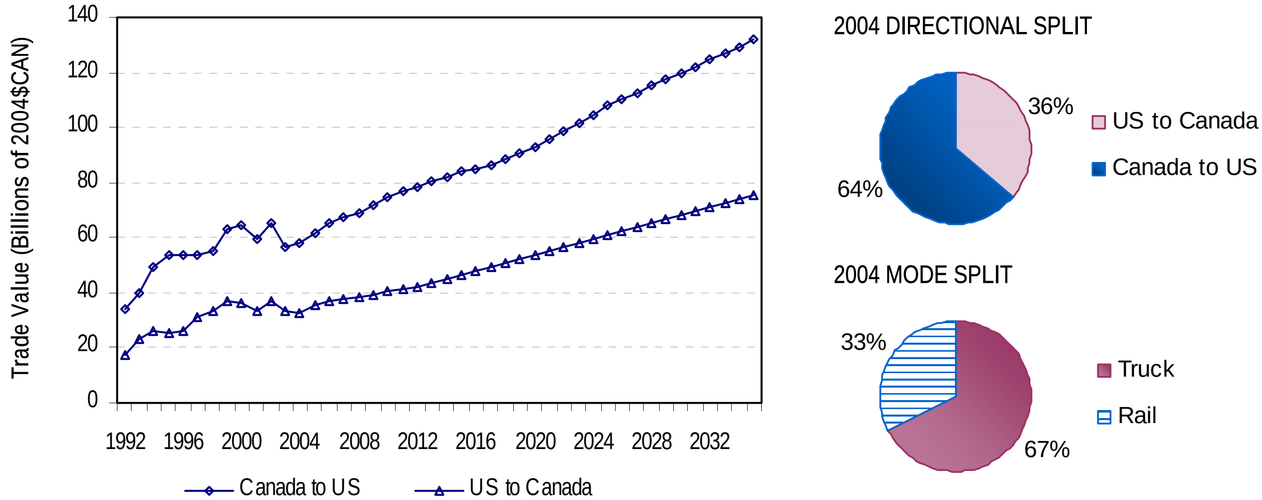
Exhibit 5-11: Factors Influencing Commercial Vehicle Travel at Detroit River Crossings



5.2.1.1 Automotive & Metal

Historical and projected automotive and metal commodities trade are presented in Exhibit 5.12. The automotive sector is the dominant industry in Southwest Michigan and Southwestern Ontario, currently representing approximately 35% of commercial vehicle traffic at Detroit River and St. Clair River crossings. Metal is combined with automotive for analysis purposes as a high proportion of the metal crossing the border within the study area is related to the auto industry. Automotive/metal as a combined category currently represents approximately 43% of the total commercial vehicle traffic.

Exhibit 5-12: Historic and Projected Automotive & Metal Commodity Trade at Detroit River & St. Clair River Crossings, All Modes



Note: Application of forecast trade growth to current trade between ON and MI/IN/IL/OH/WI.
Source: Industry Canada and analysis of Informetrica Limited trade forecasts, BTS Transborder Surface Trade data for mode splits

Trade in the automotive/metal sector has grown steadily over the past several decades, with the Auto Pact of 1965 having a long-term major influence and with NAFTA facilitating continued trade in this industry following the expiration of the Auto Pact. Historically, the dominant direction of trade value is from Canada to the US with a significant Canadian trade surplus. Trade growth was high until 2000, after which a downturn occurred given the economic slowdown in the US and increased competition from foreign car makers and out-sourcing of parts from other countries. Total value traded declined by 2.7% annually from 2000 to 2004, relative to an 8.8% growth between 1992 and 2000.

A slowdown in the auto sector was predicted in the early 2000's; however, the decline was not as significant as projected, with a combination of low interest rates, purchasing incentives and other factors contributing to growth in auto sales. Ontario exports of motor vehicle products increased by 5.1% in 2004. Previously announced plant closings have not occurred to the full extent, and while new plants have opened in the southern US and Mexico, new Ontario plants and expansion of existing plants are also strong prospects for new assembly plants and expansion of existing plants in Ontario.

However, moderating growth is the expectation that rising US interest rates will limit the ability of carmakers to maintain current incentives, which will reduce US demand for cars and light trucks.

While there is a renewed optimism for the auto industry in Southwestern Ontario, the auto industry remains in transition, with southern US states, Latin America and Asia likely to play a more significant role in production and distribution within the North American automotive sector. In particular, Asia has grown significantly in this industry, with the North American industry sourcing parts from this part of the world, and exhibiting stronger growth than Europe, southern US and Latin America. However, off-shore parts continue to be largely shipped through Canada to Michigan, via rail to the Toronto area and then by commercial vehicle to Michigan. New plants in southern US and Mexico have impacted Ontario/Michigan auto industry trade to some extent, but has not fundamentally changed distribution patterns.

Despite the on-going uncertainty, the outlook for auto industry trade between Ontario and Michigan is for continued long-term growth, although at rates lower than historic levels given increased competition and globalization in the industry. The near term growth is more optimistic than in past given the continuation of low interest rates and recent US consumption which has been higher than predicted.

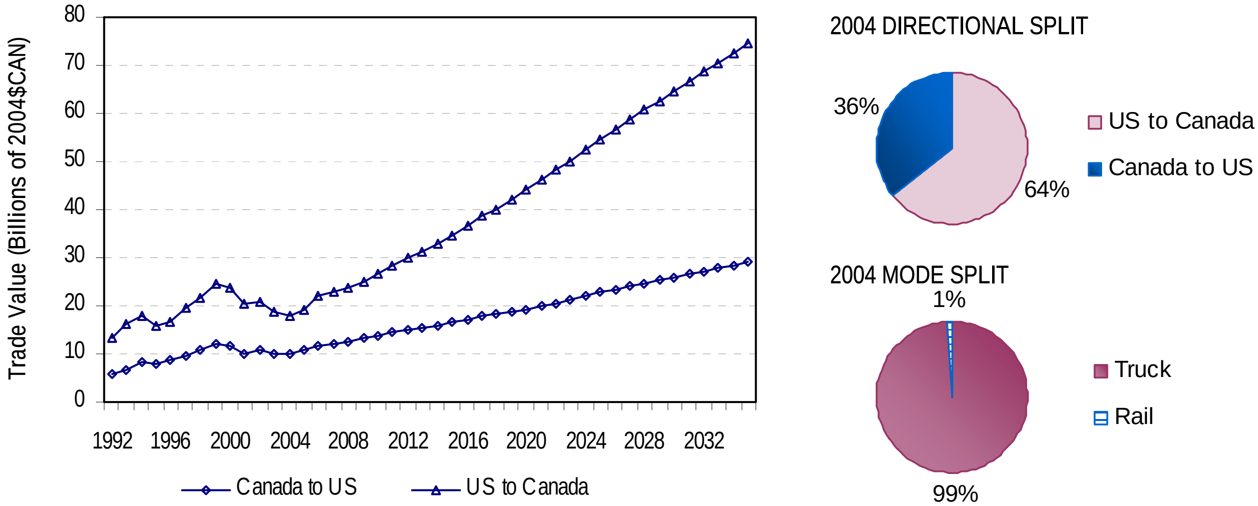
The Government of Canada merchandise trade projections indicate that all aspects of the automotive and metal commodity group will grow steadily throughout the horizon period, with growth in total Canadian exports slightly outpacing total imports. Canadian exports will initially be highest for finished trucks, although the growth in finished passenger cars and parts will be only slightly lower, with parts becoming more dominant in the later two decades. Growth in Canadian imports is expected to continue to be dominated by finished cars over the study horizon.

As noted above, the automotive and metal sectors are combined and are calculated based on an agglomeration of representative components from each sector, including finished product, parts and raw material. The metal sector is forecast to grow at a much higher rate nationwide, but it represents a somewhat smaller proportion (about 20%) of the combined value moving through the study area. The combined automotive/metal sector is projected to increase at 3.5%, 2.5% and 2.0% annually for Canadian exports and 3.3%, 2.7% and 2.1% annually for Canadian imports in each decade, respectively.

5.2.1.2 Machinery & Equipment

Exhibit 5.13 illustrates the historical and projected trade in machinery and equipment commodities. At present, this commodity group is responsible for approximately 5% of commercial vehicle traffic at Detroit River crossings, although its share in terms of value is much higher given the high value goods being transported. This group consists of such items as office machinery, aircraft and locomotive engines, electronics and other household and industrial machines. After a steep climb in trade during the 1990s, recent trade has been depressed following the collapse of the high-tech sector in the early years of this decade, particularly for Canadian exports to the US. Total trade growth was 9.5% annually during the 1992 to 1999 period, but declined almost as dramatically by 5.1% annually between 1999 and 2004.

Exhibit 5-13: Historic & Forecast Machinery & Equipment Trade at Detroit River & St. Clair River Crossings, All Modes



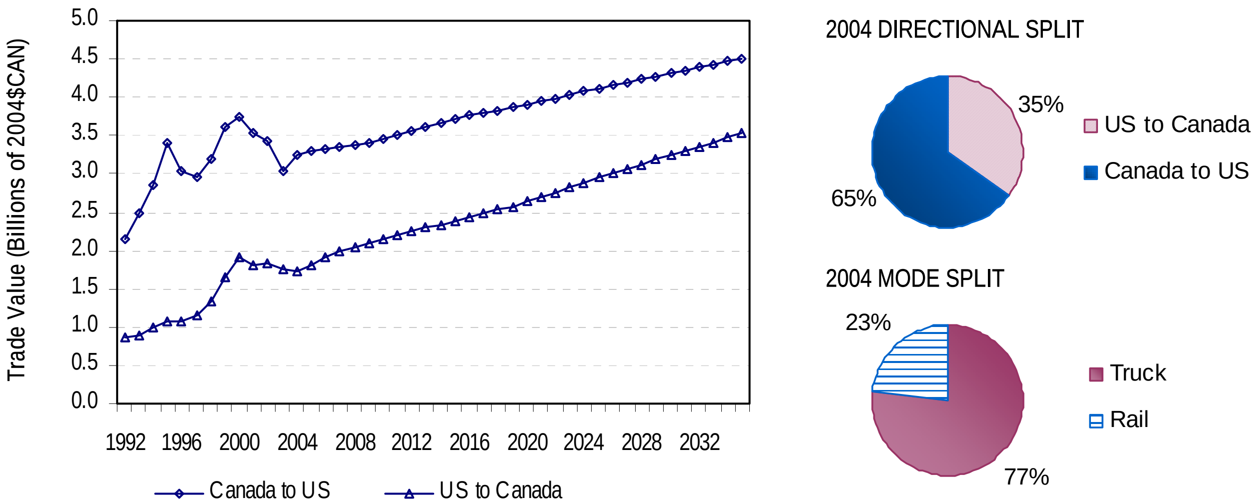
Note: Application of forecast trade growth to current trade between ON and MI/IN/IL/OH/WI.
Source: Industry Canada and analysis of Informetrica Limited trade forecasts, BTS Transborder Surface Trade data for mode splits

Machinery and equipment is projected to be the fastest growing sector, with the dominant direction of trade continuing to be from the US to Canada. This growth is expected to be spurred by low interest rates and aging capital equipment and strong demand for IT products. This trade gap projected to widen further given large growth in Canadian imports that are forecast, which the Government of Canada projections estimate at 6.2%, 4.7% and 3.1% annually in each decade. Canadian exports are expected to be almost as strong, growing at 4.6%, 3.3% and 2.4% annually. This growth is consistent with strong global demand for manufacturing inputs and robust commodity prices.

5.2.1.3 Forest

The forest sector is presented in Exhibit 5.14. At present, forestry represents approximately 9% of truck volumes at Detroit River crossings. This sector consists of raw and semi-processed wood material, including pulp, scrap paper and paperboard, wood charcoal and hardwood and softwood lumber. This sector has also experienced a recent downturn since 2000 following strong growth in the 1990s, transferring from an annual growth of 8.1% between 1992 and 2000 and declining by 3.0% since. The dominant direction of flow is from Canada to the US, although the relative proportions are much closer in the study area than at the national level.

Exhibit 5-14: Historic & Forecast Forest Commodity Trade at Detroit River & St. Clair River Crossings, All Modes



Note: Application of forecast trade growth to current trade between ON and MI/IN/IL/OH/WI.
Source: Industry Canada and analysis of Informetrica Limited trade forecasts, BTS Transborder Surface Trade data for mode splits

Pulp and paper is dominated by the newspaper industry, and it tends to move in cycles with consumer spending, driven by advertising and changing in price and volume. Demand for pulp and paper has continued despite increases in electronic communications, particularly over the Internet. The other large component of forest products is lumber and related products. In the late 1990's, this component experienced considerable growth, although the growth was curtailed and resulted in declines in trade with the imposition of punitive duties that increased the price of Canadian softwood lumber by approximately 30%. Softwood lumber disputes between Canada and the US continue to curtail trade in this sector and as resulted in low/negative growth in recent years.

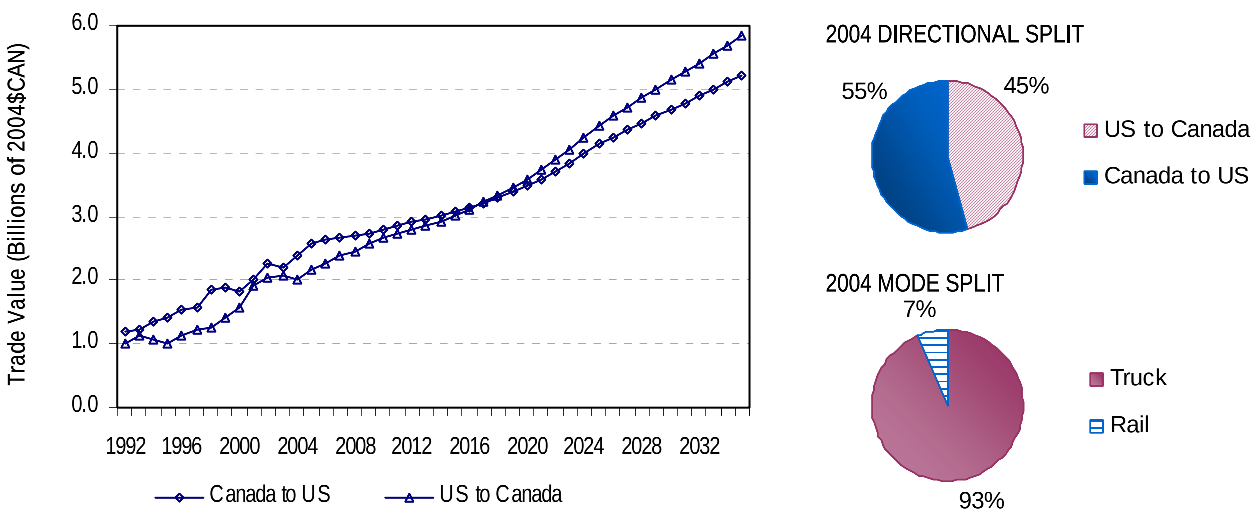
In addition to trade disputes and electronic media, a further cause for uncertainty in this sector is potential changes in environmental legislation that could have an impact on the costs of production for pulp and paper as well as lumber products. In recent years, the industry has had to adopt new technology to keep in line with policies regarding sustainability of the environment. Given uncertain demand and volatile prices, a consolidation of this industry may occur rather than assume the risk of new capital investments.

This sector continues to be a sensitive issue in Canada-US trade. Rising electricity prices and Canadian dollar and high wood fibre costs in the northeast introduce additional challenges. Nevertheless, the prospects for growth appear good in the near term due to rising prices and continued demand. The Government of Canada projections call for low to moderate growth and a narrowing of the trade gap, with Canadian exports growing at 1.3%, 1.0% and 0.9% annually in each decade and Canadian imports growing at 2.9%, 2.2% and 1.8%. This growth represents the lowest among the sectors defined in this report.

5.2.1.4 Agriculture

Historic and projected levels of trade in the agriculture sector at Detroit River and St. Clair River crossings are illustrated in Exhibit 5.15. At present, approximately 9% of commercial vehicles at Detroit River crossings are carrying agricultural products. This sector has not experienced the recent decline in trade of the previous three commodities, showing moderate to strong annual growth of 5.9% over the past thirteen years. The agricultural sector has been affected by on-going trade disputes in beef, pork and chicken, among other areas. However, strong economic activity and employment in the US has increased demand for prepared food and beverages.

Exhibit 5-15: Historic & Forecast Agricultural Commodity Trade at Detroit River & St. Clair River Crossings, All Modes



Note: Application of forecast trade growth to current trade between ON and MI/IN/IL/OH/WI.
Source: Industry Canada and analysis of Informetrica Limited trade forecasts, BTS Transborder Surface Trade data for mode splits

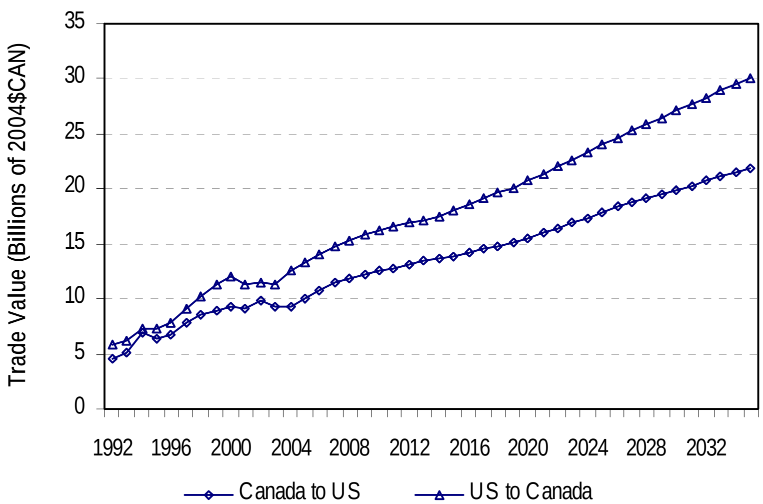
The direction of trade has been and is projected to continue to be fairly even throughout the study horizon. The Government of Canada projections of growth of Canadian imports is expected to slightly outpace exports at rates of 3.8%, 3.9% and 2.8% annually relative to 2.3%, 3.0% and 2.3% in each of the three decades, respectively.

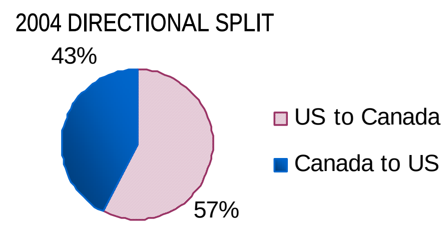
5.2.1.5 Other Commodities

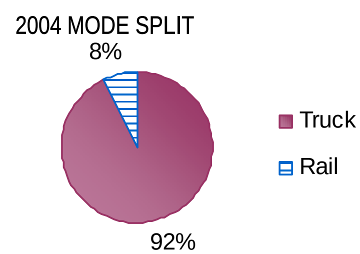
The trade of the remaining commodities is presented in Exhibit 5.16. This sector consists of such items as chemicals and plastics, energy, minerals, textiles and other consumer products not included in the previous sectors. While this sector has also undergone a decline since 2000, it has not been quite as significant and has grown by 6.4% annually since 1992. At present, other commodities represent approximately 22% of the commercial vehicle flows at Detroit River crossings.

US to Canada is the dominant direction of trade for the remaining commodities. The Government of Canada projections show strong growth of Canadian exports in the first decade, outpacing imports at 3.7% annually relative to 3.3%. Afterwards, however, the trade gap is expected to widen further due to annual growth of imports of 2.9% and 2.3% relative to 2.6% and 2.0% for exports.

Exhibit 5-16: Historic & Forecast Other Commodity Trade at Detroit River & St. Clair River Crossings, All Modes





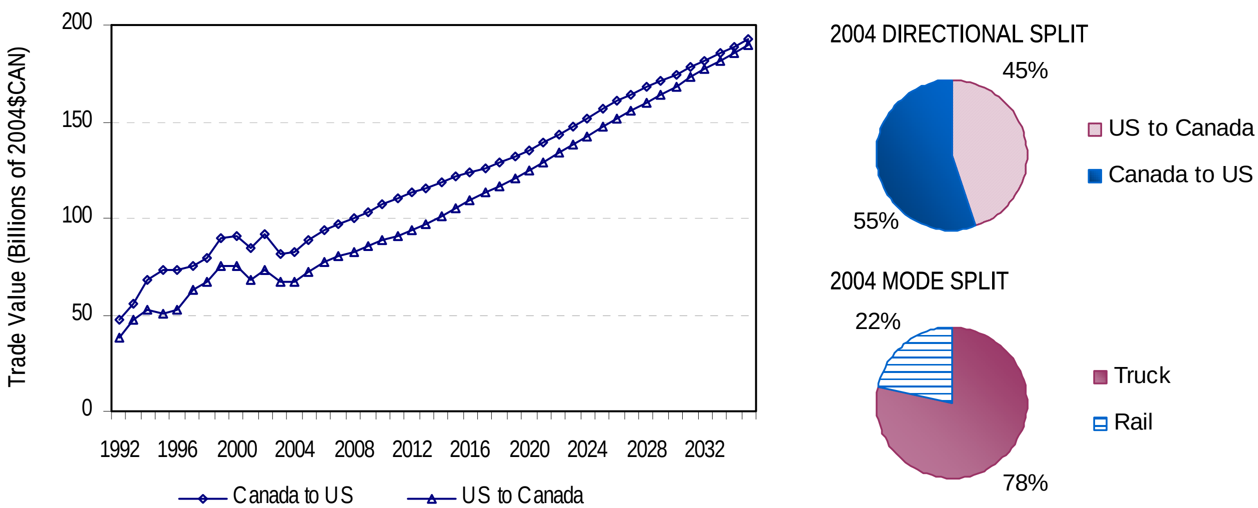


Note: Application of forecast trade growth to current trade between ON and MI/IN/IL/OH/WI.
Source: Industry Canada and analysis of Informetrica Limited trade forecasts, BTS Transborder Surface Trade data for mode splits

5.2.2 TOTAL COMMERCIAL VEHICLE DEMAND FORECAST

The Government of Canada commodity trade forecasts are summarized in Exhibit 5.17. Based on the above forecasts by commodity applied to the values of each commodity at Detroit River and St. Clair River crossings, total imports are expected to outpace total exports and the trade value gap in the study area is expected to narrow over the study horizon, with much of this occurring in the later two decades. This is consistent with the expectations for overall national trade presented in Section 4.2.1. Over the long term, Canada is expected to narrowly remain a net exporter of goods in terms of value within the study area with increases in the value of the Canadian dollar and increasing integration of the US and Canadian economies. This difference is due to the greater trade gap that currently exists at the study area and the specific mix of commodities traded, which differs from the mix at the national level.

Exhibit 5-17: Historic & Forecast Total Trade at Detroit River & St. Clair River Crossings, All Modes



Note: Application of forecast trade growth to current trade between ON and MI/IN/IL/OH/WI.
Source: Industry Canada and analysis of Informetrica Limited trade forecasts, BTS Transborder Surface Trade data for mode splits

Exhibit 5.18 shows the results of applying the growth rates by commodity group to the 2004 base year commercial vehicle demand for Detroit River and St. Clair River crossings by direction for each forecast year. In total, annual two-way commercial vehicle demand is projected to increase from 5.3 million in 2004 to 12.3 million in 2035, representing a 2.8% annual increase. While Canada to the US remains the peak direction in terms of trade, the trade deficit is projected to decrease in the future with US to Canada flows increasing at a faster rate, although remaining lower in absolute terms. The narrowing of the trade gap results in a lower proportion of empty trucks for US to Canada flows. Total commercial vehicle trips including empty vehicles from Canada to US are greater than US to Canada given triangulation in commercial vehicle routing with many vehicles entering the US via the Ambassador Bridge but returning to Canada via other crossings (e.g. Peace Bridge, International Bridge at Sault Ste. Marie).

Exhibit 5-18: Existing & Projected Annual Commercial Vehicle Demand at Detroit River & St. Clair River Crossings

Direction	Commodity Type	Volumes and Growth Rates						
		2004	2004 to 2015 CAGR[1]	2015	20015 to 2025 CAGR[1]	2025	2025 to 2035 CAGR[1]	2035
Canada to US	Auto	957,600	3.5%	1,393,300	2.5%	1,787,600	2.0%	2,186,400
	Forest	364,100	1.3%	417,700	1.0%	462,200	0.9%	505,900
	Animal/Plant	282,400	2.3%	362,000	3.0%	488,400	2.3%	613,300
	Metal	283,700	3.5%	412,700	2.5%	529,500	2.0%	647,700
	Machinery/Electronics	94,900	4.6%	156,400	3.3%	216,000	2.4%	274,100
	Other	596,200	3.7%	885,200	2.6%	1,141,800	2.0%	1,395,800
	Empty	331,000	3.1%	465,300	2.5%	593,200	2.0%	721,000
	Total	2,909,800	3.1%	4,092,500	2.5%	5,218,600	2.0%	6,344,100
US to Canada	Auto	719,800	3.3%	1,033,900	2.7%	1,353,900	2.1%	1,673,600
	Forest	98,500	2.9%	135,300	2.2%	167,600	1.8%	200,000
	Animal/Plant	347,700	3.8%	524,200	3.9%	770,000	2.8%	1,013,800
	Metal	186,000	3.3%	267,100	2.7%	349,800	2.1%	432,400
	Machinery/Electronics	120,000	6.2%	232,100	4.7%	365,700	3.1%	498,000
	Other	606,400	3.3%	865,000	2.9%	1,156,100	2.3%	1,446,700
	Empty	342,400	3.1%	478,000	2.4%	607,700	2.0%	738,000
	Total	2,420,700	3.5%	3,535,500	3.0%	4,770,900	2.3%	6,002,600
Total	Auto	1,677,400	3.4%	2,427,100	2.6%	3,141,500	2.1%	3,860,000
	Forest	462,600	1.6%	553,000	1.3%	629,800	1.1%	705,900
	Animal/Plant	630,100	3.1%	886,100	3.6%	1,258,400	2.6%	1,627,100
	Metal	469,600	3.4%	679,800	2.6%	879,400	2.1%	1,080,100
	Machinery/Electronics	214,900	5.5%	388,500	4.1%	581,700	2.9%	772,100
	Other	1,202,600	3.5%	1,750,100	2.8%	2,297,900	2.1%	2,842,500
	Empty	673,300	3.1%	943,300	2.4%	1,200,900	2.0%	1,459,000
	Total	5,330,600	3.3%	7,628,000	2.7%	9,989,500	2.1%	12,346,800

[1] Compound annual growth rate.

Exhibit 5.19 highlights the changes in crossing choice between the Detroit and St. Clair River crossings that are inherent in the Base Forecast, as determined by the logit crossing choice model, reflecting changes in travel time from congestion effects and the future trip distribution of commercial vehicle travel. Of the total Detroit River and St. Clair River crossing demand, 66% of commercial vehicles presently use Detroit River crossings. This proportion is projected to remain relatively stable in the future given the anticipated travel demand growth and assumed infrastructure improvements. The initial diversion towards the Detroit River crossings reflects the easing of border delay following the opening of new customs booths, but this benefit is eroded in time as congestion builds on the access roads. The share of total trips using the Detroit River crossings is larger than the share of long distance trips, reflecting the larger number of local trips (that do not make a crossing choice) in the Detroit-Windsor area compared to the Sarnia-Port Huron area.

Exhibit 5-19: Summary of Base Forecast Commercial Vehicle Crossing Choice

Year	Crossing Share			
	All Trips		Long Distance Trips	
	Detroit River	St. Clair River	Detroit River	St. Clair River
2004	66%	34%	63%	37%
2015	68%	32%	65%	35%
2025	66%	34%	63%	37%
2035	65%	35%	62%	38%

[1] Long distance trips have neither trip end in the SEMCOG, Sarnia or Essex area.

Reflecting the total Detroit River and St. Clair River demand and the crossing shares estimated from the crossing choice model, Exhibit 5.20 shows the projected commercial vehicle demand by direction for the Detroit River crossings. Exhibit 5.21 illustrates the estimated 2004 and 2035 commercial vehicles by crossing, commodity type and direction. Note again that these values include the effects of crossing choice between the Detroit River and St. Clair River crossings as determined by the logit model within the travel demand model. The results show a 114% increase in truck traffic at Windsor-Detroit over the study period from 3.5 million trips in 2004 to 8.1 million by 2035, equivalent to an annual growth of 2.7%. The effect of the narrowing trade gap is apparent, as the 55%:45% directional split in 2004 is reduced to a 52%:48% split by 2035, with the balance still in the Canada to US direction.

The historical and predicted commercial vehicle traffic demand at the Detroit River crossings is illustrated in Exhibit 5.22. Several time-series trend extrapolations and multivariate regression model forecasts are also presented to show a range of forecasts based on different techniques. These results show that the Base Forecast for commercial vehicles falls within this range, falling above the linear time-series trend extrapolations but falling below the multivariate regression equation based on US GDP and marginally lower than the multivariate regression based on Canadian trade and exchange rate. MDOT uses US GDP to forecast cross-border traffic and thus the Base Forecast may be considered conservative on this basis.

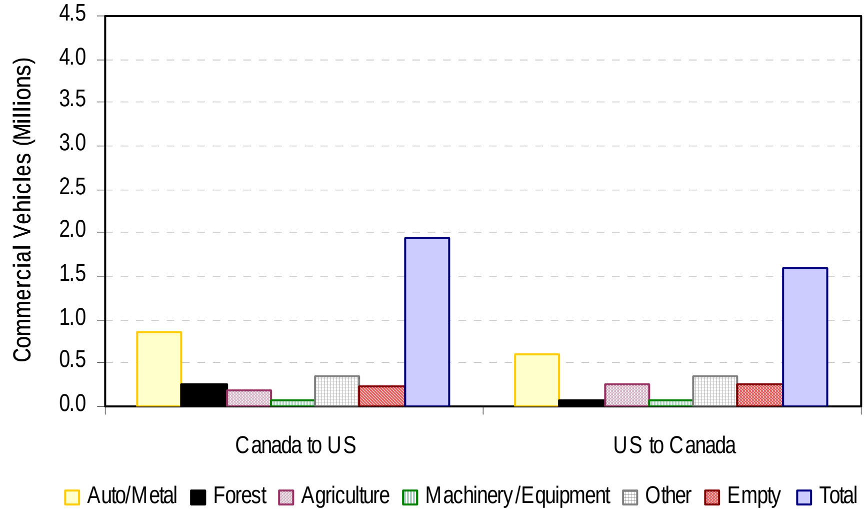
Exhibit 5-20: Existing & Projected Annual Commercial Vehicle Demand at Detroit River Crossings

Year / Period	Measure	Crossing and Direction						Total by Direction		
		Ambassador Bridge			Detroit-Windsor Tunnel					
		Canada to US	US to Canada	Total	Canada to US	US to Canada	Total	Canada to US	US to Canada	Total
2004	Volume	1,870,000	1,510,000	3,370,000	80,000	80,000	160,000	1,950,000	1,590,000	3,530,000
2015	Volume	2,710,000	2,280,000	4,980,000	100,000	100,000	190,000	2,810,000	2,370,000	5,180,000
2004 to 2015	Growth	45%	51%	48%	22%	22%	22%	44%	50%	47%
	CAGR[1]	3.4%	3.8%	3.6%	1.8%	1.8%	1.8%	3.4%	3.7%	3.5%
2025	Volume	3,390,000	3,010,000	6,400,000	110,000	110,000	230,000	3,500,000	3,130,000	6,630,000
2015 to 2025	Growth	25%	32%	28%	15%	17%	16%	25%	32%	28%
	CAGR[1]	2.3%	2.8%	2.5%	1.4%	1.6%	1.5%	2.2%	2.8%	2.5%
2035	Volume	4,070,000	3,740,000	7,810,000	120,000	130,000	250,000	4,190,000	3,870,000	8,060,000
2025 to 2035	Growth	20%	24%	22%	11%	13%	12%	20%	24%	22%
	CAGR[1]	1.8%	2.2%	2.0%	1.1%	1.2%	1.2%	1.8%	2.1%	2.0%
2004 to 2035	Growth	118%	148%	132%	56%	61%	59%	116%	144%	128%
	CAGR[1]	2.5%	3.0%	2.7%	1.5%	1.6%	1.5%	2.5%	2.9%	2.7%

[1] Compound annual growth rate.
Note: Directional split estimated from MTO 2000 Commercial Vehicle Survey.
Note: Includes Windsor-Detroit/Sarnia-Port Huron crossing choice effects.
Note: Half of projected Detroit-Windsor Tunnel demand shifted to Ambassador Bridge due to truck-type physical dimension restrictions.

Exhibit 5-21: Existing and Projected Commercial Vehicle Trips at Detroit River Crossings by Commodity & Direction

A. 2004



Source: 2004 projection based on MTO 2000 Commercial Vehicle Survey, 2004 BTS and BTOA data

B. 2035

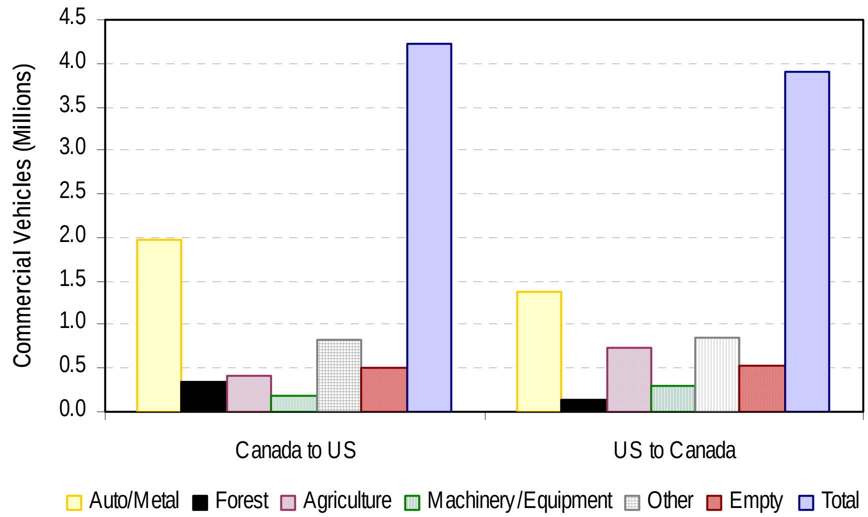
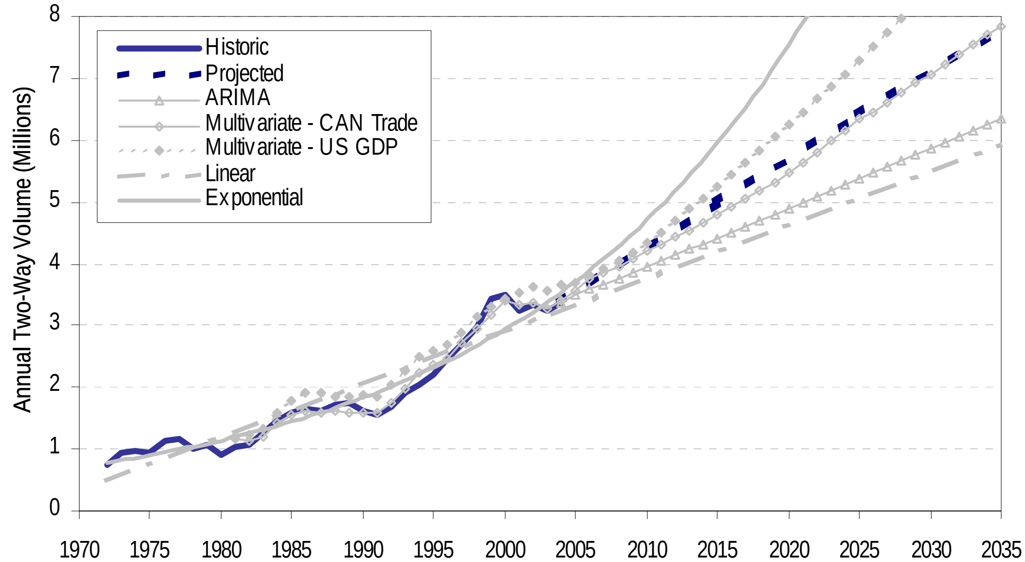


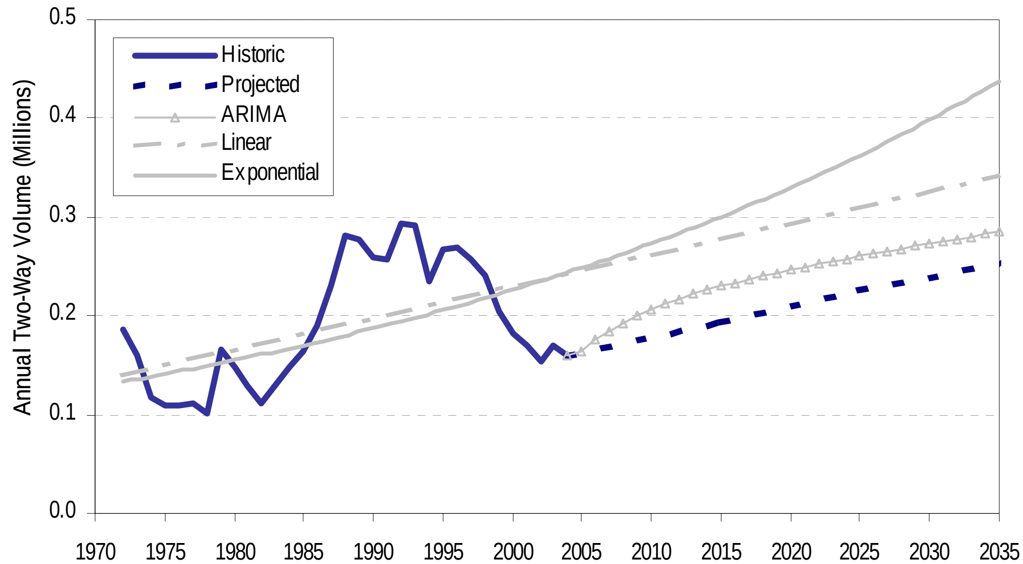
Exhibit 5-22: Historic and Projected Annual Commercial Vehicle Traffic at Detroit River Crossings

A. Ambassador Bridge



Note: Multivariate forecasts based on projections of Canadian dollar value and Canadian trade value or Canadian dollar value and U.S. GDP (see Appendix A).
Note: Half of projected Detroit-Windsor Tunnel demand shifted to Ambassador Bridge due to truck-type physical dimension restrictions.

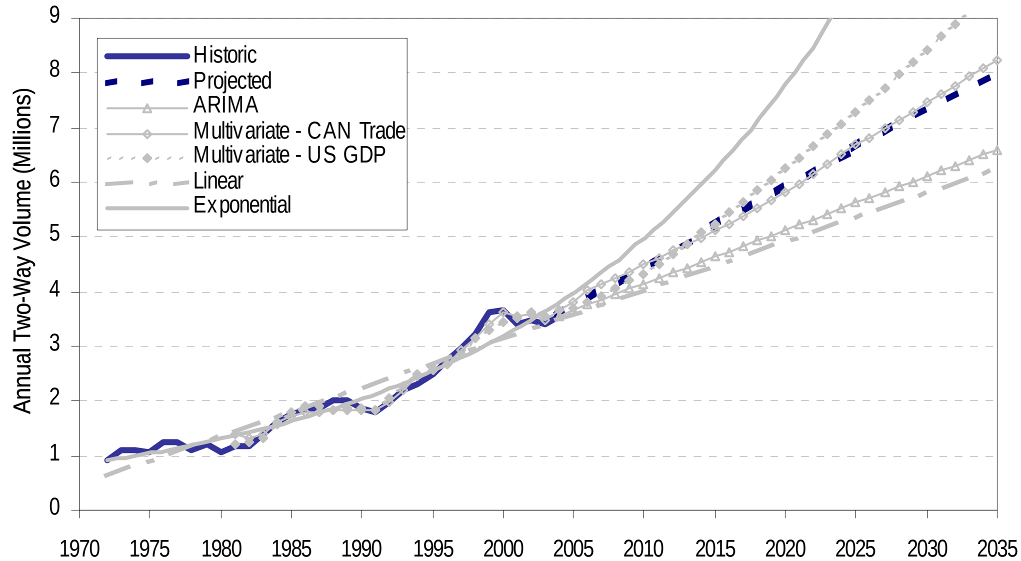
B. Detroit-Windsor Tunnel



Note: A suitable multivariate model could not be developed for the Detroit-Windsor Tunnel.
Note: Half of projected Detroit-Windsor Tunnel demand shifted to Ambassador Bridge due to truck-type physical dimension restrictions.

Exhibit 5.22 (Cont.): Historic and Projected Annual Commercial Vehicle Traffic

C. Total Detroit River Crossings



Note: Multivariate forecasts based on projections of Canadian dollar value and Canadian trade value or Canadian dollar value and US GDP (see Appendix A).

5.3 Summary of Travel Demand Base Forecast

The Base Forecast for passenger car and commercial vehicle traffic at the Detroit and St. Clair River crossings are summarised in Exhibit 5.23. In general, commercial vehicle traffic is projected to grow at substantially higher rates than passenger traffic. At the Detroit River crossings, passenger car traffic is forecast to increase from 12.0 million vehicles in 2004 to 18.7 million in 2035 (a 57% growth), while truck traffic is projected at 8.1 million vehicles in 2035 from a 2004 base of 3.5 million (a 128% growth). The overall result is a 73% increase in total road-based traffic over the study period.

Exhibit 5-23: Summary of Annual Vehicle Base Forecast by Major Crossing

Port	Vehicle Type	Volumes by Horizon Year				2004 to 2035 Growth		
		2004	2015	2025	2035	Total	%	CAGR
Ambassador Bridge	Passenger Cars	6,170,000	8,180,000	8,820,000	9,380,000	3,210,000	52%	1.4%
	Commercial Vehicles	3,370,000	4,980,000	6,400,000	7,810,000	4,440,000	132%	2.7%
	Total	9,540,000	13,170,000	15,220,000	17,190,000	7,650,000	80%	1.9%
Detroit-Windsor Tunnel	Passenger Cars	5,780,000	8,100,000	8,750,000	9,360,000	3,580,000	62%	1.6%
	Commercial Vehicles	160,000	190,000	230,000	250,000	90,000	59%	1.5%
	Total	5,940,000	8,290,000	8,980,000	9,610,000	3,670,000	62%	1.6%
Detroit River Crossings	Passenger Cars	11,950,000	16,280,000	17,570,000	18,740,000	6,790,000	57%	1.5%
	Commercial Vehicles	3,530,000	5,180,000	6,630,000	8,060,000	4,530,000	128%	2.7%
	Total	15,490,000	21,460,000	24,200,000	26,800,000	11,320,000	73%	1.8%
St. Clair River Crossing	Passenger Cars	3,760,000	5,160,000	5,550,000	5,910,000	2,150,000	57%	1.5%
	Commercial Vehicles	1,800,000	2,450,000	3,360,000	4,290,000	2,490,000	138%	2.8%
	Total	5,560,000	7,610,000	8,910,000	10,200,000	4,640,000	83%	2.0%

[1] Compound annual growth rate.
Note: Includes Windsor-Detroit/Sarnia-Port Huron crossing choice effects.

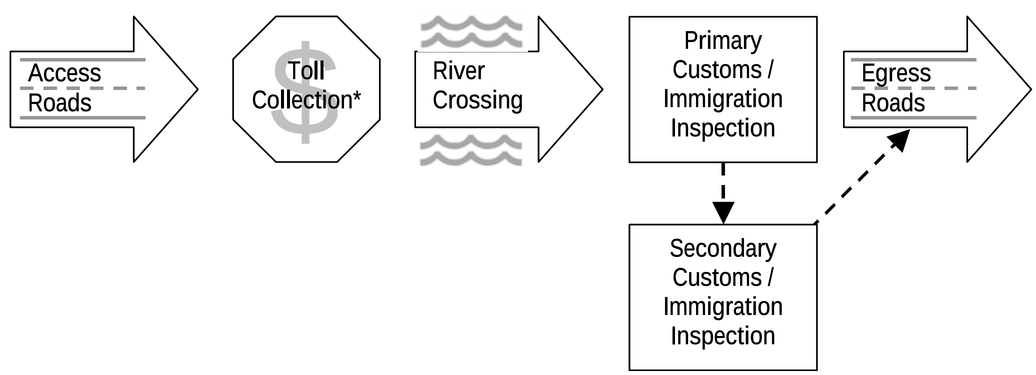
6. IMPLICATIONS OF FUTURE TRAVEL DEMAND

This chapter describes the essential components of a road-based border crossing system and then examines the existing utilisation of each component and the implications of the cross-border travel demand Base Forecast, as presented in Chapter Five. The analysis provides an indication of the future level-of-service for each border crossing system component and the timing of additional capacity needs for each component. The analysis is based on peak hour, peak direction volumes and capacities. The peak hour is defined using passenger car equivalent volumes, which represent a peak vehicle demand by combining passenger car volumes with commercial vehicle and bus volumes, with the latter expressed as an equivalent number of passenger cars. Where applicable, capacity utilisation is expressed in terms of volume-to-capacity (v/c) ratios. A sensitivity analysis is then performed by investigating the impacts of changes to the assumed behaviour of several key factors affecting cross-border travel demand. Finally, the implications of future travel demand on the choice between the Detroit River and St. Clair River crossings are discussed.

6.1 Implications on Border Crossing System Components

Road-based international border crossings must be considered as a system made up of individual components, with the movement of vehicles across the border involving a series of sequential activities related to each component of the system. As illustrated in Exhibit 6.1, the border crossing system consists of five components: access roads leading to the border crossing, toll collection, the physical crossing (i.e. bridge or tunnel), border inspection (primary and secondary) and egress roads. The border crossing capacity must consider the individual capacities of each, with the component exhibiting the lowest capacity governing the throughput capacity of the border crossing system as a whole. For example, the ultimate roadbed capacity of a bridge or tunnel will not be realised if the border processing capacity or the road access capacity is the limitation, or bottleneck, in the system. The following provides an overview of the existing and expected future conditions for each of the border crossing system components listed above.

Exhibit 6-1: Border Crossing System Components



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

6.1.1 CROSSING CAPACITY

The crossings refer to bridge/tunnel facilities across the Detroit River, as currently defined by the Ambassador Bridge and Detroit-Windsor Tunnel. The Ambassador Bridge is a four-lane facility and the dominant facility for commercial vehicle traffic. The Detroit-Windsor Tunnel is a two-lane facility, serving primarily passenger car traffic given its downtown-to-downtown connection and geometric constraints that restrict its use by most tractor-trailer commercial vehicles.

Within this study, capacity is defined as the maximum vehicle service flow rate that can be sustained by a facility and represents a severe breakdown in traffic operations. This is a very undesirable condition with long queues and delays. Although traffic volumes up to the capacity can be accommodated, it is prudent to provide a level of service that is better than that provided at capacity volumes. As such, capacity values within this study are defined as a range, with the upper limit corresponding to the maximum rate (as defined above) and the lower limit to the flow rate at which traffic operations start to become unstable due to the high number of vehicles using the facility. Given the high importance of an international crossing, the long lead time to construct/expand a crossing, large economic costs associated with unstable cross-border traffic and the range of uncertainty inherent in the forecasts (which represent the peak conditions for a typical day and not the periods of extreme traffic volume that inevitably occur from time to time), the lower limit has been identified to serve as a practical volume that should not be exceeded for an extended period of time. This suggests that, while a crossing is able to accommodate higher traffic volumes than the lower capacity limit, those within the range defined by the lower and upper limits are not desirable and a new or expanded crossing is needed before consistently high levels of congestion and unstable operations are reached.

The development of crossing capacities is documented in the ***Travel Demand Update Report*** of this study and are based on the capacity analysis undertaken in the ***Planning/Need and Feasibility (P/N&F) Study***, which used Highway Capacity Manual 2000 methods. To determine capacity needs, both passenger vehicles and commercial vehicles are expressed in passenger car equivalent (PCE) units. PCEs are a measure of total combined passenger car and commercial vehicle volumes, where commercial vehicles are expressed as a multiple of passenger cars and then added to passenger cars. A PCE factor of 3.0 for commercial vehicles on the crossings is assumed, given the predominance of multi-unit vehicles and the steep grade. These assumptions reflect the vehicle mix and high proportion of tractor-trailer combinations (i.e. greater than 90% of total commercial vehicle traffic), the long and steep grade (4.5%) and the geometric characteristics of these facilities, which include limited lateral clearance and curves in the roadbed alignment. The crossing capacity assumptions have been verified through on-site observations and have been independently reviewed by the US-based DRIC consultant.

Exhibit 6.2 presents the existing volume and capacity for each bridge/tunnel and the total for the Detroit River crossings. The roadway crossing upper limit capacities are estimated to be 1,750 PCE/h/lane for the Ambassador Bridge and 1,500 PCE/h/lane for the Detroit-Windsor Tunnel. These represent flow rates at the level-of-service E/F boundary. The lower limit capacities are estimated to be 1,450 PCE/h/lane for the Ambassador Bridge and 1,250 PCE/h/lane for the Detroit-Windsor Tunnel. These represent flow rates at the level-of-service D/E boundary that, if the facilities were being designed, would be used to represent desirable operating conditions.

Based on Fall 2004 peak hour traffic volumes, the volume-to-capacity (v/c) ratio for the Ambassador Bridge is estimated to be 0.67. The Detroit-Windsor Tunnel has a similar v/c ratio of 0.65.

Exhibit 6-2: Assessment of Existing Roadbed Capacity

Measure	Crossing		
	Ambassador Bridge	Detroit-Windsor Tunnel	Detroit River Crossings
Peak Hour Capacity (PCE/h/lane)	1,750	1,500	N/a
Number of Lanes (one-way)	2	1	3
One-Way Capacity (PCE/h)	3,500	1,500	5,000
Peak Hour Demand[1]			
Passenger Cars	1,176	931	2,106
Commercial Vehicles	390	14	404
Peak Hour Total PCE Demand[2]	2,346	973	3,319
Peak Hour & Direction Volume-to-Capacity Ratio	67%	65%	66%

[1] Represents 4 p.m. to 5 p.m. of average Thursday/Friday in September, 2004.
[2] Based on PCE factor of 3.0 for commercial vehicles.

The projected Base Forecast future year peak hour, peak direction PCE volumes and v/c ratios are presented in Exhibit 6.3. Based on these results, the year in which crossing capacity is reached is illustrated in Exhibit 6.4. The high and low forecast bounds that bracket the Base Forecast line represent the future range of uncertainty in the forecasts. This envelope was determined through an analysis of the historic variation in cross-border traffic.

The results show that the Ambassador Bridge has adequate capacity to accommodate growth in cross-border traffic until approximately the year 2020. The lower capacity limit indicates that bridge traffic operations will become unstable by approximately 2011. The Detroit-Windsor Tunnel is not expected to reach capacity until approximately 2035, with unstable traffic operations projected by approximately 2015.

Exhibit 6.4 also presents total passenger car and commercial vehicle demand and capacity at Detroit River crossings, presenting the two crossings as a combined system. Based on the combined capacity and assuming vehicle traffic will effectively distribute itself between the two crossings, the Detroit River crossings have adequate capacity to approximately 2022, with the lower capacity limit reached in approximately 2012. However, over 90% of international truck traffic is tractor-trailer combinations that cannot use the tunnel due to the physical geometry of the tunnel. As such, this is not a realistic indication of the actual timing when the crossing capacity is reached, with the Ambassador Bridge, as shown above, providing a better indicator of the timing and need for additional capacity.

The preceding assumes that passenger cars and commercial vehicles will have shared access to the four Ambassador Bridge lanes to make the most efficient use of the available crossing capacity. Exhibit 6.4D presents a truck-only lane scenario, reflecting current operations on the Ambassador Bridge but without FAST commercial vehicles being allowed use of the general purpose lanes (as is currently allowed). Under this scenario, commercial vehicle traffic operating in the truck lane will have operational issues before the general purpose lanes, with adequate truck-only lane capacity provided until approximately 2015 and unstable traffic conditions occurring around 2010.

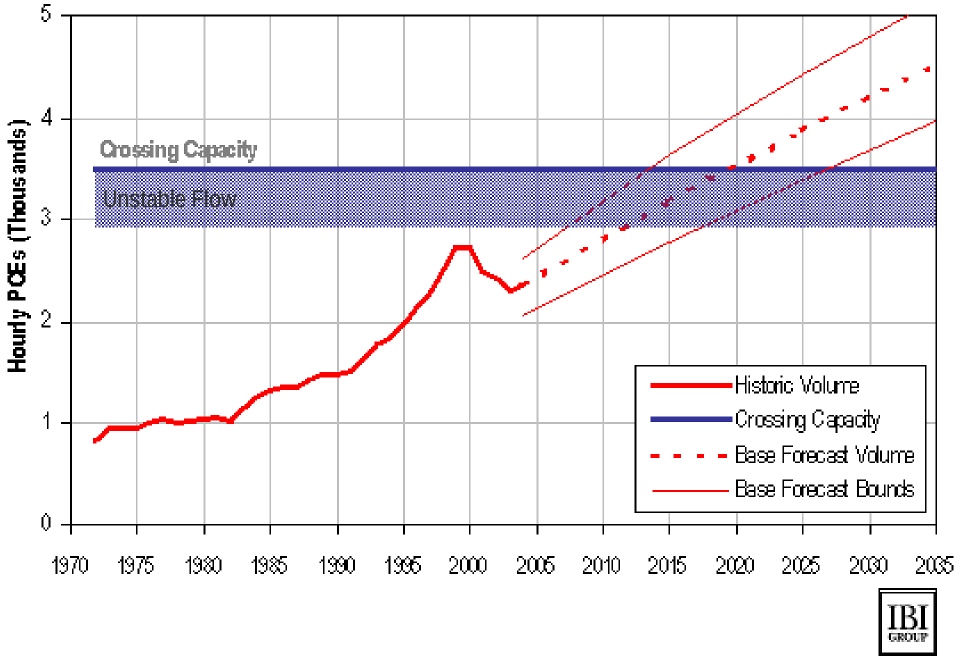
Exhibit 6-3: Existing & Base Forecast Detroit River Crossings Volumes & Capacity Utilisation

Crossing	Year	PCE Volume (1-way)		Volume / Capacity Ratio	
		AM Peak Hour	AM Peak Hour	AM Peak Hour	PM Peak Hour
Ambassador Bridge	2004	1,930	2,350	55%	67%
	2015	2,510	3,180	72%	91%
	2025	2,900	3,880	83%	111%
	2035	3,300	4,520	94%	129%
Detroit-Windsor Tunnel	2004	900	970	60%	65%
	2015	1,070	1,250	71%	84%
	2025	1,190	1,370	79%	91%
	2035	1,310	1,480	87%	99%
Detroit River Crossings	2004	2,830	3,320	57%	66%
	2015	3,580	4,440	72%	89%
	2025	4,090	5,250	82%	105%
	2035	4,610	6,000	92%	120%

Note: Morning peak direction is Canada to US, afternoon peak direction is US to Canada.

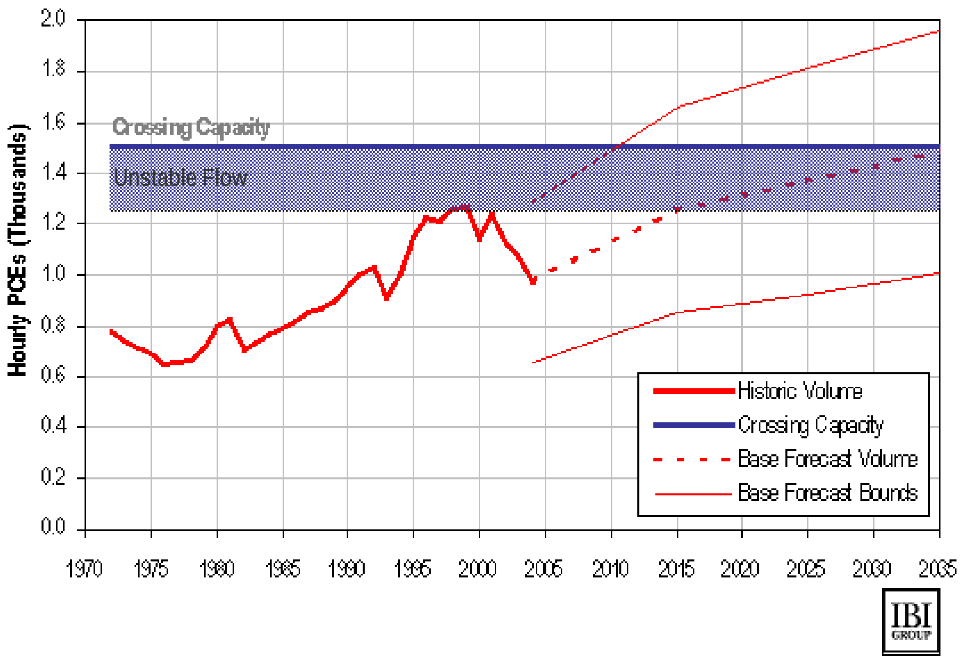
Exhibit 6-4: Base Forecast Year Detroit River Crossings Capacity Reached

A. Ambassador Bridge PCEs



Note: Peak hour is 4 to 5 p.m.; peak direction is US to Canada.
Note: Historic peak hour volume estimated from historic annual data.

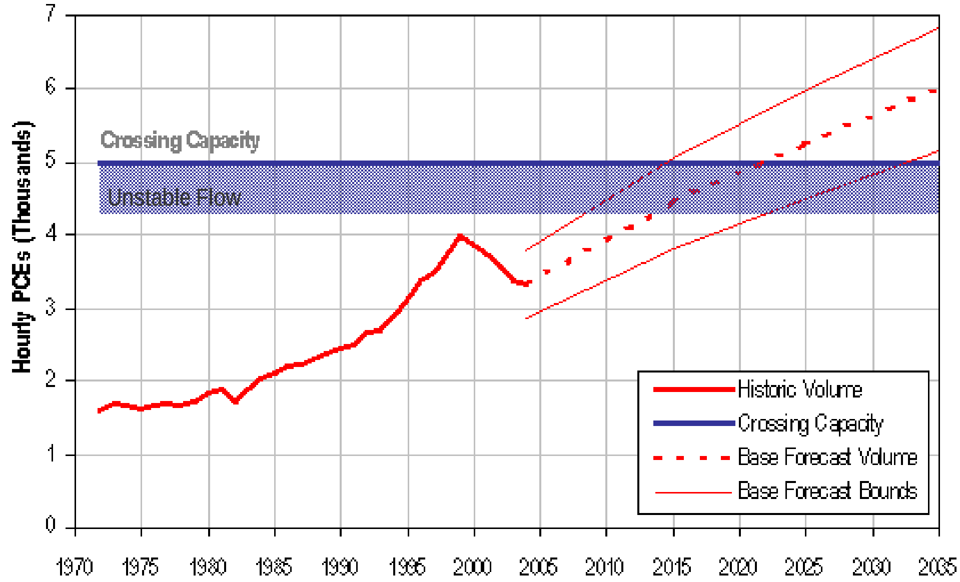
B. Detroit-Windsor Tunnel PCEs



Note: Peak hour is 4 to 5 p.m.; peak direction is US to Canada.
Note: Historic peak hour volume estimated from historic annual data.

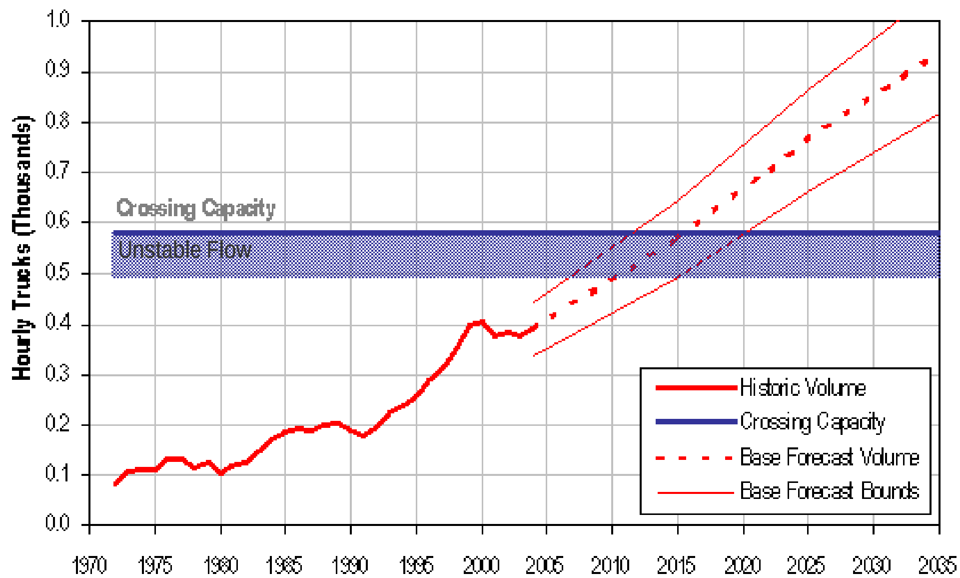
Exhibit 6.4 (Cont.): Base Forecast Year Detroit River Crossings Capacity Reached

C. Detroit River Crossings PCEs



Note: Peak hour is 4 to 5 p.m.; peak direction is US to Canada.
Note: Historic peak hour volume estimated from historic annual data.

D. Ambassador Bridge Trucks with Truck-Only Lanes



Note: Peak hour is 12 to 1 p.m.; peak direction is US to Canada.
Note: Historic peak hour volume estimated from historic annual data.

6.1.2 CANADIAN ACCESS/EGRESS ROADS

The Ambassador Bridge access/egress road analysis on the Canadian side of the border is based on a Synchro model of the seventeen intersections between Highway 401 and the Ambassador Bridge Plaza and traffic volumes from the DRIC Travel Demand Model. The Synchro model approach uses Highway Capacity Manual methods for signalized intersections, with the analysis based on the approach level-of-service in the peak traffic direction. The 2004 base year conditions and future year analyses are based on 2004 intersection counts and traffic signal timings for Huron Church Road and Highway 3/Talbot Road, as obtained from the City of Windsor and Travel Demand Model traffic estimates. This Ambassador Bridge access/egress road analysis focuses strictly on the Canadian side of the border, as the Ambassador Gateway project will address future access/egress road needs on the US side.

Exhibit 6.5 indicates the 2004, 2015 and 2025 traffic volumes on road links for Huron Church Road and Highway 3/Talbot Road from the Ambassador Bridge plaza to Highway 401 for the p.m. peak hour, peak direction (US to Canada), representing the most congested time and direction of the day. The graphs also indicate the amount of domestic and cross-border traffic and capacity for each link, expressed in PCEs. A truck PCE factor of 2.5 is used for the access/egress road analysis due to the lack of any significant grade. The capacities are consistent with current signal timings.

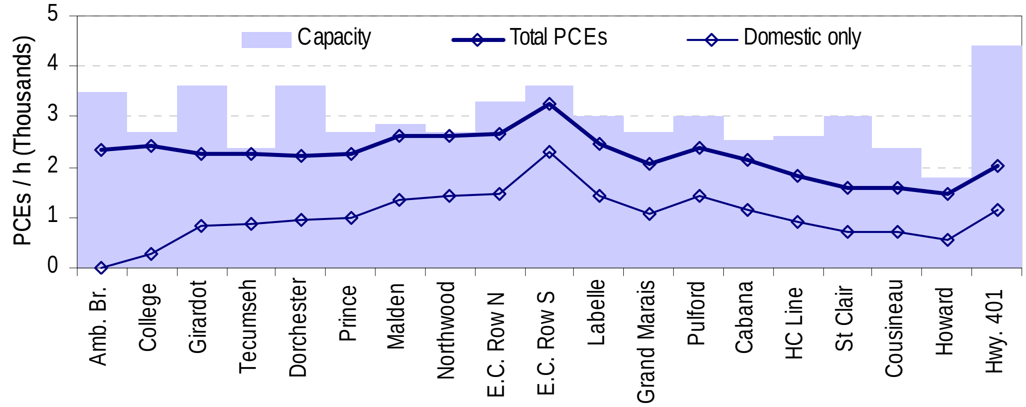
DRIC Travel Demand Model assignments provide estimates of local and international traffic levels on the road network. In the vicinity of the Ambassador Bridge (College), approximately 88% of the PCE traffic is international with approximately 65% of the international PCE traffic comprised of passenger cars. The proportion of traffic that is international reduces to approximately 40% near the E.C. Row Expressway and then increases to over 50% south of Cabana Road. The capacity shown for each link is based on the approach capacity of the upstream intersection, calculated using Synchro and reflecting the existing traffic signal timings at intersections. Given the differences in the green cycle split for the peak northbound or southbound direction (affected by the amount of green time for east-west traffic) and the characteristics of the roadway and number of lanes, there is significant variation in the capacity along the road link on Huron Church Road and Highway 3/Talbot Road.

The impacts of a.m. and p.m. peak hour traffic on the level-of-service of the section of Huron Church Road and Highway 3/Talbot Road from the Ambassador Bridge plaza to Highway 401 (which represents the primary access/egress facility on the Canadian side of the bridge) are presented in Exhibit 6.6. The exhibit summarises the analysis in tabular form with Huron Church Road/Highway 3/Talbot Road divided into two sections, north and south of the E.C. Row Expressway and illustrated for the section as a whole. The critical intersection level-of-service for each section is indicated, as overall access/egress road throughput is largely regulated by the lowest capacity intersection over the road section given the high proportion of international vehicles.

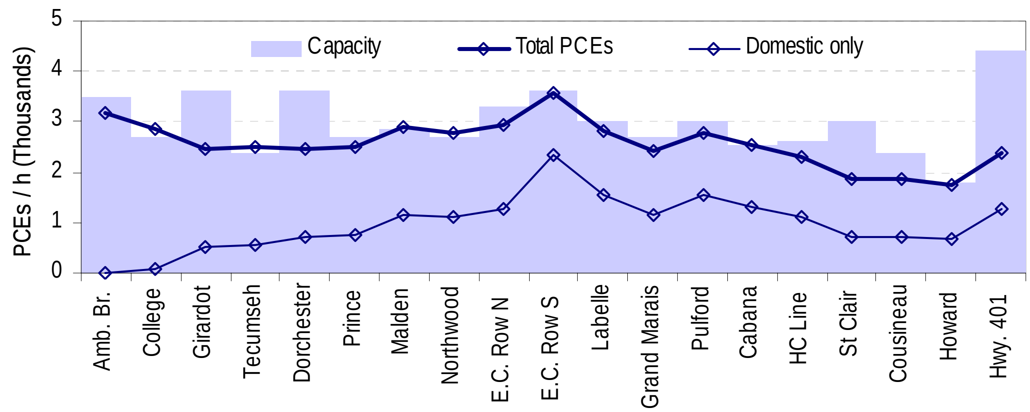
In 2004, adequate road capacity is provided between the Ambassador Bridge Plaza and Highway 401, with a sufficient level-of-service (E) provided in the p.m. peak hour. This is also verified by observations of current traffic conditions, with queuing of commercial vehicles on Huron Church Road no longer a problem since additional US border processing capacity was provided in June 2004.

Exhibit 6-5: Existing and Projected Volume & Capacity on Huron Church Road and Highway 3/Talbot Road, PM Peak Hour

A. 2004



B. 2015



C. 2025

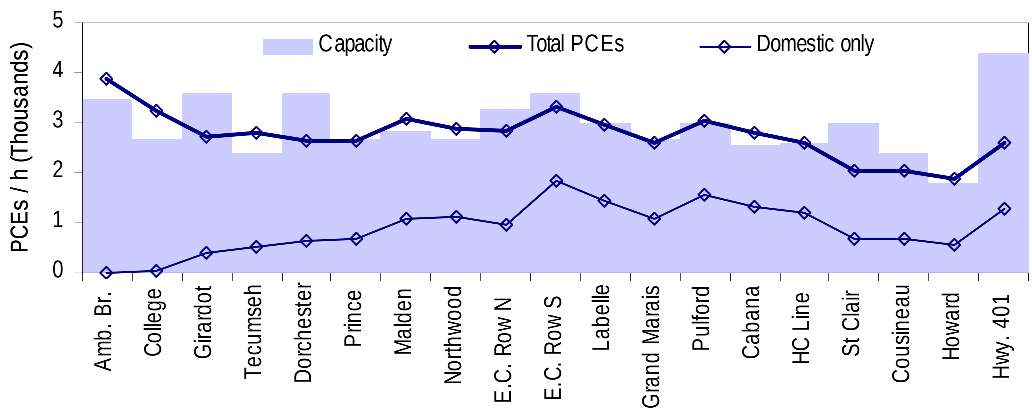
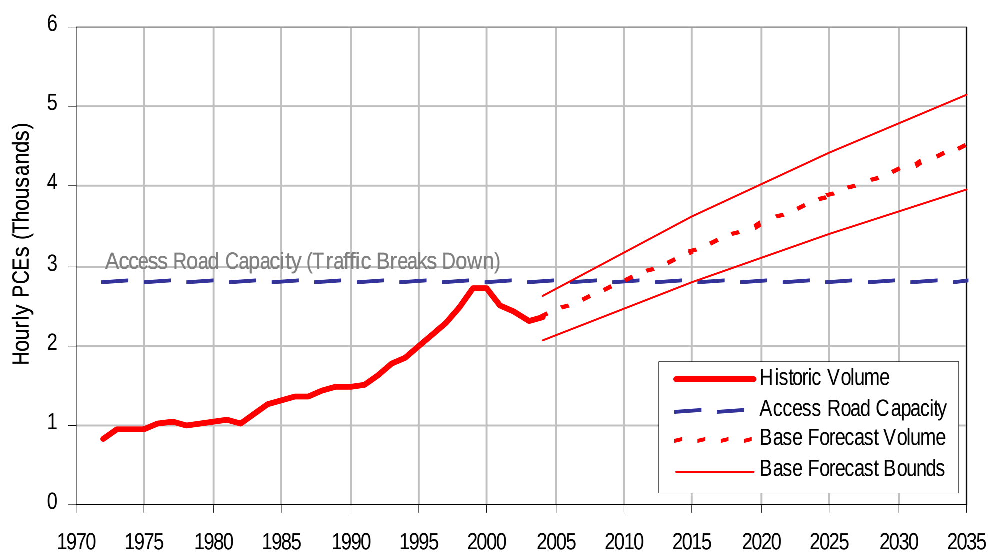


Exhibit 6-6: Existing & Projected Level-of-Service on Huron Church Road & Highway 3/Talbot Road

A. Level-of-Service

Year	Road Section of	Time Period and Direction			
		AM Peak Hour		PM Peak Hour	
		Northbound	Southbound	Northbound	Southbound
2004	Ambassador Bridge to EC Row Expressway	A – C	A – C	A – C	E
	EC Row to Highway 401	D	A – C	E	E
2015	Ambassador Bridge to EC Row Expressway	D	A – C	A – C	F
	EC Row to Highway 401	E	A – C	F	F
2025	Ambassador Bridge to EC Row Expressway	F	E	E	F
	EC Row to Highway 401	F	D	F	F
2035	Ambassador Bridge to EC Row Expressway	F	F	F	F
	EC Row to Highway 401	F	E	F	F

B. Year Road Capacity Reached



Note: Historic volumes are those on bridge facility, representing traffic on access roads approaching bridge.

By 2015, traffic volumes are projected to be at or above the road capacity for many sections of this corridor, operating at level-of-service F in the p.m. peak hour. By 2025, the majority of sections are projected to be over capacity and operating at level-of-service F in both the a.m. and p.m. peak hours. Taking the access/egress road system as a whole, it is projected that capacity will be reached (i.e. level-of-service F), by approximately 2010, although localised intersection improvements at critical locations could potentially extend the timeframe before capacity reached by several years.

Access roads leading to the Detroit-Windsor Tunnel are near capacity during peak hour traffic conditions on the Canadian side of the border based on 2004 traffic counts, with the level-of-service at intersections impacted by the high volumes of local traffic travelling through downtown Windsor. In Detroit, operations are generally congested on Jefferson Avenue near the Detroit-Windsor Tunnel entrance, with Detroit Police managing traffic during daily periods of high demand and the many public events that occur in this area. The potential for significant capacity improvements is limited due to the locations of the access roads within the built-up downtown area, which make road widening or grade separation for cross-border traffic impractical.

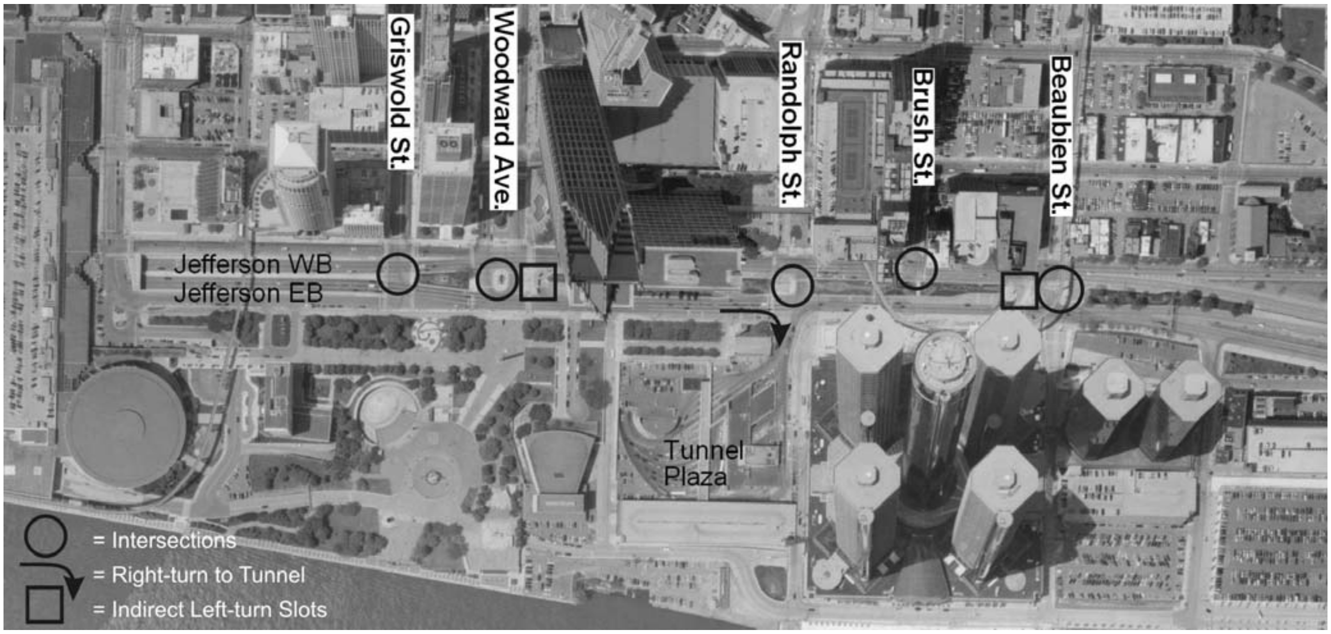
6.1.3 US ACCESS/EGRESS ROADS

The Ambassador Bridge access/egress road conditions on the US side of the border are addressed by the Ambassador Bridge Gateway Project. The project is currently under construction, and will address future access/egress road needs on the US side. The Project will provide acceptable freeway operations through 2035 according to MDOT, as documented in the 1999 Final Traffic Report Supplement and the 2003 Ambassador Bridge/Gateway Project Reassessment Final Traffic Technical Report. Therefore, no further analysis has been conducted regarding access/egress conditions on the US side of the Ambassador Bridge.

The Detroit-Windsor Tunnel access/egress road analysis on the US side of the border was performed by The Corradino Group and is based on a set of Synchro/CORSIM models for five intersections adjacent to and connecting the Detroit-Windsor Tunnel with Jefferson Avenue in downtown Detroit. As depicted in Exhibit 6.7, the M-10 Lodge freeway ends on the west side of the Jefferson Avenue at the intersection of Griswold Avenue. The I-375 freeway ends on the east end of the network at the Beaubien Avenue Intersection with Jefferson Avenue. The Detroit-Windsor Tunnel is connected at Randolph Street. The signal at Randolph, Jefferson and the Detroit-Windsor Tunnel operates in a simple two-phase manner.

The 2004 base year conditions and future year analysis are derived from November 1999 traffic counts collected from the I-375 East Riverfront Area Access Improvement Project Traffic Report. These counts were extrapolated to 2004, and adjusted using 2004 traffic count data at the Detroit-Windsor Tunnel. Local traffic growth is 1.6 percent per year based on I-375 traffic analysis. Traffic signal timings in the study area intersections were field measured. Signal timings were optimized for future year analyses but optimization provided little benefit to traffic operations, confirming that signal optimization would not eliminate congested conditions at the Detroit-Windsor Tunnel. The allocation of green time on Jefferson is constrained by the boulevard configuration, conflicts with heavy volumes at the indirect left-turn locations, and potential conflicts with pedestrians.

Exhibit 6-7: Detroit-Windsor Tunnel Traffic Analysis Study Area



The data in Exhibit 6.8 indicate the impact of afternoon peak hour traffic on the level-of-service, delay, and V/C ratios for 2004, 2010 and 2015. Target years of 2010 and 2015 were chosen to assess conditions in five-year increments. Directional traffic conditions resulting in the most congestion occurs for US to Canada traffic during the p.m. peak hour.

In the base year (2004), unstable road capacity is evident at the entrance of the Detroit-Windsor Tunnel, with a level-of-service E in the p.m. peak hour, as verified by field observations of current traffic conditions. Detroit Police personnel manage traffic operations at the Detroit-Windsor Tunnel's entrance during recurring periods of high traffic congestion, which typically occur on Thursday and Friday afternoons. Even with managed traffic operations, traffic will frequently back up onto the Lodge freeway under Cobo Hall, and onto I-375.

By 2010, Detroit-Windsor Tunnel access roads are projected to exceed available capacity (level-of-service F) for traffic seeking to make a right turn from eastbound Jefferson to the Detroit-Windsor Tunnel and for through movement from Randolph Street southbound into the Detroit-Windsor Tunnel entrance. The indirect left turn on westbound Jefferson Avenue prior to Woodward Avenue is also forecast to operate at a level-of-service F, due to the backups from the right-turn lane from Jefferson eastbound to the Detroit-Windsor Tunnel entrance. These indirect left-turn movements are primarily destined for the Detroit-Windsor Tunnel.

Exhibit 6-8: Traffic Analysis of US Roadway Intersections Serving the Detroit-Windsor Tunnel (PM Peak Hour)

A. Level-of-Service[1]

Jefferson Avenue Intersection	Performance Measure and Direction					
	2004		2010		2015	
	Eastbound	Westbound	Eastbound	Westbound	Eastbound	Westbound
At Griswold	B	B	B	C	B	C
At Woodward	B	B	B	D	B	F
At Randolph	C	B	E	D	F	E
To Tunnel[2]	E	B	F	F	F	F
At Brush	-	A	-	A	-	C
At Beaubien	C	B	C	B	C	C
Westbound prior to Woodward[1]	-	C	-	F	-	F
Eastbound prior to Beaubien[1]	C	-	C	-	F	-

B. Delay (seconds)

Jefferson Avenue Intersection	Performance Measure and Direction					
	2004		2010		2015	
	Eastbound	Westbound	Eastbound	Westbound	Eastbound	Westbound
At Griswold	11.0	18.5	10.4	25.2	11.7	29.1
At Woodward	14.1	19.2	15.2	48.2	18.8	89.1
At Randolph	27.9	12.1	76.5	35.2	87.6	61.1
To Tunnel[2]	64.0	16.1	208.7	114.7	228.5	144.8
At Brush	-	8.1	-	6.9	-	29.5
At Beaubien	20.5	15.2	21.4	15.6	30.8	25.9
Westbound prior to Woodward[1]	-	23.8	-	372.3	-	487.9
Eastbound prior to Beaubien[1]	16.3	-	17.0	-	51.0	-

C. Volume to Capacity (V/C) Ratio

Jefferson Avenue Intersection	Performance Measure and Direction					
	2004		2010		2015	
	Eastbound	Westbound	Eastbound	Westbound	Eastbound	Westbound
At Griswold	0.52	0.96	0.58	1.05	0.62	1.12
At Woodward	0.57	0.66	0.63	0.73	0.67	0.77
At Randolph	0.67	0.77	0.74	0.85	0.79	0.90
To Tunnel[2]	0.31	0.64	0.42	0.71	0.49	0.76
At Brush	-	0.60	-	0.66	-	0.70
At Beaubien	0.80	0.78	0.89	0.79	0.95	0.83
Westbound prior to Woodward[1]	-	0.43	-	0.52	-	0.57
Eastbound prior to Beaubien[1]	0.15	-	0.19	-	0.21	-

[1] Unsignalized Intersections. Indirect left-turn slots to accommodate tunnel traffic.
[2] Jefferson eastbound traffic makes right-turn to the Detroit-Windsor Tunnel. Westbound traffic moves through the intersection to access the Detroit-Windsor Tunnel. Performance measures are for these specific movements only.
Source: The Corradino Group of Michigan, Inc.

By 2015, the eastbound movement on Jefferson Avenue at Randolph Street and the westbound movement on Jefferson Avenue at Woodward Avenue will fail to operate at an acceptable level-of-service. The eastbound indirect left-turn lane at Beaubien (unsignalised) is also expected to fail to operate efficiently because of the downstream queuing and congestion on the westbound side of Jefferson Avenue.

The capacity and operational issues of the access road into the Detroit-Windsor Tunnel are significantly influenced by the geometric configuration of the Detroit-Windsor Tunnel entrance. Through traffic, moving from southbound Randolph Street to the Detroit-Windsor Tunnel, is limited to vehicles enrolled in the NEXUS program. This traffic is provided an exclusive lane through the plaza entrance and exclusive use of a tollbooth. The roadway immediately downstream from this movement narrows to the equivalent of 1½ lanes due to the exclusive NEXUS lane. This causes frequent backups onto Jefferson Avenue. Queues and delays downstream are not affected by the signal timing at Jefferson Avenue and the Detroit-Windsor Tunnel entrance. Limited sight distance and manoeuvring space at the tollbooths exacerbate these delays.

The existing tollbooths on the US side of the Detroit-Windsor Tunnel further limit capacity. During peak-hour traffic conditions, non-NEXUS vehicles are limited to four tollbooths that are unable to process the traffic at a rate that prevents significant queuing. The storage for traffic at the Detroit-Windsor Tunnel entrance is very limited and quickly causes the backup to spill over onto Jefferson Avenue. The US Customs plaza for inbound traffic, the historic Mariner's Church, the Duty Free shop, and the roadway configuration that eventually narrows to one lane as it enters the Detroit-Windsor Tunnel limit possible expansion of the number of tollbooths.

6.1.4 BORDER PROCESSING

Border processing includes customs and immigration inspection on entry to Canada and the US and is performed by Canada Border Services Agency (CBSA)[2] and US Department of Homeland Security (DHS), Customs and Border Protection (CBP)[3], respectively. Upon entry to the country, vehicles are required to stop at primary inspection where an officer performs checks on the vehicle, driver and passengers. Individuals requiring further questioning or carrying goods requiring further inspection are directed to secondary inspection. Discussions were held with CBSA and DHS to determine appropriate border processing assumptions for this study, as described below. The processing times presented represent current average processing times and do not reflect new initiatives/technologies that may result in reductions or increases in these times. Among current initiatives, the US Department of Homeland Security and the Government of Canada have called for border operators to improve processing time for cars and trucks by 25 percent by the end of 2005.

[2] CBSA was created on December 12, 2003, with certain functions of Canada Customs and Revenue Agency (CCRA), Citizenship and Immigration Canada (CIC) and Canadian Food Inspection Agency (CFIA) transferred to the new agency.
[3] CBP is a newly formed agency within the DHS with a primary responsibility to secure the US border from terrorist activities. It is also responsible for border processing and inspection activities.

6.1.4.1 Primary Inspection

The capacity of primary inspection is a function of the number of primary inspection lanes and the processing time per vehicle. There is a high degree of variability in processing times depending on the circumstances of the driver and/or passenger(s) and the nature of the contents of the goods within the vehicle. The existing number of primary inspection lanes at the Detroit River crossings is shown in Exhibit 6.9 for travel to Canada and to the US. The existing number of primary inspection lanes includes the recent expansion in border processing capacity and increased staffing by both Canada and the US to address significant queuing and delays at the Detroit River crossings. At present, queuing delays are minimal.

Exhibit 6-9: Number of Primary Inspection Lanes

Facility	To Canada		To US	
	Autos	Trucks	Autos	Trucks
Ambassador Bridge	10 / 16 [1]	10 / 13 / 19 [2]	12	13 [3]
Detroit-Windsor Tunnel	9	3	9	3

[1] The regular number of auto lanes is ten. When required in special circumstances, six truck lanes can be converted to auto lanes for a total of sixteen lanes.
[2] Three new lanes are to be opened in July, 2005. Six additional lanes are to be added in the next two to three years.
[3] 13 lanes are open for primary inspection. A 14th lane is used for trucks exiting from secondary inspection.

Exhibit 6.10 presents the estimated processing time per passenger car and per commercial vehicle at primary inspection. NEXUS is a joint US/Canada program for passenger car travel designed to simplify border crossing for frequent low-risk travellers. Participants in the NEXUS program are not regularly subjected to the usual customs and immigration questioning, with a pass based on proximity card technology providing information and photo identification to the inspection officer. The officer verifies the photo and the driver and provides approval to proceed. There is a fee for NEXUS users ($80 Canadian, $50 US per applicant). The average processing time for a passenger car is 15 seconds and approximately 25% of passenger cars travelling during peak periods are enrolled in the NEXUS program. Regular or non-NEXUS travellers undergo questioning by border inspection officers with the average processing time per vehicle estimated at 35 seconds per vehicle for travel to Canada and 40 seconds to the US. The weighted average processing time is therefore estimated to be 30 seconds per vehicle to Canada and 34 seconds to the US. CBSA and CBP consider the existing NEXUS participation rates and overall processing rates to be appropriate in future years, given that NEXUS enrolment has reached a mature state and with dedicated lanes and/or other incentives required to increase participation over current levels.

Commercial vehicle processing times at primary inspection depend on the line release program. Most commercial operators presently use the Pre-Arrival Review System (PARS), which allows pre-approved shippers/carriers to transmit documents to customs in advance of arrival at the border to expedite border processing. This information is displayed to the border inspection officer in the primary inspection lane booth. The recent US Trade Act (2005) now requires all commercial vehicles entering the US to transmit documentation electronically at least one hour in advance of crossing. For travel to Canada, non-PARS commercial vehicles will also be phased out in the near term with the introduction of the Advanced Commercial Information program. The elimination of non-PARS traffic will reduce the number of vehicles referred to secondary inspection given that all documentation will be electronically transmitted resulting in a higher proportion of the inspections occurring strictly at primary inspection. The processing time for PARS commercial vehicles entering Canada is 85 seconds on average and two to three minutes entering the US.

Exhibit 6-10: Primary Inspection Processing Times

A. Autos Passenger Cars

Factor	Type / Country	Year	
		2004	Future
Distribution – Peak Period (Daily)	NEXUS	25% (12%)	25% (12%)
	Regular	75% (88%)	75% (88%)
Processing Times (sec/veh)	NEXUS	15	15
	Regular – To Canada	35	35
	Regular – To US	40	40
Average Time – Peak Period	To Canada	30.0	30.0
	To US	33.8	33.8

B. Commercial Vehicles

Factor	Line Release / Country	Year	
		2004	Future
Distribution by Line Release Program	Non-PARS – to Canada	22%	0%
	Non-PARS – to US	22%	0%
	PARS/ACI – to Canada	66%	85%
	PARS – to US	66%	75%
	FAST – to Canada	12%	15%
	FAST/PAPS – to US	12%	25%
Processing Times (sec/veh)	Non-PARS – to Canada	120	n/a
	Non-PARS – to US	120 – 180	n/a
	PARS – to Canada	85	85
	PARS – to US	120 – 180	120 – 180
	FAST – to Canada	30	30
	FAST/PAPS – to US	80	80
Weighted Average Processing Time (sec/veh)	To Canada	78.4	76.8
	To US	141.6	132.5

Source: Discussions with CBP and CBSA

The Fast and Secure Trade (FAST) program is the commercial vehicle equivalent of NEXUS and provides expedited processing for low-risk pre-approved carriers. FAST participants must be enrolled in the Customs-Trade Partnership Against Terrorism (C-TPAT) or Canada's Partners in Protection (PIP). The processing time for FAST commercial vehicles entering Canada is estimated to be approximately 30 seconds. For commercial vehicles travelling to the US, expedited processing is provided to FAST vehicles and also those enrolled in the Pre-Arrival Processing System (PAPS) program, which uses barcode technology for the release of commercial shipments. The average processing time for FAST/PAPS eligible commercial vehicles entering the US is 80 seconds.

Given the projected demand and the processing times per vehicle, Exhibit 6.11 presents the existing and projected required future number of passenger car and commercial vehicle primary inspection lanes for the Detroit River crossings. The peak design hour differs given the temporal patterns of car and truck travel. For passenger cars, the peak hour is based on weekday p.m. peak conditions for travel to Canada and on weekday a.m. peak conditions for travel to the US. For truck travel, the peak hour occurs during the mid-day. For passenger car traffic, the existing/planned number of primary inspection lanes is considered sufficient to accommodate future cross-border travel demands in the near term, with capacity increases needed by 2015. Projected commercial vehicle growth will result in the need for additional capacity at primary inspection by 2035 for travel to Canada and before 2015 for travel to the US.

Exhibit 6-11: Projected Required Number of Primary Inspection Lanes

Crossing	Lane Type	Number of Lanes		Peak Hour Demand (veh/h)				Required Number of Lanes			
		Existing	Planned	2004	2015	2025	2035	2004	2015	2025	2035
Ambassador Bridge	Auto to Canada	10	10	1,180	1,470	1,590	1,700	10	13	14	15
	Auto to US	12	12	1,140	1,340	1,470	1,600	11	13	14	15
	Trucks to Canada	10	19	400	580	780	960	9	13	17	21
	Trucks to US	13	13	300	440	540	640	10	17	20	24
Detroit-Windsor Tunnel	Auto to Canada	9	9	930	1,200	1,300	1,390	8	11	11	12
	Auto to US	9	9	850	1,000	1,100	1,190	8	10	11	12
	Trucks to Canada	3	3	30	50	70	80	1	2	2	2
	Trucks to US	3	3	30	40	50	60	1	2	2	3
Total Detroit River Crossings	Auto to Canada	19	19	2,110	2,670	2,890	3,090	18	23	25	26
	Auto to US	21	21	1,980	2,340	2,570	2,790	19	22	25	27
	Trucks to Canada	13	22	430	630	850	1,050	10	14	19	23
	Trucks to US	16	16	330	480	590	700	11	18	22	26

Given the above, the improvements required for primary inspection at the Detroit River crossings to meet the projected 2035 demand are as follows, based on existing productivity levels:

- Seven additional auto and one additional commercial vehicle lanes for vehicles entering Canada; and
- Six additional auto and ten additional commercial vehicle lanes for vehicles entering the US.

As noted previously, these primary inspection needs would need to be adjusted for new initiatives/requirements that may be implemented in the future.

6.1.4.2 Secondary Inspection

A proportion of vehicles at primary inspection are referred to secondary inspection for further questioning and inspection. Exhibit 6.12 shows these proportions for travel to Canada and the US, respectively, existing secondary inspection capacity and the average inspection for vehicles referred to secondary inspection.

Based on the secondary inspection referral rates, inspection times and the projected passenger car and commercial vehicle travel demands, Exhibit 6.13 presents the existing and future capacity needs. Given the direction to pre-clearance and automated commercial inspection, the proportion of commercial vehicles referred to secondary inspection is expected to decrease in the future, thereby reducing secondary inspection capacity needs. As such, existing capacity at secondary inspection is considered adequate to accommodate the long-term capacity needs. However, the existing off-site Canadian secondary inspection location for commercial vehicles is not considered an acceptable long-term solution by CBSA, given the unsecured route between the bridge plaza and secondary inspection.

Exhibit 6-12: Secondary Inspection Capacity & Processing Times

Description	Year / Crossing	To Canada		To US	
		Autos	Trucks	Autos	Trucks
Proportion Referred to Secondary Inspection	2004	3% – 5%	20%	6%	30%
	Future	6%	10%	6%	10%
Secondary Inspection Lot Capacity	Ambassador Bridge	60	290 [1]	20	88 [3]
	Detroit-Windsor Tunnel	26	18 [2]	23	0 [3]
	Total Detroit River Crossings	86	308	43	88
Inspection Time (minutes)		9	90	10 – 15	45

Source: Discussions with CBSA and CBP
[1] Capacity at offsite facility; three buses and two trucks can also be accommodated on-site at the plaza.
[2] Fourteen trucks offsite, four trucks on-site.
[3] Use of Fort Street Facility.

Exhibit 6-13: Secondary Inspection Capacity Requirements

Lane Type	Existing Capacity	Required Capacity [1]			
		2004	2015	2025	2035
Auto to Canada	86	15	29	31	33
Auto to US	43	30	35	38	42
Trucks to Canada [2]	308	156	114	153	188
Trucks to US	88	59	43	53	63

[1] Includes a 20% contingency.
[2] The exiting Canadian secondary commercial vehicle location is not considered an acceptable long term solution by CBSA due to security issues with the present off-site location.

6.1.5 TOLL COLLECTION

The capacity of the toll collection component is a function of the number of toll collection lanes/booths and the time that is required to process each vehicle. Manual collection (e.g. cash, commuter cards) and electronic toll collection utilising transponders is provided in both directions at the Detroit River crossings. At present, toll collection facilities are able to accommodate peak hour demands and are not a bottleneck in the border crossing system.

Toll collection is the responsibility of the bridge/tunnel operator and it is in the operator's best interest to provide adequate capacity. Given the efficiencies of electronic toll collection and the relatively low cost to increase capacity, it is assumed that toll collection will not be a future constraint to border crossing 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. As such, future toll collection needs are not addressed in this report.

6.1.6 SUMMARY

Exhibit 6.14 summarises the capacity needs of the Detroit River crossings based on the above findings.

Exhibit 6-14: Summary of Future Detroit River Crossings Capacity Needs

Crossing	Time Capacity Reached				
	US Road Access	US Border Processing	Bridge / Tunnel Roadbed[1]	Canadian Border Processing	Canadian Road Access
Ambassador Bridge	Beyond 30 years	5 to 10 years	10 to 15 years	5 to 10 years	5 to 10 years
Detroit-Windsor Tunnel	0 to 5 years	5 to 10 years	30 years[1]	5 to 10 years	5 to 10 years

[1] If no improvements are made at the Detroit River, there would be some diversion from the Ambassador Bridge to the Detroit-Windsor Tunnel. Diversion of car traffic may move the timeframe that capacity is reached to between 25 and 30 years. Physical restrictions of the Tunnel limit the diversion of most types of trucks.

6.2 Sensitivity Analysis

The Base Forecast 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 Forecast to some key factors that could strongly affect international traffic and, consequently, future capacity needs at the Detroit River crossings, which are being driven mainly by increases in commercial vehicle demands.

Five sensitivity analyses are performed to examine the impacts on future capacity needs at Windsor-Detroit, based on the following scenarios:

1. **High and Low Trade Growth Scenarios –** These 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 Forecast commodity trade projections are described in Section 5.2.2.

2. **Intermodal Rail Diversion Scenario** – This examines the possible impact of alternatives that could divert demand from over-capacity road-based crossings, as described in the previous sections of this chapter, to other modes where there is excess capacity available. This would involve fundamental changes in the transportation characteristics and behaviour currently exhibited by the passenger car and commercial vehicle users of the Detroit River border crossing facilities. This consists of 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. 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% and 95% for autos and commercial vehicles, respectively), only traffic using the Ambassador Bridge is considered.

3. **High Diversion to St. Clair River Crossing Scenario** – This examines the impact of the disappearance of the currently observed bias towards the Detroit River crossings over the St. Clair River crossing in future years, given public awareness of the true travel time characteristics for routings through Sarnia-Port Huron, improved amenities at Sarnia-Port Huron, etc. This test is accomplished by setting the bias constants of the two logit crossing choice models to zero.

4. **High and Low Passenger Car Demand Forecast Scenarios –** Given the extreme volatility of recent passenger car volumes, this tests the Base Forecast assumption that one-half of the same-day discretionary/recreation traffic lost between 2000 and 2004 returns by 2015.

5. **Extreme Scenarios –** The above sensitivity test scenarios are combined to show the potential cumulative effects of unexpected behaviour that could bring forward or delay the year in which capacity at the crossings is reached, characterising the most extreme scenarios.

As the Ambassador Bridge carries the vast majority of cross-border commercial vehicle traffic in the Windsor-Detroit area, the Trade Growth and Intermodal Rail Diversion

Scenarios are essentially tests of the sensitivity of commercial vehicles on this facility. The following analysis is based on the Ambassador Bridge, which dictates the capacity needs of the study area.

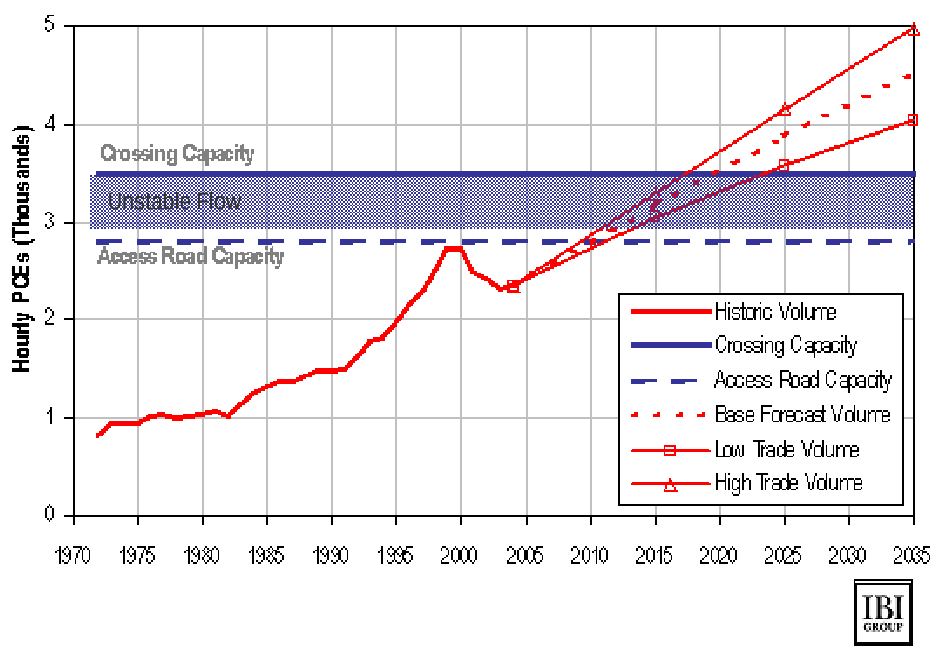
6.2.1 TRADE GROWTH SCENARIOS

The Base Forecast trade projections are based on economic forecasts prepared for Government of Canada by Informetrica Limited. 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 integration of the economies of the world. Two alternative scenarios were developed:

- **Low Trade Growth** – A 20% reduction in the growth rates across the entire study period; and
- **High Trade Growth** – A 20% increase in the growth rates across the entire study period.

Exhibit 6.15 shows the impact of low and high trade forecasts on future traffic (in peak hour PCEs) at the Ambassador Bridge. For the Low Trade Growth Scenario, the associated reduction in commercial vehicle traffic will defer the time when the roadbed capacity of the crossings is reached by approximately four years compared to the Base Forecast, with the need for a new crossing arising about 2024. For the High Trade Growth Scenario, the time when capacity is reached is moved forward by approximately three years to about 2017.

Exhibit 6-15: Trade Growth Scenarios Forecast Year Ambassador Bridge Capacity Reached



Note: Peak hour is 4 to 5 p.m.; peak direction is US to Canada.
Note: Historic peak hour volume estimated from historic annual data.

6.2.2 INTERMODAL RAIL DIVERSION SCENARIO

As discussed in Section 3.5.1, the recent emergence of intermodal rail has resulted in some diversion of commercial vehicle traffic to rail. As this phenomenon could have significant implications for future road-based traffic, the sensitivity of the Base Forecast to the assumption of the constant rail mode share is tested.

After a minimum travel distance, intermodal rail is a less expensive mode of travel relative to truck. In addition to this minimum distance, the use of intermodal rail is limited by such factors as travel speed, the nature of the goods being transported, the extent of railway infrastructure and the presence of intermodal terminal facilities (in general, the freight must still travel to and/or from the rail line by truck, so it must be transferred). As such, there is an upper limit to the proportion of total freight that can be transported by intermodal rail in the study area. This proportion is termed the “in-scope” traffic.

In-scope traffic is the commercial vehicle market that could realistically be diverted to intermodal rail. It is defined based on the travel distance and the locations of intermodal facilities throughout the study area. For this study, it represents freight travelling between at least the western border of the Greater Toronto Area on the Canadian side and at least Detroit and major rail corridors beyond Detroit connecting to primary market nodes on the US side. Freight traffic with an origin and/or destination between these points is not in-scope. The commercial vehicle traffic considered in-scope and potentially divertible to rail represents approximately 44% of the current total truck volumes on the Ambassador Bridge.

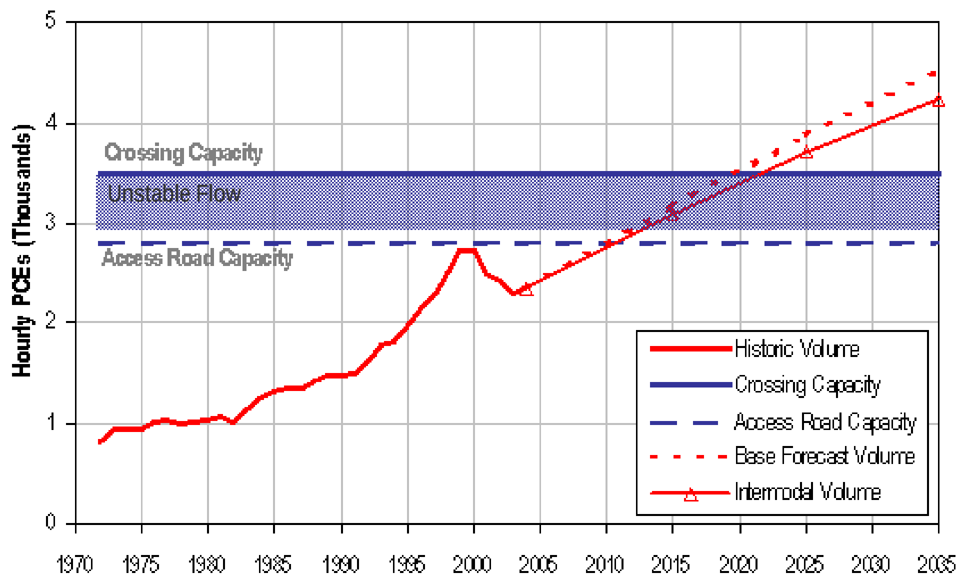
One scenario involving diversion to intermodal rail was examined, consisting of a 10% diversion of in-scope commercial vehicles to intermodal rail in 2015, increasing to 15% in 2025 and 20% in 2035 for in-scope trips. A 20% diversion of 2035 commercial vehicle volumes represents approximately 120% of the existing intermodal rail traffic in the study area. For this level of diversion to occur, significant investment in infrastructure and technology will be required over and above the 120% growth in rail capacity assumed in the Base Forecast, with changes in the current goods movement trends and patterns to which shippers are accustomed. As previously indicated, some investment and change in shipping patterns is underway, but there is large uncertainty as to the amount of commercial vehicle traffic that could be diverted to intermodal rail. The potential is also brought into question given the recent cancellation of the CP Xpressway intermodal rail service in 2004.

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.

The net impact of diversion to intermodal rail is a 4.3% reduction in truck trips at the Ambassador Bridge in 2015, increasing to 8.3% by 2035. The diversion impacts on Ambassador Bridge traffic in the later years of the study period are not quite double due to the reduction in local traffic congestion and, consequently, travel time, which results in a reduced amount of traffic diverted to the Blue Water Bridge.

Exhibit 6.16 illustrates the impacts of intermodal rail diversion on the Ambassador Bridge. The effect is to postpone capacity shortfalls by about two years. The diversion of goods from commercial vehicles to intermodal rail shifts about 10.5 million tonnes to the total weight carried by rail across the border in 2035. This results in a 175% increase in demand on rail facilities, relative to the 120% increase in the Base Forecast.

Exhibit 6-16: Intermodal Rail Diversion Scenario Forecast Year Ambassador Bridge Crossing Capacity Reached



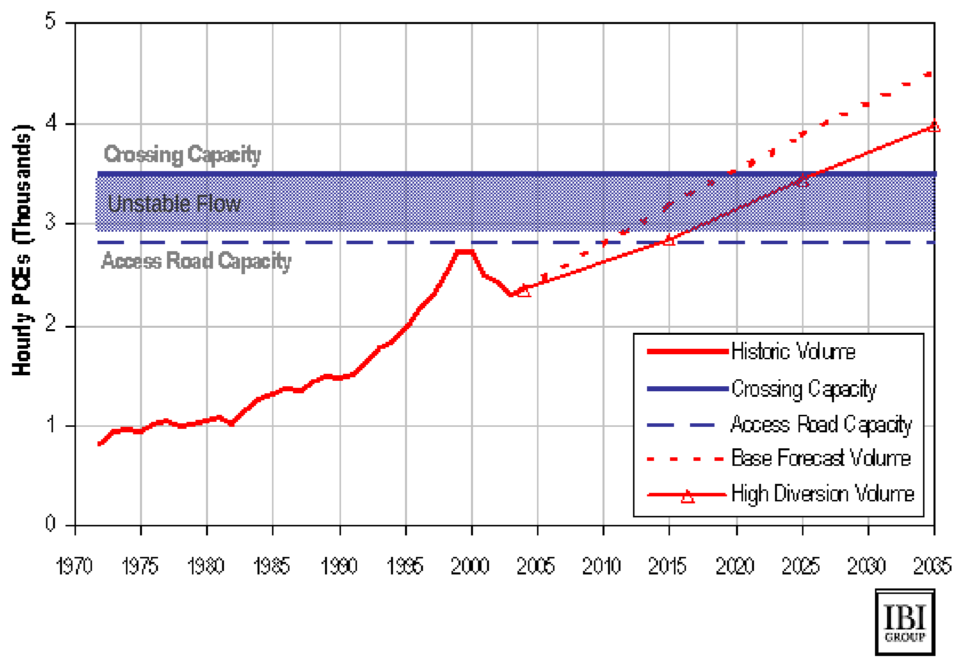
Note: Peak hour is 4 to 5 p.m.; peak direction is US to Canada.
Note: Historic peak hour volume estimated from historic annual data.

6.2.3 HIGH DIVERSION TO ST. CLAIR RIVER CROSSING SCENARIO

Exhibit 6.17 illustrates the impacts of the elimination of the Detroit River crossings bias (discussed in Section 3.7) on the year in which capacity is reached at the Ambassador Bridge. This is accomplished by setting the estimated bias constants from the crossing choice logit models to zero.

As discussed in the ***Travel Demand Model Update Report***, the estimated bias constants are equivalent to about 15 and 14 minutes of travel time for passenger cars and commercial vehicles, respectively. This means that there is a higher probability of using the Detroit River crossings when the travel times and costs of using the St. Clair River crossing are equal. Setting the constants to zero results in an equal probability of using the crossings when the travel times and costs are the same. The result is a six-year delay of the Base Forecast estimate to 2026.

Exhibit 6-17: High Diversion to St. Clair River Crossing Scenario Forecast Year Ambassador Bridge Capacity Reached



Note: Peak hour is 4 to 5 p.m.; peak direction is US to Canada.
Note: Historic peak hour volume estimated from historic annual data.

6.2.4 PASSENGER CAR DEMAND FORECAST SCENARIOS

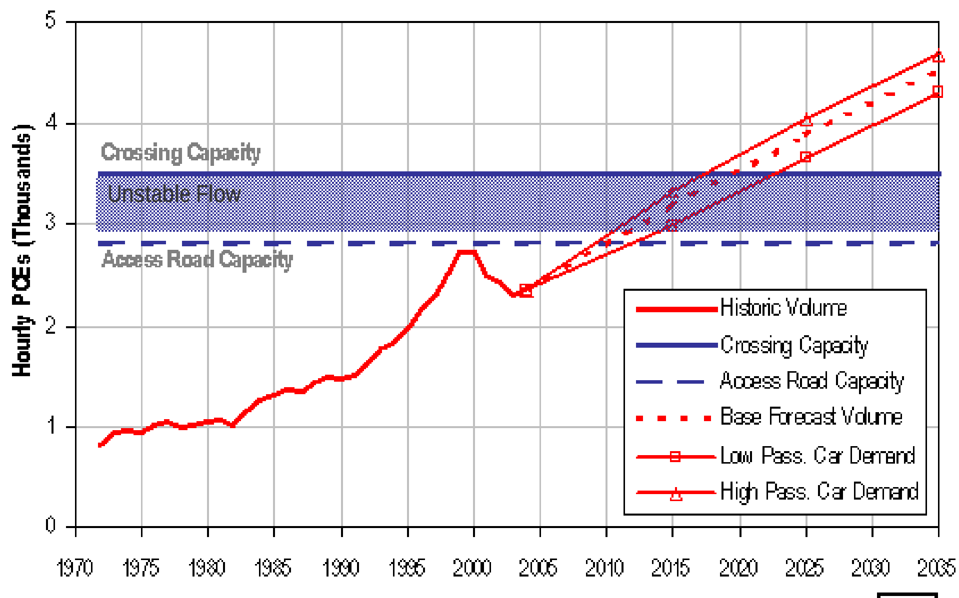
Exhibit 6.18 illustrates the sensitivity of the Base Forecast to the assumption of a passenger car rebound on the year in which capacity is reached at the Ambassador Bridge. The Base Forecast assumes that one-half of the same-day discretionary/recreation traffic lost between 2000 and 2004 returns by 2015. Two alternative scenarios were developed, as follows:

- **Low Passenger Car Demand Forecast** – Assumes that none of the loss is regained by 2015, with the growth instead in relation to local population; and

- **High Passenger Car Demand Forecast** – Assumes that all of the loss is regained by 2015.

The result is to delay the year in which capacity is reached by three years to approximately 2023 for the Low Passenger Car Demand Forecast Scenario, and to bring it forward three years to approximately 2017 for the High Passenger Car Demand Forecast Scenario.

Exhibit 6-18: High & Low Passenger Car Demand Scenarios Forecast Year Ambassador Bridge Capacity Reached

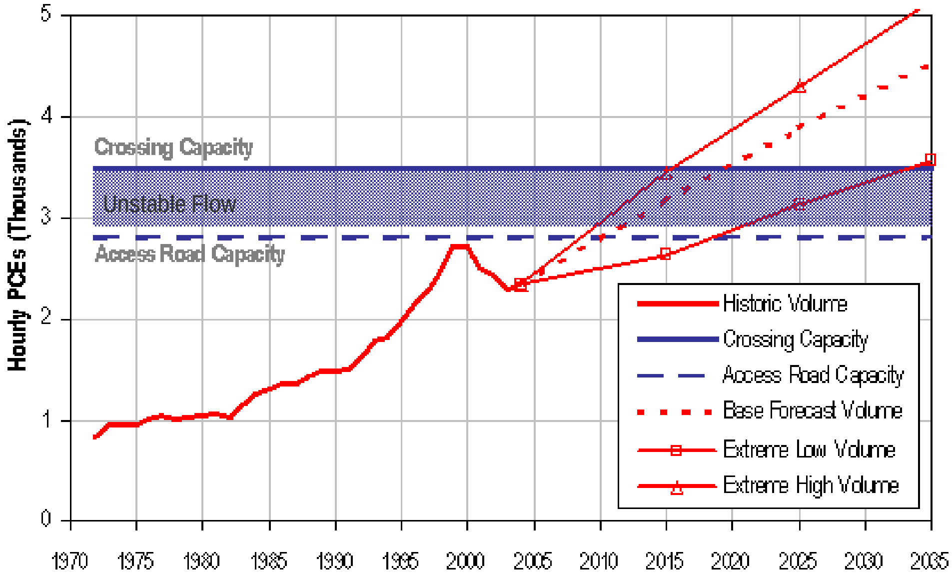


Note: Peak hour is 4 to 5 p.m.; peak direction is US to Canada.
Note: Historic peak hour volume estimated from historic annual data.

6.2.5 EXTREME SCENARIOS

Finally, Exhibit 6.19 shows the combined effects of all of the above factors that could move forward or delay the time when a new or expanded crossing is required. The Extreme High Scenario consists of a combination of the High Trade Growth and High Passenger Car Demand Forecast Scenarios. The Extreme Low Scenario consists of a combination of the Low Trade Growth, Diversion to Intermodal Rail, High Diversion To St. Clair River crossing and Low Passenger Car Demand Forecast Scenarios. Such unlikely scenarios would advance the year in which capacity is reached by five years to about 2015 or delay it by fourteen years to about 2034, respectively.

Exhibit 6-19: Extreme Scenarios Forecast Year Ambassador Bridge Capacity Reached



Note: Peak hour is 4 to 5 p.m.; peak direction is US to Canada.
Note: Historic peak hour volume estimated from historic annual data.

6.2.6 SUMMARY

Exhibit 6.20 summarises the above sensitivity tests and the impact on border crossing infrastructure needs. Under the Base Forecast, additional crossing capacity will be required in the next ten to fifteen years and additional access road capacity will be required in the next five to ten years. Under the range of sensitivity tests examined, the need for additional capacity could advance by approximately one year under the High Trade Growth Scenario and be deferred by approximately three years under the High Diversion to St. Clair River Crossing Scenario. The Extreme Low Scenario that combines all of the pessimistic growth scenarios is not considered a realistic scenario, but defers the need for additional crossing capacity by approximately ten years, which is still within the horizon period of this study. This demonstrates the need for additional capacity even under the most pessimistic circumstances.

Exhibit 6-20: Sensitivity Analysis Timing of Infrastructure Needs

Scenario	Time Capacity Reached
Base Forecast	10 to 15 years
Sensitivity Tests	
High Trade Growth	Advance 3 years
Low Trade Growth	Defer 4 years
Diversion to Intermodal Rail	Defer 2 year
High Diversion to St. Clair River Crossing	Defer 6 years
High Passenger Car Demand	Advance 3 years
Low Passenger Car Demand	Defer 3 years
Extreme High Scenario[1]	Advance 5 years
Extreme Low Scenario[2]	Defer 14 years

[1] Combines all of the optimistic scenarios, consisting of High Trade Growth and High Passenger Car Demand Forecast Scenarios.
[2] Combines all of the pessimistic scenarios, consisting of Low Trade Growth, Diversion to Intermodal Rail, High Diversion To St. Clair River crossing and Low Passenger Car Demand Forecast Scenarios.

7. SUMMARY & CONCLUSION

The preceding has outlined the existing and expected future travel demands at the Detroit and St. Clair River international border crossings. The trends and existing conditions were established based on historical traffic count data and two extensive travel surveys. Business-as-usual future conditions were estimated based on official projections of study area population and employment and the North American economy and Canada-US trade. The comparison of future traffic volume estimates to existing crossing capacity at Windsor-Detroit establishes a need for an increase in capacity within the thirty-year study horizon. The Base Forecast estimates put this need at within the next ten to fifteen years, when the upper capacity limit of the Ambassador Bridge is reached. Other border crossing system component capacity issues were also identified. Access road capacity on the Canadian side and US and Canadian border inspection capacity will be reached within the next five to ten years. Access road capacity on the US side serving the Detroit-Windsor Tunnel is already near capacity.

7.1 Travel Demand

The Base Forecast traffic volumes, summarised in Exhibit 7.1, project a 58% increase in passenger car traffic and a 128% increase in commercial vehicle traffic between 2004 and 2031. 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 recreation trips to the US. This was followed by the opening of Casino Windsor in the late 1990s, which also resulted in a large increase in cross-border traffic. In each case, these types of movements have declined significantly from the original peaks due to several reasons including 9/11, SARS, North American political and economic conditions (i.e. security, production, exchange rate), the continued integration of consumer markets and the opening of three casinos in Detroit. A return to these levels is not expected in the future. As such, after a near-term rebound from the recent excessively steep decline, future growth of passenger car traffic is expected to be more in line with the projected population and employment growth in the Windsor-Essex and SEMCOG areas.

In the last thirty years, commercial freight movements across the Detroit and St. Clair Rivers, 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. 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. Between 2000 and 2004, truck traffic has undergone a decline and rebound, such that current volumes are about the same as those in 2000. 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 increasing trade ties that Canada has with the US and the rest of the world.

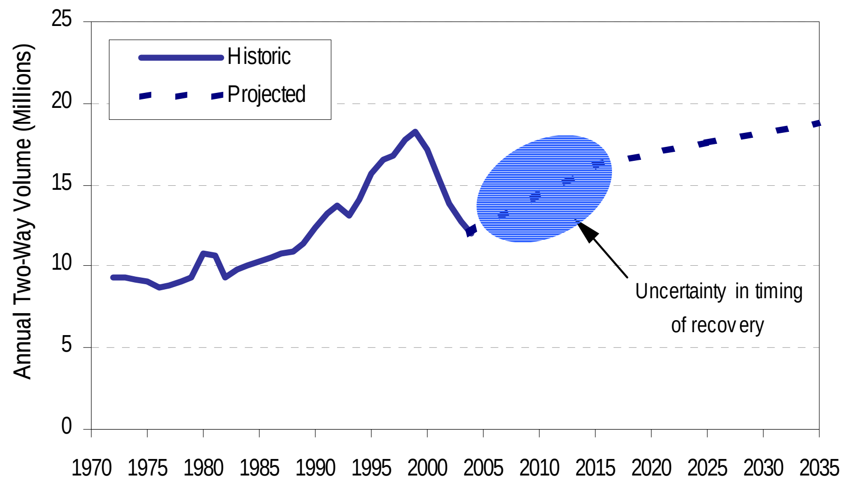
Exhibit 7-1: Summary of Annual Detroit River Crossings Base Forecast

A. Total

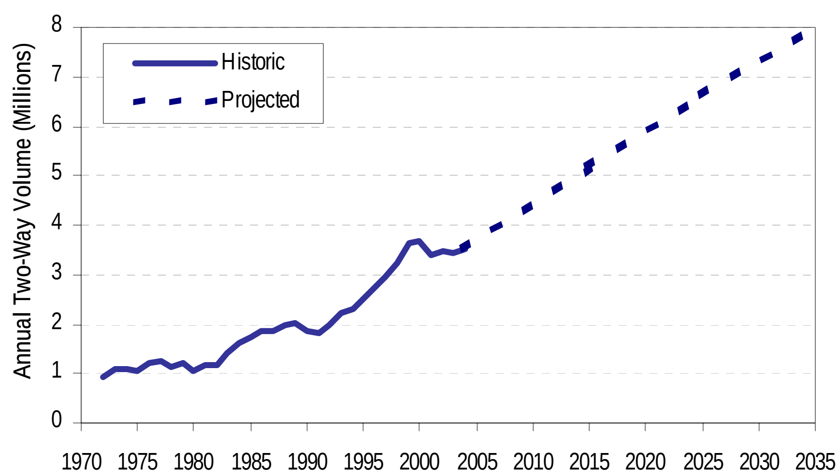
Vehicle Type	Volumes by Horizon Year				2004 to 2035 Growth		
	2004	2015	2025	2035	Total	%	CAGR[1]
Passenger Cars	11,950,000	16,280,000	17,570,000	18,740,000	6,790,000	57%	1.5%
Commercial Vehicles	3,530,000	5,180,000	6,630,000	8,060,000	4,530,000	128%	2.7%
Total	15,490,000	21,460,000	24,200,000	26,800,000	11,310,000	73%	1.8%

[1] Compound annual growth rate.
Note: Includes Windsor-Detroit/Sarnia-Port Huron crossing choice effects.

B. Passenger Cars



C. Commercial Vehicles



7.2 Border Crossing System Capacity

Within this study, capacity is defined as the maximum vehicle service flow rate that can be sustained by a facility and represents a severe breakdown in traffic operations. This is a very undesirable condition with long queues and delays. Although traffic volumes up to the capacity can be accommodated, it is prudent to provide a level of service that is better than that provided at capacity volumes. As such, capacity values within this study are defined as a range, with the upper limit corresponding to the maximum rate (as defined above) and the lower limit to the flow rate at which traffic operations start to become unstable due to the high number of vehicles using the facility. Given the high importance of an international crossing, the long lead time to construct/expand a crossing, large economic costs associated with unstable cross-border traffic and the range of uncertainty inherent in the forecasts (which represent the peak conditions for a typical day and not the periods of extreme traffic volume that inevitably occur from time to time), the lower limit has been identified to serve as a practical volume that should not be exceeded for an extended period of time. This suggests that, while a crossing is able to accommodate higher traffic volumes than the lower capacity limit, those within the range defined by the lower and upper limits are not desirable and a new or expanded crossing is needed before consistently high levels of congestion and unstable operations are reached.

The impacts of the Base Forecast peak hour, peak direction travel demand on the Detroit River border crossing system are summarised in Exhibit 7.2, with the need and timing for additional capacity for each border crossing component as follows:

- **Crossings** – Capacity reached within ten to fifteen years;
- **Access/Egress Roads** – The section of Huron Church Road between Highway 401 and the Ambassador Bridge will reach capacity within five to ten years;
- **Primary Inspection** – Passenger car inspection in both directions will reach capacity within five to ten years. For commercial vehicles, capacity will be reached within twenty to twenty-five years in the US to Canada direction and within five to ten years in the Canada to US direction; and
- **Secondary Inspection** – No capacity shortfalls are expected within the study horizon period.

The limiting components of the Detroit River border crossing system are the Ambassador Bridge crossing, the access/egress road system (i.e. Huron Church Road) and US and Canada border inspection, where additional capacity will be needed within five to ten years. This timing is based strictly on demand and capacity considerations, with the possibility that the analysis of safety, environmental and other considerations could justify an earlier need.

The preceding assumes that passenger cars and commercial vehicles will have shared access to the four bridge lanes to optimize use of the facility. In the event that the bridge is operating as two car-only lanes and two truck-only lanes, commercial vehicle traffic will have operational issues before passenger car traffic. Bridge truck-only lanes would provide adequate level-of-service until approximately 2010, after which unstable traffic conditions are projected to occur and additional capacity is needed.

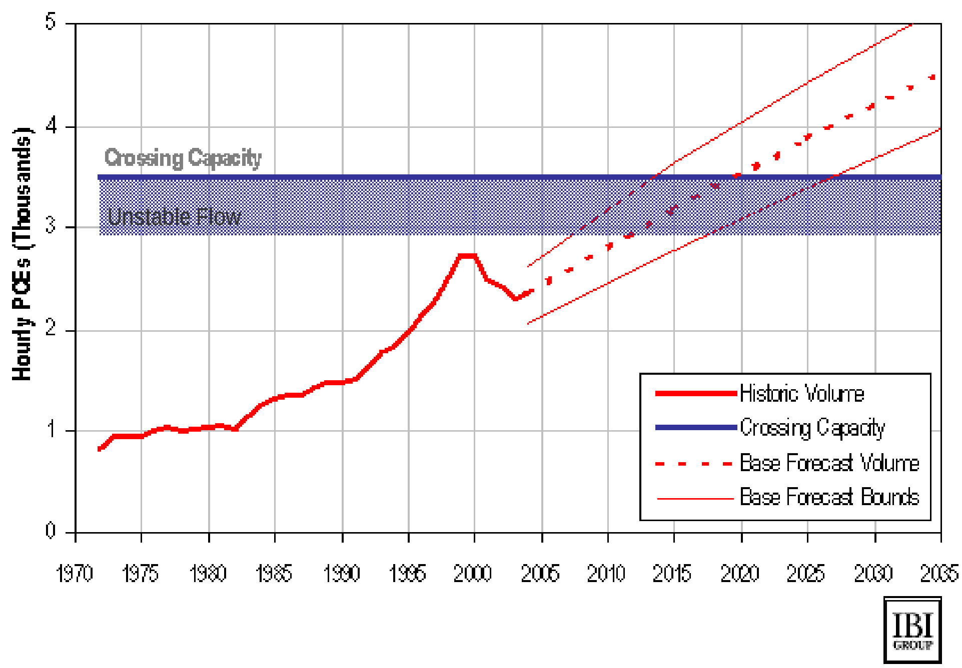
Exhibit 7-2: Summary of Future Detroit River Crossings Capacity Needs

A. All Components

Crossing	Time Capacity Reached				
	US Road Access	US Border Processing	Bridge / Tunnel Roadbed[1]	Canadian Border Processing	Canadian Road Access
Ambassador Bridge	Beyond 30 years	5 to 10 years	10 to 15 years	5 to 10 years	5 to 10 years
Detroit-Windsor Tunnel	0 to 5 years	5 to 10 years	30 years[1]	5 to 10 years	5 to 10 years

[1] If no improvements are made at the Detroit River, there would be some diversion from the Ambassador Bridge to the Detroit-Windsor Tunnel. Diversion of car traffic may move the timeframe that capacity is reached to between 25 and 30 years. Physical restrictions of the Tunnel limit the diversion of most types of trucks.

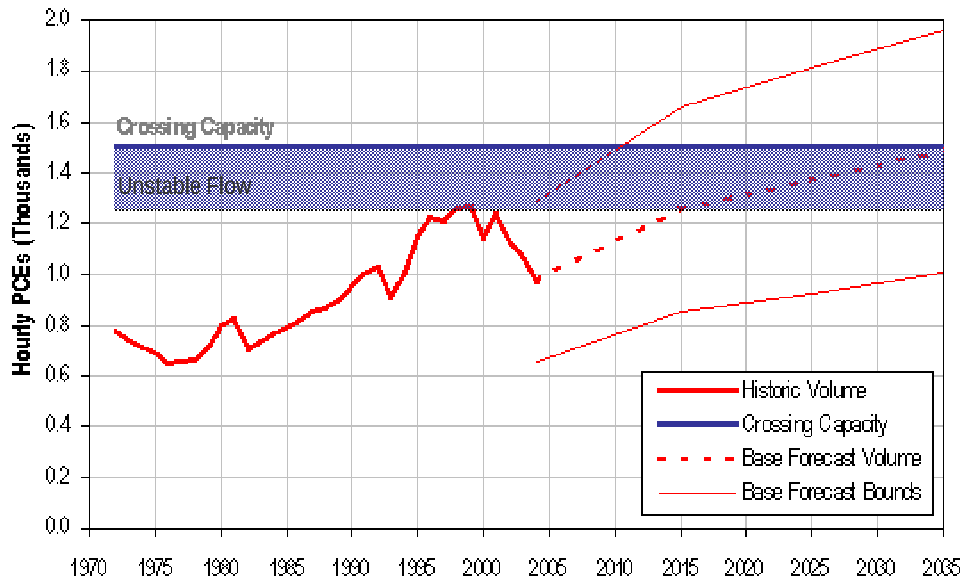
B. Ambassador Bridge



Note: Peak hour is 4 to 5 p.m.; peak direction is US to Canada.
Note: Historic peak hour volume estimated from historic annual data.

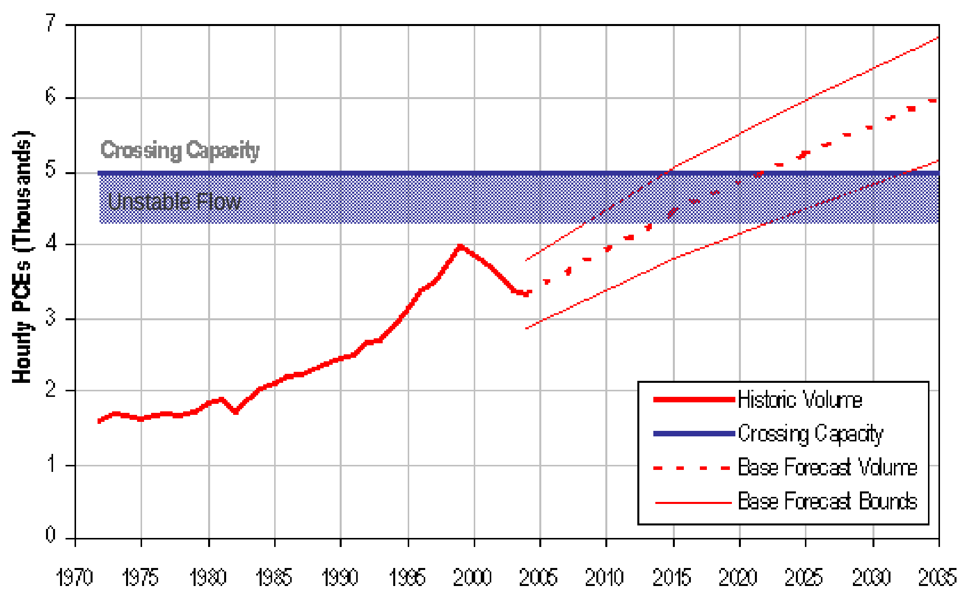
Exhibit 7.2 (Cont.): Summary of Future Detroit River Crossings Capacity Needs

C. Detroit-Windsor Tunnel



Note: Peak hour is 4 to 5 p.m.; peak direction is US to Canada.
Note: Historic peak hour volume estimated from historic annual data.

D. Detroit River Crossings



Note: Peak hour is 4 to 5 p.m.; peak direction is US to Canada.
Note: Historic peak hour volume estimated from historic annual data.

7.3 Range of Forecasts

As mentioned, the Base Forecast refers to business-as-usual conditions, representing the effects of increased travel demand from expected demographic and economic growth on a transportation system with committed improvements. The sensitivity of these forecasts to changes in the basic assumptions about key factors was analysed, considering the potential for change in the expected behaviour of Canadian trade growth, the mode by which goods are transported, the diversion of traffic to the St. Clair River crossing and a high or low recovery in passenger car demand. The analysis is summarised in Exhibit 7.3.

The impact of the various sensitivity tests on the timing of the need for additional border crossing system capacity ranges from one to several years, with most of the tests advancing or deferring the need by less than three years. Under the Extreme Low scenario, involving a combination of all of the pessimistic scenarios, the need for additional capacity is deferred by approximately ten years. Thus, the sensitivity analysis shows, while changes to these factors may defer the need for a new or expanded crossing within the Detroit-Windsor area, the need for additional capacity will be reached within the study horizon period under all scenarios examined.

While most of the sensitivity tests have examined pessimistic scenarios, historic cross-border traffic levels indicate that changes can occur very quickly, with large increases occurring in short periods. These changes typically reflect phenomena that cannot be predicted (e.g. cross-border shopping, casino patronage, gas shortages, etc.), but underlies the need for an infrastructure plan to be in place to protect for higher than projected demand.

Exhibit 7-3: Summary of Sensitivity Analysis

Scenario	Time Capacity Reached
Base Forecast	10 to 15 years
Sensitivity Tests	
High Trade Growth	Advance 3 years
Low Trade Growth	Defer 4 years
Diversion to Intermodal Rail	Defer 2 year
High Diversion to St. Clair River Crossing	Defer 6 years
High Passenger Car Demand	Advance 3 years
Low Passenger Car Demand	Defer 3 years
Extreme High Scenario[1]	Advance 5 years
Extreme Low Scenario[2]	Defer 14 years

[1] Combines all of the optimistic scenarios, consisting of High Trade Growth and High Passenger Car Demand Forecast Scenarios.

[2] Combines all of the pessimistic scenarios, consisting of Low Trade Growth, Diversion to Intermodal Rail, High Diversion To St. Clair River crossing and Low Passenger Car Demand Forecast Scenarios.

7.4 Conclusion

The above indicates that the crisis of inadequate border crossing system capacity and lengthy queues at Detroit River crossings has been addressed by recent initiatives by US and Canadian governments to significantly increase border processing capacity. This has eliminated queues during normal operations and has provided a five to ten year window before the growth in cross-border demand is projected to result in major delays. While this is a short timeframe, it does provide sufficient time to properly plan, design and build a new or expanded crossing under an accelerated schedule.

APPENDIX A

MULTIVARIATE & TIME SERIES REGRESSION ANALYSES

A.1. MULTIVARIATE REGRESSION ANALYSIS

Multivariate regression analysis relates a dependent variable to a set of independent, or explanatory, variables. The first step in this type of analysis is hypothesising what variables will explain the behaviour observed in the data; that is, there should be some logical explanation as to why and how any independent variable will affect the dependent variable. These hypotheses are most commonly tested using scatter plots. The relationships between annual passenger car and commercial vehicle Detroit River crossing volumes and various explanatory variables are shown in Chapter Four of the report. The relationships (i.e. as either directly or inversely related) are as expected in all cases, however some are stronger than others (as shown by the goodness-of-fit of a univariate regression line).

Once these relationships were established, regression models were developed based on the historic values of the chosen explanatory variables. Explanatory variables were chosen based on the best combination of explanatory power, the availability of a reasonable large historical series and forecast future values from a reputable source, and minimal correlation with other chosen variables. For example, commercial vehicle volumes show strong relationships (i.e. explanatory power) with each of Canadian GDP, US GDP and Canadian trade value (as shown in the report). Canadian GDP was not chosen, as there is no forecast available to the study team. US GDP and Canadian trade value are very highly correlated (i.e. greater than 90%) and therefore cannot both be included in the same model. Canadian trade value was chosen over US GDP for the final model given the slightly stronger explanatory power and the hypothesis that it is a more direct determinant of truck volumes in the study area. For comparison purposes, a multivariate regression including US GDP (and exchange rate) is retained in the exhibits because it has been used previously in MDOT forecasts.

Exhibit A.1 shows the estimated parameters for each model. A suitable model could not be developed for commercial vehicles on the Detroit-Windsor Tunnel. Each model consists of a constant and two explanatory variables. The explanatory variables consist of the average yearly population of Ontario and the average yearly exchange rate for passenger cars and the average yearly exchange rate and the annual value of Canadian trade for commercial vehicles. The dependent variable is the annual volume.

The models range in goodness-of-fit, but the majority exhibit strong adjusted-R^2 measures. All of the estimated parameters are signed (i.e. positive or negative) as hypothesised. Most of the explanatory variable parameters are statistically significant at the one-tailed 95% confidence level, with the exception of the exchange rate parameters for passenger cars, which are significant at around the 80% level. These were included, however, as they improved the model goodness-of-fit. Also, the model F statistics indicate that all models (as wholes) are statistically significant.

In general, the commercial vehicle models are superior to the passenger car models. As can be seen in the scatter plots, the relationship of passenger car crossings to the presence of the Windsor Casino is very strong, so much so that it distorts other relationships. While the inclusion of a dummy variable indicating when the Windsor Casino was the only casino in the vicinity (i.e. equal to 1 for 1994 to 2000 and 0 otherwise) greatly improved the model performance, forecasting such a variable is impossible. As such, it was not included in the final model specification.

Exhibit A.1: Estimated Multivariate Regression Model Parameters

A. Passenger Cars

Crossing (Annual Volume x 10^0)	Explanatory Variable				Model Adjusted-R^2	Model F Statistic
	Measure	Constant	Ontario Population (x 10^0)	Exchange Rate (cents US/ $ CAN)		
Ambassador Bridge	Value	-1,982,042	0.9295	-19,318	77%	53.2
	(t-stat)	(-0.59)	(5.27)	(-0.89)		(p<0.000)
Detroit-Windsor Tunnel	Value	3,123,938	0.5441	-26,742	54%	20.1
	(t-stat)	(0.83)	(2.75)	(-1.10)		(p<0.000)
Detroit River Crossings	Value	1,141,896	1.474	-46,061	68%	35.2
	(t-stat)	(0.165)	(4.03)	(-1.02)		(p<0.000)

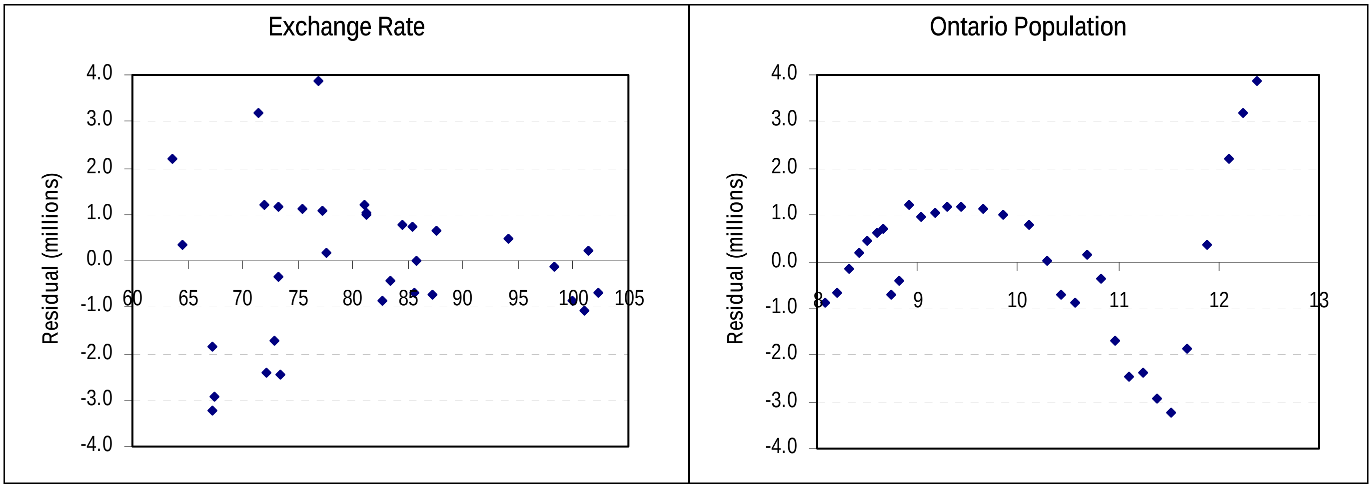
B. Commercial Vehicles

Crossing (Annual Volume x 10^0)	Explanatory Variable				Model Adjusted-R^2	Model F Statistic
	Measure	Constant	Exchange Rate (cents US/ $ CAN)	Canadian Trade (1997 $CAN x 10^6)		
Ambassador Bridge	Value	1,878,080	-17,991	3.668	98%	741.0
	(t-stat)	(4.837)	(-4.052)	(24.02)		(p<0.000)
Detroit-Windsor Tunnel	Value	n/a	n/a	n/a	n/a	n/a
	(t-stat)	n/a	n/a	n/a		n/a
Detroit River Crossings	Value	1,746,298	-14,046	3.768	98%	549.2
	(t-stat)	(3.878)	(-2.728)	(21.27)		(p<0.000)

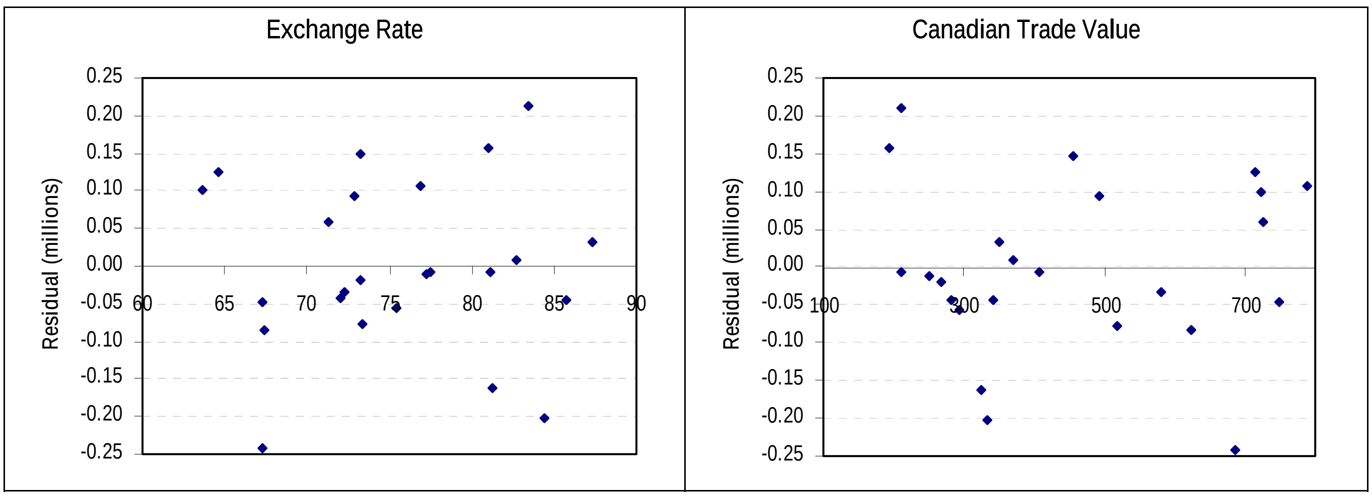
As another check of model specification, regression residual analyses were also completed. None of the explanatory variables were transformed and all relationships were assumed linear (as suggested by the scatter plots). Plots of the residuals (i.e. the difference between actual and predicted values of the dependent variable) against each independent 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 homogeneous, or homoskedastic). Exhibit A.2 plots the Detroit River crossings model residuals against the explanatory variables used in each model. As can be seen, the commercial vehicle model residual variances are homogenous across both variables while, as discussed above, the lack of a Windsor Casino explanatory variable results in some degree of heteroskedasticity in the passenger car models. The passenger car models, however, are considered suitable enough for the purposes intended in this study.

Exhibit A.2: Detroit River Crossings Multivariate Regression Model Residual Plots

A. Passenger Cars



B. Commercial Vehicles



A.2. TIME SERIES REGRESSION 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 straight line (or other shape, depending on the theorised behaviour of the variable) to them and extending it forward to the forecast year. More sophisticated methods, however, can also be applied. Three time-series regression techniques/assumptions were applied to the data, consisting of:

- **Linear** – The absolute growth per year is constant. The equation of the line is assumed to be of the form $y = ax + b$;

- **Exponential** – The absolute growth per year is continuously compounded. The equation of the line is assumed to be of the form $y = be^{ax}$;

- **Auto Regressive Integrated Moving Average (ARIMA)** – This method represents one of the industry standard time-series analysis techniques. It integrates auto-regression, in which the current value of a series is a function of one or more prior values of the series, with moving averages, in which the current value of a series is a function of the random shocks (or white noise) of one or more prior values of the series.

While the first two methods are fairly simple least squares techniques for which no real model specification is required, the latter requires that parameters be specified to identify the appropriate number of auto regressive and moving average terms to be included in the model. As such, only the specification of the ARIMA models is discussed.

The general formulation of ARIMA models utilised in this study is:

$$y_t = \mu + \beta x_t + \phi_1 y_{t-1} + \phi_2 y_{t-2} + \ldots + \phi_p y_{t-p} + \varepsilon_t + \theta_1 \varepsilon_{t-1} + \theta_2 \varepsilon_{t-2} + \ldots + \theta_q \varepsilon_{t-q}$$

where:

y_t = the value of the series at time *t*
μ = a constant
β = a linear regression parameter
x_t = the linear regression independent variable (i.e. the year)
ϕ_p = the auto regression parameter of order *p*
ε_t = white noise, or random shock at time *t*
θ_q = the moving average parameter of order *q*

The modelling procedure therefore involves the estimation of the linear regression, auto regression and moving average component parameters. The auto regression and moving average orders (i.e. p and q) are specified by the user and are typically based on an analysis of the autocorrelation and partial autocorrelation functions of the data series.

Many time series modelling techniques assume that the data are stationary. A stationary series has the property that its mean, variance and autocorrelation structure do not change over time, meaning that it is flat, without trend and has a constant variance over time. As the data have a definite increasing trend, the model includes the linear regression component to "remove" it before the other parameters are estimated. Also, as the data are annual, there is no seasonality to them that would otherwise need to be considered in the specification of the orders.

Analysis of the autocorrelation and partial autocorrelation functions for both the passenger car and commercial vehicle data indicated that the data are stationary. It also identified models of order (2,0,0) and (1,0,1) for passenger cars and commercial vehicles, where the first and third digits refer to the auto regressive and moving average orders, respectively. The second digit specifies differencing, which is required if the data are not stationary. The estimated model parameters are presented in Exhibit A.3.

Exhibit A.3: Estimated ARIMA Time Series Regression Model Parameters

A. Passenger Cars

Crossing	Measure	Parameter			
		μ	β	ϕ_1	ϕ_2
Ambassador Bridge	Value	-54,241,464	27,795	1.692	-0.8722
	(t-stat)	(-1.438)	(1.445)	(6.181)	(-3.032)
Detroit-Windsor Tunnel	Value	-34,168,110	17,841	1.353	-0.5572929
	(t-stat)	(-0.8980)	(0.9160)	(3.324)	(-1.384)
Detroit River Crossings	Value	-82,465,559	42,602	1.487	-0.6717288
	(t-stat)	(-1.379)	(1.394)	(6.185)	(-2.668)

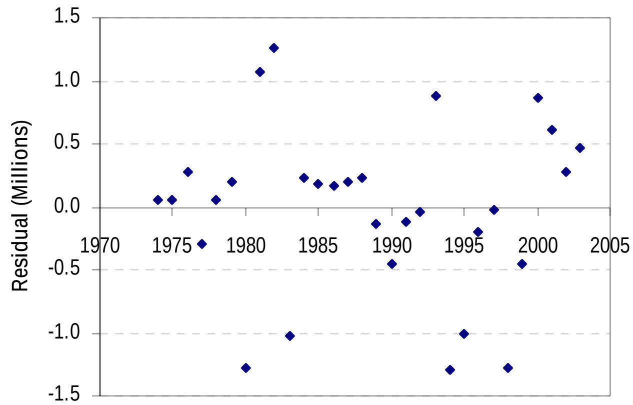
B. Commercial Vehicles

Crossing	Measure	Parameter			
		μ	β	ϕ_1	θ_1
Ambassador Bridge	Value	-39,112,459	19,897	0.7955	0.3933
	(t-stat)	(-3.724)	(3.730)	(13.36)	(2.091)
Detroit-Windsor Tunnel	Value	-785,246	411	0.8281	0.2841
	(t-stat)	(-0.8530)	(0.8780)	(10.71)	(1.438)
Detroit River Crossings	Value	-46,453,921	23,645	0.7593	0.3396
	(t-stat)	(-3.540)	(3.545)	(10.56)	(1.725)

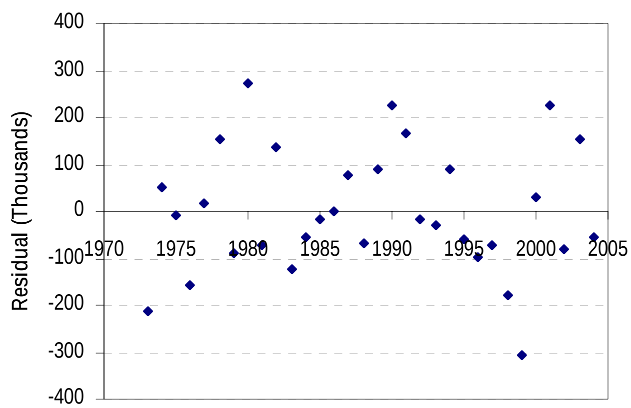
As with multivariate regression models, the specification can be checked by plotting the residuals to ensure homoskedasticity. This is shown in Exhibit A.4 for the Detroit River crossings. As can be seen, the residual variances are quite homogenous for both passenger cars and commercial vehicles.

Exhibit A.4: Detroit River Crossings ARIMA Time Series Regression Model Residual Plots

A. Passenger Cars



B. Commercial Vehicles



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