7 ECONOMIC AND BUSINESS CASE ANALYSIS

This section sets out the economic and business case analysis. Three cases are described:

- The Base Case - bored (TBM) tunnel with a railway shuttle;
- Upgraded Ferry Link from St Barbe to Blanc Sablon; and,
- The Base Case augmented by High Voltage Direct Current (HVDC) transmission income.

The tunnel option under consideration uses two TBM machines and a seven day work week; thus, the period for planning design and construction of the facility is 11 years and the operating period examined is 30 years, for a total economic life cycle of 41 years. Sensitivity analyses were also carried out to assess the possible effects of significant changes to the assumptions underlying these forecasts. There are three major parts to this Section, as follows:

- Transportation Demand
- Tolls and Revenue Forecasts
- Economic Evaluation

7.1 Transportation Demand

Transportation demand projections are developed based on an understanding of the existing markets served. Consideration of the potential of new market opportunities attributable to the existence of a fixed link are then developed to estimate future traffic levels. The sub-sections are as follows:

- Markets Served
- Primary Target Markets
- Traffic Projections - Fixed Link
- Traffic Projections - Upgraded Ferry Link

7.1.1 Markets Served

The existing markets for transportation between the Mainland and the Island of Newfoundland are described briefly below.

- St. Barbe to Blanc Sablon (Ferry)
- Quebec North Shore (Coastal Shipping)
- Direct Water Route (Oceanex)
- Marine Atlantic (Ferry)

St. Barbe to Blanc Sablon

Surface freight and passenger transportation between St. Barbe, NL and Blanc Sablon, QC is currently available by ferry between May 1 and mid-January, depending on weather conditions. The Government of Newfoundland and Labrador, Department of Transportation and Works recently renewed a four-year contract with Labrador Marine Inc to operate the M/V *Apollo* across the Strait of Belle Isle. The current contract

started in 2004 at an annual subsidy of approximately $5.5 million including fuel that is purchased by the province on behalf of the operator. The M/V *Apollo* handles passenger and vehicle traffic only (all cargo must be in vehicles). The 108 metres long vessel has a certified passenger capacity of 240 (although it is capable of carrying 1,200 passengers), 220 cars and up to 6 tractor-trailers. The number of crossings per week varies with the season. In the peak season of July and August, the *Apollo* has 17 trips in each direction per week. For the rest of the operating period the frequency is 12 per week in May and June, 13 per week in September and October and 10 per week November 1st onwards. Each trip takes approximately 90 minutes, depending on the weather.

According to the Department of Transportation and Works, the demand for passenger service on this route has increased 59% for passengers, 76% for vehicles and 27% for tractor-trailers from 1999 to 2002. In 2003, the service was used by 23,229 vehicles (private passenger plus commercial vehicles), This service would provide a benchmark for toll pricing, revenues, traffic and costs for comparison with the impacts of a fixed link that would replace this ferry service. For year 1 (2004) of the study period a total vehicle count of 24042 was used, based on information provided by the Department of Transportation and Works.

Quebec North Shore

Access to Labrador Coastal Drive is also available by another seasonal ferry operated by Groupe Desgagnés under contract to Transports Québec. The M/V *Nordik Express* provides weekly passenger and freight service to the Quebec North Shore from Rimouski terminating at Blanc Sablon from May to January. This 1,865-ton ship has a capacity of 268 passengers with 282 m^2 of deck cargo space. The 3½-day trip stops at 10 villages between Rimouski/Sept-Îles and Blanc Sablon for passengers and freight; one trip is made each week in each direction. The volume of traffic to the Island of Newfoundland is not significant for this immediate analysis.

Oceanex

Oceanex operates a regular container service from Montréal and Halifax to St. John's and Corner Brook.

The company's fleet includes the following vessels:

- M.V. *Cabot*, a 193 metre long ice class Ro/Ro (Roll-on/Roll-off) containership constructed in 1979. The *Cabot*, which is dedicated to the Montreal service, has a capacity for 644 TEU's (Twenty-foot Equivalent Units);
- M.V. *Cicero*, a 147 metre ice class Ro/Ro containership constructed in 1978. The *Cicero*, which is dedicated to the Montreal service, has a capacity of 420 TEU's; and
- M.V. *Sanderling*, a 193 metre ice class Ro/Ro containership constructed in 1977. The *Sanderling*, which is dedicated to the Halifax service has a capacity of 1,125 TEU's.

Oceanex offers two day service between Halifax and St. John's weekly, and three day service between Montreal and St. John's twice weekly. Service to Corner Brook is provided weekly by the *Sanderling* on its return trip from St. John's to Halifax.

Prospects for diversion from this service to a new fixed link are negligible for reasons that are more fully explained later in this text.

Marine Atlantic

Marine Atlantic Inc. is a Federal Crown Corporation offering year-round passenger and freight ferry services from North Sydney, Nova Scotia to the Island of Newfoundland at Port aux Basques and summer service to Argentia. The North Sydney to Port aux Basques crossing is a constitutional obligation of Canada having been included in the Terms of Union between Canada and Newfoundland in 1949. The company's fleet includes the following vessels:

- M.V. *Caribou* -- An Ice Class 1A Super Ferry with capacity for 1200 passengers and 370 automobiles or 77 tractor-trailers. This vessel was custom built for Marine Atlantic and delivered in 1986;
- M.V. *Joseph and Clara Smallwood* -- An Ice Class 1A Super Ferry with capacity for 1200 passengers and 370 automobiles or 77 tractor-trailers. This vessel was custom built for Marine Atlantic and delivered in 1990;
- M.V. *Atlantic Freighter* -- was built in 1978 and purchased by Marine Atlantic from the Stena Line in 1986. It has capacity for 75 drop trailers and 12 passengers; and
- M.V. *Leif Ericson* -- was built in 1991 and purchased by Marine Atlantic in 2003. It has capacity for 500 passengers and 250 automobiles or 72 tractor trailers.

Off-peak season schedules to and from Newfoundland generally include twice daily ro-ro service between North Sydney and Port aux Basques using either the *Caribou* or the *Joseph and Clara Smallwood*. As well, the *Atlantic Freighter* provides drop trailer service between these ports on a demand basis.

Peak scheduling generally includes thrice daily service between North Sydney and Port aux Basques and thrice weekly service between North Sydney and Argentia. The latter is largely a passenger related service that carries very few commercial vehicles.

Crossing times, on the North Sydney to Port aux Basques service are 6 hours, and on the North Sydney to Argentia crossing, are approximately 14 hours. During peak season operations, faster sailings can occur.
The Gulf Ferries are a source of traffic that could be diverted, at least in part. Both existing and upgraded service offerings would be used as benchmark references for estimating diversion potential. Traffic originating west of Quebec City might be diverted along a new Trans Canada Highway link to Blanc Sablon along the North Shore of the Gulf of St. Lawrence.

During 2003, Gulf Services in both directions accounted for approximately 151,000 passenger vehicles and 81,000 commercial vehicles.

7.1.2 Primary Target Markets

Future potential demand for a fixed link can come from a number of sources, as follows:

- New developments to attract tourism and induced demand (i.e. new demand for trip making that is "induced" by the existence of the tunnel or the convenience it may afford, not traceable to historical trends)
- New economic developments to attract long term commercial vehicle traffic and major projects that can generate elevated demand for defined periods (e.g. construction of Lower Churchill Power Generating capacity)

Tourism And Induced Demand

Tourism is important for the economy of Newfoundland and Labrador over the time frame under consideration. New potential growth could result from creation of new National and Provincial Parks, expansion of tourism infrastructure including hotels and dining facilities, and successful major advertising campaigns. There is little specific evidence upon which to build growth projections. Implications of this type of potential are developed by indirect approaches, contacting Zonal Boards and tourism departments, and drawing inferences from comparable studies.

For example, discussions were held with representatives of Zonal Boards in Central and Southern Labrador, and Western Newfoundland to determine the status of potential major projects that could impact upon traffic demand for the Fixed Link. Based upon these discussions, no identifiable major new projects in the conceptual and initial planning stages were identified.

Provincial Trends

A number of sources have been reviewed to arrive at conclusions on the expected range of impacts from the project. Table 7.1 details the markets which the Department of Tourism, Culture and Recreation has identified as offering the best potential for tourism activity in Newfoundland and Labrador:[1]

Table 7.1 – Tourism Markets

Geographic Markets	
Primary	**Secondary**
Ontario	North-east USA
Maritimes	
Primary Purpose of Trip Markets	
Primary	**Secondary**
Sightseeing / Touring	Adventure / nature viewing
Hunting / Fishing	Meetings , Conventions and Incentive Travel

The Maritimes and Ontario are the largest non-resident markets, with the Maritime provinces accounting for 42% of non-resident visits and Ontario accounting for 32% in 2003. The primary and secondary geographic markets for Newfoundland and Labrador are similar to Nova Scotia; thus, filling "data gaps" in Newfoundland and Labrador can draw from insights obtained from studying Nova Scotia trends. See Table 7.2.

[1] *Newfoundland and Labrador Tourism Marketing Strategy Review, prepared by Economic Planning Group of Canada, November 2002, P ii.*

Table 7.2 Non-Resident Visitors to Newfoundland and Labrador

By Origin: January to December					
Origin	**Auto**			**Air**	
	2003	**2002**	**2001**	**2002**	**2001**
Nova Scotia	43,042	49,115	46,710	29,320	30,089
P.E.I	2,774	3,153	2,960	1,816	1,864
New Brunswick	13,205	15,983	13,776	8,303	8,521
Total Maritimes	**59,021**	**68,251**	**63,446**	**39,439**	**40,474**
Quebec	8,354	8,794	6,823	12,973	13,314
Ontario	44,582	50,562	42,097	107,419	110,238
Western Canada	9,603	11,083	8,721	45,926	47,131
New England	4758	5,860	5,254	5,449	5,592
Mid Atlantic	3364	4,171	3,656	6,227	6,391
East North Central	2151	2,838	2,672	4,670	4,793
South Atlantic	3837	4499	4126	5708	5858
Other USA	4679	5,319	4,878	11,676	11,982
Total USA	**18,789**	**22,687**	**20,586**	**33,730**	**34,616**
International	58	141	102	19,719	20,237
Total	**140,401**	**161,442**	**141,675**	**259,467**	**266,276**

Source: Dept. of Tourism, Culture and Recreation: Data for Air travelers for 2003 were not available at the time of writing.

Table 7.3 below provides an overview of the volume of non-resident visitors to Newfoundland and Labrador for the past 10 years. Total visits to the province have increased overall by 30% from 1996 to 2003. More than half the visitors come during the peak tourist season (June-September); in fact, the ratio of peak to annual visitors has increased from around 51% in 1994 to over 54% in 2003.

Also, more recent information (Non-Resident Summary Statistics, Department of Tourism, Culture and Recreation, April 2003) reveals a newly emerging market for cruise ship arrivals. It appears to be growing from a small base of 10,000 to 20,000 visitors per year. Significant annual fluctuations since the data were first captured in 1998 conceal evidence of any trend in these early days.

Table 7.3 Annual Non-Resident Visits and Expenditures ($ Millions) Newfoundland and Labrador: 1994-2003

Year	Auto		Air		Total
	Visitors	Expenditures	Visitors	Expenditures	Visitors
1994	114,629	$46.2	214,800	$119.0	329,429
1995	118,133	$48.5	204,364	$119.9	322,497
1996	109,626	$46.3	195,436	$118.2	305,062
1997	122,425	$56.2	247,265	$175.5	369,690
1998	127,960	$60.3	244,253	$177.8	372,213
1999	140,864	$68.0	256,600	$195.4	397,464
2000	149,975	$75.3	266,480	$212.1	416,455
2001	141,675	$72.2	266,276	$215.1	407,951
2002	161,442	$85.2	259,467	$216.0	420,909
2003	140,401	$74.1(E)	287,300	$239.1(E)	427,701

Source: Department of Tourism, Culture and Recreation

(E) – estimated

The Department of Tourism, Culture and Recreation did an in-depth auto exit survey for the Province in 1997. This survey gives insight into the profile of the non-resident visitors on a sub-provincial basis. The methodology behind the survey was to administer a questionnaire to a sample of passengers in vehicles exiting Newfoundland and Labrador via Argentia or Port aux Basques on the ferry during June to October 1997.

Information from the 1997 Auto and Air Exit Survey of the Department of Tourism, Culture and Recreation is converted to 2004 dollars using the Consumer Price Index to estimate spending by tourists. The average daily expenditures for non-resident auto visitors are estimated at $93 (business), $59 (pleasure), $32 (visiting friends and relatives) and $52 (other visitors). The overall daily average is $49. Those visitors entering the Province by air have a higher overall daily expenditure at $90 with the purpose of trip breakdown being $165 (business), $128 (pleasure) and $51 (visiting friends and relatives).

From the above expenditives, distributions of traveller type have been assumed as follows:

Auto visitors:	10%	business
	30%	pleasure
	50%	visiting friends and relatives
	10%	other

Air visitors:	20%	business
	20%	pleasure
	60%	visiting friends and relatives

These distributions provide average expenditures that approximate those given above.

For the traveller type distribution for the users of the fixed link, the business travellers have been assumed not to use the facility. Further, for the auto travellers it is assumed that the pleasure traveller component would increase signficantly. Therefore the following distributors have been used.

Auto visitors:	50%	pleasure
	40%	visiting friends and relatives
	10%	other

Air visitors:	25%	pleasure
	75%	visiting friends and relatives

Base on Table 7.3, the ratio of the auto visitors to our visitors is 35% auto versus 65% air. This gives an average expenditure to be employed in this study of $62.35 (2004 dollars).

It is apparent that air visitors are an important segment of the tourist market. Visitors from further away than the Maritime Provinces destined to tourist attractions in the Great Northern Peninsula and in Labrador tend to fly in and rent cars for their local sightseeing. Many of these tourists are round-trip travellers across the Strait of Belle Isle.

Since there is not enough information to break down the expenditures by region, this spending pattern will be taken as the benchmark for estimating incremental tourism expenditures.

Regional Tourism Insights

The 1997 Survey also estimated that on a regional basis, 37.8 % of the nights that non-residents auto visitors spent were in Western Newfoundland, 28.4% were on the Avalon Peninsula, 23.0% in Central Newfoundland, 9.7% in Eastern Newfoundland and 1.0% in Labrador.

Other findings from this survey are:

- The primary reason for travel to Newfoundland and Labrador by non-resident auto visitors was sightseeing, followed by visiting friends and family, pleasure seekers, business travelers and finally "other" reasons. ‘Pleasure’ includes outdoor recreation, special events, fishing etc.
- Greater than two-thirds of the non-resident auto visitors reported Newfoundland and Labrador as their primary destination, while less than one-third indicated the Province visit was part of an Atlantic Canada tour.
- The average party size was 2.67 persons and the most popular group composition was as husband and wife, at 41.5% of the population surveyed. The average length of stay was 11 nights with average expenditures at $41.76 per night per person (1997 dollars). Therefore, the average party was spending $1,226 per visit.
- Activities which generated the most interest in overall market segments were iceberg viewing, whale watching, boat tours, visiting historical sites/museums, scenic touring and attending festivals/events,.

These data suggest that those traveling to Newfoundland and Labrador are interested in activities related to the natural and historical heritage of the Province's coastlines.

The primary sources of data concerning Labrador include data from the annual Statistics Canada surveys of both domestic and international travel to and within Canada. The sample size for Labrador is too small for breaking out any details, but the figures do provide some sense of the number of visits. Data for the year 2000 show the following:

Overnight visits to Newfoundland & Labrador of 1 plus nights	
Overseas –	99,900
US –	49,700
Total –	149,600

Overnight visits to Labrador	
Overseas –	4,900
US –	6,700
Total –	11,600

The only other useful source of data for Labrador tourism is ad hoc data from operators throughout Labrador. There are accessible data on passenger movements across the Labrador Straits from May to October. The *Apollo* ferry data for the Labrador Straits include significant resident travel, but it may also provide a proxy for tourist visitation growth. For comparative purposes, the out-of-province visits to the Great Northern Peninsula exceed 50,000 annually.

The major attractions in the region posted visitation levels as follows:

- Red Bay National Historic Site – 8,144 between June and September 2000(6% increase over 1999).
- Pointe Amour Lighthouse – 4,584 visitors between June and October 2000 (decrease of 4% over 1999).
- Battle Harbour – average of 2,000 visitors between June and October 2000.

The Newfoundland and Labrador Exit Survey of 1997 is being updated in 2003/04. The new data are not yet available for use in this study. Therefore 1997 data is the best available indicator of current and expected future conditions. The data were compiled from interviews of air and auto visitors to the 21 tourism zones in Newfoundland and Labrador. Two zones are in Labrador and another two zones are located in the adjacent area of Western Newfoundland.

Air visitors to Southern Labrador represent less than 1.5% of the party visits, less than 0.5% of party nights and stay around five days. This profile is not expected to change significantly with a fixed link. Auto visitors have a different profile. In 1997, Southern Labrador accounted for 2.4% of party visits and 0.43% of party nights with the average stay ranging from 1.7 nights in the Labrador Straits to 3.0 nights in Mary's Harbour to Cartwright. It is important to note that the auto visitor profile for Mary's Harbour to Cartwright is representative of conditions prior to the completion of the Trans-Labrador Highway to Cartwright.

Another approach used was to examine accommodation occupancy data. The Department of Tourism, Culture and Recreation collects occupancy statistics on a monthly basis for each tourism zone. Operator participation in this survey can vary from year to year but overall trends can be isolated. As a proxy of

changes in Southern Labrador and Western Newfoundland since the completion of the Trans Labrador Highway to Cartwright, the year 1999 was selected as the base year. The compounded annual increase in room nights sold was:

- Zone 4 Mary's Harbour to Cartwright 2.7%
- Zone 5 Labrador Straits 2.4%
- Zone 4 & 5 Southern Labrador 2.5%
- Zones 6 & 7 Great Northern Peninsula 3.4%

Zones 4 and 5 have spare capacity to meet increased visits from a fixed link to Newfoundland. In 2003, Southern Labrador had an annual occupancy rate of 32%. The available room nights were around 34,900 and total rooms sold were approximately 7,650. The monthly occupancy ranged from 16% in January to 64% in July and 61% in August. Occupancy rates were 47% in both shoulder months, June and September. The current accommodation occupancy profile indicates spare capacity that could be fully or partially utilized given improved access from a fixed link.

Tourism Projections

Based on the above trends and information, it is apparent that tourism to Newfoundland and Labrador is growing at an increasing rate, and that the share of market in Southern Labrador and the Great Northern Peninsula is keeping pace with the overall trend. The base case projection, therefore, with or without a fixed link will be to sustain 3.5% annual growth in tourism, broadly based on recent trends for the Great Northern Peninusula. This would be applied to a base number of visitors of 13000. This is derived from overnight visits to Labrador in year 2000 inflated by 3.5% per year to year 2004.

There is a basis to consider that the annual growth in visits can be sustained at its current level, and possibly increased with completion of a fixed link based on improved accessibility for vehicles. Emphasis on related marketing initiatives in the study area will influence the actual outcome. The excess growth over the base case projection will be used to estimate economic spin-offs attributable to construction of a link.

As mentioned above, tourist spending will be determined at the rate of $62.35 per person-night. Induced trips are based on the average overall stay of 11 nights in the province, and diverted trips are consider to add on the Great Northern Peninsula and Labrador to an existing itinerary, so one night per trip is considered to be the incremental stay. These are the factors applied to incremental trips to estimate total tourism direct expenditures as inputs to estimates of economic impact.

New Economic Developments To Attract Long Term Commercial Vehicle Traffic

Labrador is a large land mass with significant natural resources. One may envisage a long term scenario in which the development of such resources could lead to the populating of southeast parts of this land mass and to the increased movement of people, goods and services from one part of the province to the other. In such a scenario, a fixed link would promote the development of more vibrant and viable communities on both sides of the Strait. It is in the context of such a vision that a review was made in this study of potential industrial development opportunities in Labrador and how such developments might foster population growth in the area and movement across the Strait.

Mining

While there is a large mining industry in Labrador, it is located in the west and north. Discussions with the provincial government suggest that the opportunity for significant mining development in southeast Labrador is low given the geological structure of the area. This part of Labrador falls within the Grenville province which is known primarily for dimension stone rather than any commercial quantities of minerals. There may be pockets of small deposits but these would not be expected to lead to large-scale developments like Voisey's Bay, for example. If there were to be mining developments in the area, product would be very likely shipped by sea to its destination.

Forestry

A rather spasmodic, small forestry industry has existed in southern Labrador for a long time as a number of small sawmills have come and gone. Various plans have been developed for major lumber and pulp enterprises, perhaps the largest of these being the proposed harvesting of fibre for the former linerboard mill at Stephenville on the Island of Newfoundland. Today, pulpwood is cut in the Port Hope Simpson area and is barged to the Island for use by Abitibi Consolidated in Stephenville. It would not be cost competitive to ship fibre by road through a fixed link given today's fuel and paper prices, except in periods of high demand and constrained capacity by water. A small amount of lumber is also sawn as a part of this operation for use in the local area.

It might be argued that a larger sawmill industry could ship finished lumber through a fixed link to the Island for retail or for transhipment to other points. It is also possible that, if the road along the Quebec north shore were completed as part of an overall link project, lumber could be shipped westward by road.

Natural Gas

The Labrador Shelf holds substantial reserves of natural gas as proven during exploration in the area in the late 1960's. The current technology for producing, processing and shipping natural gas from offshore fields is through either a pipeline to shore or liquefying offshore and shipping in special LNG carriers. Developments are also underway to research, design and test vessels for the transport of compressed gas, without liquefaction (the so-called CNG technology), particularly from harsh environment areas such as the Grand Banks where a simplification of the processing that is done offshore would be beneficial. When, and if, Labrador gas is developed, this method may have application. It is unlikely that a pipeline to shore would be feasible because of iceberg scour, and in any event, transhipment from shore would still be required to reach market. A fixed link between Labrador and the Island of Newfoundland would have no known benefit to such an industry.

Hydroelectric Developments

The development of hydroelectric capacity on the Lower Churchill River has been referred to in this report in the context of transmitting some of the power developed to the Island of Newfoundland. The potential capacity at two sites on the river is approximately 3000 MW. It has been stated on various occasions in the public domain that these projects represent the single largest and lowest cost undeveloped hydroelectric potential in North America. One concept, which would mesh with the overall vision of integrating the two parts of the province and promoting the development of northern Newfoundland and southern Labrador, is to build an industry, based on aluminum smelting, around the availability of electricity from a Lower Churchill Development. It is well known that aluminum smelters use large amounts of electricity and the major international companies locate plants around the world at sites of low-cost power. One of the latest examples is an ongoing development in Iceland in which Alcoa is building a smelter that will use power from a new

hydroelectric development in that country. There are several such existing developments in Quebec also. If one considers the concept presented in this report of a fixed link with electrical transmission cables to the Island of Newfoundland, locating a smelter at the south end of the Strait, say, in the vicinity of the fixed link terminus would be more or less synergistic with the overall objective of government of physically linking the two parts of the province, providing electrical power to the Island from the Lower Churchill, and of providing an opportunity for social and economic success in northern Newfoundland and southern Labrador. However, aluminum smelting in this area has been studied on several previous occasions and has not been pursued. There are many factors that must be considered by a large industrial customer, such as an aluminum smelter, in siting a processing facility, that are beyond the scope of this report.

7.1.3 Traffic Projections – Fixed Link

The primary generators of new traffic for a fixed link are tourists (entering the province by both air and road) and freight that could possibly be diverted from other routes. The tourist market has potential for significant new growth once the link is open. The freight market will likely experience modest growth and some diversion from Marine Atlantic services. The traffic growth rates assumed for the crossing, with and without a fixed link, are presented in Table 7.4.

Table 7.4 Traffic Growth Rates for Fixed Link

% Annual Growth Rates	Without Fixed Link	With Fixed Link			
		Continuing Growth	Plus Post Completion Increment		
			One-time effects		Annual Increment to Growth
			Shift	Tunnel Surge	
Strait of Belle Isle					
Tourists	3.5%	3.5%			1.25%
Local and Business	2.2%	1.5%		30.0%	
Tractor-trailers	2.5%	2.5%			
From Marine Atlantic					
Auto	2.5%		10.0%	3.0%	1.50%
Tractor-trailers	2.5%		15.0%		1.00%

Projections of traffic growth rates without a fixed link are based on a 3.5% increase in overall tourist traffic as explained earlier, with an overall growth rate for all vehicles of 2.5% per year based on long term historical trends for total traffic to the Island of Newfoundland. Using 3.5% growth for the tourist component, results in a 2.2% growth for the local and business component, to achieve an overall growth of 2.5%

Post completion of the tunnel, four types of changes are evaluated.

- One time surge in demand affecting local and business traffic;
- Diversion from Marine Atlantic to the new fixed link;
- Sustained annual growth as indicated in the right hand column of Table 7.4
- Induced demand

The Confederation Bridge between Prince Edward Island and New Brunswick stimulated a 54% one time surge in traffic that has been sustained, but is not growing significantly from that new threshold. This suggests that travellers already operating on the route are now going back and forth with greater frequency because of the convenience of the fixed link. In the case of the proposed link across the Strait of Belle Isle, population density on either side of the link is considerably smaller than in the case of Prince Edward Island and New Brunswick and the diversity of trip purposes is relatively more restricted. Consequently, a more conservative estimate of one time surge to local and business traffic levels of 30% is used for this link. After the start of operations, the annual growth rate is used of 1.5%, slightly less than the 2.2% prior to the surge.

Determining the amount of diversion from Marine Atlantic to a fixed link is a more difficult proposition. In the first case, only that portion of traffic originating west of Québec City is likely to consider a Labrador alternative. In total, this market is about 30 to 40% of the traffic on Marine Atlantic, and a 10% overall diversion represents a significant portion of this market. With a continuous new road built along the north shore of the Gulf of St. Lawrence, some drivers might be induced to try this route, and if the experience proves rewarding then word-of-mouth advertising could sustain a reasonable growth rate.

With this optimistic outlook, the forecast traffic is based on 10% diversion of passenger vehicles from Marine Atlantic to the new fixed link. A one time induced surge in new volume equal to 30% of the diverted traffic, results in an initial traffic base for the new link that would be 13% of the previous year's projected traffic for Marine Atlantic. This traffic is assumed to continue to grow at the annual rate of 1.5%. Sensitivity analyses will test the significance of these assumptions to the overall economic assessment for the project.

With respect to freight, a net diversion from Marine Atlantic in the first year of 15% of the previous year's vehicle traffic is assumed. This is equivalent to 10% of the total trailer and container traffic to the Island, expressed as a percentage of Marine Atlantic. It is further projected that this volume will be sustained and continue to grow at a compounded annual rate of 1%.

Graphical representation of the growth in passenger and freight vehicle traffic both before and after completion of the tunnel is shown in Figures 7.1 and 7.2. The pre-operation traffic projections are self-evident, and the impact of the introduction of a fixed link is clearly shown by the sudden increase in traffic and the subsequent increased growth.

Passenger vehicle projections show the growth of the existing tourist and local markets. The largest segment, growing to approximately two thirds of the total traffic by the end of the study time frame, represents diversion and induced traffic. There is a need for more reliable information to understand this market segment and improve on these projections as the project moves forward.

A similar caveat applies to the forecasts for tractor-trailers. In this case, the reliance on traffic diversion and induced demand is even more prominent because the induced component is approximately seven times the existing traffic levels.

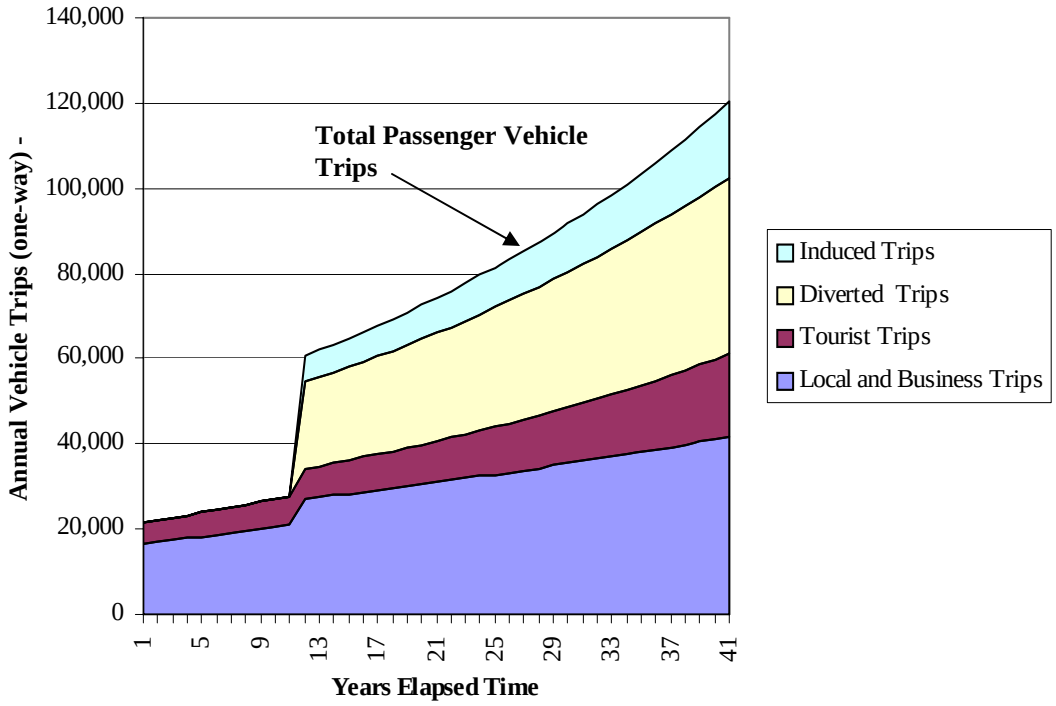

Figure 7.1 Passenger Vehicle Traffic Projections – Fixed Link

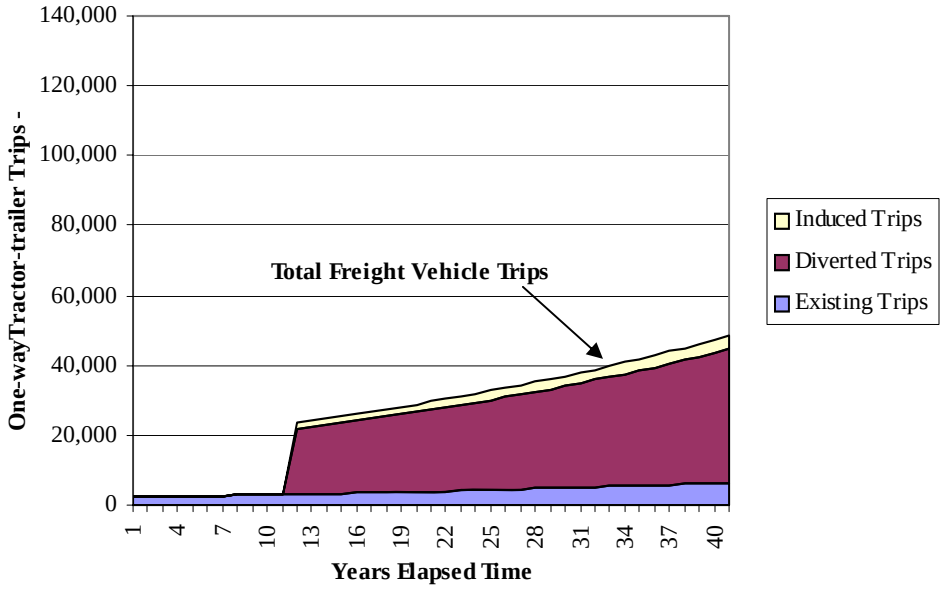

Figure 7.2 Freight Vehicle Traffic Projections – Fixed Link

Freight Transportation Considerations

Transportation carriers estimate that inbound shipments to Newfoundland exceed outbound shipments by a factor of four or five to one. The large front haul imbalance creates a very competitive environment for Newfoundland back hauls. It also assists forecasting of freight traffic since one can concentrate on the factors influencing inbound shipments. This latter statement follows from the presumption that outbound shipments can be easily handled within the surplus available capacity. If one can reasonably estimate the number of traffic units required to accommodate inbound shipments, then total movements are simply inbound traffic units times two.

During the 1980s, Transport Canada's Economic Analysis Division completed an analysis of Newfoundland's inbound freight shipments over a period of approximately 20 years. This analysis concluded that there was a correlation between Newfoundland general freight shipments and changes in provincial Real Gross Domestic Product (Real GDP). For each one percent change in Newfoundland GDP, inbound freight shipments would on average be expected to change by 0.8 to 1.0 percent.

In recent years, the Province of Newfoundland and Labrador has experienced very high real rates of growth due largely to offshore petroleum developments. Provincial economic performance for the past five years is summarized in the Table 7.5. Annual rates of growth during this period exceed national performance by approximately 90%. The largest single increase occurred in 2002. The Terra Nova offshore development commenced production then and rapidly achieved full production levels. An increase in Hibernia output also contributed to the strong growth in the same year.

Table 7.5 Newfoundland Gross Domestic Product (1997 Dollars) 1999-2003

Year	Nfld. GDP (millions)	% Change Nfld.	% Change Canada
1999	11,715	5.5	5.5
2000	12,400	5.8	5.3
2001	12,509	0.9	1.9
2002	14,432	15.4	3.3
2003	15,364	6.5	1.7
1999-2003, Average Annual Growth		6.8	3.5

While healthy growth in inbound shipments has been recorded for the period being examined, it is evident that there has been a disconnect between rates of growth in Real GDP. Inbound freight shipments (shown in Table 7.6) have grown by an average of 2.75 per cent during the 5 year period being examined which is about 40% of the increase seen in Real GDP, or one-half the historical expected rate of growth. Both major carriers have participated in the growth of the freight market from 1999 to 2003, with Oceanex increasing its share slightly.

Offshore developments and their concomitant effects on GDP, although positive, did not translate into equivalent impacts in employment and other measures of economic activity.

There is relatively little inbound freight tonnage from Goose Bay to the Island of Newfoundland or from either northern or southern Labrador communities. Freight activity to coastal communities is largely of a re-supply nature and only a limited amount of freight has been travelling on the *Apollo* service from Blanc Sablon to the Island ferry terminal in St. Barbe. As noted earlier there was a one time surge in volume during 2003, but this is excluded from the current forecasts.

While general measures of economic activity in the 1999-2003 period have indicated robust growth in the Province, there has been significant emigration and Provincial unemployment levels hover in the 15-17% range. On the Great Northern Peninsula and in Labrador, unemployment rates are as high as 24%. Clearly not all of the wealth generated in offshore petroleum fields has translated into similar increases in demand for general freight and indeed for a number of economic measures. General freight growth has of course been positively influenced by the petroleum industry and has achieved a very respectable 2.75% per annum increase despite the significant emigration and high levels of unemployment.

Table 7.6 Estimated General Freight Tonnage, Mainland to Newfoundland, 1999-2003

Marine Atlantic	1999	2000	2001	2002	2003
Tractor Trailers	337,114	338,805	342,187	356,517	351,746
Drop Trailers	322,091	325,865	338,242	329,496	353,472
Straight Trucks	9,672	9,536	10,062	9,601	9,705
Other	3,520	4,570	1,330	0	0
Total M.A. Tonnes	672,397	678,776	691,921	695,614	714,923
% of Total	59.5	59.7	59.2	58.0	57.8
Oceanex					
Containers	426,760	423,056	443,751	466,144	485,704
New Vehicles	33,656	34,365	33,849	37,378	35,833
Total Ocean. Tonnes	460,416	457,421	477,600	503,522	521,537
% of Total	40.5	40.3	40.8	42.0	42.2
Total Inbound Freight	1,129,293	1,136,197	1,169,521	1,199,136	1,236,460
Annual % Change	4.7	0.6	2.9	2.5	3.1

There are some indications that emigration is levelling off and that the Newfoundland and Labrador economy will continue to record positive rates of growth in the 2.5% range for both 2004 and 2005. For years beyond 2005, the Newfoundland and Labrador Department of Finance notes that GDP will increase at higher rates owing to oil from the White Rose offshore project and the start of Voisey's Bay nickel production. The Department of Finance has adjusted future GDP projections to "exclude production income from major projects accruing to non-residents." These adjusted numbers show very little growth in the 2006-2007 period. It is interesting to note that the adjusted Real GDP figure for 2003 shows a 2.0% increase versus an unadjusted growth of 4.7%.

Based on recent history and the projection of modest growth for the short to medium term, a 2.5% per annum growth for general freight shipments for the duration of the study period is considered to be realistic as a base case.

Traffic diversion and induced demand represented the dominant source of traffic, as noted earlier. The reasons for great caution and uncertainty concerning this diversion potential are explained below.

The discussion, which follows is intended to reflect a carrier's perspective and largely pertains to driver accompanied traffic. Furthermore, the modal choice variables discussed are not mutually exclusive.

Distance Travelled

For shipments from central Canada to the Island of Newfoundland one can compute the impact of a fixed link by choosing common link points. Two common link points for a central Canadian shipment to Newfoundland using a fixed link or the existing Gulf Ferry service are Quebec City and St. John's as shown on Figure 7.3. Presupposing a highway is constructed along the north shore of the St. Lawrence to connect the Labrador Straits area with Natashquan and points west, driving distances from Quebec City to St. John's are roughly equal. There will therefore, be no distance advantage for highway-based travel from Central Canada to the Island of Newfoundland using a fixed link.

For travel from the Maritimes using Halifax as the point of departure, the fixed link route would add approximately 1,450 kilometres to a St. John's destination compared to the existing highway/Gulf Ferry connection. Therefore, for all practical purposes the fixed link routing alternative is not a viable alternative for Maritime province based travel.

Travel Time

Travel time is a function of distance and operating speed. From the above, using the Quebec City and St. John's link points, distances for both alternatives are equal. Operating speeds on the highways however could be expected to be different. Operating speeds on the Trans-Canada Highway from Quebec City to St. John's will be in the 100-110 kilometre per hour range. Virtually all of the Quebec to North Sydney portion of the highway is, or soon will be, four lane controlled access highway with posted speeds ranging from 100 to 110 kilometres per hour. Travellers along the North Shore of the St. Lawrence can be expected to experience operating speeds of 80 to 90 kilometres per hour. Similar average operating speeds on the Great Northern Peninsula section of highway can be expected. The Gulf Ferry takes approximately 6 hours with all vehicular traffic requested to be at the terminal at least one hour in advance of sailing (i.e. total of 7 hours). The fixed link crossing would take about 25 to 60 minutes, inclusive of terminal time. Thus a travel time advantage will occur in respect of the crossing.

Combining the impacts of operating speeds and crossing times, however, there is minimal difference in overall travel time from central Canada to the Island of Newfoundland. Figure 7.3 shows road distances between Quebec City and St. John's with driving times calculated based on the above speed assumptions. Ferry crossing times are not included in the times shown.

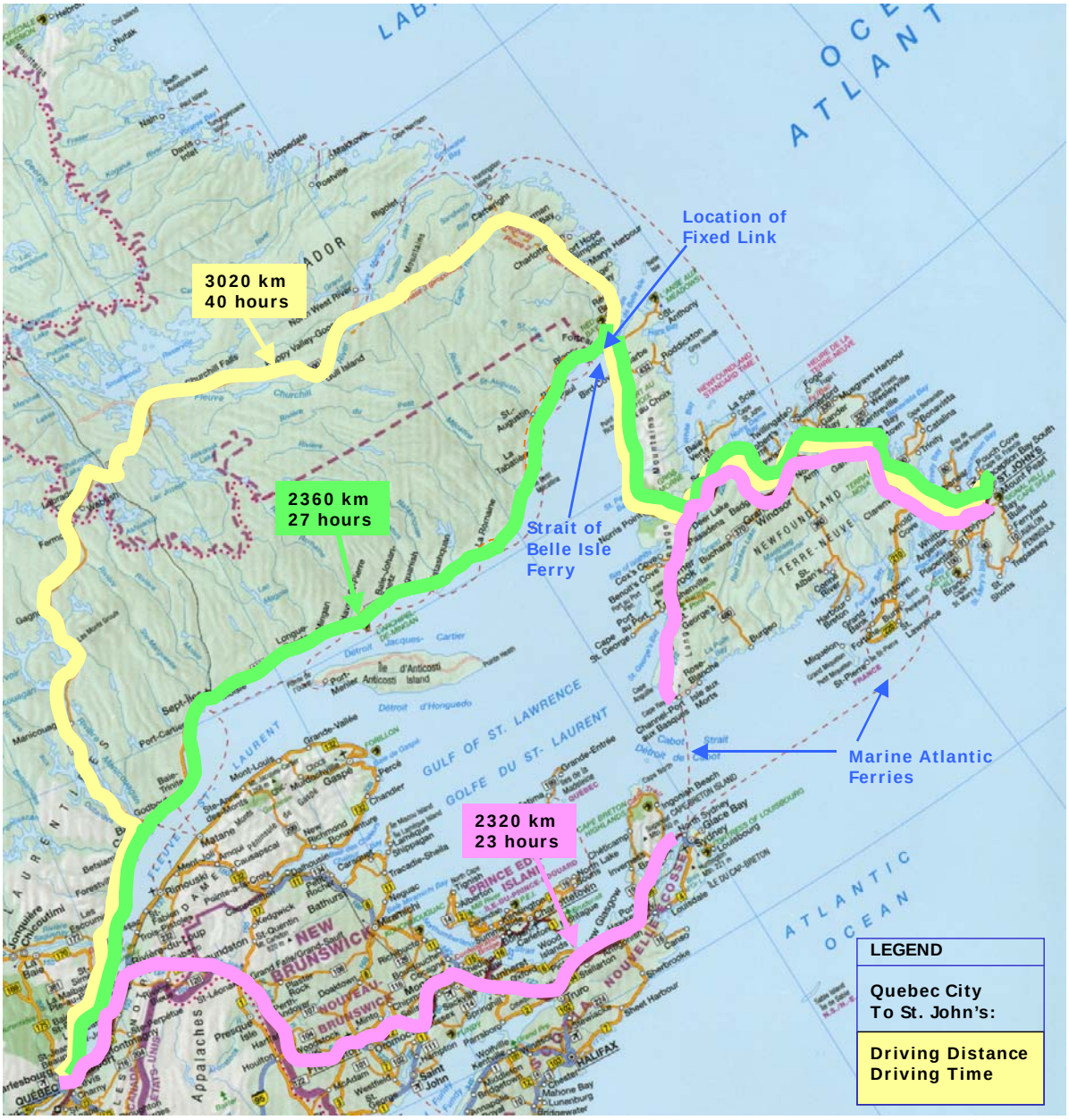

Figure 7.3 Travel Distances

Reliability

Service interruption due to unfavourable ambient conditions (high winds, ice conditions) or vessel repairs is a frequently mentioned concern associated with the Gulf Ferry service. The proposed fixed link will be immune to ambient conditions in the Strait of Belle Isle and from this perspective will provide heightened reliability compared to the Gulf Ferry service.

Winter weather conditions along the north shore of the St. Lawrence and the Great Northern Peninsula are probably worse than those along the Trans-Canada Highway for travel from Quebec to Nova Scotia although detailed inspection of meteorological data and the impact on highway conditions was not carried out for this study. With respect to mechanical interruptions, a fixed link rail tunnel is likely to have a reliability advantage over the ferry.

In total, therefore, a fixed link and connecting roadway accesses would be expected to provide an enhanced level of reliability compared to the existing highway and ferry alternative.

Terrain

Roadway gradients and curvature are significant contributors to operating costs for motorized freight traffic. Steep coastal fjords are present along the North Shore of the St. Lawrence and through parts of the Great Northern Peninsula and, potentially, create a large number of steep inclines/declines. While these conditions are present along the Trans-Canada Highway from Quebec to Deer Lake (notably in the Riviere du Loup to Edmundston and Cape Breton sections) their length is relatively short and mitigation has occurred as a consequence of geometric improvements to the highway. An operating advantage to the existing Gulf Ferry route would occur as a consequence.

Weight Limitations

Restrictions on the Gross Vehicle Weights (GVWs) of trucks are imposed on Canadian highways to reflect vulnerability of underlying roadbeds and/or surface material to heavy loads. These restrictions are frequently implemented during spring operating conditions but can be imposed year round if highway quality dictates. Trans Canada Highway weight limits are generally unrestricted year round. Since the alternative route via the north shore of the St. Lawrence is yet to be constructed, it would be reasonable to expect that weight limits would also be unrestricted on this route.

Claims

Damage to vehicles or cargo is a function of operating conditions and the quality and frequency of handling. Operating conditions along the existing route are considered to be more favourable than on a future route along the north shore of the St. Lawrence and on the Great Northern Peninsula. While this would lend some support to the existing route, one must also consider the impact of vessel loading and marine operating conditions on the Gulf Ferry service. Operating conditions dictate that freight traffic is tied to the vessel deck to prevent damaging movements of vehicles. Drop trailer traffic is also tied down but is loaded and unloaded with yard tractors. Marine Atlantic staff is believed to have a good claims record for these procedures but damage does occur. It is felt that the fixed link route will have a marginal net advantage in claims experience.

Competition

One of the factors affecting utilization of new routing alternatives is the presence and viability of competing means of access. The existing Gulf Ferry service is a constitutional commitment of Canada to the Province of Newfoundland, which is enshrined in the 1949 Terms of Union. Furthermore it serves an important trade corridor that will not disappear with the construction of a fixed link.

There will always be a need for a robust, and likely subsidized, ferry service. The degree of subsidization may be an issue if a fixed link is built. The Gulf Ferry, during 2003, achieved an operating cost recovery of 57.6%. On a total operating budget of $111.1 million, a federal subsidy of $43.8 million was required. Pressure to reduce the operating subsidy, and even make a contribution to capital requirements, would likely ensue if a fixed link were constructed.

Increases in rates and reduction of operating costs through efficiencies and/or service level reductions would be targeted but their overall occurrence and degree of such moves would be a matter of government policy. Given that the current rate for moving a 60-foot tractor-trailer and driver across the Gulf Ferry Service is $284.25 while the comparable rate for the *Apollo* Service is $161.25 (the assumed rate structure for the fixed link) some price elasticity of demand impacts on the Gulf Ferry service would be expected and are accounted for in the traffic diversion estimates.

Oceanex, in providing service from Montreal and Halifax to St. John's and Corner Brook, is an important player in Newfoundland freight transportation, having some 42% of the market place in 2003. The company has increased the overall volume of traffic moved and its market share during the past five years. In December of 2003, Oceanex announced that it would be purchasing a new 150-metre ice-class container ship to be delivered in 2005. The new vessel will increase weekly capacity from Montreal by some 350 TEU's per week and provide operating efficiencies in the form of fuel savings and a fully automated engine room. The new ship will be designed to handle 53-foot containers and have movable container cell guides to provide maximum operating flexibility for future changes in customer requirements. Oceanex may also increase the frequency of Halifax sailings if they decide to retain the M.V. *Cicero* and thus expand the fleet size from three to four vessels.

The overall likely outcome of the Oceanex capacity addition is that the company will strengthen its competitive position with respect to all existing and contemplated freight options to Newfoundland. The freight traffic forecasts for a fixed link, therefore, contain no diversion of traffic from Oceanex.

Table 7.7 summarizes the discussion on modal share variables that will affect freight shipments to Newfoundland in a fixed link environment.

Table 7.7 Modal Share Variables and Impacts

Variable	Fixed Link vs Gulf Ferry Alternative	Conclusion
Driving Distance	Equal distance for Central Canadian traffic but significant advantage to Gulf Ferry for service via Maritimes	Gulf Ferry position is strong for Maritime traffic and neutral for Central Canadian traffic
Travel Time	Operating speeds in favour of Gulf Ferry route and crossing time differentials in favour of fixed link essentially balance out	Neutral
Reliability	Crossing reliability higher for a fixed link but winter highway conditions may be more favourable for Gulf Ferry route	Increased reliability for fixed link
Terrain	More difficult terrain on fixed link route will increase operating costs versus Gulf Ferry Route	Gulf Ferry route is superior
Weight Limitations	Weight restrictions along the Northshore St. Lawrence highway will likely be upgraded to TCH standards	Neutral
Claim	Claims from poor operating conditions along North Shore St. Lawrence highway more than compensated by handling claimed on Gulf Ferry service	Slightly better claims experience with fixed link
Competition	Gulf Ferry service and direct water services will remain with good quality / frequency of service to compete with fixed link	Gulf ferry is more vulnerable than direct water service but will still be a very significant component of future freight service.

7.1.4 Traffic Projections – Upgraded Ferry

For the upgraded ferry it is important to analyse the practicality of increasing the service. During July and August, the MV *Apollo* presently provides up to three return voyages per day. For a 90 minute crossing and 60 minute turnaround at the terminal, this presents a 13.5 hour operating day. By increasing the operating day to 18 hours, four return voyages are possible. This is considered to be the maximum number of trips for a single ship ferry. An upgraded ferry service would therefore, extend this maximum service level for a longer season and provide service for the rest of the year. The proposed service frequency is presented in Table 7.8, with the existing frequency for comparison.

Table 7.8 Ferry Service Frequency for Strait of Belle Isle

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Trips/Month													
Present	9*	0	0	0	52	52	74	74	56	56	43	19*	435
Upgraded	93	84	93	120	124	120	124	124	120	120	90	93	1305
Trips/Day													
Present	1-2	0	0	0	1-2	1-2	2-3	2-3	1-2	1-2	1-2	1-2	
Upgraded	3	3	3	4	4	4	4	4	4	4	3	3	

*varies with weather conditions

For the single ship, this level of service would result in scheduled sailings, at 5 hour intervals. Therefore, a traveller would experience a minimum of 2.5 hours travel time for the crossing and a maximum of 7 hours, the latter if the traveller misses or fails to get on a particular sailing.

Projections were developed for a case representing substantial upgrade to the existing ferry services across the Straits of Belle Isle. Cost projections are developed to be representative of extending the operating season for as long as possible (essentially year-round operations for purposes of economic comparison). Ship replacement continuing with a status quo arrangement has been estimated to cost approximately $75 million (2004 dollars). The costs of an upgraded vessel are not precisely known because the vessel design would depend on service plans. For purposes of this analysis, a conservative estimate with a 100% premium is used. Therefore, approximately $150 million (2004 dollars) is considered to be the upgraded vessel cost representing a larger Ice Class 1A Ferry or two vessels of equivalent total capacity to offer higher peak frequency, using the same replacement timing as the base case.

The annual subsidy is presumed to double on account of a longer sailing season and increased frequency of sailing. This would represent approximately three times as many departures as at present, mostly occurring in the extended season, although there would be also peak season enhancement. The rationale for this estimate is as follows:

- Subsidy for operating the existing service is $5.5 million per year (2004 dollars), and the revenues would be approximately $2 million by year 11, for a total annual operating cost of $7.5 million;
- It is estimated that 50% of these total costs are variable with the number of voyages, that is $3.5 million (rough rule-of-thumb for fuel, crew and terminal wages, supplies and repairs);
- Tripling the number of departures would triple these costs to $10.5 million per year, bringing the total operating cost to $14.5 million per year (2004 dollars);
- With revenues in the range of $3.5 million in year 12, the gap that would be met by subsidies would be about $11 million, or approximately double the present subsidy.

The timing for introduction of service improvements would coincide with completion of the Highway 138 extension to Blanc Sablon, presumably in the same general time frame as is considered for the fixed link construction.

The growth assumptions applicable to the existing traffic base employed for this case are as follows:

- Tourist trips would continue to grow at an annual rate of 3.5% throughout the study time frame;
- Local and residential travel will experience a 15% one-time surge upon introduction of the new service, followed by growth at the rate of 1.5% annually.
- Tourist travel will experience increased annual growth of 0.5% following completion of the highway and introduction of the new service;
- Truck traffic would experience 2% (of total Oceanex and Marine Atlantic, equivalent to 3% of Marine Atlantic) diversion from the Cabot Strait and would continue to grow annually at previously established growth rates.
- Auto traffic would experience a 1% diversion from the Cabot Strait

These assumptions are presented in Table 7.9

Table 7.9 Traffic Growth Rates for Upgraded Ferry

% Annual Growth Rates	Existing Ferry	With Upgraded Ferry			
		Continuing Growth	Plus Post Completion Increment		
			One-time effects		Annual Increment to Growth
			Shift	Tunnel Surge	
Strait of Belle Isle					
Tourists	3.5%	3.5%			0.5%
Local and Business	2.2%	1.5%		15.0%	0%
Tractor-trailers	2.5%	2.5%			0%
From Marine Atlantic					
Auto	2.5%		1%	0%	0%
Tractor-trailers	2.5%		3%		0%

This set of assumptions is considered as reliable and appropriate as any other in the absence of detailed market data to test sensitivity to these improvements. The growth rates are reduced from those for the fixed link based on the less attractive level of service and potential delays associated with the upgraded ferry. The results, in terms of annual vehicle trips for passenger cars and trucks, are shown in Figures 7.4 and 7.5.

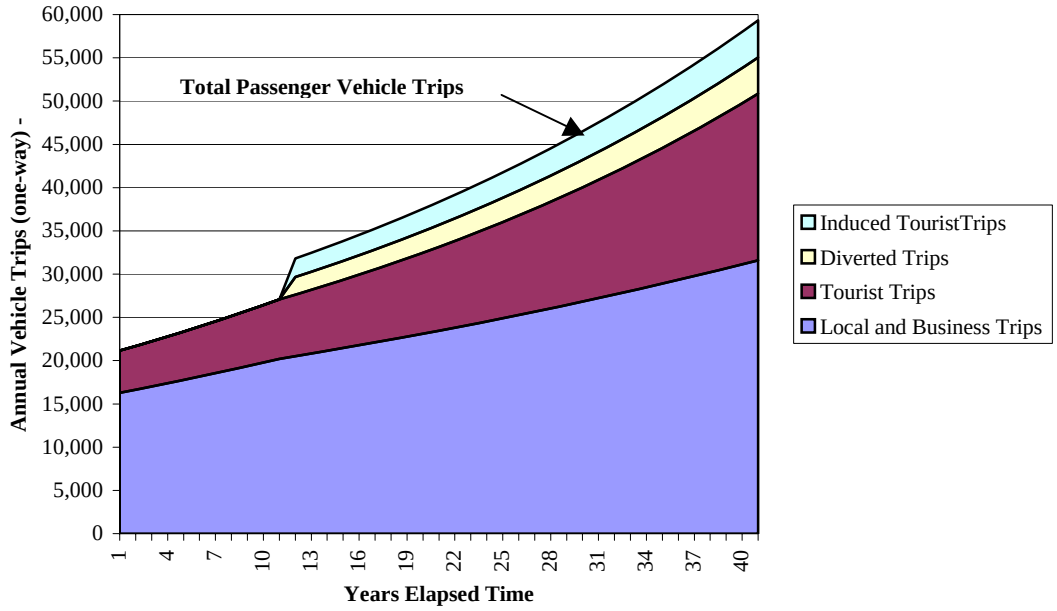

Figure 7.4 Passenger Vehicle Traffic Projections – Upgraded Ferry

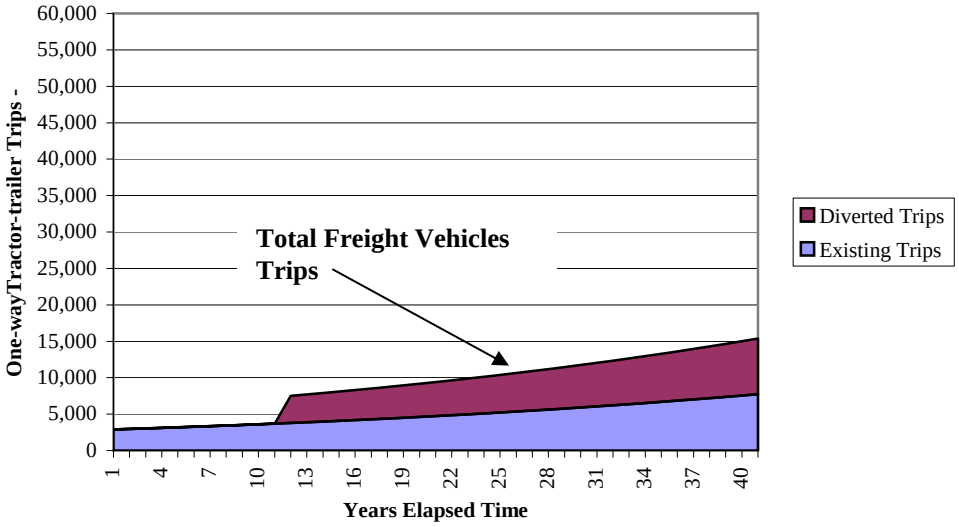

Figure 7.5 Freight Vehicle Traffic Projections – Upgraded Ferry

7.2 Tolls and Revenue Forecasts

Revenue forecast were devleoped for the three cases noted previously. Revenues were calculated based on existing *Apollo* tolls these are $30.50 per vehicle and driver and $10 per additional passenger. Freight revenues were based on the existing average revenue per tractor-trailer on the *Apollo*,of $161.25. The resulting revenue projections for the base case for the study operating period of 30 years are shown on Figure 7.6.

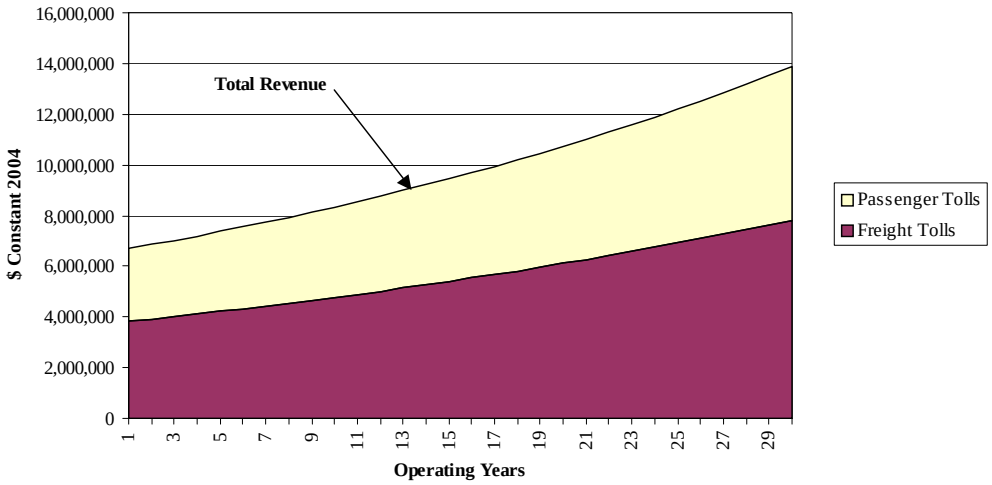

Figure 7.6 Fixed Link Revenue Projections

Similarly, Figure 7.7 shows revenue projections for the case of an upgraded ferry for the same operating period.

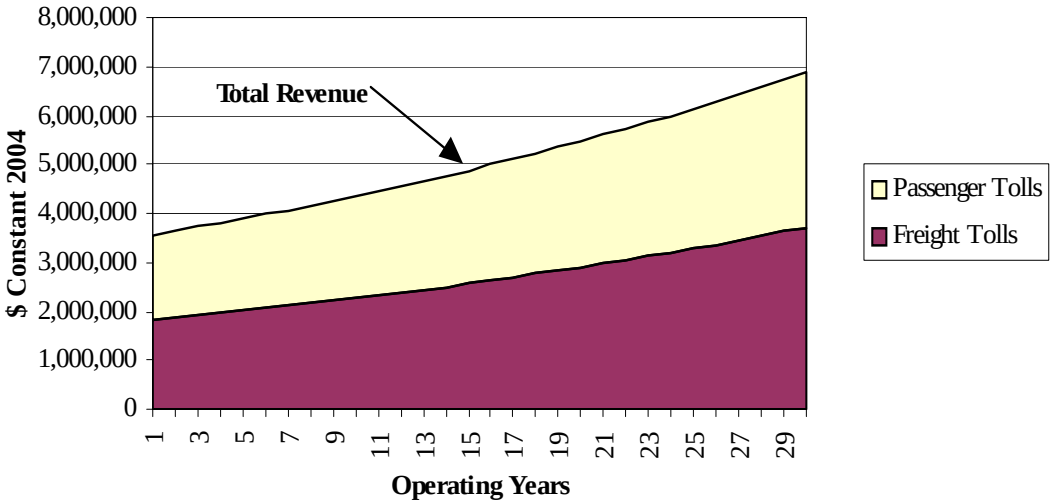

Figure 7.7 Upgraded Ferry Revenue Projections

The third case examined is the Base Case with revenue from HVDC transmission cables within a fixed link. Project cost estimates were developed to include HVDC power cables in the fixed link on behalf of Newfoundland and Labrador Hydro (NLH), as part of a future transmission line between Labrador and the Island. For purposes of the economic analysis, NLH also provided capital cost estimates to install submarine cables across the Strait. These costs would be avoided if the transmission line were to go ahead using the fixed link across the Strait. The incremental capital and operations cost attributable to the HVDC line in the fixed link are virtually insignificant compared to the other costs except for the power cables and their installation. The issue is how to value this opportunity for a power transmission facility. The approach applied to forecasting a reasonable revenue stream was based on the amortization of the avoided capital cost of an HVDC installation in the fixed link versus a dedicated submarine HVDC system over the 30-year time horizon of this study. The range of potential revenue streams considered is as follows:

- Cable cost recovery - that which results in neither incremental cost nor revenue to the tunnel owner – below that, losses would be incurred and be of no interest to the tunnel owner; this would be represented by amortization of the cable installation and annual cable maintenance costs;
- Highest possible revenue - the annualized equivalent of 100% of the costs that would be avoided by NLH by using this facility instead of building a dedicated crossing – higher charges would drive the power utility to a dedicated facility, if the market could support it;
- An intermediate value - revenue that might ultimately be negotiated between the tunnel developers and the utility.

In the absence of a final determination of developing the hydro potential of Labrador and the consequential decision to deliver hydro electricity to the Island of Newfoundland, the outcome of such negotiations is premature to predict at present. Consequently, for purposes of evaluating the revenue impact of hydro transmission, it was considered most reasonable to use a median between the limits and to calculation a case at 50% of the avoided cost of a dedicated hydro link. The upper and lower limits would be checked in sensitivity analyses. In all three cases, the annual fees are based on amortization to null residual value over a period of 30 operating years.

Table 7.10 Annual HVDC Revenue Ranges

$ Millions (constant 2004)	Lowest Limit	Highest Limit	Mid Point
Recovery of Cable Costs	$7.1	$7.1	$7.1
Transmission Revenue	-	$34.4	$17.2
Total	$7.1	$41.5	$24.3

Consequently, the transportation toll revenue would be augmented by a real constant annual amount equivalent to one of the totals shown in Table 7.10, depending upon the case under consideration. For purposes of the analysis, for the Base Case with HVDC income case, $24.3M per year was used.

7.3 Economic Evaluation

Three indicators of economic value are employed for the base case and various sensitivity tests that were conducted. The three indicators are Net Present Value (NPV), Internal Rate of Return (IRR), and Benefit Cost Ratio (BCR). Descriptions of the application of each of these are as follows:

- NPV is calculated using a real social discount rate of 7.5%, which is the recommended rate of the Federal Treasury Board assuming annual inflation at 2.5% over the project time horizon(i.e. 10% nominal). The net cash flow for each year (positive or negative) is discounted to reflect the equivalent value in 2004, and all the years are summed to one total NPV.
- IRR is calculated internally, before cash flows are discounted; it is the effective discount rate that would produce a null NPV.
- BCR is calculated using the same cash flow inputs as the NPV, except activities that are meant to produce benefits are separated from those that are meant to cause cost and are summed independently of each other. The ratio of the summed benefits to the summed costs is the BCR; values greater than one are desirable and suggest economic justification; values less than one are undesirable but not necessarily conclusive in themselves, without taking into account external factors that are not quantified in the analysis.

Each of the three indicators was estimated in accordance with three distinct perspectives for each case studied. The perspectives depend upon the nature of the observer (private investor, lending institution, government, etc.) and they reflect increasing scope from a strictly internal cash-flow perspective to a broader socio-economic context. The three levels are:

- **Internal revenues and costs** for planning, design, construction and operation of the tunnel – this would be the most appropriate perspective for a proponent considering stand-alone development and exploitation of the project;
- **Economic impacts** directly attributable to the fixed link, such as changes to the revenues and costs of existing marine ferries in the Cabot and Belle Isle Straits, and it would include some external effects such as environmental mitigation, safety enhancement, reduced delays and congestion etc. (which are estimated to be insignificant in this case) – this would be an appropriate perspective for a transportation economist to use to estimate net effects on the industry or on subsidies;
- **Socio-economic impacts** include consequential stimulation of GDP growth in the province from the activity of construction and subsequent tourism and other activities, and other externalites that might include quality of life improvements that could be estimated – these estimates are macro-economic in nature and tend to be used as public policy indicators; they are difficult to measure in small scale systems because data are rarely available; in this study, aggregate indicators used by the Newfoundland Department of Finance were provided to the team.

7.3.1 Internal Revenues and Costs

The profile of cash outflows over 30 years of operations for the base case after construction is completed is illustrated in Figure 7.8. In constant currency terms, the costs are uniform for a fixed level of operation except for periodic major maintenance consisting of major equipment replacement shown as peaks in years 7, 12, 16, 20, 25 and 30.

During the study, it was determined that the shuttle operation could be commissioned incrementally to match the development of traffic. This refinement has not been incorporated into the analysis. The full fleet is assumed in the first year of operation.

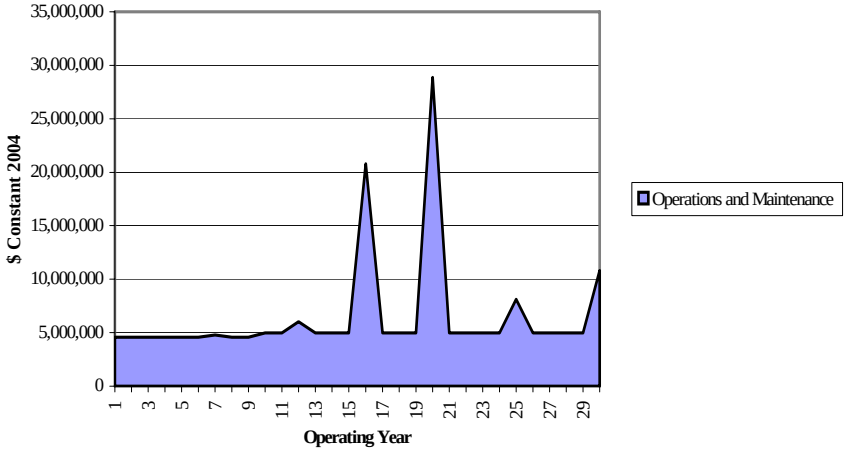

Figure 7.8 Costs by Operating Year

Figure 7.9 shows the effect of combining the revenue and costs from Figures 7.6 and 7.8 and converting the resulting cash flow to present value for the Base Case.

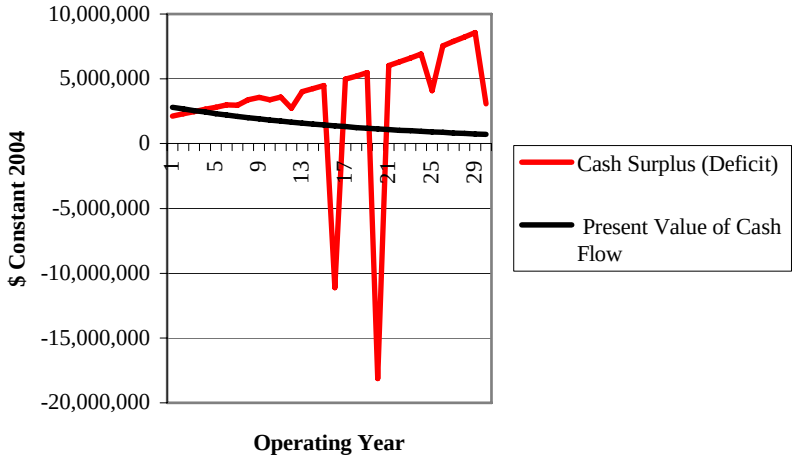

Figure 7.9 Operating Cash Flow in 2004 dollars

The upper red line in figure 7.9 represents the net result of subtracting the operating costs from the base case revenues and the lower black line represents those same values discounted to present value at 2004, considering also that year 1 in the graph is actually year 12 in the project life cycle. The effect of long time frames in a project of this nature are clearly evident in the gap between the two lines in Figure 7.9.

7.3.2 Present Value Analysis for Base Case

For the Base Case, project economics are presented for the entire project life cycle assuming an 11 year period of planning, design and construction and 30 year period of operation. Figure 7.10 presents the annual present values in 2004 dollars for the internal economics of the project. Figure 7.11 modifies these annual values by including the economic effects of avoidance of the present Strait of Belle Isle ferry operating deficit costs and minor adjustments that would result to the Gulf Ferry costs. Figure 7.12 further modifies the annual values by including the social benefits in terms of increased economic activity that may be caused by the project.

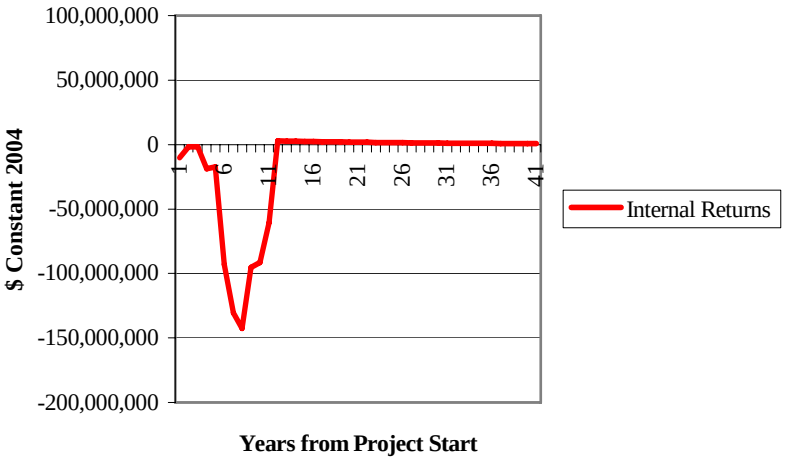

Figure 7.10 Annual Net Present Values (Internal Returns) Base Case

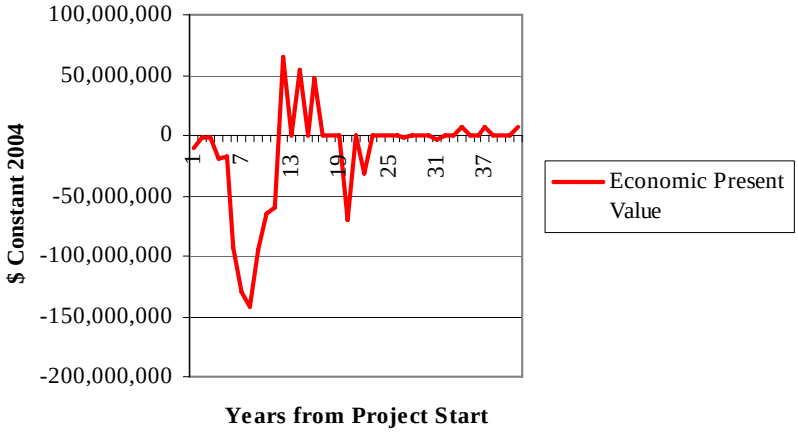

Figure 7.11 Annual Net Present Values (with Economic Returns) Base Case

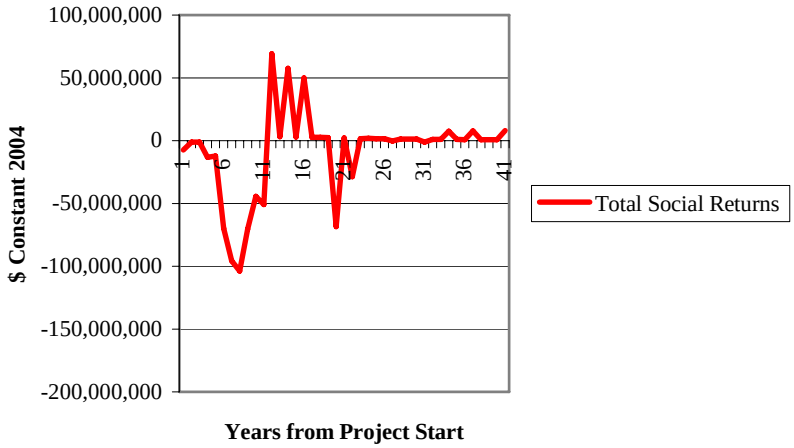

Figure 7.12 Annual Net Present Values (with Social Returns) Base Case

The capital development costs are shown, in Figures 7.10, 7.11 and 7.12, as negative amounts occurring in years 1 through 11. Since these occur early in the time frame, they are not so heavily discounted as the revenue stream, which does not start until much later. The economic present value graph, Figure 7.11, also includes the impacts on Marine Atlantic and the avoided costs of replacing the *Apollo*. Deferral and avoidance of ship replacements account for all of the positive peaks appearing post year 12. The ship replacement assumptions are the critical drivers of the external economic benefits. These assumptions would have to be reviewed, particularly with Marine Atlantic, in light of the actual projected timing of events if there is a decision to proceed further.

The projected economic impacts of tourism development, GDP stimulation and employment during construction are combined with the other benefits and shown in Figure 7.12. While these are significant in themselves, when discounted over a long period of time and compared with the scale of the costs of the project, they show up as minor. One exception occurs in the early years in which the GDP impacts of indirect and induced economic activity during construction offsets in part the impact of the costs.

The direct, indirect and induced impacts on GDP, wages and employment were determined using information provided by the Newfoundland and Labrador Department of Finance. The approach used is to split the impacts into direct, indirect and induced. Direct investment, labour income and employment information was provided by the project team. The indirect impacts (which are impacts generated when companies supply inputs to the direct activity) use indirect multipliers for standard industries generated from Economic Input/Output data. The induced impacts (which are impacts generated when direct and indirect employees and business owners spend their earnings in the general economy) are estimated using a multiplier of 0.3, but for employment this may need to be adjusted up or down depending on the average wage rates in direct and indirect industries. For example, the 0.3 induced impact is the average for the entire economy, but if the average wage in the direct and indirect industries is twice the average wage in the entire economy then more money will most likely be spent per direct and indirect employee and the induced impacts are larger. In this case we would use an induced employment multiplier of 0.6. If the direct and indirect wage rates were half the economy average one would use an induced multiplier of 0.15.

Specifically, in this project, and based on communications with the Department of Finance, the following parameters were selected:

For Construction:

Since the Transportation Engineering Construction industry is the industry which most closely resembles tunnel construction its parameters were used. For estimating direct effects, data for 2000 puts the GDP to gross output ratio at 34%, the labour income to gross output ratio at 22% and the employment per $1 million of expenditure/gross output at 6 full time equivalent jobs. To estimate the indirect impacts the following multipliers were averaged over the 1997 to 2000 period:

- GDP 0.63
- Labour income 0.53
- Employment 0.63.

The induced multiplier of 0.3 is applied to the direct and indirect impacts. (This is based on average annual labour income per person year (full year equivalent) of employment in 2003 at $35,200, calculated by dividing Labour Force Survey employment into total labour income from Statistics Canada Provincial Economic Accounts).

For Tunnel Operation:

Since the Rail Transportation is the industry that most closely resembles tunnel operation its parameters were used. To estimate the indirect impacts the following multipliers were used for rail transportation; they are averaged over the 1997 to 2000 period.

- GDP 0.28
- Labour income 0.85
- Employment 0.71.
- Induced multiplier 0.3.

For Tourism:

While data are available for auto and air tourism impacts, the travel information concerning the target market is sparse, and the time frame is relatively far out in the future so that composite industry assumptions are used. Based on 1998 spending Department of Finance came up with the following estimates of the direct impacts from non-resident tourist spending (excluding spending on marine transportation).

- Direct GDP 0.35
- Direct labour income 0.24
- Direct employment per $1 million, 12.8 full time equivalent jobs

The indirect multipliers are:

- GDP 0.44
- Labour income 0.33
- Employment 0.24.
- Induced multiplier 0.15.

7.3.3 Present Value Analysis for the Upgraded Ferry

For the upgraded ferry, the project economics are presented for the entire life cycle of the project assuming the implementation of the new service at year 12. Figure 7.13 present the annnual net present values in 2004

dollars for the internal economics of the project. The negitive peak at year 10 indicates the vessel acquistion the peak at year 40 shows the vessel replacement. Figure 7.14 modifies these annual net present values by including the economic effects of avoidance of the present ferry operating deficit costs. Figure 7.15 further modifies the annual net present values by including the social benefits in terms of increased economic activity that may be caused by the project. It should be noted that the social benefits associated with this case are relatively small.

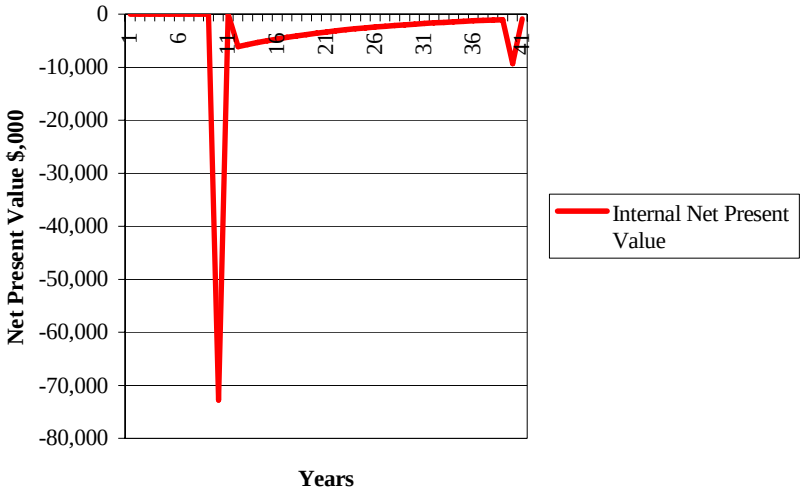

Figure 7.13 Annual Net Present Values (Internal Returns) Upgraded Ferry

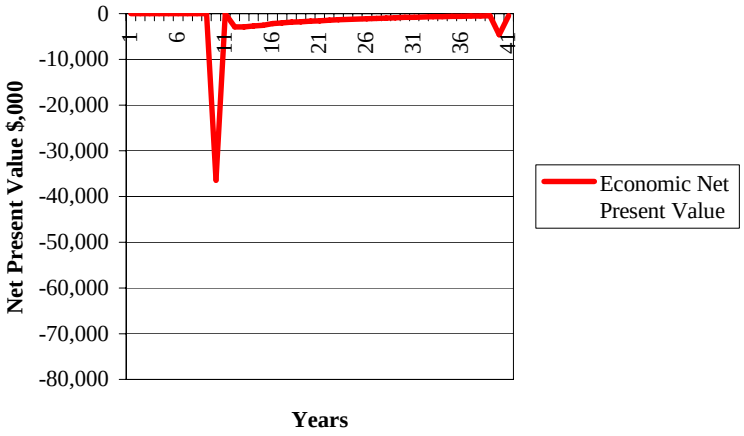

Figure 7.14 Annual Net Present Values (with Economic Returns) Upgrade Ferry

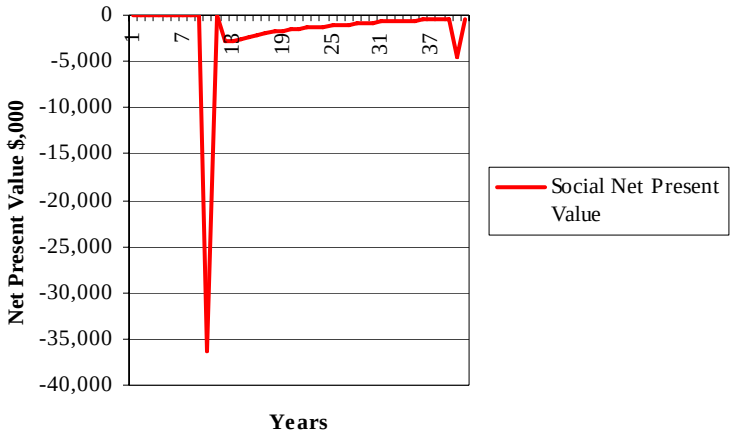

Figure 7.15 Annual Net Present Values (with Social Returns) Upgraded Ferry

7.3.4 Results of Economic Analyses

The results of applying the method outlined above to each case are shown in Table 7.11. The Internal Returns section of the table refers to the recovery of the fixed link or upgraded ferry investment and recovery of the capital investment (i.e. costs) from the operating benefits – cash flow from operations.

The Base Case and the HVDC Case have both positive and negative cash flow so all three measures are applied for comparison purposes (NPV, IRR and BCR). The Ferry Upgrade does not have any years with positive cash flow therefore IRR cannot be calculated. Results are shown in Table 7.11.

Table 7.11 Economic Evaluation Results

LEVEL	CASE	NPV	IRR	BCR
		$ millions 2004	%	#
Internal Returns	BASE CASE	- $648	-9.5%	0.07
	HVDC	-$554	-2.1%	0.25
	FERRY UPGRADE	-$164	N/A	0.13
Internal Returns & Economic Returns	BASE CASE	-$559	-5.2%	0.20
	HVDC	-$466	-1.0%	0.37
	FERRY UPGRADE	-$116	N/A	0.38
Internal Returns & Economic Returns & Social Returns	BASE CASE	-$333	-1.3%	0.53
	HVDC	-$240	1.6%	0.68
	FERRY UPGRADE	-$114	N/A	0.39

The following observations apply to Table 7.11:

- The NPVs are all negative - this clearly places every alternative in the realm of the public sector because quantifiable benefits are insufficient to sustain viability.
- Including HVDC in the fixed link improves all indicators and improves the NPV by $94 million (at 50% sharing of avoidable cost). At 100% of the avoidable cost, the NPV would improve by a further $84 million.
- Upgrading the Strait of Belle Isle ferry service is significantly less costly compared to the base case – the NPV for Economic Returns is negative $116 million. The negative $116 million NPV results from increases to annual subsidies for the ferry, plus Marine Atlantic loss increases resulting from revenue diversion, plus ship replacement.
- The Benefit Cost Ratios (BCR) are all substantially less than unity – suggesting that project justification, if pursued would have to depend on factors that are external to this study, e.g. consequences of electrical energy transmission, social and political considerations associated with uniting the Province with a physical link.
- The difference between internal cash flows and economic impacts generates an improvement in NPV around $89 million
- The Social Returns for the Base Case, which include GDP growth effects of incremental tourism and activity stimulated by construction of the fixed link generate additional impacts around $226 million NPV ($2004 dollars).

Figures 7.16, 7.17 & 7.18 show the data presented in Table 7.11 in graphical form for ease of comparison.

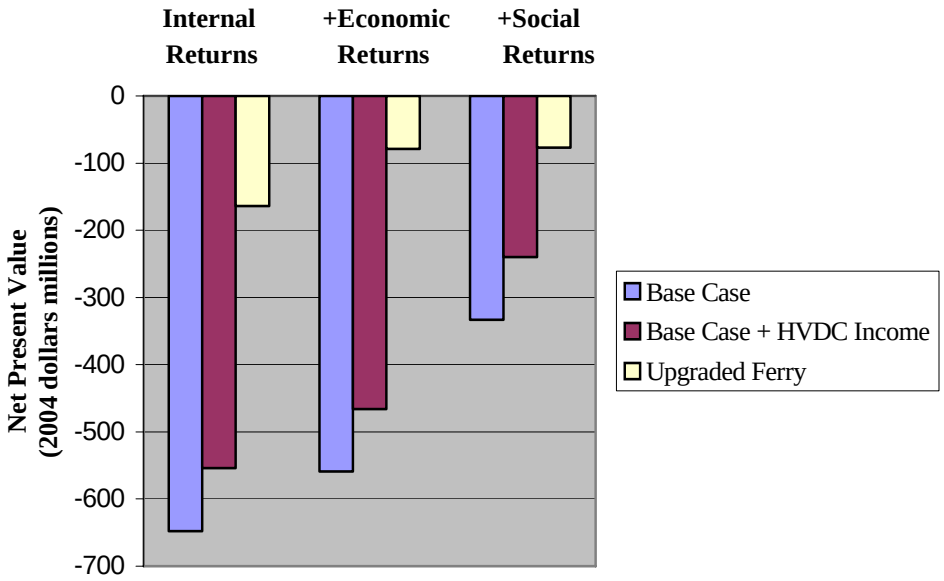

Figure 7.16 Net Present Values for Each Study Case

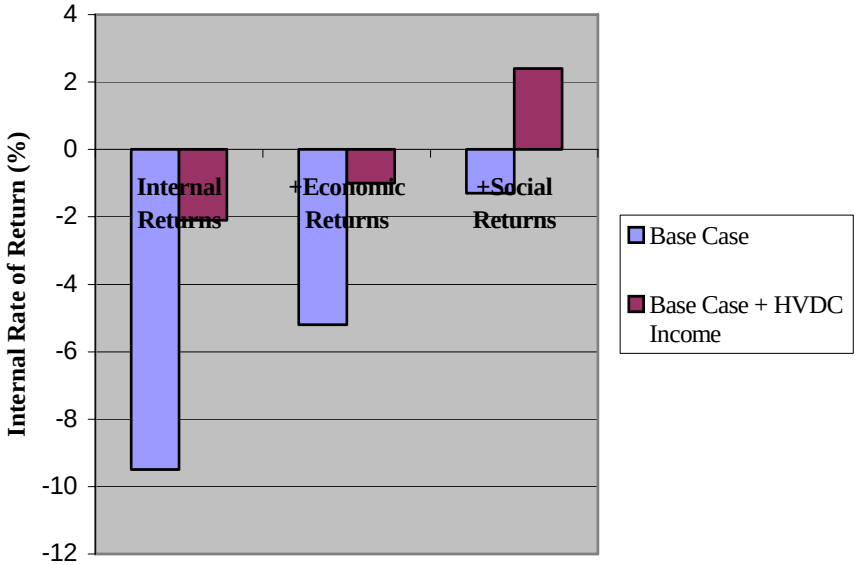

Figure 7.17 Internal Rates of Return for Each Study Case (where calculable)

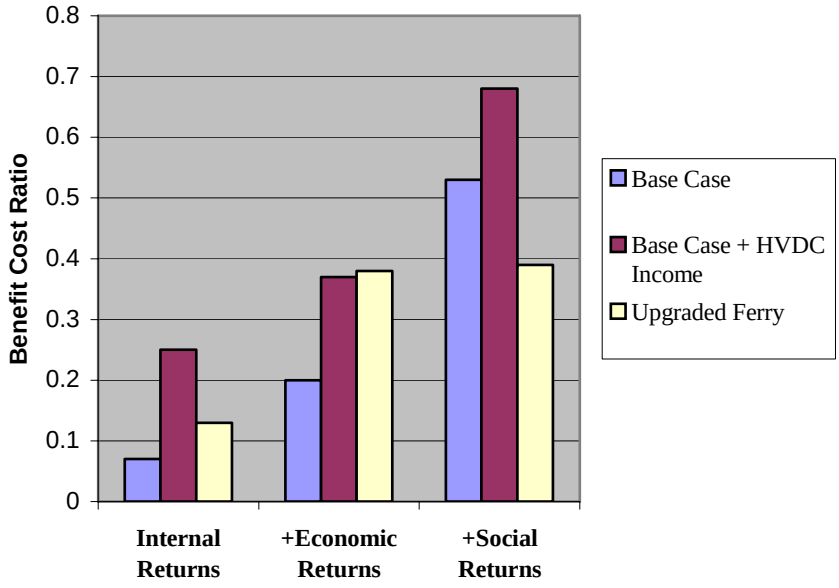

Figure 7.18 Benefit/Cost Returns for Each Study Case

In addition to the analyses described above, various sensitivity tests were carried out to determine if these findings are sufficiently robust and to support overall project conclusions. The sensitivity to electricity transmission tolls is significant, as mentioned above. Tolls for freight and passenger vehicles were also tested.

Table 7.12 below shows the results for a range of variation in toll revenues for the base case demand levels. For example, doubling the tolls with inelastic demand could have the effect of improving NPV by $46 million and increasing the Internal BCR from 0.07 to 0.14. The absence of reliable market information at this time precludes delving further into this topic. Demand factors and elasticity to tolls should be examined much more closely, particularly in the years approaching tunnel completion.

Table 7.12 Economic Sensitivity Analysis to Toll Revenue

			Unit Toll % of Base Case Value		
Results		**Base Case**	**50%**	**150%**	**200%**
Internal Project Revenues and Costs	NPV $millions	-$648	-$671	-$625	-$602
	IRR	-9.53%	N/A	-6.60%	-4.84%
	BCR	0.07	0.03	0.10	0.13
Economic Impacts	NPV $millions	-$559	-$582	-$536	-$513
	IRR%	-5.28%	-6.66%	-4.11%	-3.09%
	BCR	0.19	0.16	0.23	0.26
Socio-Economic Impacts	NPV $millions	-$333	-$356	-$310	-$288
	IRR	-1.4%	-2.5%	-0.4%	-0.4%
	BCR	0.52	0.49	0.55	0.59

Variations in traffic growth rates for different segments(e.g. local and business travelers, diverted tourists and induced travel) were evaluated. No major impacts were observed. In general, the range of change in NPV attributable to market variations is less than 10% of the base case over the maximum extent of the range, as reflected in Table 7.13.

Table 7.13 Traffic and Cost Sensitivity Analyses

Description	Range Tested	NPV Range $MM	NPV Range/Base Case
Toll Rates	50–200% of Base Case	69	11%
Diversion ex Cabot	0-15%	44	7%
Incremental Growth Rate	2.5-7.5%	20	3%
Operating Costs	50-200% of Base Case	46	7%
Capital Costs	70-130% of Base Case	398	61%

Operating and capital costs were also considered. Capital costs were tested over the design range of accuracy of the estimates for this pre-feasibility study (i.e. plus/minus 30%), as also shown in Table 7.13. Clearly, the results are very sensitive to capital costs and accuracy of cost estimates represents a significant risk factor going forward.

With respect to the upgraded ferry option, the significant factor is vessel replacement cost. If the actual vessel cost were $100 million, instead of $150 million, then the overall impact on NPV would be $27 million (2004

dollars). That is the NPV for Economic Impacts would be negative $52 million instead of negative $79 million.

Operating cost projection uncertainty is not very significant relative to capital cost. Over a range of half to double the base case value, the total impact is only 7% of the base case NPV. These costs are planning details that would have to be considered more thoroughly in a full feasibility study and operating plan, however they do not affect the general thrust of the findings in this report.

Table 7.14 Discount and Inflation Rate Sensitivity Analysis

		Nominal Social Discount Rate					Inflation Rate			
Results		**4.0%**	**6.0%**	**8.0%**	**10.0%**	**12.0%**	**1.0%**	**2.0%**	**4.0%**	**5.5%**
Operating Cash Flow	NPV $MM	-$985	-$858	-$746	-$648	-$564	-$584	-$626	-$720	-$800
	IRR %	-9.53%	-9.53%	-9.53%	-9.53%	-9.53%	-.9.53%	-9.53%	-9.53%	-9.53%
	BCR	0.17	0.12	0.09	0.07	0.05	0.05	0.06	0.08	0.10
Direct Economic Impact	NPC $MM	-$829	-$737	-$644	-$559	-$486	-$503	-$540	-$621	-$690
	IRR %	-5.28%	-5.28%	-5.28%	-5.28%	-5.28%	-5.28%	-5.28%	-5.28%	-5.28%
	BCR	0.30	0.24	0.21	0.19	0.18	0.18	0.19	0.21	0.23
With Indirect and Induced Impacts	NPV $MM	-$325	-$367	-$359	-$333	-$302	-$310	-$326	-$354	-$367
	IRR %	-1.42%	-1.42%	-1.42%	-1.42%	-142%	-1.42%	-1.42%	-1.42%	-1.42%
	BCR	0.72	0.62	0.56	0.52	0.49	0.50	0.51	0.55	0.59

Sensitivity to the social discount rate and to projected inflation is significant also. Table 7.14 illustrates results for comparison to the base case (Nominal discount rate – 10%, Inflation rate 2.5%). Higher discount rates improve the NPV and diminish the BCR because the front end costs are so high compared to the downstream benefits. A range of plus/minus 2% around the base case causes the NPV range to extend over 15% of the base case amount. This is a significant variation.

The inflation rate also is significant, and along with capital costs, represent the most significant risk factors in economic terms. The difference between 1% and 4% inflation is $217 million in terms of net present value or 33% of the base case NPV.

Finally, significant spikes in the costs and benefits are noted when the vessels in existing ferry services to the Island of Newfoundland need to be replaced, or additions to the fleet are required. The timing of these events have a more significant impact than variations to internal revenues or costs after the tunnel is operating. Further, these events can happen throughout the entire project lifecycle, especially in years prior to start up of revenues. A full feasibility study of the tunnel would require coordinated planning approach involving Marine Atlantic (with respect to funding decisions) and the existing ferry services to Labrador (with respect to both subsidies and funding ship replacement).

If Highway 138 were not completed, then it would be reasonable to compare the base case to a case with neither diversion nor incremental/induced growth, but with traditional growth levels sustained. In such a case the NPV would be reduced another $170 million. The consequential mitigation of negative value would be modest. In other words, without completion of Highway 138 to the tunnel entrance, in the same time frame as the tunnel is built, the Net Present Value of the tunnel project would be $170 million lower than with the highway. This is a major risk factor that would be removed with a commitment to complete Highway 138.

In summary, the major risk factors emerging from the sensitivity analysis are uncertainty in development and construction costs (not an unusual occurrence at this stage of considering a major infrastructure undertaking), uncertainty regarding completion of Highway 138 on the St. Lawrence Lower North Shore, and, to a lesser extent, inflation.

Employment impacts were also determined for each case described above. There is not much variation between the cases, and the overall impacts are summarized as follows:

- Employment during construction is around 350-500 Full Time Equivalent (FTE) jobs for 6 years
- 40 new permanent jobs for operations & maintenance, replacing the part-time ferry

Total employment impact including spin-off effects

- 1,000 FTE (approx.) during construction (6 years)
- 350 FTE initially on start-up, growing to 550 FTE over 30 years
- Net Present Value of all wages $400 million

A further sensitivity analysis was carried out for the ferry upgrade option in which the upgraded ferry is introduced at year 5, instead of year 11 to match the fixed link, as assumed in the previous analysis. This has the effect of increasing the size of the economic negative net present value from negative $79M to negative $84M as the costs are incurred earlier. This option does, however, provide the improved service at an earlier date than for the fixed link.