March 22, 2005

Commercial Navigation
Contextual Narrative

1. General Socioeconomic Context

a. *Production value of the interest:*

The Great Lakes and their connecting channels, the St. Lawrence River and the Gulf of St. Lawrence, provide a continuous deep draft waterway from the Atlantic Ocean into the heart of the North American Continent. Basically, the Great Lakes-St. Lawrence River Navigation System can be described as follows:

1) From the Atlantic Ocean to just downstream of Québec City, the system is a deep draft waterway. Transhipment facilities in that section of the river are among the deepest drafts in the world.
2) From just downstream of Québec City through Montreal Harbour, the system is defined as the St. Lawrence Ship Channel, with a 10.7 to 11.3 m draft waterway.
3) From Montreal through Lake Superior, the system offers a 8.2 m draft waterway.
4) The Montreal-Lake Ontario section of the St. Lawrence River, with a total of seven locks, provides a lift of about 70 m.
5) Lake Ontario is connected to Lake Erie by the Welland Canal and its 8 locks which provide a lift of about 99 m.
6) From Lake Erie to Lake Michigan-Huron, the waterway is the natural and dredged channels of the Detroit River, Lake St. Clair, and St. Clair River. There are no locks required to assist navigation in that section of the waterway.
7) From Lake Michigan-Huron to Lake Superior, the waterway rises about 6.7 m by way of St. Mary's River and 5 locks, all located at the outlet of Lake Superior.

On average, Great Lakes ports enjoy a nine and one half month ice-free navigation season. The Montreal and downstream ports of the St. Lawrence River are open year round.

In the United States, the Great Lakes-St. Lawrence River Navigation System connects with the Mississippi River Inland Waterway System at the south end of Lake Michigan, which has about 3,100 km of navigable shallow draft channels and provides barge transportation through the Gulf of Mexico. The Great Lakes-St. Lawrence River Navigation System also connects with the New York State Barge Canal near Buffalo, New York to provide a shallow draft link between the Great Lakes and the U.S. east coast ports (Atlantic Ocean) via the Hudson River.

In Canada, the Rideau, Trent, and Ottawa Canal systems link the hinterland with the Great Lakes and the St. Lawrence River. In addition, the shallow draft Richelieu-Champlain Waterway provides a connection between the Hudson River (U.S.) and the St .Lawrence River just downstream of Montreal.

With 90 commercial harbors and ports located throughout the system, the Great Lakes St. Lawrence River Navigation System is one of the World's major waterborne systems. Today, this integrated navigation system serves miners, farmers, factory workers and commercial interests from the western prairies to the eastern seaboard. The annual commerce exceeds 180 million metric tons. For every ton of cargo, there are scores, and often hundreds of human faces behind the scenes.[1] Marine commerce on the Great Lakes / Seaway System each year generates more than $4.3 billion

[1] The St. Lawrence Seaway Management Corporation Annual Report 2002/03

in personal income, $3.4 billion in transportation-related business revenue and $1.3 billion in federal, state and local taxes. Approximately 10,000 tonnes of general cargo handled by a Great Lakes Port contributes more than half a million dollars in local economic benefits.

b. *Number of stakeholders:*

The St. Lawrence Seaway opened in April 1959. The Seaway, combined with the 8 locks on the Welland Canal, allow ocean-going vessels and lakers up to 78 feet (23.8m) in width and 740 feet (225.4 m) in length to access all of the Great Lakes. The Montreal-Lake Ontario Section of the Seaway is an integral part of this system. This section encompasses a series of 7 locks which allow ships to navigate between the lower St. Lawrence River and Lake Ontario. The St. Lawrence Seaway portion of the system has moved more than 2.1 billion metric tons of cargo in 40 years, with an estimated value of $Cdn 258 billion ($US 173 billion). The Seaway supports 75,000 direct and indirect jobs in Canada and 150,000 jobs in the U.S.

c. *Organizational characteristics:*

The Great Lakes / St. Lawrence Seaway corridor is unique for the scale and sophistication of its market, and the extensive integration of its economy. The system serves the area called “the Midcontinent region”, which constitutes the industrial and agricultural heartland of North America. This area encompasses eight Great Lakes States, and the Provinces of Ontario and Quebec. The system also serves the large Canadian mining operations in Québec and Labrador, as well as large metropolitan areas located along the St. Lawrence River in the Province of Québec. This area is home to almost 100 million people, a third of the combined U.S-Canada population. On the Canadian side, Ontario and Quebec represent over 60 percent of Canada’s gross domestic product, while the Great Lakes States generate some 26 percent of the entire U.S. manufacturing base.[2]

The Midcontinent of North America is a highly productive area. It produces about 34 percent of the combined gross national products of the United States and Canada, one third of their capital investments and about 30 percent of their combined personal incomes. Its industrial and agricultural based economy accounts for about 37 percent of values added to manufacture in Canada and the United States and, over 42 percent of the two countries' total agricultural income. The agricultural sector is concentrated on grains, livestock, dairy and poultry products, with much of this production being surplus to the area's requirements. At the same time, the region is a net importer of light and diversified industrial products together with fibre, fish, and forestry products.

The Midcontinent region depends heavily upon transportation, initiating about 42 percent of the total tonnage of rail freight in the United States and about 45 percent of the rail movement in Canada. It is also the destination of over 41 percent of the shipments of the United States, and 38 percent of those in Canada. The Midcontinent is also strategically located for both nations, as it is the centre through which most of the other east-west interregional traffic and much of the north-south contiguous trades must flow. The United States portion of the Midcontinent generates over one-third of that nation's exports of manufactured products.

Overall, imports and exports to, from, and within the region average some 100 billion ton miles annually. Over 30 million tons per year, representing some 3,300 ship movements, move annually through the Montreal-Lake Ontario section of the system. Since 1959, over 175,000 transits have been made through the St. Lawrence River above Montreal.

[2] Great Lakes – St. Lawrence Seaway System Directory 2003 / 04

About 85 percent of the total tonnage carried on the waterway is iron ore, coal, limestone and grain. The remaining 15 percent of the traffic includes overseas general cargo such as petroleum products, newsprint, rock salt, iron and steel products, cement, chemicals, and many other goods.

In Canada, a large proportion of the Great Lakes commerce, particularly grain (downbound) and iron ore (upbound) transits the St. Lawrence waterway to and from ports on the lower St. Lawrence River. The Montreal Harbor facilities annually handle over 20 million metric tons of cargo. Montreal Harbour is also the most important container harbour in Canada and one of the most important in North America.

d. *Values and perceptions of the interest:*

In terms of environmental impacts, studies have demonstrated that ships emit one-tenth the environmental pollution of trucks and half that of trains. Seaway ships move a tonne of freight up to 800 km on 4 liters of fuel.[3] Marine transport produces less noise, less waste and less traffic congestion. Marine safety and spill records are far superior to rail and truck transportation: one marine accident for every 13.7 rail and 74.7 truck accidents and one marine spill for every 10 rail and 37.5 truck spills.

e. *Significant statutory, regulatory and policy restrictions:*

The signing and application of the Kyoto Accord may have significant impacts on the shipping industry. On the one hand, due to its low emissions per tonne-km, the marine sector is in an enviable position as an alternate transportation mode. Short-sea shipping is seen as having significant potential to reduce highway congestion and vehicular emissions, and is a viable alternative and complement to rail and truck transportation. On the other hand, decisions to close coal-fired electrical plants in Ontario Canada would reduce or eliminate the need to transport I coal to these plants. The on-going Great Lakes- St. Lawrence Seaway Study will assess the maintenance and capital requirements to sustain and optimize the Great Lakes St. Lawrence Seaway System and the existing marine transportation infrastructure on which it depends. The results of this study will have to be monitored closely. There is also generally an increasing demand for a longer navigation season.

f. *History of the interest:*

The Seaway is a competitive mode of transport for a wide variety of bulk products (iron ore, grain, coal) serving Canada and the U.S., as well as steel products, heavy lift equipment and project cargoes going to and from Europe. Several Great Lakes ports are closer to European markets than east coast or gulf ports. Typically Great Lakes ports have lower port costs than competing ocean ports for the handling, wharfage, dockage and stevedoring of grain, iron ore, steel coils and machinery. Stevedoring costs for steel products are around $2.20 (U.S.) a metric ton less at Great Lakes ports. Prevalent Seaway trade patterns include:

- Upbound movements of general cargo, including semi-finished steel in the form of slabs, coils, beams and other products, from overseas producers
- Upbound movement of iron ore from mines in eastern Canada
- Downbound shipments of export grain by Canadian bulkers to transshipment points on the lower St. Lawrence, and by ocean vessels for direct export overseas.

[3] A Comparative Study of the Environmental Impacts of Modes of Freight Transport in the St. Lawrence Axis (November 2000)

- Approximately 29 million tones of cargo were shipped via the Montreal-Lake Ontario Section of the Seaway in 2003, and approximately 32 million tonnes were shipped via the Welland Canal. The removal of steel tariffs will help the Seaway to return to its classic trading patterns.
- Traffic at the Port of Montreal is expected to grow from the 23.6 million tonnes moved in 2004. Growth is expected to be derived mainly in the container sector and an increase in liquid bulk traffic.

g. *Trade flows and current market conditions:*

The Port Of Montreal is a year round international port that services shipping lines that trade with more than 100 countries around the world. The ports main markets are North Europe and the Mediterranean, with increasing penetration into markets in the Middle East and Southeast Asia. The port has also been connected to South Africa by a regular service for many years. The principal ports of origin or destination are as follows: Antwerp, in Belgium; Felixstowe, Liverpool and Thamesport, in England; Rotterdam, in the Netherlands; Hamburg and Bremerhaven, in Germany; Le Havre and Marseilles/Fos, in France; Cadiz and Valencia, in Spain; Genoa, Livorno, Naples and Gioia Tauro, in Italy; and Lisbon, in Portugal.

Montreal offers the shortest route between Northern Europe and the Mediterranean, and the vast markets of North America: which represents a pool of some 100 million Canadian and American consumers. The Port of Montreal contributes to the competitiveness of exporters from North America's industrial heartland, and facilitates the supply of raw materials and all types of products to industry in Central Canada, the U.S. Midwest and the U.S. Northeast.

The Port of Montreal handles all types of cargo year-round, creates some 17,600 direct and indirect jobs, and generates nearly $2 billion in economic impacts for Montreal, Quebec and Canada. The navigation channel to the Atlantic has a depth of 11.3 metres (37 feet) beneath chart datum, which corresponds to the lowest water level. It can accommodate ships of all types and almost all dimensions, including containerships with operating capacities of up to 4,100 TEUs.

Electronic water-level monitors allow deep-draft vessels to optimize their loading. The port handled over 23.6m tonnes in 2004, comprised of general cargo, and dry and liquid bulk. More than three-quarters of the ports total traffic is international. Montreal Port Authority is a autonomous federal agency that builds and maintains infrastructures leased to private stevedoring companies and operates its own grain terminal, passenger terminal and railway network. The port has 16 transit sheds for non-containerized general cargo and dry bulk, four ramps for roll-on/roll-off cargo, five dry bulk terminals and a grain terminal, 16 liquid-bulk berths and a passenger terminal for cruise ships. Every year, the Port of Montreal welcomes thousands of cruise ship passengers to its Iberville Passenger Terminal, located in the Old Port and historic district of Montreal.

Montreal is a leader on the North Atlantic container market. About half of its container traffic has its point of origin or destination in the United States. The Port of Montreal topped the one million container mark for the very first time in 2000. The port handled 10.8 million tonnes of container traffic in 2004, with 95 percent of the traffic coming from northern Europe and the Mediterranean. The port's four modern container terminals feature 15 dockside gantry cranes and other equipment for handling container cargo. Major container shipping lines offer frequent, regular liner services out of the port, and most make Montreal their one port of call in North America. Montreal is a terminus where container vessels can be completely unloaded and loaded, making for considerable savings in time and money.

The port of Montreal has one of the best intermodal systems in North America. It has its own railway network, with 60 miles of railway tracks. This network provides two transcontinental railway companies (Canadian National and Canadian Pacific) with access to almost every berth – thereby eliminating double handling in transshipment. Both railway companies offer double-stack container service. Approximately 45 trains a week, each averaging 1.7 kilometres (over one mile) in length leave for such cities as Toronto, Detroit and Chicago. Sixty per cent of the port' container traffic is transported by rail, while some 25 trucking companies carry the remaining 40 per cent. Trucking companies typically serve markets in Quebec, Ontario, New England and the State of New York.

h. *Effect of last high or low water conditions:*

Shipping has changed significantly over the past 40 years. In the early years of the Seaway, the vessel fleet was mainly composed of smaller canalers, and vessel draft was limited to 25 feet (7.6 m). Since then, the fleet of vessels has changed drastically. Vessels of up to 225 m (740') and 23.8 m (78') beam now regularly transit the system. Vessel draft has also increased to 80.8 dm (26' 6") for the lakers and for specially equipped ocean vessels. For these reasons, the low water events of the 1960's did not have the impact that the same low water level conditions would have today. The low's of the 1960's could mean slower transits and / or reduced draft. In either case, this results in increased shipping costs, which, if conditions were to persist, could impact the general economy. The commercial navigation transportation industry is very competitive, and a slight increase in cost may mean lost business to another mode of transportation.

The channel depths available for navigation are a function of the water levels on the lakes and their connecting channels. Any change in the regime of these levels can have an effect on the cost of shipping of certain commodities in the system. As regulation of the Great Lakes waters can alter, to a certain extent, the Great Lakes-St. Lawrence River water level regimes, it has an influence on navigation.

High water levels are generally more favorable for navigation, unless they are accompanied by high currents. If currents are too fast, conditions may be unsafe for navigation at which point vessels will be required to stop. This again would have an economic impact on transportation costs. High water levels, in certain areas may increase the susceptibility of certain riparian docks to flooding, and / or expose shorelines to vessel wave action. Traditionally, when water levels reach a certain high level threshold, vessels are required to proceed at reduced speeds, again, increasing their transit time and transportation costs. If water levels become extremely high, the Iroquois lock will be flooded if water levels reach 85.27m. At this level the operation of the locks will no longer be possible and all vessels transiting through this area would stop until water levels returned to an acceptable range.

2. Performance Indicators

a. *List the key performance indicators chosen for the analysis and any important assumptions that could affect the benefits analysis.*

The performance indicator chosen by the commercial navigation technical working group (CNTWG) is total cost of transportation associated with commercial navigation between Bécancour, Quebec and Port Weller, Ontario. Transportation costs include vessel capital and operating costs, fuel costs, seaway tolls, piliotage charges and Canadian Coast Guard fees (marine navigation service and maintenance dredging service fees). Costs do not include port fees and port cargo handling costs. The Commercial Navigation Economic Impact model provides cost estimates for various plans and is using the 1995-1999 commercial navigation traffic being representative of the commercial activities, cargo and vessel mix.

b. *What are the conceptual and data limitations and are the measured performance indicators likely to overstate or understate net economic benefits relative to ideal, fully fungible measures.*

Total transportation cost curves were derived for each quarter-month for three geographical areas: Lake Ontario (from Port Weller to Cape Vincent), the Seaway, (from Cape Vincent to St. Lambert) and Montreal to Batiscan (St-Lambert to Batiscan). These cost curves were incorporated into the Shared Vision Model.

Quarter-monthly water levels were converted to daily water levels assuming linear interpolation between quarter-monthly data points. Quarter-monthly data removes some of the high water, low water and high velocity events and presents more of an average, which will underestimate the economic impacts. Vessel departure dates were used to identify the range of water levels that the vessel would encounter during its transit. These water levels govern the ships maximum load it could carry. The lowest water level encountered during the transit governed the ships carrying capability. These water levels were compared to the metrics developed for the geographical areas the vessel would transit through. These metrics determined whether the vessel could proceed at normal speed, whether it had to slow down because of high water, reduce its draft due to low water, or stop because of high gradients and flows. A running summary of total transit time was computed for each vessel. These transit times were then converted to costs using daily vessel operating costs associated with one of the 26 various vessel types.

Commercial navigation costs actually arise from three factors: costs due to ship transits based on tons carried according to available water levels, costs due to currents and costs due to high gradient delays. Commercial navigation costs are affected by water levels in that vessels are required to slow down, light load and/or stop for both high and low water levels. High water velocities/currents, which are represented by gradients between gauges, increase transit times and/or fuel usage for upbound transits. If water velocities become too high, vessels will have to stop because conditions are not safe for navigation. The cost curves only capture vessel transit costs due to ship loading according to available water levels and travel times and fuel usage based on traveling with or against the currents. Costs related to vessels having to slow down, stop, or offload cargo are calculated by the SVM based on other algorithms. All of these costs are computed by the Economic Impact Model.

Transportation costs can be used to rank plans. However, using just transportation costs to evaluate/rank plans is not as straightforward as it may seem. Since all plans are compared to 1958DD, any increase in transportation cost savings is an improvement over the current conditions. There are three possible types of plans with respect to transportation cost impacts: those that provide savings for all geographical areas (Lake Ontario, the Seaway and Montreal), those that provide losses for all areas, and those that provide gains for some areas and losses for others. The system of ranking plans could vary for each of these three plan grouping types. For example given the following net transportation savings based on preliminary results, Cornell IV would be ranked number 1 based on total transportation cost savings. Ranking plans by minimizing impacts to all geographical areas and having them share in the losses equally would result in Benefits H being ranked number 1.

Plan Transportation Savings				
Plan	L.O	Seaway	Montreal	Total
Cornell IV	$28,703	$2,221,285	$52,194	$2,140,388
Natural A	$42,881	$2,140,535	$83,372	$2,014,282
Benefits H	$ 5,220	$ 858,903	$ 7,132	$ 846,551

Red **Losses**
Green **Savings**

The commercial Navigation Technical Working Group has identified 42 metrics that can be used to rank various water level plans. The metrics identify at what water level specific impacts happen to shippers. The main link between impact to shippers and water levels are the affects that various water levels have on vessel carrying capacities, vessel speeds and the ability to transit the system.

Characteristically, when transiting through the Seaway, vessels are told what their maximum draft can be. Typically, vessels have been allowed to transit at 26'-0" draft during Seaway opening and closing periods and at 26'-3" during the rest of the season. Last year, due to favorable water levels, some vessels were allowed to transit at 26'-6" draft. These drafts assume a specific amount of under keel clearance. Water levels needed to accommodate these drafts are known for various points throughout the Seaway System.

One way to rank various plans is to see how they perform against the 42 metrics identified by the Commercial Navigation Technical Working Group. Counts can be made of how many quarter months over 101 years of water levels that critical high levels are exceeded, levels drop below critical low levels and critical velocities/gradients are exceeded. Ultimately, the selection of a plan must be made based on both, transportation costs and how well a plan performs based on the metrics. The CNTWG will provide this information to the Study Team so that it can be incorporated in the Shared Vision Model.

3. Potentially Significant Benefit Categories

a. Environmental Benefits of Marine Transport over other Alternative Modes. In terms of environmental impacts, studies have demonstrated that ships emit one-tenth the environmental pollution of trucks and half that of trains. Seaway ships move a tonne of freight up to 800 km on 4 liters of fuel.[4] Marine transport produces less noise, less waste and less traffic congestion. Marine safety and spill records are far superior to rail and truck transportation: one marine accident for every 13.7 rail and 74.7 truck accidents and one marine spill for every 10 rail and 37.5 truck spills. Due to its low emissions per tonne-km, the marine sector is in an enviable position as an alternate transportation mode. Short-sea shipping is seen as having significant potential to reduce highway congestion and vehicular e missions and is a viable alternative and complement to rail and truck transportation.

b. Benefits To The Economies of Both The U.S. And Canada. Marine commerce on the Great Lakes - Seaway System each year generates more than $4.3 billion in personal income, $3.4 billion in transportation-related business revenue and $1.3 billion in federal, state and local taxes. The

[4] A Comparative Study of the Environmental Impacts of Modes of Freight Transport in the St. Lawrence Axis (November 2000)

Seaway supports 75,000 direct and indirect jobs in Canada and 150,000 jobs in the U.S. approximately 10,000 tonnes of general cargo handled by a Great Lakes Port contributes more than half a million dollars in local economic benefits. The eight Great Lakes States, and the Provinces of Ontario and Quebec are home to almost 100 million people, a third of the combined U.S-Canada population. On the Canadian side, Ontario and Quebec represent over 60 percent of Canada's gross domestic product, while the Great Lakes States generate some 26 percent of the entire U.S. manufacturing base.

c. Other Waterborne Transportation Costs Following an event when gradients and currents were such that vessels had stopped, the model assumes that all vessels resume navigation simultaneously. In practical terms, depending on the duration of the event and the number of vessels stopped, the rate at which navigation resumes is limited by the locks' capacity to process vessels. Consequently, the impacts of excessive flows/gradients will be underestimated for any plan evaluated. This becomes even more important since all water level data used is based on quarter monthly data. Quarter-monthly data masks high and / or low water events that could impact vessel movements. Quarter-monthly data is an average of the water levels during that time period. It takes out the highs and the lows and presents an average.

4. Key Baseline Conditions

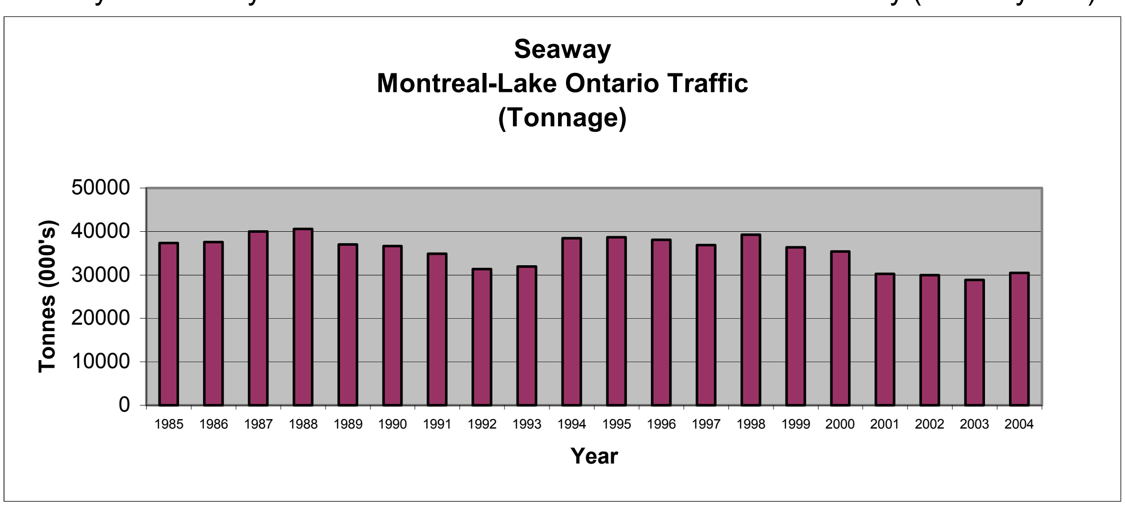
a. The impact model does not consider a widening or deepening of the navigation channel, nor any changes to the current infrastructure, whether it be locks, bridges or regulating works.

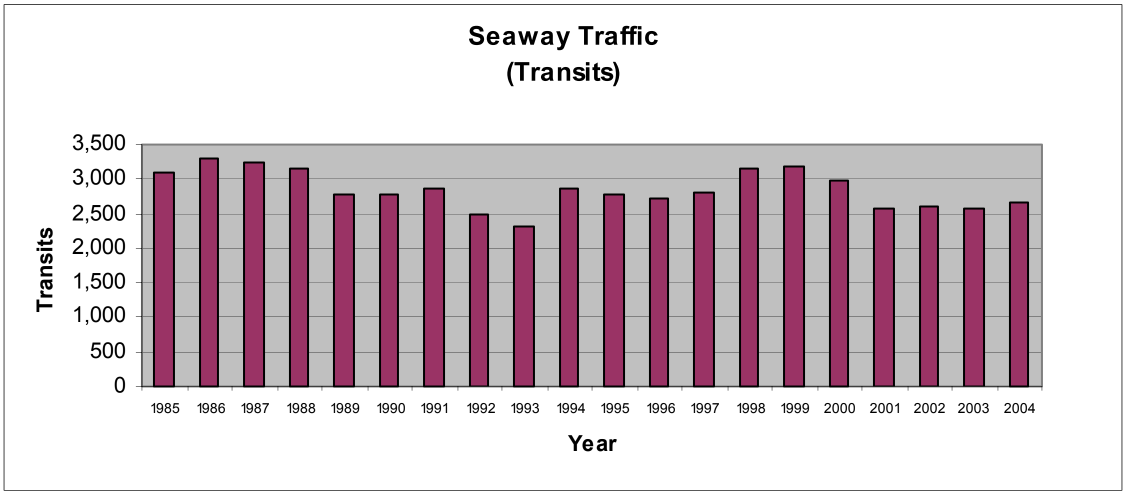
b. The impact model does not consider any changes in fleet composition, which could occur should the infrastructure be changed dramatically.

c. The Economic Impact Model uses actual vessel transit data in the Becancour to Lake Ontario segment from 1995 to 1999 (5 years). It is using this same set of 5 years of data for all 101 years of water levels. It tracks the negative impacts of high and low water levels and high velocities/gradients which are: vessels having to reduce speed, stop, light load or offload cargo.

5. Key Trends

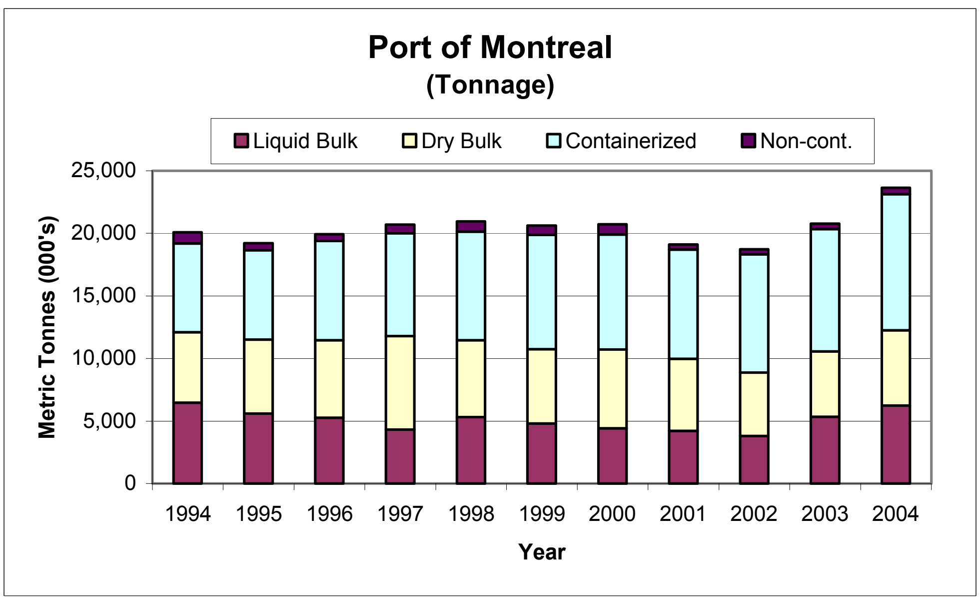
Provided below are historical tonnages for the St. Lawrence Seaway and the Port Of Montreal. The Seaway shows a cyclical trend. Near term traffic levels in the Seaway (Next 5 years) are





expected to be at least equal to 2003 and 2004 levels. The tonnages moved during the 2004 season are estimated at 30,494,000.

Montreal Tonnages shows a moderate growth, with most of the growth taking place in container traffic. Montreal tonnages are expected to continue to grow. Growth is expected to be derived mainly in the container sector and an increase in liquid bulk traffic.



Key trends and issues affecting the system include the following:

- Continued trend toward containerization
- Short-sea shipping to alleviate highway congestion and facilitate trade, improve utilization of facilities and reduce greenhouse emissions
- Demand for year-round service, one stop, door-to-door supply chain logistics
- Seaway operating at approximately 50% of its capacity

- GL/SLS Study to be completed
- Ontario decision to close coal-based electricity production
- East-West transportation route, when growth is mainly North-South
- Aging infrastructure – Seaway, Great Lakes Ports, Vessels
- Fewer Seaway-sized ocean vessels
- Reduction in traditional Seaway staples

6. Expected Consequences of Changes

a. Dependable and predictable water levels within the existing parameters (or better) are required to maintain, and possibly grow this segment of transportation. Because of the competitive nature of this industry, low water levels or unacceptably high water levels or flows could negatively impact the shipping industry as a whole and may cause some shippers to use other modes of transportation. Once lost to other modes, regaining this business would be very difficult.

7. Adaptive Behaviors

a. There are many responses to lower water levels that the shipping community can initiate depending on the magnitude and the duration of the low water event. If a low water event occurs and is anticipated to be of a short duration and only in a very specific area of the system, vessels can reduce speeds in that section and still maintain the amount of commodity carried. This increases transit times but not number of vessel trips. This adaptation also has limitations, since the vessels must, at all times maintain sufficient speed so as to not impact maneuverability and safety.

If the low water event is significant and is expected to last an extended period, vessel draft may be reduced. This will result in increased costs since more trips will be required to move same tonnage, assuming vessel availability. Generally, the Seaway and the industry can adapt to low water conditions when basin supplies are low for extended periods, as all users would have to, but plan-induced low levels would not be looked upon favorably.

However, if falling water levels cause large reductions in draft and is anticipated to last for an extended period of time, the last approach is deepening of channels and harbors. This option has many concerns associated with it. The feasibility of dredging would require environmental assessments, including the quality of the sediments, defining depositional areas, possible containment, defining costs and who picks up the costs.

For the port of Montreal traffic, dredging is not an option for a reduction in water column. The last channel dredging ($10m) was undertaken only after four years of debates with environmental groups and agencies. In the extremely unlikely event that the Port of Montreal would obtain permission to dredge deeper, the cost this time would be much much larger since in some areas channel bottoms have reached rock and channel deepening would necessitate changes to the port's existing infrastructure (docks).

Some proactive mitigation dredging was done in 1999 for existing channel depths. The port funded the total cost of the effort. The dredging was done to accommodate large vessels to handle the growing volumes of traffic, and also to make the route less vulnerable to water fluctuations under 1958DD. Any plan that would provide less water than 1958DD would negate the positive impacts of dredging in 1999.

Another adaptive measure to falling water levels is to change fleet composition. The fleet of vessels calling regularly at the port of Montreal has been custom designed and built specifically for that trade. The last generation of vessels was built at a total cost of approximately one billion US dollars. New vessels are likely to be on the drawing board in the near future, and the design may have to change again to accommodate the ever-increasing volumes within the ports actual draft limitations. The economic gains of building a new fleet will have to be evaluated very closely given that freight rates for exports are 60% of what they were in 1994 and rates for imports during the same period have failed to follow inflation.

As for Great Lakes vessels, the last new Canadian vessel was built in 1985 (M/V Paterson). The American fleet has concentrated on modifying their existing fleet (adding self unloading capabilities, and converting vessels to tug barges). There is no indication that the economics of the Great Lakes trade could support a Great Lakes fleet modification.

8. Risk Assessment/Sensitivity Analysis.

There are a number of caveats that need to be identified when using Total Cost of Transportation as the Cost Performance Indicator.

a. The vessel database used to develop this PI (1995-1999 vessel movements) is only representative of the fleet, traffic volumes, and commodity movement patterns within the system for the near future (Next 3 to 5 years).

b. The fleet mix using Montreal Harbor has already exhibited a shift to larger sized vessels.

c. Water level data was provided on a quarter-monthly basis. However, daily and even hourly changes in water level can impact vessel movements and loadings. The quarter-monthly data tends to “average out” these impacts and leads to an underestimation of transportation costs.

d. The PI can be used to identify a good year of water levels from a bad year. However, usage to determine the ranking of plans is more problematic. Two plans may result in the same average total transportation costs. However, the two plans may not be equal in ranking. A plan that provides a more consistent set of water levels would be preferred to a plan that has extreme fluctuations in water levels. Commodities moving by water require loading and schedule planning to assure that the vessels have adequate water depths to accommodate their passage throughout the entire length of their trip. A plan that provides a more consistent set of water levels, providing the levels are sufficient to maintain existing or deeper vessel drafts, would be preferred to a plan that has extreme fluctuations in water levels.

e. This PI is also sensitive to seasonality. A plan that provides more water than the current plan from say June through December would be preferred. This is the time of year water levels are typically decreasing and tonnage movements are highest.

f. The limiting factors [(5)] for navigation that are currently recognized in the Impact Evaluation Model throughout the Seaway portion of the system are:

(1) The minimum water-levels (elevation above sea level in IGLD 1985) for navigation at 8.0m (26 feet-3 inches) draft in the Montreal-Lake Ontario through Montreal reach of the system are as follows:

Location	nimum Water Level (metres IGLD85
Lake Ontario	74.27
Ogdensburg	73.90
Cardinal	73.45
Iroquois	73.35
Morrisburg	72.79
Long Sault	72.50
Summerstown	46.58
Coteau Landing	46.48
Lake St-Louis	20.60

(2) The maximum gradients which represent velocities that are not safe for navigation are as follows:

Location	Maximum Gradients (cm)
Ogdensburg-Cardinal	72
Cardinal-Iroquois HW	26
IroquoisTW-Morrisburg	46
Morrisburg-Long Sault	35

(3) Water levels exceeding the following require vessels to slow down to prevent damage to shorelines and shore structures:

Location	Maximum Water Level (IGLD)
Lake Ontario	75.37
Ogdensburg	75.37
Morrisburg	74.00
Summerstown	47.00
Coteau Landing	46.58

(4) A level of 85.27m at Iroquois Lock will flood the lock and make it inoperable.

As water levels approach those in the table in (1) above and are continuing to decline, vessels are required to reduce their speeds and when the levels drop below those in the table, vessels are required to anchor until levels recover. If the levels do not recover, cargo would have to be offloaded from those vessels before they could proceed. Vessels not yet loaded and headed for the Seaway will be light loaded to accommodate for lower water levels. The drafts in the Seaway have been set at 8.0 meters (26'-3") since 1994. Recently, vessels have been allowed to transit the system at 26'- 6" during the summer. Very low water levels for extended periods of time can translate into losses of competitiveness for ports, carrier and other industries that might end up paying more for the transportation of the raw material required for their specific activities. The economic activity of a whole region, state, province or country can therefore be affected by potential increases in unemployment and the price of goods. For example, draft reduction in the Seaway will result in the following economic affects:

	Effect per Ship			Effect per Year (1300 ships)		
Draft Reduction	Cargo reduction tonnes	Loss of revenue SLSMC	Loss of revenue Shipping	Cargo reduction tonnes	Loss of revenue SLSMC	Loss of revenue Shipping
1 cm	40	$ 80	$ 800	52,000	$ 104,000	$ 1,040,000
8 cm	320	$ 640	$ 6,400	416,000	$ 832,000	$ 8,320,000

SLSMC = St. Lawrence Seaway Management Corporation

Vessels transiting areas having gradients in excess of those listed in the table in (2) above will be required to stop until gradients are below those listed. When water levels exceed those listed in the table in (3) above, vessels are required to reduce their speeds to prevent damages to shorelines and shore structures. If the water level at Iroquois Lock reaches 85.27 meters, navigation must be suspended because the lock will be flooded and therefore inoperable.

g. In Montreal, water-levels impact the amount of cargo loaded or unloaded on a deep draft vessel. Ships having a loaded draft of 10m or less are not considered deep draftand are typically not limited by variations in water levels. The available water is usually sufficient to allow full loading of this type of vessel. However, deep draft vessels, representing 30 per cent of tonnage transiting the Port of Montreal requires water levels of 0.6m or more above chart datum in order to be economically viable. During periods of low water-levels, they might not be able to carry a full load of cargo, or might have to partially discharge in an alternate port if not forewarned of low water levels. Both circumstances cause increased operating costs and reduces effectiveness in service. The Port of Montreal's competitiveness is therefore greatly affected by variations in water-levels.

There is a direct relationship between lake levels and cost of transporting bulk commodities and it is based on the allowable draft of shipping. Lake vessels tend to take advantage of every cm of available depth because shipper's profits essentially come from the last few cm of loading. For instance, 2.5 cm of vessel draft on a freighter of 25,000 tons carrying capacity represents 125 tons of cargo. For a 65,000 ton capacity bulk carrier, 2.5 cm would mean a loss or gain of 220 tons or about 0.3 percent of carrying capacity. Similarly, a 30 cm reduction in available draft means that about 114 fewer 6 m containers can be loaded on a typical ship of 1800 container capacity.

While water levels on the Great Lakes in general are fairly stable due to the great inertia of the Montreal Harbour water levels are very sensitive to Lake Ontario outflow changes at the Moses-Saunders control structure for the purpose of regulation. For example, a 570 m3/s flow reduction at Moses-Saunders would result in a drop of about 24 cm in the Harbour at equilibrium, while it would mean a rise of only about 0.25 cm per day on Lake Ontario. For instance, in the fall, when levels are generally at their lowest in the Harbour, consequences of large Lake Ontario outflow reductions could be disastrous on the Montreal shipping industry compared to the negligible benefits similar reductions provide to the navigation interest upstream of the Moses-Saunders project.

9. Sources

1 The St. Lawrence Seaway Management Corporation Annual Report 2002/03
2 Great Lakes – St. Lawrence Seaway System Directory 2003 / 04
3 A Comparative Study of the Environmental Impacts of Modes of Freight Transport in the St. Lawrence Axis (November 2000)
4 A Comparative Study of the Environmental Impacts of Modes of Freight Transport in the St. Lawrence Axis (November 2000)
5 Planning Objectives and Performance Metrics For Evaluating Impacts of Lake Ontario Outflow Regulation Plans on Commercial Navigation-