Ocean Shipping In the Great Lakes:
Transportation Cost Increases That Would Result From A Cessation of Ocean Vessel Shipping

by

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Biographies

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Dr. Taylor is an Associate Professor of Marketing and Logistics in the Seidman College of Business at Grand Valley State University in Grand Rapids, Michigan. Dr. Taylor's primary research interests are in the area of logistics and transportation policy. His research has focused on topics such as intermodal transportation, U.S.-Canada-Mexico transportation policy and border crossing issues, Michigan highway funding, economic deregulation of trucking, and logistics customer service issues. His work has been published in journals such as the *Transportation Journal; the Journal of Transportation Law, Logistics and Policy; Regulation; the Journal of Business Logistics; the International Journal of Physical Distribution and Logistics Management; the International Journal of Logistics Management; and the International Journal of Purchasing and Materials Management.* He also has been the principal investigator on a number of Michigan related transportation research projects. His government policy background includes roles as a Commissioner on the Congress's 11 person National Commission on Intermodal Transportation, serving as a member of the U.S. Department of Transportation's National Motor Carrier Advisory Committee, and serving as a member of the former Michigan-Ontario Maritime Commission. He has testified before Congress and the Michigan legislature on a number of transportation policy issues, and he is frequently quoted on transportation policy matters in national journals such as The Wall Street Journal, and in the Michigan press. Dr. Taylor holds a Ph.D. from Michigan State University.

Mr. James L. Roach

Mr. Roach is an East Lansing based transportation consultant specializing in freight and passenger planning, infrastructure and strategic issues. He has over 35 years of experience in the transportation industry including many years with the Michigan Department of Transportation where he served as Manager of the Freight and Intermodal Planning Sections. In this capacity he was responsible for a 20-person section dealing with marine and port issues, intermodal transportation, freight and passenger rail, trucking, airports, international trade, and border crossings. He has supervised or been directly involved in numerous Michigan port and maritime activities, including management of Michigan's port and marine planning program, supervision of initiatives to build a new lock at Sault Ste. Marie, responsibility for freight and marine components of the Michigan Transportation Needs Study, supervision and staffing of activities of the Governor's Michigan-Ontario Maritime Advisory Committee, and participation in the development of goals, objectives and studies for the Detroit-Wayne County Port Authority. Since his retirement in 1997, he has served as President of JLRoach, Inc. and undertaken a wide range of freight and passenger related projects for both the public and private sector. He has extensive consulting experience in projects related to intermodal transportation, commuter rail, and border crossings. Mr. Roach has a BS degree from Michigan State University and a master's degree from Pennsylvania State University.

Table of Contents

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Executive Summary

The principal conclusion of this study is that a cessation of ocean shipping on the Great Lakes would result in a transportation cost penalty of US$54.9 million per year. The relatively small transportation cost penalty of US$54.9 million is due to the fact that just 12.3 million metric tons of ocean vessel cargo passed into and out of the Lakes via the MLO Section of the St. Lawrence Seaway in 2002, or some 6.8% of total Great Lakes – St. Lawrence Seaway System tonnage. It is also due to the fact that the costs of the alternative modes, for lakers, rail and barge primarily, are not substantially higher than the cost for the ocean direct routings into and out of Great Lakes ports. While these other modes have some potential capacity constraints, we believe laker and rail capacity would be able to accommodate the extra volume. Overall, whether the cost penalty for any non-availability of ocean shipping on the Lakes is the calculated US$54.9 million or in a range up to US$100 million, the basic conclusion remains the same. That conclusion is that ocean vessels on the Lakes make only a modest contribution to transportation cost savings for users of the System. The calculated cost penalty represents a 5.9% increase in the current door to door transportation cost for the goods currently moving via ocean shipping in the Great Lakes.

The Great Lakes – St. Lawrence Waterway System (GL/SLW) beginning at the Gulf of St. Lawrence, and more specifically, the Great Lakes – St. Lawrence Seaway System (GL/SLS) beginning just west of Montreal and extending westward, has been extremely important to the development of the North American mid-continent area, and continues to play a vital role in the region's economy. However, because of the evolving role and contribution of the GL/SLS as a freight transportation system there has been a growing need to reassess its contribution to freight transportation cost savings and overall supply chain effectiveness. This need for a reassessment of the System's freight transportation value has grown more acute as new information becomes available about the risks related to invasive aquatic species, and as a series of new invasives control regulations are considered. However, it should be noted that aquatic invasives are introduced by ocean going vessels, and not by lakers that remain within the North American exclusive economic zone (EEZ). As a result, any assessment of the benefits of waterborne commerce vis-à-vis invasives damage should focus on ocean-going freight movements into the Lakes alone. The purpose of this study then is to determine what the transportation cost penalty would be if ocean going vessels were to cease carrying goods into and out of the freshwater Lakes System.

In order to address this question of transportation cost penalties that would be incurred if ocean vessel moves were not available, the authors first examined the level and type of ocean vessel traffic tonnage on the GL/SLS, and then developed estimates of the door to door transportation/handling costs for these moves using the current ocean vessel direct mode. Secondly, alternative modes and routings were analyzed, and the door to door

transportation/handling costs for such moves were calculated. The third step involved an estimation of the volumes of goods that would move on each of these alternative mode/routings, and calculation of the cost for the “most likely” alternative mode/routings. The methodology involved a comprehensive literature review, and a series of trips to conduct personal interviews in key cities. A total of 95 research reports and articles were reviewed, along with 41 web pages and hundreds of trade articles. A total of 24 organizations were visited for personal interviews, and another 34 organizations were interviewed by phone.

Several assumptions were made prior to the start of the study. First, a decision was made to focus on the Great Lakes because of the critical importance of this fresh water resource. Secondly, there was a decision to use the MLO section as the point of entry into the Great Lakes. This location was used because it is west of Montreal and its extensive ocean shipping activity, because the location allows for capture of all ocean vessel traffic entering any of the Great Lakes, because it is at a point where the natural barriers to invasive species begin, and because the SLSMC/DC maintains data on ocean vessel transits and tonnage at this MLO point. Third, 2002 was selected as the study year for traffic levels because volumes that year were representative of recent history, and higher than in 2003 or 2004. While 2002 traffic levels were used, it was decided to use mid 2004 transportation rates as they were more timely and feasible for interviewees to comment on, and more representative than unusually high early 2004 ocean rates. Unless otherwise noted, all tonnages have been converted to metric, and the currency is in US$.

The 12.3 million metric tons of ocean vessel tonnage that passed through the MLO Section of the Seaway into and out of the Lakes in 2002 represented 6.8% of the total Great Lakes and Seaway volume of 180 million tons that year. In 2002, there were 1137 ocean vessel passages through the MLO, with 569 up-bound moves and 568 down-bound. Ocean tonnage through the MLO Section totaled the noted 12.3 million metric tons in 2002, 9.6 million metric tons in 2003, and 11.0 million metric tons in 2004. The peak year for ocean traffic at the MLO was in 1978 with 23.1 million metric tons. In contrast, laker moves totaled 1116 in 2002, with 17.7 million metric tons. Total 2002 MLO tonnage was than 30.0 million metric tons, with one of the highest traffic levels of 56.9 million tons recorded in 1978. While no forecasts of future ocean vessel tonnages were found, one credible forecast suggests a 2020 MLO tonnage of 37.6 million metric tons. However, it should be noted that past forecasts have been very inaccurate, with six studies from 1954-1985 forecasting volumes in 2000 ranging from 49.4-130.1 million metric tons at the MLO for combined lakers and ocean vessels. Section 4.0 summarizes the traffic information.

The findings in this report are generally in line with prior studies on the competitiveness of the Seaway, although most of these studies have focused on generic Lakes shipping vs. rail, as opposed to a detailed examination of ocean shipping’s benefits. The literature review for this report included seven key sets of studies dating from 1985-2004, including 14 specific articles, proceedings papers or reports. These reports are reviewed in Section 5.0 and summarized in Table 6. The most recent study, for the U.S. Army Corp of Engineers, found that for grain from Duluth, that rail was actually close to

US$5/metric ton cheaper than the generic Lakes System. Other earlier studies in the 1980-90's generally found modest differences in costs per ton for ocean, laker and rail options, with some advantages for the Lakes route in most cases. However, some of the earlier studies also found an advantage for direct rail shipments, or for barge shipments, in certain situations.

The specific cost calculations supporting the US$54.9 million penalty cost for non-availability of ocean vessels are included in Section 6.0 and summarized in Table 13. These cost calculations are based on detailed 2002 traffic volume estimates that indicate the 12.3 million metric tons of ocean traffic consisted of 2.1 million metric tons of Thunder Bay export grain, 2.0 million metric tons of Duluth export grain, 4.6 million tons of imported steel, and 3.6 million tons of "all other" product consisting primarily of chemicals, sugar, mine products and other grain. For Thunder Bay grain, we found that the "most likely" alternative mix of laker and rail modes would have a blended cost that would be US$3.47/metric ton higher than the ocean direct movement, with a total cost penalty of US$7.3 million. For Duluth grain, we found that the "most likely" alternative mix of laker, rail and barge modes would have a blended cost that would be US$1.61/metric ton higher than the ocean direct movement, with a total cost penalty of US$3.3 million. However, this analysis found that both rail and barge options would be cheaper than ocean direct shipments, with laker moves more expensive than ocean shipments. For imported steel we found the "most likely" alternative mix of modes would cost US$5.78/metric ton more than the ocean direct routing to the Lakes, with a total penalty cost of US$26.4 million. Finally, we estimated the "all other" product category would have a penalty cost of US$5/metric ton, or US$17.9 million.

While transportation cost savings is the primary variable driving shipper/receiver decisions about shipping route selection, there are several other variables that need to be considered in evaluating the value of ocean shipping to society and the users. Factors that are potentially favorable or unfavorable to lakes ocean shipping are reviewed in Section 7.0 and summarized in Tables 14 and 15. For society in general, an important favorable factor is the fact that Seaway tolls would continue if ocean shipping levels are maintained. If ocean shipping ended laker tolls would have to be raised, or government subsidies increased, by an estimated US$17.4 million, to offset the loss of ocean tolls. Another benefit of continued ocean shipping is that it would preserve current ocean shipping related port employment and infrastructure. For shippers and receivers, the ocean option also may provide beneficial competition to other modes. Continued ocean shipping also provides a degree of capacity that some have argued would not be available from lakers or rail. As it relates to grain, the ocean shipping option also may provide for reduced cycle times, reduced damage from less handling and cooler temperatures on the northern route, seasonal surge capacity, bio-security benefits from less handling, and the ability to fully utilize existing facilities. For steel importers, the System also is said to provide shorter cycle times and greater reliability than is found on the rail system. Some have also argued that the System results in less handling damage however we found that handling levels are similar with the use of coastal ports and rail delivery to processors. From a societal perspective there also are several unfavorable factors relating to ocean shipping on the Lakes. Environmental damage from invasives and PM10/SO2 air pollution are key negatives. Another negative relates to the fact that ocean shipping primarily employs foreign crews, with minimal domestic handling employment, as compared to the alternative routing/modes which use domestic crews and require more handling employment within North America. A related unfavorable factor relates to foreign owned and crewed ocean vessels passing into the heartland of North America, with potential national security concerns. From a shipper/receiver perspective, there also are several major unfavorable factors related to ocean shipping on the Lakes. A key limitation relates to the short nine month shipping season which requires other plans for the rest of the year. Another key limitation relates to vessel size which is limited compared to coastal port ship size. We also believe it is unlikely that the season or vessel size limitations will ever be increased significantly, thereby locking the System's efficiency in time. On the other hand, rail has made steady progress in increasing efficiency and is likely to continue making progress in the future. Finally, from a broad user perspective, environmental damage, while currently is a societal concern, may become a major cost factor for users in the future, if contemplated and possible future regulations impose ballast water control costs and/or liability for invasive species damages.

What do the ocean volumes and the US$54.9 million cost penalty mean in the broader context of U.S. and Canadian movements of these kinds of products? Section 8 and Table 16 provide some perspectives or benchmark information on the significance of the volumes and costs reported on in this study. In terms of Lakes ocean shipping, it is important to note that this route accounts for 1.9% of all U.S. grain exports, and 10.9% of all Canadian grain exports. For U.S. steel imports the ocean route to the Lakes accounts for 6.3% of all iron and steel imports, while for Canada the ocean direct route accounts for 21.4% of total steel imports. The calculated cost penalty of US$54.9 million represents a 5.9% increase in the current door to door transportation cost for the goods currently moving via ocean shipping in the Great Lakes. The transportation cost penalty for Duluth and Thunder Bay ocean shipped grain represents a roughly estimated .1% of the transportation cost for all U.S. and Canadian exported grain. For steel, the transportation cost penalty on the Great Lakes ocean shipped product represents .7% of the transportation cost for all Canadian and U.S. imported steel. By way of comparison, we estimate the costs of existing invasive species on Great Lakes utilities at US$200-500 million per year. It should be noted however that the costs of future invasives that might be introduced by continued ocean shipping is not known.

Section 9 of the report focuses on the modal shifts that would result if ocean vessel tonnages switched to the "most likely" combination of alternative modes/routes contemplated in the section on detailed cost calculations. The net result would be that an additional 2.97 million metric tons would move by laker, 5.98 million metric tons by rail, 1.18 million metric tons by barge, and 2.16 million metric tons by truck. This volume would require an additional 7.4 lakers worth of capacity per year, an additional 1.6 trains per day, and 197 trucks per day, in addition to the extra 1.18 million metric tons of barge traffic. For perspective, there currently are some 70 lakers in the Canadian fleet making Seaway transits, there are some 100-150 trains per day in the relevant east-west corridors north and south of Lake Erie, and there of course are many hundreds of thousands of truck trips per day in these areas. While there are questions about laker capacity, we believe that given long term demand, the industry would find a way to supply capacity. Options include increasing utilization rates of currently underutilized vessels, returning lakers from international operations, buying laid up American ships and paying duties, or building new boats. To the extent that laker capacity cannot be found, tonnages would shift to rail and barge, which in many cases, have lower costs per ton than lakers for the door to door total transportation cost. Rail capacity problems are also an issue, however, the additional volume is small enough, and the rail system's ability to respond to volume increases is great enough, that we believe the additional tonnage could be handled with minimal changes to the status quo situation. Railroad representatives have also indicated that the rail system has adequate capacity in the east. Finally, the section on modal shift impacts also reviews air pollution effects and finds there would be minimal air pollution increases resulting from using the alternative modes.

In conclusion, a cessation of ocean shipping on the Great Lakes would result in a transportation cost penalty of US$54.9 million per year. The relatively small transportation cost penalty of US$54.9 million is due to the fact that just 12.3 million metric tons of ocean vessel cargo passed into and out of the Lakes via the MLO Section of the St. Lawrence Seaway in 2002, or some 6.8% of total Great Lakes –St. Lawrence Seaway System tonnage. It is also due to the fact that the costs of the alternative modes, for lakers, rail and barge primarily, are not substantially higher than the cost for the ocean direct routings into and out of Great Lakes ports.

Ocean Shipping In the Great Lakes:
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1.0 Introduction

The Great Lakes – St. Lawrence Waterway System (GL/SLW) beginning at the Gulf of St. Lawrence, and more specifically, the Great Lakes – St. Lawrence Seaway System (GL/SLS) beginning just west of Montreal and extending westward, has been extremely important to the development of the North American mid-continent area, and continues to play a vital role in the region's economy. However, over the years, changes in the nature of the region's economic activity, changes in supply chain management logistics and transportation practices favoring speed and reliability, and changes in the competitive positions of rail and waterway modes, have all contributed to an evolving role for the GL/SLS. The System's overall importance to the continent and region's overall economy has been reduced, and the nature of the contribution has moved towards intra-lake commerce and somewhat away from Seaway related commerce. At the same time, the Lakes position as the world's largest fresh water body has taken on greater significance, as has the System's role in tourism and overall quality of life contributions.

Because of the evolving role and contribution of the GL/SLS as a freight transportation system there has been a growing need to reassess its contribution to freight transportation cost savings and overall supply chain effectiveness. This need for a reassessment of the System's freight transportation value has grown more acute as new information becomes available about the risks and costs related to invasive aquatic species. Given the level of economic and environmental damage caused by existing and potentially new invasives, and the fact that most aquatic invasives have been introduced to the Lakes by transoceanic waterborne commerce ballast water[1], it is important to be able to assess the cost benefits of continued use of the GL/SLS for maritime commerce. However, it should be noted that aquatic invasives are introduced by ocean going vessels, and not by lakers that remain within the North American exclusive economic zone (EEZ), and therefore, any assessment of the benefits of waterborne commerce vis-à-vis invasives damage, should focus on ocean-going freight movements in the GL/SLS alone. Interestingly, while there have been many past studies of the overall benefit of freight transportation on the overall GL/SLS System, there have been very few studies that have focused on the specific transportation cost benefits of ocean going shipping into and out of the Lakes.

The purpose of this study then is to conduct an analysis of the transportation cost benefits to Canada and the U.S. that result specifically from ocean going vessel movement of freight cargoes into and out of the Lakes via the GL/SLS. Conversely, the study determines what the transportation cost penalty would be if ocean going vessels were to cease carrying goods into and out of the freshwater Lakes System. This cost penalty question is indeed the focus of the study, given a variety of developments, both market

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[1] Holeck, Kristen T., et al., "Bridging Troubled Waters : Biological Invasions, Transoceanic Shipping, and the Laurentian Great Lakes," *BioScience*, Vol. 54, No. 10, October, 2004, pp. 919-929.

based and regulatory, which could lead to a reduction or even elimination of ocean vessel passages into the Lakes at some future point.

For instance, market forces involving shipping demands to service the growing Chinese market could make it much more attractive for ocean going vessels to serve that market as opposed to the long trip into the North American mid-continent. Likewise, supply chain management practices increasingly favor speed and reliability of small shipments, making slower waterborne moves less attractive. At the same time, growing concerns about the costs of invasives have led to a number of proposed new regulations for the treatment of ballast water, and ship-owner costs for complying with these regulations and possible related liability for environmental damages, could lead owners to decide not to serve the Great Lakes with ocean going vessels. Examples of recent regulatory action include the new but yet to be ratified IMO Treaty on ballast water treatment[2], District Court Judge Susan Illston's decision requiring the EPA to repeal regulations exempting ship operators from the Clean Water Act's water discharge rules[3], Michigan's new law requiring ballast water discharge related permits to enter state ports[4], and new Coast Guard regulations that are currently being drafted[5]. While most proposals for dealing with the invasives problem have called for ballast water treatment approaches, this approach will not address invasives brought in with ship hull and pipe fouling[6], and some scientists have suggested that the St. Lawrence Seaway into the Lakes should be closed to "non-Great Lakes boats."[7] Of course, this latter approach would result in an end to all shipping, or at least ocean going shipping. Finally, some U.S. officials have even speculated about whether the Seaway is "worth the risks," given not only invasives, but also increasing concerns about terrorism.[8] Given the various calls for regulations that could increase the costs sufficiently to cause a voluntary end to ocean going shipping into and out of the Lakes, and the potential for a regulatory ban on ocean shipping at some future date, it is very important to understand the transportation cost penalty to industry that would be incurred if ocean going shipping were not available.

In order to address this question of transportation cost penalties that would be incurred if ocean vessel moves were not available, the authors have first examined the level of ocean vessel traffic tonnage on the GL/SLS along with the commodity type and origin-

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[2] Anonymous, "UN Sets Treatment Standard for Ballast Water," *Environmental Science & Technology*, May 1, 2004, p.153A.

[3] Free Press Staff, "Judge: Limit the Species In Lakes," *The Detroit Free Press*, April 2, 2005, p. A3.

[4] Anonymous, "Law Requires Permit for Oceangoing Ships," *Lansing State Journal*, June 8, 2005, p. A5.

[5] Moore, Kathy, "Ballast Water Regulation and Technology," presentation at the *Transportation Research Board's 84th Annual Meeting, Workshop 123 – Invasive Species and Transportation: Issues and Challenges*, Washington D.C., January 9, 2005.

[6] Gollasch, S., "The Importance of Ship Fouling As A Vector of Species Introductions Into the North Sea," *BioFouling*, Vol. 18, No. 2, 2002, pp. 105-121.

[7] McDiarmid, Hugh, Jr., "Some Ships Could Lose Lake Access," *Detroit Free Press*, December 30, 2004, www.freep.com; and Alexander, Jeff, "NOAA Scientist: Close Door On Lake Invaders," *The Muskegon Chronicle*, December 26, 2004, www.mlive.com.

[8] Heller, Marc, "Seaway Security Focus Insufficient: Analyst Says Attack on Waterway Could Hurt Midwest Economy," *Watertown Daily Times*, March 15, 2005, quoting Stephen E. Flynn of the Council on Foreign Relations and Terry A. Breese, Director, U.S. Department of State, Office of Canadian Affairs, p. D3.

destinations of the cargos, and then developed estimates of the door to door transportation/handling costs for these moves using the current ocean vessel direct mode. Secondly, the alternative modes and routings have been analyzed for the key commodity movements, and the door to door transportation/handling costs for such moves have been calculated. The third step involved an estimation of the volumes of goods that would move on each of these alternative mode/routings. Finally, the cost for the "most likely" alternative mode/routings was compared to the current costs to determine the cost penalty that would be incurred absent ocean vessels.

The report begins with an overview of the GL/SLW and the more specific GL/SLS System, and then moves to a summary of the methodology and key study parameters. The next section includes a review of the traffic levels, history and prior forecasts of traffic on the GL/SLS and includes a breakout of ocean going traffic as opposed to laker traffic. The report then focuses on the two key commodities moved on the GL/SLS via ocean vessels, steel inward and grain outward, and provides some perspective on the importance of the Lakes routing relative to other modes/routings for moving these commodities in international commerce. The next section includes a review of prior studies of the transportation cost savings generated by the GL/SLS, although many of these studies have focused on the overall System without distinguishing between laker and saltie traffic. The report then turns to a section with detailed calculations of the costs of each mode/routing, and the estimation of the cost penalties that would be incurred if ocean vessels were not available. Following this section, the report considers the cost penalties that would be incurred relative to the current transportation costs and value of the goods, and relative to other environmental regulation costs. The report then evaluates the modal shifts that would result if ocean vessels were not used in the Lakes, the impacts of that modal shift, and the air quality impact of that shift. Finally, the report considers a number of more subjective variables that affect the value or negative impact of ocean shipping on the Lakes.

2.0 Great Lakes – St. Lawrence Waterway (GL/SLW) And Seaway (GL/SLS) Overview

The Great Lakes – St. Lawrence Waterway System (GL/SLW) stretches some 2,300 miles from the Gulf of the St. Lawrence all the way to the head of the Lakes at Duluth, Minnesota, while the Seaway (GL/SLS) extends some 1300 miles from Montreal to Duluth.[9] Figure 1 depicts the GL/SLW and identifies key cities along the System. There are in essence two key parts to the GL/SLS System itself: 1) the Great Lakes, and 2) the St. Lawrence River above Montreal. The Great Lakes consist of the five major Lakes- Superior, Huron, Michigan, Erie, and Ontario. Together, the Great Lakes contain some 5,439 cubic miles of fresh water, making them the largest freshwater body in the world,

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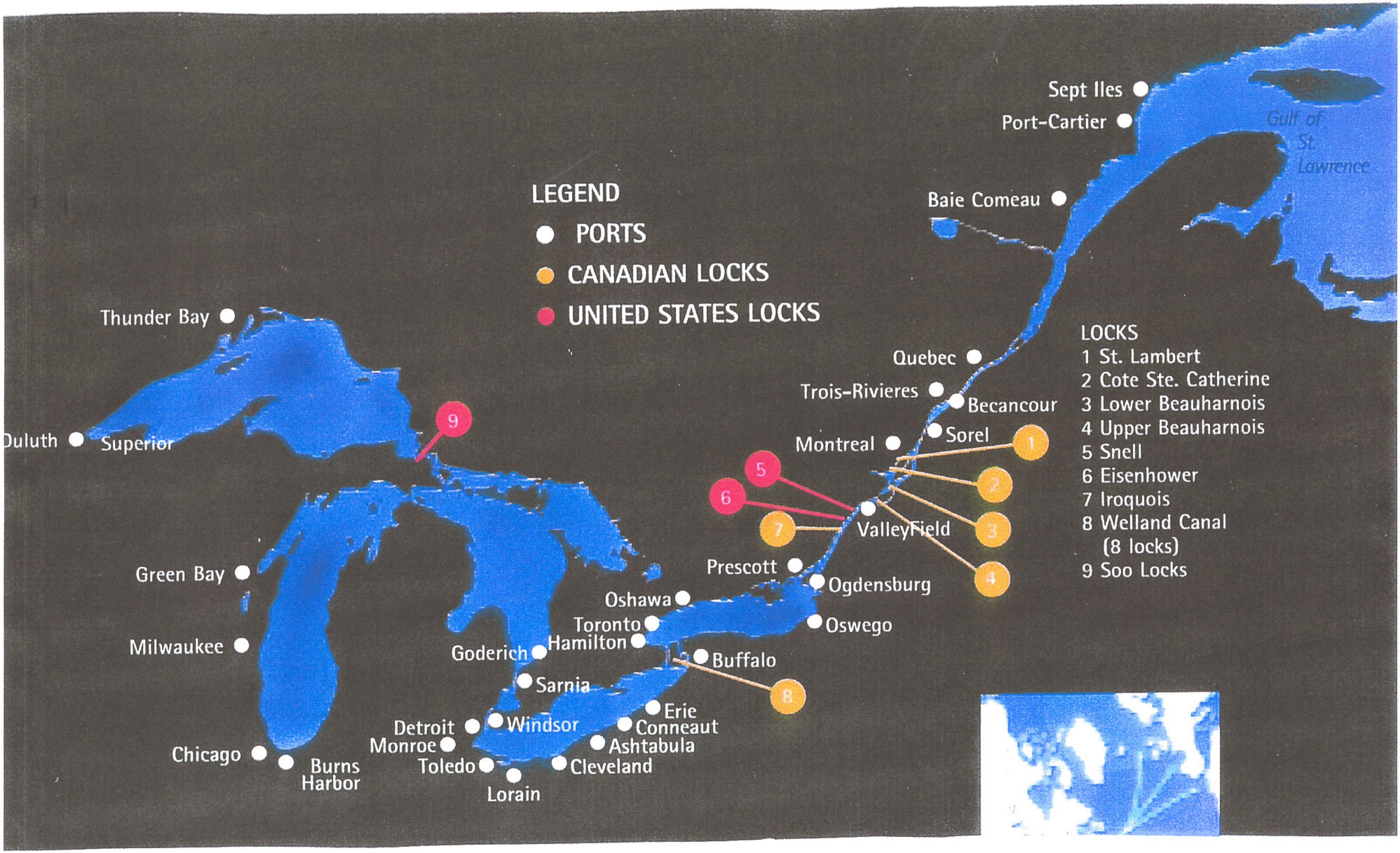
[9] This section draws primarily on information contained in the report entitled U.S. Army Corps of Engineers, *Great Lakes Navigation System Reconnaissance Study: Appendix A – Economic Analysis*, June, 2002, p. 2-1.

Figure 1
Great Lakes-St. Lawrence Seaway System Map



Source: St. Lawrence Seaway Management/Development Corporation. Overview of the Great Lakes-St. Lawrence Seaway Brochure. www.greatlakes-seaway.com/en/pdf/overview_brochure.pdf. pp. 1-8.

and representing some 95% of fresh water in the U.S. The St. Lawrence River, the other part of the overall GL/SLW, connects Lake Ontario to the Gulf of the St. Lawrence. The upper 190 miles of the St. Lawrence River, above Montreal, is known as the Montreal-Lake Ontario (MLO) Section of the GLSLS. The St. Lawrence Seaway, in total, includes the St. Lawrence River MLO Section, Lake Ontario, the Welland Canal around the Niagara escarpment, and Lake Erie as far West as Long Point. For the purposes of this study, the focus is on GL/SLS ocean shipping activity moving beyond Montreal and through the MLO Section, as the study revolves around the issue of invasives in the freshwater Great Lakes.

The overall GL/SLW System begins at the Gulf of St. Lawrence where ships sail some 700 miles to reach the mouth of the St. Lawrence River at Father Point. The Seaway itself begins at Montreal, 340 miles west of the River's mouth, and some 1000 miles from the open Atlantic. At the beginning of the Seaway at Montreal, the river level is some 20 feet above sea level, having risen gradually over 300 miles. This portion of the System is maintained to 35 feet by the Canadian government. Ships travel another 190 miles from Montreal along the St. Lawrence River to reach Lake Ontario, rising more than 225 feet. In the first sub-section of this Montreal-Lake Ontario (MLO) Section ships would encounter the first natural barriers consisting of the Lachine Rapids, and pass through two locks to rise 50 feet above the Montreal elevation. The second subsection through the Beauharnois Canal includes two locks which raise ships another 82 feet above Lake St. Louis. The third subsection of the MLO consists of Lake St. Francis where major channel deepening was required, but where there are no locks. All three of these subsections are exclusively within Canada. The international section of the Seaway begins at the upstream end of Lake St. Francis and extends to just east of Ogdensburg, New York. This section originally rose 90 feet over its 44 miles but is now a reservoir created by the Moses-Saunders Power Dam and is known as Lake St. Lawrence. The elevation is scaled by ships passing through the U.S. operated Eisenhower and Snell Locks by Massena, New York, and the Canadian operated lock at Iroquois, Ontario. The final leg to the Lakes consists of 68 miles of rapids free River known as the Thousand Islands Section.

The Lakes portion of the System begins at Lake Ontario which ships traverse to reach the Welland Canal. The wholly Canadian Welland allows ships to bypass the Niagara River/Niagara Falls natural connection between Lake Ontario and Lake Erie. The Welland and its locks raise ships 326 feet to Lake Erie. The Welland includes eight total locks that limit ships to Coast Guard Category VII vessels which have maximum beams of 78 feet and lengths of 740 feet. After traversing Lake Erie ships pass through the relatively shallow Detroit River, Lake St. Clair, and the St. Clair River, all of which require extensive dredging to maintain navigation depths. Ships then enter Lake Huron and Lake Michigan, considered to be one Lake by hydrologists given that they are at the same elevation. Ships passing into Lake Superior must get past the natural connecting St. Marys River rapids. This is accomplished by rising 23 feet through locks at Sault St. Marie, Michigan and Ontario. Commercial vessels use either the U.S. operated Poe or MacArthur locks, with the MacArthur limited to Class VII vessels, and the Poe able to accommodate Class X 1000 footer ships.

The GL/SLW System is bordered by eight U.S. states and two Canadian provinces that are the home to "nearly one third of the combined population of Canada and the U.S." The states contain one-fourth of U.S. industrial production, and two-thirds of Canada's production. The region's economy is supported by both Lakes and Seaway related trade. The principal commodities moved on the Lakes include iron ore, coal, limestone and grain, with these commodities representing some three fourth's of total tonnage. These commodities move overwhelmingly in U.S. or Canadian flag laker vessels, including the 1000' vessels that are captive to the Great Lakes since they cannot fit through the St. Lawrence Seaway.

Seaway borne trade includes commodities moving both by lakers and salties. Lakers carry a variety of commodities including grain and other bulk products, but are not generally able to carry steel due to cargo hold design configuration. Lakers transiting the Seaway are all Canadian owned, with U.S. Lakers choosing not to transit the Seaway due to size limitations, cabotage restrictions, and market forces. A typical laker vessel move through the Seaway would involve a Seaway size vessel, (i.e. 740 feet or less in length)[10] with an outbound load of grain from Toledo, Thunder Bay or Duluth to an elevator in the upper St. Lawrence (for topping off an ocean vessel) and a return load of iron ore from mines in Labrador or northern Quebec.

Salties move grain directly from the Lakes to overseas destinations primarily in Northern Europe, Northern Africa and the Mediterranean. A typical ocean vessel move would involve an inbound cargo of European steel products for Detroit or Burns Harbor, an empty move to Duluth or Thunder Bay, and an outbound trip with grain to an elevator on the St. Lawrence for top off and onward move to Europe. The top off is necessary since a fully loaded ocean vessel could not transit the Seaway because of draft restrictions. The availability of backhaul moves for both the ocean and laker vessels keeps costs down and provides for efficient utilization of resources. Salties also carry a variety of other commodities into and out of the Lakes, including, chemicals, pulp, sugar, and minerals. It should however be noted that Salties do not carry any significant volume of container cargo west of Montreal.

It is important to place ocean vessel traffic in the GL/SLS System into the context of total cargo movements in the System. It is estimated that approximately 180 million metric tons of cargo were moved on the GL/SLS System west of Montreal in 2002, excluding Montreal bulk and container traffic which is part of the broader GL/SLW System. This total System tonnage figure is somewhat difficult to pin down given well known difficulties with the multiple data sources which cover varying parts of System commerce, and year to year variations in iron ore production. The St. Lawrence Seaway itself, in 2002, handled 30.0 million metric tons of cargo at the MLO Section, with a total of 41.4 million metric tons moving through a combination of the MLO Section and Welland Sections. However, ocean vessels moving through the MLO Section of the

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[10] St. Lawrence Seaway Management Corporation and St. Lawrence Seaway Development Corporation (SLSMC/DC), *St. Lawrence Seaway System Website*, 2005, www.greatlakes-seaway.com; and SLMSC, *Seaway Facts*, 2005, p..3. Vessel maximum: 225.5 m (740 feet) length; 23.7 m (78 feet) beam; 8.0 m (26 ft. 3 in.) draft; 35.5 m (116.5 feet) height above water.

GL/SLS System carried just 12.3 million metric tons in 2002, representing about 6.8% percent of total tonnage moving in the GL/SLS System.

3.0 Methodology and Study Parameters

3.1 Methodology

The methodology first involved an overall literature review and examination of prior studies on the beneficial impact of the overall and ocean vessel borne portions of the System. Following the literature review, information on traffic volumes were summarized, and a control total for ocean vessel tonnage at the MLO Section was obtained (12.3 million metric tons in 2002).[11] Subsequently, personal and telephone interviews were conducted with a wide variety of knowledgeable sources.[12] Personal interviews were conducted in Montreal, Ottawa, Winnipeg, Philadelphia and Cleveland with representatives of the maritime shipper/receiver and carrier trade organizations, railroads, grain shippers, and stevedores. Phone interviews were conducted with various port representatives, ocean freight brokers, ocean freight rate services, grain shippers, carriers, trade organizations, stevedores, steel importers, and related government organizations.

Based on the information developed from the literature review and interviews, the total ocean vessel tonnage was broken out by commodity, by key port, and by key origin-destination. Given the large number of commodities and origin-destinations (O-D) involved, and budget constraints, a decision was made to focus on the major commodity origin-destinations. These key commodity/O-D's were for Canadian grain from Thunder Bay, U.S. grain from Duluth, and steel moving inbound to Canada and the U.S. These three groupings of volume represented some 70% of the total volume. An "all other" category made up the balance of the volume. Then, for each of the three key product groups, detailed analysis of the current door to door cost from origin to final destination was performed. For grain this included the costs from the Plains elevator to the overseas port location. For steel, costs were calculated from the overseas port to the North American final steel processor or mill destination. Costs considered included rail, handling, ocean transportation, truck, and other related transportation and handling costs. Based on these costs per ton, and the tonnages moved in each category, total transportation costs were calculated for the ocean direct current mode.

The next step involved a review of the possible alternative means of transporting the goods in question. For grain, the key alternatives involved rail to St. Lawrence ports, laker moves to the St. Lawrence for transshipment to ocean vessels, rail directly to the Gulf, and rail to barge for shipment to the Gulf. In each case the ocean vessel charges would be the final portion of the move. For steel, the alternative involved product coming to various U.S. and Canadian coastal ports, and then moving by rail to destination

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[11] A total of some 41 web pages and 95 reports/articles were reviewed for this study.

[12] A total of 24 organizations were visited for personal interviews, along with another 34 organizations that were interviewed by telephone.

markets, or in the case of the Gulf, steel potentially moving by barge to Chicago for transfer to final destinations. For each of these options a detailed analysis of the specific costs per ton for various parts of the move were calculated. These costs involved rates for rail moves to the coast, barge rates, laker rates, and various handling and related charges. In each case rates per ton were developed for each specific move that would occur. As with the estimation of these costs for the current ocean direct moves, the estimation process for each of the alternative mode/routings required a good deal of judgment in order to allow for valid comparisons.

The final step in the cost estimation process involved deciding on the “most likely” alternative mode/routing mix for each of the three major commodity groupings. The most likely alternative represented a judgment call, and there are other possible alternatives. For grain in the most likely alternative, it was assumed there would be a 50/50 split between rail direct and laker moves to the St. Lawrence. For steel, a very detailed set of assumptions were made about which of a series of ports would be used on the coasts and in what volumes, with various rail/truck mixes for transit to final destination areas. Based on the “most likely” scenario for each grouping, the total cost per ton for the grouping was calculated, along with actual total cost of the move. This total cost was then compared to the total cost of the current ocean direct move for each of the three key commodity groupings. For the “all other” category, an analysis of the commodities involved and their origin-destinations was made, and an overall composite cost per ton was estimated for the current ocean direct approach, and for the likely cost using a composite of alternative modes/routings. The final result was a comparison of the per-ton and total cost of transportation for the 12.3 million metric tons of goods moving by the current ocean direct approach, vs. the “most likely” alternative scenario.

Another important dimension of the methodology involved literature reviews to determine the percentage that these ocean direct tonnages represent out of total U.S. and Canadian imports and exports of the key grain and steel commodities. In addition, other sources were used to calculate and put into perspective the cost penalty relative to total transportation costs, the value of the goods, the transportation costs for all imports and exports of steel and grain, and how the cost penalty compared to other environmental regulation costs as well as the costs of invasive species in the Great Lakes. Other sources were used to evaluate and study the impact of the modal diversion in the “most likely” scenario. Issues related to volumes and capacity of these other modes were studied given estimates of the current volumes already moving on these other modes. An analysis of the air pollution impact of the modal shift was also calculated. Finally, an analysis was completed of more subjective variables that either favored ocean direct usage, or that favored use of other modes/routings.

3.2 Key Study Parameters

The focus of the study is on determining the relative cost advantage associated with ocean vessels carrying cargo to and from ports on the Great Lakes. The Great Lakes are the focus because of the critical importance of this fresh water resource. Ocean vessels are the focus because it is ocean vessels that bring invasive species into the Lakes, as compared to lakers which never leave the North American exclusive economic zone. Ocean vessels transmit invasive species via their ballast water[13], and to a lesser but measurable extent through ship fouling on the hull and intake/outflow water piping and lockers.[14] If ocean vessels, for whatever reason, cannot or choose not to enter the Lakes there is a perception that transportation costs to the user would increase and this would have adverse economic impacts. The study is designed to study the extent of the transportation cost impacts.

Several assumptions were made prior to the start of the study. These included the decision to use the MLO section as the point of entry into the Great Lakes. This location was used because it is west of Montreal and its extensive ocean shipping activity, because the location allows for capture of all ocean vessel traffic entering any of the Great Lakes, because it is at a point where the natural barriers to invasive species begin, and because the SLSMC/DC maintains data on ocean vessel transits and tonnage at this MLO point. There was some debate about whether to use the MLO Section or the Welland section as the control point given that the SLSMC/DC keeps data at both locations, and given the large drop-off in ocean vessel passages beyond the MLO. 2002 ocean vessel tonnage at the MLO totaled 12.3 million metric tons, while there was just 9.1 million metric tons at the Welland. This drop off is due to the fact that a significant percentage of ocean vessel tonnage is limited to Lake Ontario with the ships not proceeding beyond the Welland. However, on further analysis, and in order to be conservative, it was decided that the study should focus on the Great Lakes as a whole, and that the cost penalties of not using ocean vessels should be considered for the greater tonnages found at the MLO.

Another important issue relates to the time period to be used for data base development. One problem faced by the authors was that 2003-year ocean traffic was inordinately low[15] and not considered representative because of steel tariffs and droughts in the west. Year 2004 traffic was not yet available at the beginning of the study, but is now available. Further complicating this was that interviews and meetings that occurred in late 2004 and early 2005 generally involved a discussion of existing rates and issues. With a few exceptions there was little ability to recall 2002 rates in a consistent or reliable manner. In addition, the world had changed since 2002 especially with respect to ocean shipping costs. The emergence of the Chinese and other eastern economies had caused ocean rates to increase dramatically in 2004, before falling back to more sustainable levels in later 2004. Following considerable evaluation, it was decided to use 2002 traffic levels due to them being more representative of recent history than 2003. At the time of the decision 2004 trends also seemed to support the use of 2002 rather than the much lower 2003 ocean shipping tonnages, and in fact, full year 2004 results support the decision to use 2002 data. Traffic in 2004 was up from 2003 but was still lower than 2002 levels. The decision to use 2002's higher tonnages results in the maximum possible value of seaway

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[13] Holeck, Kristen T., et al., "Bridging Troubled Waters : Biological Invasions, Transoceanic Shipping, and the Laurentian Great Lakes," *BioScience*, Vol. 54, No. 10, October, 2004, pp. 919-929.

[14] Gollasch, S., "The Importance of Ship Fouling As A Vector of Species Introduction's Into the North Sea," *BioFouling*, Vol. 18, No. 2, 2002, pp. 105-121.

[15] Ocean cargo through the MLO was 12.3 million tons in 2002 and 9.6 million tons in 2003.

transportation savings for the 2002-2004 period being calculated, thereby adding a level of conservatism to the findings. While 2002 traffic levels were used, it was decided to use mid 2004 transportation rates as they were more timely and feasible for interviewees to comment on, and more representative than earlier 2004 ocean rates. As such all transportation rates were estimated for mid 2004.

Another complicating issue relates to the use of U.S and Canadian currency by various parties. It was decided to convert all currency values to US$[16]. A further source of confusion relates to the use of English (Short Tons—2000#)) or Metric (Long Tons—2204.62#) measurement in different data sources. The Canadians, The St. Lawrence Seaway and even many U.S. ports use metric tons. The U.S. Army Corps of Engineers uses short tons in their Waterborne Commerce Reports, as do many U.S. ports. Given the prevailing maritime use of metric tons and the importance of the St. Lawrence Seaway Traffic Report as a controlling document, it was decided to use metric tons[17]. As such, Corps data and other data expressed in short tons were converted to metric tons. Any reader trying to compare data in this report to other published reports should be aware of the possibility that the currency issue or the metric/non-metric ton issue could affect the comparison.

4.0 System Traffic and Tonnage

4.1 Traffic Data Issues

Before beginning a detailed review of GL/SLS System tonnages, it is important to elaborate on some of the problems encountered in generating total system tonnage values. Unfortunately, no one entity maintains a comprehensive data base of total System tonnages. Instead, various entities maintain data on the specific parts of the System they are responsible for. These entities include:

- U.S. Army Corps of Engineers (U.S. port data)
- Statistics Canada (Canadian port data)
- Lake Carriers Association (dry bulk cargo in U.S. & Canadian flagged lakers)
- SLSMC/DC (traffic in laker or ocean vessels moving through the Seaway)

Each entity maintains data appropriate to their specific needs and definitions and interpretations of data are sometimes difficult. As stated in the last section, this issue is complicated by the fact that SLSMC and Canadian data is expressed in metric tons (2,204 pounds) whereas U.S. data is generally in short tons (2000 pounds). Our review of these data bases does not indicate a single comprehensive and consistent source of traffic data on cargo movements. This view is supported by comments in the Great Lakes System Reconnaissance Study.[18]

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[16] Canadian currency was converted to US$ using a factor of C$1.00=US$.80.

[17] Short tons were converted to metric tons using a factor of .907.

[18] US Army Corps of Engineers *Great Lakes Navigation System Reconnaissance Study*, June 2002, p. 4-1.

4.2 Total GL/SLS System Tonnage

Given the above data problems in determining total System tonnage, some estimation was necessary. Following considerable review, it was concluded that a value of 180 million metric tons for total GL/SLS volume in 2002 was appropriate and representative of recent years. While this total System tonnage is not particularly relevant to our detailed calculation of ocean shipping transportation cost benefits, it is important in trying to put the ocean shipping volumes into perspective. Using the 180 million metric ton figure for the overall GL/SLS System, the 12.3 million metric tons of 2002 ocean volume passing through the MLO Section into and/out of the Lakes represents just 6.8% of total volume.

The primary source for the total System tonnage estimate is the Army Corp of Engineers Reconnaissance Study referred to earlier.[19] This report includes a table on total GL/SLS System tonnage the Corps pieced together from a variety of sources but the table is for 1998. The table is also in short tons and the authors have converted it to metric tons. The table is reproduced here:

Table 1
GL/SLS System, 1998 Traffic Tonnage by Country
Metric Tons

Destination	U.S. Origin	Canada Origin	Overseas Origin	Total
U.S.	115.7	18.6	5.4	139.7
Canada	29.4	23.7	3.1	56.2
Overseas	4.2	1.3	0.0	5.5
Total	149.3	43.6	8.5	201.4

Source: U.S. Army Corps of Engineers, *Great Lakes Navigation System Reconnaissance Study: Appendix A-Economic Analysis*, June 2002, Table 4-5.

After converting to metric tons, this table indicates total GL/SLS System tonnage of 201.4 million metric tons for 1998. However, other sources suggest total traffic fell somewhat after 1998, and we believe the total System tonnage needs to be revised downward somewhat for 2002.

The most comprehensive individual source of traffic information comes from the U.S. Army Corps of Engineers in their annual Waterborne Commerce publication[20]. This lists traffic by port, connecting channel or combinations of ports for traffic using U.S. ports. Totals include U.S. domestic traffic, traffic between U.S. and Canadian ports, and traffic between U.S. ports and overseas destinations, but exclude Canadian domestic traffic and Canadian traffic with overseas points. Table 2 from the Waterborne Commerce of the

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[19] U.S. Army Corps of Engineers, *Great Lakes Navigation System Reconnaissance Study: Appendix A-Economic Analysis*, June 2002, Table 4-5.

[20] U.S. Army Corps of Engineers, *Waterborne Commerce of the United States*, 2002, pp. 1-140.

U.S. Report shows traffic tonnages (adjusted to metric tons) over the 1993-2002 period. This indicates that traffic levels did fall significantly between 1998 and 2002.

Table 2
U.S.* Great Lakes/SLS Traffic
1993-2002
Thousands of Metric Tons

Year	U.S. Traffic on Great Lakes/SLS
2002	151,674
2001	155,423
2000	170,053
1999	165,856
1998	174,357
1997	171,041
1996	164,868
1995	161,219
1994	158,974
1993	144,783

*Includes traffic between U.S. and Canadian ports and overseas traffic using U.S. ports. Converted from short tons to metric.
Source: U.S. Army Corps of Engineers; *Waterborne Commerce of the United States, Table 3,* 2002, pp. xii.

Based on the above data, it appears that the U.S. related portion of total 2002 tonnage was 151.7 million metric tons. While the authors do not have data on 2002 Canadian related domestic and overseas traffic, we estimate Canada's additional traffic to be in the range of 28 million metric tons in 2002. When combined with the 151.7 million U.S. metric tons this would result in total System tonnage in 2002 of around 180 million metric tons.

4.3 St. Lawrence Seaway Laker and Ocean Vessel Traffic and Tonnage

More relevant to the focus of this study is the extent of traffic transiting the St. Lawrence Seaway. Table 3 shows traffic data for both the MLO and Welland sections. The table indicates that 2253 ships transited the MLO portion of the Seaway in 2002. Traffic for 2003 and 2004 was at lower levels than 2002. The 2002 traffic consisted of 1116 lakers and 1137 ocean vessels. For the Welland Section there were 2550 total vessels of which 1741 were lakers and 809 were ocean vessels. The large drop-off in ocean vessels between the MLO and the Welland Sections is explained by ocean vessels utilizing ports on Lake Ontario and on the St. Lawrence west of Montréal. Hamilton especially, but also Toronto, Oshawa, Valleyfield and several other ports handle significant volumes of cargo in ocean vessels.

The vessel values shown in Table 3 represent traffic in both directions. Thus, in 2002, there were 569 up-bound ocean vessels and 568 down-bound ocean vessels passing through the MLO Section. There were 276 days of navigation in 2002[21] - meaning that approximately two ocean vessels enter the Great Lakes each day and two depart each day through the MLO. This number decreases to about 1.5 ocean vessels per day that enter the Great Lakes through the Welland Section and 1.5 per day that depart. The significant drop off in volumes is due to ships passing through the MLO only into Lake Erie where they serve the ports of Hamilton, Toronto, Oshawa and others. Hamilton is by far the most significant in terms of tonnage.

Table 3
Ocean and Laker Cargo* Vessel Transits
1999-2004

Year	MLO Section			Welland Section		
	Total Vessels	**Ocean Vessels**	Laker Vessels	Total Vessels	Ocean Vessels	Laker Vessels
2004	2236	**1021**	1215	2627	702	1925
2003	2199	**929**	1270	2493	662	1831
2002	2253	**1137**	1116	2550	809	1741
2001	2235	**1133**	1102	2791	867	1924
2000	2548	**1316**	1232	2858	1023	1835
1999	2684	**1282**	1402	3057	979	2078

* Cargo vessels include cargo, barge, and tanker vessels. Non-cargo and passenger vessels are not included.
Source: SLSMC/DC*, St. Lawrence Seaway Traffic Report: 1959-1992 Navigation Season, 2005,* pp.1-43; SLSMC/DC, *St. Lawrence Seaway Annual Traffic Reports, 2002-2004*.

Tonnages for the MLO Section and Welland Sections of the Seaway are also available by laker vs. ocean vessel type, and additional history is also available. Table 4 summarizes the tonnage data. The most important figure is the control number for the study, 12285 thousand metric tons, or 12.3 million metric tons of cargo that moved through the MLO Section in 2002. As noted earlier in the report, 2003 was not used as the study year because of the very low tonnages resulting from steel quotas/tariffs and drought in the Plains. The 2003 tonnage totaled just 9.6 million metric tons. The 2004 traffic was not used because it was not available at the beginning of the study, and as it turns out, the 2004 tonnage also was lower than 2002. Ocean vessel tonnages have been fairly constant over the years following lower ramp-up volumes in 1960. The peak year for ocean traffic at the MLO Section was in 1978 with 23.1 million metric tons. However laker traffic tonnage passing through the MLO has dropped considerably since the 1970's, reflecting

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[21] SLSMC/DC, *St. Lawrence Seaway Traffic Report: 2002 Navigation Season: Table S3, 2003,* p. 7. There were 276 days of navigation on the MLO and 275 on the Welland Section.

reductions in grain and other bulk and general cargoes. Somewhat similar trends can be observed at the Welland Section.

Table 4
Ocean and Laker Vessel Cargo Tonnage
1999-2003
(Thousands of metric tons)

	MLO Section			Welland Section		
	Total Tonnage	**Ocean Vessels**	Laker Vessels	Total Tonnage	Ocean Vessels	Laker Tonnage
2004	30800	**11017**	19783	34285	8206	26078
2003	28900	**9562**	19338	31870	6943	24928
2002	30002	**12285**	17718	32108	9119	22989
2001	30278	**11702**	18576	32485	9072	23412
2000	35406	**14987**	20419	36572	11569	25003
1999	36412	**13887**	22524	37441	10917	26524
1990	36656	**11295**	25361	39398	8255	31143
1980	49454	**14717**	34737	59606	12519	47087
1978	56943	**23077**	33866	65671	20560	45111
1970	46422	**13559**	32863	57119	11821	45298
1960	18426	**7206**	11220	26535	5711	20824

Source: SLSMC/DC, *St. Lawrence Seaway Traffic Report*: *1959-1992, 2005, pp. 1-43; and 2002-2004 Navigation Seasons,* 2005, pp. 1-46.

4.4 Current Traffic Forecasts and Review Of Pre-1990's Forecast Accuracy

The above data indicates that 12.3 million metric tons of cargo moved through the MLO Section on ocean vessels in 2002. This value is the basis for later calculations of the transportation cost savings that can be attributed to ocean shipping into and out of the Lakes. In 2002 an additional 17.7 million metric tons of goods moved through the MLO Section on lakers, for total traffic of 30.0 million metric tons. One could ask if the 12.3 million figure is a valid one to use given recent past volumes and future projections. As can be seen in the Table, 2002 is fairly representative of ocean vessel values since 1990, and is considerably above the tonnages seen in 2003 and significantly higher than 2004 tonnages. Going forward, no forecasts of ocean vessel tonnage were available to the researchers, but a comprehensive forecast of total ocean vessel and laker tonnage expected at the MLO Section was available.

This forecast is included in a report presented to a meeting of the U.S. Transportation Research Board (TRB) and Royal Society of Canada's (RSC) Committee on the St.

Lawrence in September, 2004.[22] The report by Hazem Ghonima forecasts a ”most likely” .7% per year AAPC growth rate with traffic reaching 37.6 million metric tons by 2020. This forecast traffic level compares to our 2002 base year volume of 30.0 million metric tons, and the year 2000 volume of 35.4 million metric tons. The Ghonima forecast includes a 2020 range from a low of approximately 30.0 million metric tons to a high of approximately 47 million metric tons. The “most likely” forecast shows a gradual rise punctuated by periodic periods of traffic fall offs, consistent with the history of the Seaway. The report does not envision traffic levels returning to the Seaway’s MLO peak traffic levels of just under 60 million metric tons that were recorded in the late 70’s. One additional forecast that was reviewed dealt specifically with Canadian grain.[23] This forecast by the Canadian Wheat Board, made in 2003, predicts flat grain movements through the Eastern route through 2011, at about 6.2 million laker/ocean vessel metric tons. Given the recent history of Seaway tonnages, and the Ghonima forecast, the research team felt the 2002 ocean vessel tonnages were appropriate for calculation of transportation cost savings generated by such vessels.

It is also interesting to consider the current Seaway MLO tonnages and forecasts in the light of earlier forecasts of Seaway volumes. Table 5 summarizes some of these earlier forecasts.

As can be seen, earlier forecasts substantially overstated future volumes. The 1954 Hazard forecast was the closest to actual 2002 volumes but still highly overstated likely traffic. The Stanford 1964 and Ghonima 1985 forecasts were more than double actual 2002 volumes. However, the 1977 Hazard forecast and the Acres 1982 forecasts were even higher, perhaps because of the high Seaway volumes in the mid to late 1970’s. Much of the variance can be explained by the grain forecasts. For instance the 1982 Acres Consulting study forecast MLO grain tonnages of 39.4 million metric tons in 2000, but actual tonnages were closer to 11.0 million metric tons.

These studies point out the difficulty in forecasting Seaway traffic levels. Given the recent history of traffic levels, and the past problems with forecasting traffic, the research team feels that the 2002 ocean vessel tonnage of 12.3 million metric tons is a reasonable one from which to calculate System transportation cost savings benefits.

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[22] Ghonima, Hazem, TAF Consultants, *Trends In Seaway Use & Competition With Other Modes*, in a presentation to the Transportation Research Board (TRB) and Royal Society of Canada’s (RSC) Committee on the St. Lawrence Seaway meeting on the topic of Options to Eliminate Introduction of Non-Indigenous Species Into the Great Lakes, Montreal, Canada, September 28, 2004, pp. 1-50.

[23] Weisensel, Ward, Canadian Wheat Board, *Industrial Outlook: Grain*, a presentation at the 66th International Joint Conference, Canadian Shipowners Association, Niagara-On-The-Lake, Ontario, Canada, June 17, 2003, pp. 1-12.

Table 5
Prior Forecasts vs. Actual Seaway MLO Tonnages
(Million Metric Tons (MT))

Kates Associates 1965[24]	Forecast for 2010	130.1 Million MT
Hazard 1977[25]	Forecast for 2000	99.1 Million MT
Acres 1982[26]	Forecast for 2000	72.6 Million MT
Stanford Research 1964 18	Forecast for 2000	69.6 Million MT
Ghonima 1985[27]	Forecast for 2000	65.0 Million MT
Hazard 1954[28]	Forecast for Max Volume	49.4 Million MT
Actual Volume 2000	Actual Volume 2000	35.4 Million MT
Actual Volume 2002	Actual Volume 2002	30.0 Million MT
Actual Volume 2003	Actual Volume 2003	28.9 Million MT
Actual Volume 2004	Actual Volume 2004	30.8 Million MT

5.0 Prior Studies on Seaway Transportation Cost Savings

While there have been many past studies on the advantages and disadvantages of the Seaway for specific commodity groups, there have been few studies in recent years that examined the Seaway as a whole. Studies that have been done have also tended to focus on the Canadian or the U.S. side, but not both. To the best of the researcher's knowledge, there have been no studies that took a comprehensive look at Seaway transportation cost savings for ocean vessel traffic in particular. What studies have been done on ocean vessel savings have tended to focus specifically on grain.

The following subsections review the findings from several studies that have focused on one aspect or another of the research question. The studies are organized with the most recent first.

5.1 TVA Sault Locks Navigation Study Update: Appendix B – Addendum 8 – Transportation Rate Analysis – Post 2000

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[24] Hazard, John L. , *Transportation: Management Economics Policy* (Cambridge, Maryland: Cornell Maritime Press, Inc.), 1977, p. 394, Table 14.2 summarizing J. Kates Associates 1965 study, and Stanford Research Study in 1964.

[25] Hazard, John L. , *Transportation: Management Economics Policy* (Cambridge, Maryland: Cornell Maritime Press, Inc.), 1977, p. 398.

[26] Acres Consulting Services Limited and Data Resources, Inc., *Seaway Commodity Flow Forecast 1980 to 2000,* for the Canadian Seaway Authority and the St. Lawrence Seaway Development Authority, February, 1982, pp. 1-196.

[27] Ghonima, Hazem, "The Future of the Seaway Traffic and Its Role In the Economy of the Great Lakes – Seaway Region," *20th Proceedings of the Canadian Transportation Research Forum*, Vol. 20, 1985, pp. 1-25.

[28] Hazard, John L., "Shipping and Transportation Perspectives in Utilizing and Managing the Great Lakes – St. Lawrence System," in *Our Great Lakes: Resources for Growth With Quality*, Proceedings of a Conference held at Michigan State University, March 21, 1984, pp. 10-29.

This study examined the door to door transportation cost savings attributable to the Soo Locks.[29] While most of the volume at the Soo is intra-lakes oriented, the study did do a commodity by commodity review and thus also examined grain shipments that would have been moving down-bound from Duluth and Thunder Bay. The study compared transportation and handling costs at 1998 rates for a waterway move, to the next best all land transportation alternative. Costs used in the study were actual freight rates and handling charges paid by the shippers. However, the study did not distinguish between ocean vessel and laker moves.

In total, the study found that users saved an average of US$4.90 per ton, with most of this savings relating to iron ore. However, the study did specifically examine wheat and oats. Interestingly, in both cases the study found that the all land route was actually cheaper than the water route. For wheat, the study estimated that the water route was US$4.99 per ton more expensive than an all land route. For oats, the water route was also found to be more expensive than the all land route – by US$5.68. These findings are somewhat counter intuitive but perhaps not surprising given the overall progress that rail has made in lowering costs over the last 40 years.

The authors noted the higher cost for water moves and explored some of the reasons that might help explain why, in their study, shippers would ship some 4.4 million metric tons of wheat via a more expensive mode than the all land routing. Several possible reasons were noted. First, they noted that in some situations there may not be available rail cars, and water shipments might be the only option. Secondly, they suggest long term contracts and large capital investments in facilities may lead to discontinuities in the relationship between rates and modal choice. Our interpretation is that this might mean that grain trading companies would offer a slightly higher price per bushel for shipments to their Lakes terminals, as compared to prices offered for grain delivered to other terminals. This might be necessary to achieve desired utilization rates for terminals, or to assure supply for a ship arriving under contract. The third reason suggested was that “salties” may occasionally offer very low rates to obtain a cargo out of the Lakes.

5.2 Martin Associates Study of Transportation Cost Savings of the Seaway - 2001

Martin Associates prepared an analysis of the economic benefits of the Seaway for the St. Lawrence Seaway Development Corporation (SLSDC) in August, 2001. As part of that analysis they examined transportation cost savings in particular.[30] However, the analysis only considered the major (16) U.S. ports and did not evaluate Canadian savings. Nor did the report break out savings for ocean vessels vs. laker traffic.

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[29] Tennessee Valley Authority, *Soo Locks Navigation Study Update: Appendix B – Addendum 8 – Transportation Rate Analysis*, for the U.S. Army Corps of Engineers Soo Locks Navigation Study, post 2000, pp. 1-19.

[30] Martin Associates, *Economic Impact Study of the Great Lakes St. Lawrence Seaway System: Transportation Cost Savings*, prepared for the St. Lawrence Seaway Development Corporation, August 1, 2001, pp. 1-3.

They estimated savings of US$1.2 billion to the users of the System for the 2000 shipping season. However, virtually all of the savings are for commodities that remain intra-lake, or that generally do not transit the Seaway on ocean vessels. For instance they found savings of US$661.2 million for iron ore, US$102.0 million for coal, US$243.5 million for stone and aggregates, US$113.4 million for cement, and US$80.0 million for salt. The savings for these generally non ocean vessel goods in fact totaled exactly US$1.2 billion, suggesting that the savings number does not include any tonnage from ocean borne freight. This may mean they did not find any specific dollar savings from ocean shipments.

The study did however comment on savings or cost penalties for two commodities that move on ocean vessels. In the case of grain, which moves both by laker to the St. Lawrence for transfer to ocean vessels, and directly by ocean vessels from the Lakes, they estimated the waterborne routing contributes to saving US$5.10 to US$10.20 per ton by providing a competitive option to rail. What they specifically indicate is that "if the Seaway System ceased to exist, rates would increase by US$.15-30/bushel, since rail would no longer have a competitive alternative transportation system." However, this is not a savings estimate for ocean vessels specifically, and it could be argued that the laker alternative alone would be enough to keep rail rates honest. We estimate later in this report that some 4.89 million metric tons of grain moved out of the Lakes from both Canada and the U.S. on ocean vessels in 2002. Using this tonnage and the midpoint of their savings value, or US$7.65 per ton, one could calculate estimated potential ocean borne grains savings of US$37.5 million in 2002 for Canada and the U.S. if the Seaway were to completely close, although again, this does not suggest the current use of lakers or ocean vessels saves any dollars at all compared to rail.

The Martin study also commented on the one other major ocean vessel borne commodity – iron and steel. While Martin does not estimate any cost savings or penalties for use of direct ocean shipping into the Lakes, they do note that "in many cases, the use of Great Lakes ports is not the least cost routing compared to an East Coast port or use of the Mississippi River System." They go on to note however that "the time of delivery is critical, and for the most part, the use of the GL/SLS System provides the most time effective routing." They go on to suggest that "delays of up to six weeks are not uncommon when railing steel products from East Coast ports." We will comment on this issue more later in the report, however, while we understand there have been some significant problems with rail transit time and reliability, we believe these problems are much more limited than implied.

Overall, this study focused on intra-lakes commodity moves and the savings they generate. For the two key commodities that move on ocean vessels, grain and steel, they did not provide any specific savings totals, and in fact, suggested that steel moving on the Lakes is actually more expensive than if it moves by the alternative mode/routings.

5.3 Wilson and Heads - CTRF Proceedings – Thunder Bay: Grain Gateway to the East? - 1996

This paper in the Proceedings of the Canadian Transportation Research Forum examined the competitiveness of Thunder Bay as a grain clearance port for exports.[31] The paper makes a number of general observations, and includes some estimates of the rates per ton to move export grain via various modes/routings. However, the paper does not distinguish between ocean direct vs. laker transshipments. They point out that Canadian grain exports via Thunder Bay declined between 1984-1995 from 50% of the total to just 20%. The authors comment that "Pacific ports have eroded the volume moving through Thunder Bay to such an extent as to relegate this port to the point of becoming a residual outlet."

The paper presents estimates of transportation costs per ton for alternative modes/routes at two different exchange rates. At C$1=US$.74 they find the traditional rail route to Thunder Bay with a laker move to Quebec City costs C$55.49/ton, but that a direct rail move to Quebec City would be slightly cheaper at C$54.51. They also found that a rail/barge move to New Orleans would cost C$55.01. However, as the Canadian dollar strengthens to C$1=US$.90 they find the rail/barge route to New Orleans declines to C$49.52. At this exchange rate a direct rail route to New Orleans would also be cheaper than the traditional Thunder Bay route. However, the authors point out that an additional factor is the relative ocean rates from New Orleans vs. Montreal, and that Montreal may have an advantage in serving European markets when Gulf rates are higher.

In commenting on the above data the authors note that there is considerable potential for the rail route to Quebec City. We would note however that these comments were made in 1996 and while there appears to continue to be potential, this potential has not yet been realized on any scale. The authors also note, however, that "since achievement of additional economies in lake vessel operation is limited by the size of the locks, while economies in rail operation continue to be experienced, that the competitive position of the Thunder Bay route can be expected to erode further." They then go on to suggest that they expect exports via Thunder Bay to fall somewhat from the average 1992/1995 level of 7.4 million metric tons before gradually increasing to a 2000 level of 6.4 million metric tons, and 7.0 million tons by 2005. The paper concludes by stating that the "previous attractiveness of Thunder Bay has been seriously eroded." In fact, Thunder Bay grain exports by laker/ocean vessel totaled 5.1 million metric tons in 2002.

5.4 Brodeur and Kibedi CTRF papers - 1991

T.J Brodeur; and Kibedi, Hackston and Lake; each had papers on Seaway competitiveness in the 1991 CTRF Proceedings.[32] Interestingly, the Brodeur paper was

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[31] Wilson, Arthur G. and John Heads, "Thunder Bay: Grain Gateway to the East?," *31st Proceedings of the Canadian Transportation Research Forum*, Vol. 31, 1996, pp. 459-469.

[32] Brodeur, T. J., " Great Lakes Shipping: A Foundering Industry," *26th Proceedings of the Canadian Transportation Research Forum*, Vol. 26, 1991, pp. 1-15; and Kibedi, Andrew, Hackston, David and

titled “Great Lakes Shipping: A Floundering Industry,” and the Kibedi, et al paper focused on the “situation facing transportation in the Great Lakes.” Both presented relatively negative assessments of the situation facing shipping on the Lakes/Seaway.

The Brodeur paper states that “what was once a very healthy, vibrant business has deteriorated into an industry whose future viability is in grave jeopardy.” The paper notes that the “Staggers Act of 1980 was another blow to the industry by allowing the railways to carry grain in unit trains to the U.S. East Coast at rates more competitive than the lakers.” The paper also notes that spot laker rates from 1985 to 1989 were in the range of US$11-14/ton but does not state the currency.

The Kibedi , et al paper concludes by stating that “optimism abounded when the Great Lakes Seaway entered the eighties. It was not borne out. Pessimism abounds as the System enters the nineties. It need not be borne out.” This quote sums up the negative perceptions of the future of the Lakes – Seaway System, especially as it related to the laker business, but also notes that the future does not need to be bleak if the industry and government work together to increase competitiveness. The paper also notes the gains in competitiveness by the railroads, and states that “Grain at this moment could move competitively on rail direct from the West to Eastern Canadian tidewater, unthinkable even five years ago.” The paper indicates this would require cleaning capacity in the prairies and/or lower St. Lawrence and notes that this was developing in the prairies. Since then we would note that cleaning capacity has also become available in Quebec City. Kibedi, et al conclude this point about rail by stating that “Based on 1987 costs, rail could be competitive with the marine movement at laker rates of US$19/20 per tonne (we assume C$ and metric tones).

5.5 The Ghonima CTRF Papers – 1985-1991

Hazem Ghonima, a former St. Lawrence Seaway Authority employee wrote a number of Canadian Transportation Research Forum Proceedings papers on Seaway competitiveness and likely future volumes from 1985 to 1991.[33]

Richard Lake, “A Review of the Regulatory, Competitive and Institutional Situation Facing Transportation in the Great Lakes and St. Lawrence Seaway,” *26th Proceedings of the Canadian Transportation Research Forum*, Vol. 26, 1991, pp. 1-12.

[33] Ghonima, Hazem, “The St. Lawrence Seaway: Causes of Its Decline and Future Perspective,” *26th Proceedings of the Canadian Transportation Research Forum*, Vol. 26, 1991, pp. 1-15; Ghonima, Hazem, “Transportation Rates and Seaway Competitiveness for Exporting U.S. Grain,” *24th Proceedings of the Canadian Transportation Research Forum*, Vol. 24, 1989, pp. 1-15; Ghonima, Hazem, “Transportation Rates and Seaway Competitiveness for Moving Canadian Grain,” *23rd Proceedings of the Canadian Transportation Research Forum*, Vol. 23, 1988, pp. 1-15; Ghonima, Hazem, “The St. Lawrence Seaway Competitiveness,” *21st Proceedings of the Canadian Transportation Research Forum*, Vol. 21, 1986, pp. 1-15; and Ghonima, Hazem, “The Future of the Seaway Traffic and Its Role in the Economy of the Great Lakes – Seaway Region,” *20th Proceedings of the Canadian Transportation Research Forum*, Vol. 20, 1985, pp. 1-25.

Ghonima's 1985 forecast for 2000 MLO Section volumes was for a "most probable" level of 65 million metric tons. He indicated a minimum traffic level for 2000 would be 43 million metric tons, with a maximum traffic level of 85 million metric tons. This forecast assumed grain would total 35 million tons in the "most probable" scenario, and is the most important reason why the forecasts were overly optimistic by more than 100%. In 1991 Ghonima wrote another paper on causes of the Seaway's decline and indicated that a pessimistic scenario would be one that might question the Seaway's ability to maintain the then 36.7 million tons of MLO traffic. The paper analyzes the reasons for decreases in traffic and focuses on world trends in the grain markets, and other related factors.

Ghonima also wrote two papers on Seaway transportation rates and competitiveness in 1988 and 1989. The first, in 1988, focused on Canadian grain and involved a comprehensive analysis of grain transportation rates from the prairies to Rotterdam via the Seaway with laker transfers to ocean vessels at Montreal, vs. the costs of moving grain via the Pacific Coast. The study found that domestic freight charges to Montreal including elevation to the ocean vessel in Montreal were in the range of C$42-45/ton in 1986, as compared to charges to the Pacific of around C$27/ton. Laker transportation charges, excluding elevation in Montreal, were estimated at C$14-17/ton, but did not indicate any Seaway tolls. The paper also found that the Western Grain Transportation Act had a major effect in lowering rail transportation rates to the Pacific, at the expense of the Seaway.

Ghonima's 1989 paper focused on U.S. grain but did not consider ocean direct moves from the Lakes. The paper found that for grain within 100 miles of Toledo, that the Seaway Route to Rotterdam was some C$12.85/metric ton cheaper than the coastal route via Baltimore. However, for grain shipped from within 100 miles of Chicago, the study found that a route via barge to the Gulf was just C$1.09 more expensive than a route via the Seaway. However, most importantly, the paper found that the Seaway advantage rapidly diminished as the catchment area moved beyond 300 or so miles from the Lakes. the study also noted that ocean rates to most destination areas were just some C$3-4/ton higher from the Gulf than they were from the Seaway. The paper estimated laker rates at C$12.14/metric ton excluding tolls.

5.6 Booz, Allen & Hamilton–Transportation Cost Analysis of the St. Lawrence Seaway 1985

This report on a transportation cost analysis of the Seaway was prepared for the SLSDC in 1985.[34] The study focused on four bulk commodities including grains, imported iron and steel, machinery, and imported iron ore. Only U.S. origin-destinations were examined. The study took into account ocean rates, inland transportation costs in North America, and port handling costs in determining the least cost routing for each state.

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[34] Booz, Allen & Hamilton, *Transportation Cost Analysis of the St. Lawrence Seaway,* April 15, 1985, pp. 1-59.

With respect to grain, the report does not address wheat, but does examine the competitiveness of Lakes moves vs. tidewater moves for corn and soybeans. The study found that the Lakes were competitive for grain originating in a relatively small area of northern Illinois, south Wisconsin, and a small part of Ohio. The advantage ranges from US$3-7 per short ton. Mediterranean destinations provided the greatest geographic area of advantage for the Lakes, followed by European and then African destinations. The study found, however, that for states like South Dakota, Minnesota, Iowa and most of Wisconsin and Illinois; that tidewater ports had a cost advantage ranging from US$9-22 per short ton.

For steel, the study found a cost advantage for Lakes ports that averaged US$11-31/ short ton. The study also found Lakes advantages for machinery, imported iron ore, and containers.

5.7 Saint Lauren Project - The St. Lawrence: A Vital National Resource - 1985

This report compares the costs of transportation by water to all land routes and examines both Canadian and U.S. origin-destinations.[35] It is also one of the few reports that explicitly compared ocean vessel direct costs to a laker transshipment routing, vs. the all land routings. However, the ocean vessel option was only considered for the Thunder Bay origin. The principal commodities studied involving an ocean vessel move were export grain and import iron ore. The study was based on actual transportation prices paid by shipper/receivers for the total door to door transportation cost, and provided breakouts for various categories of cost. However, the report is 20 years old so it is becoming fairly dated. It should also be noted that the source and basis for most of the comparisons was the 1982 Acres Consulting and Data Resources study discussed earlier in the section on Prior Forecasts.

For Canadian wheat, the study examined shipments from Thunder Bay to Rotterdam, and considered options of ocean direct via a 20,000 ton vessel, laker transshipment to an 80,000 ton ocean vessel at Quebec City, laker transshipment to a 100,000 ton vessel at Port Cartier, rail direct from the Prairies to Quebec City for transfer to an 80,000 ton ocean vessel, and rail via Thunder Bay to Quebec City for transfer to an 80,000 ton ocean vessel. The original analysis, conducted by Acres Consulting and Data Resources in 1982, and presented by the authors of this study in Table 29, found that the cheapest move was by rail direct to Quebec City with transfer to the 80,000 ton vessel. The most expensive option was for ocean direct shipments, with the two laker options in-between. However the total cost spread on the options ranged from a low of C$30.70 per ton for the rail direct shipment to Quebec City, to a high of C$33.12 for an ocean direct move. The Project Saint-Lauren authors go on, however, to point out that an additional C$3.00/ton of export preparation/cleaning costs should be added to the rail direct option, making the revised cost of C$33.70/ton slightly higher than the ocean direct cost, and a couple dollars higher than the laker transshipment options. The Saint Lauren authors go

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[35] Saint-Laurent Project, *The St. Lawrence: A Vital National Resource*, June, 1985, pp. 1-183.

on to suggest a number of other adjustments to assure apple to apple comparisons, and present a revised Table 30 showing their cost comparisons for the five routings. The revised numbers show ocean direct to be the cheapest, with rail direct the most expensive, and the laker options again in-between the other two. While it is difficult to follow all the adjustments, the bottom line from this study is that ocean direct costs were estimated to be C$3.51/ton cheaper than the best laker option, and C$7.64/ton cheaper than the rail direct option.

For American grain exports, the authors point out that the Seaway is in brisk competition with the Mississippi route. Comparisons were made for Duluth moves via laker to Port Cartier and 60,000 ton ocean vessel to Rotterdam, and a barge move from Minneapolis to New Orleans with transfer to a 60,0000 ton ocean vessel. No comparisons were provided for an ocean vessel direct move from Duluth. The authors concluded that the Seaway routing with laker transshipment to a 60,000 ton ocean vessel had a US$10.29 advantage over the Minneapolis to New Orleans barge route assuming an ocean freight cost to Rotterdam that was US$6.00 per ton higher than out of Port Cartier. The Seaway option was found to have a US$14.62/ton advantage over the all rail route to New Orleans with subsequent transfer to a 60,000 ton ocean vessel. The study also examined Toledo to Rotterdam grain exports, and compared the Seaway option with a laker move to Port Cartier with transfer to a 60,000 ton vessel, with a route by rail to Baltimore with transfer to a 60,000 ton ocean vessel. For these options the authors found the Seaway had a US$5.63 per ton advantage.

5.8 Conclusions On Prior Studies

Generally, the studies that have been done previously have primarily looked at the Seaway route in general, without differentiating between ocean vessel and laker options. Table 6 summarizes the findings of the above studies:

Table 6
Summary of Prior Study Findings

TVA - Soo Locks Study – for U.S. Army Corp of Engineers	Post 2002	All Seaway routing for wheat costs US$4.99/ton more than all land move. No specifics on ocean vessels. Provides some reasons for why shippers continue to use Seaway given this finding.
Martin Associates – Transportation Cost Savings to Users of 16 U.S. Ports – for SLSDC	2001	Reported savings of US1.2 billion for U.S. ports all relate to intra-Lakes moves. Estimate grain export costs would increase US7.65/metric ton (midpoint) if Seaway closed completely. For steel, comment that all land move is cheaper in many cases, but that Seaway move is faster and more reliable and that this trumps price. No specifics on ocean vessels.

Heads and Wilson – Thunder Bay Viability – for academic CTRF Proceedings	1996	Focuses on Thunder Bay grain exports. No specifics on ocean vessels. Conclude port grain traffic will drop to 6.4 million metric tons in 2000 (actual was 5.1 million metric tons). At C$100=US$.74 finds all rail move is C$1.48/metric ton cheaper, and barge/rail move is C$.48/metric ton cheaper. Rail and rail/barge routing savings increase as Canadian dollar rises.
Brodeur and Kibedi Papers – for academic CTRF Proceedings	1991	Generally depict a negative picture of Seaway competitiveness. Indicate that rail has become cost competitive with the Seaway. Details on laker rates.
The Ghonima Papers – for academic CTRF Proceedings	1985-1991	Forecast MLO 2002 traffic at 65 million tons. For Canadian grain, found the Pacific Coast route had domestic transportation rate advantages over the Seaway. Detailed laker cost data. For U.S. grain found the Seaway continued to have a small advantage over rail and barge.
Booz, Allen & Hamilton – Transportation Cost Analysis of Seaway – for SLSDC	1985	Finds corn and soybean Seaway savings of US$3-7/short ton for origins in small areas of northern Illinois, southern Wisconsin and eastern Ohio. However, for South Dakota, Minnesota, Iowa and northern Wisconsin finds Seaway routing is US$9-22 more expensive than an all land move to tidewater. No specifics on ocean vessels. For steel, Seaway has a US$11-31/short ton advantage depending on O-D.
Saint Laurent Project – St. Lawrence Seaway Future – for unknown client	1985	For Canadian grain, found Seaway all ocean direct routings had a C$3.51/metric ton advantage over the laker transshipment option, and a C$7.64 per metric ton advantage over an all rail move to Quebec City. For U.S. grain, Seaway option had a US$10.29/metric ton saving over rail/barge, and a US$14.62/metric ton savings over rail to New Orleans.

6.0 Transportation Costs for Ocean Vessels and Alternative Modes

The principal purpose of this study is to determine the relative cost advantage provided by ocean vessels moving cargo into and out of the Great Lakes. For purposes of this study, this traffic level was deemed to be the tonnage moving west of Montreal, as reported by the SLSMC/DC in their traffic report for the Montreal-Lake Ontario (MLO) Section of the Seaway. A series of scenarios was developed to compare the cost of movement by ocean vessels to that of other modes such as, laker vessels, rail, and barge. The entire movement was included from origin to destination - typically from a foreign port to the end user in the U.S. or Canada for steel; or, from a farm elevator on the Prairies to a foreign port. Usually a European port was assumed since that represented the source of much of the steel, and a fair amount of the grain was bound for there. In any event, Europe seemed to be a reasonable surrogate for any number of worldwide destinations. The foreign port might change and the ocean rate in turn might change but the basic relationships would remain the same. It was necessary to utilize this approach since ocean vessels typically offer a single rate for the movement between the foreign port and the Great Lakes port.

The assessment process developed costs for three different movements that represent approximately 70 percent of the ocean vessel traffic moving in the Great Lakes. Subsequently, judgments about the costs associated with the remaining 30 percent of the traffic were made so that a cost comparison for all of the ocean vessel traffic could occur. The three ocean vessel movements are:

- Canadian grain movements from the prairies through Thunder Bay to Europe
- U.S. grain movements from the plains through Duluth to Europe
- Steel movements into the Great Lakes to/from Europe or Brazil

The cost estimation exercise was a complicated undertaking that required considerable time and effort. The process involved meetings and/or phone interviews with a wide range of individuals and organizations including ports, stevedores, railroads, maritime trade organizations, agricultural organizations and agencies, ship brokers, and steel brokers and importers.

Information on rates and charges was obtained from these and other organizations. In addition, a literature search was undertaken to obtain information and background on rates, issues, and previous studies. Some general observations on costing issues were as follows:

- Ocean rate volatility makes comparisons difficult. In 2004, the world economy was very strong and countries like China were emerging as major consumers of transportation in the world. Ocean shipping rates from the St. Lawrence to the Mediterranean grew from US$18 per metric ton for grain in summer 2003 to US$35/metric ton in late 2003 to US$63/metric ton in early 2004 to US$35/metric ton in mid-2004. Higher ocean rates result in increased rates for a ship coming into the lakes because of the opportunity costs to utilize the ship elsewhere.[36]

- Ocean rates also vary significantly depending on ship size. Several sources including the International Grain Council provide vessel rate data for large vs. small ships.
- Barge rates are also subject to volatility.
- Port Authority tariffs are complex to understand and may not reflect actual charges to volume customers.
- Ocean and laker rates often differ in terms of inclusion or non-inclusion of tolls and loading/unloading costs.
- Port and elevation costs vary greatly even within a general cargo type and between modes. For example, at the Port of Montreal, the cost to elevate a metric ton of wheat from a water vessel is C$2.82, whereas flax is C$3.81. The cost to unload a rail car into an elevator is C$4.75 per ton.[37]
- Rail rates are increasing because of a perceived ability to price more aggressively against their competition.
- Rail rates for a similar distance may vary widely if a "captive" situation exists.
- Terminal ownership may cause the cost structure to vary significantly. For example, a ship using a company owned dock or other facilities might incur lower handling charges than a ship using the services of a public port authority.
- Contract rates vary greatly. Some shipper/receivers have contracts for a number of years that are under priced for today's conditions. These organizations may provide information that does not accurately affect the current situation.
- Laker vessel rates do not cover the cost of ship replacement .[38]

All of the above factors had to be taken into consideration in analyzing rate data and developing comparisons across modes/routes. In developing total costs for a mode/route all of the cost components had to be considered so as to assure apple to apple comparisons across modes. These cost components included land transportation costs involving rail or truck, port costs, elevator and terminal costs, and costs associated with the water portion of the movement.

The role that non-water transit costs play in the total cost structure can be observed in the following example. The cost of moving a metric ton of wheat from the Prairies through Thunder Bay to the St. Lawrence by laker is about US$44. However, the laker portion including tolls and other charges is only about US$13. There is a rail cost of around US$21 to get the grain to Thunder Bay; there are over US$7 in elevator costs at Thunder Bay, and costs of about US$2 to get the grain into the St. Lawrence elevator. There are additional elevator and port charges to load the ocean vessel before movement to Europe. Finally, there is the actual cost of ocean transportation to Europe. It is important to

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[36] International Grain Council, www.igc.org.uk; Dry Baltic Index, www.balticexchange.com; U.S. Department of Agriculture, *Ocean Rate Bulletin*, www.ams.usda.gov/tmd0ocean/index.asp; and interviews with grain trading organizations and ship brokers.

[37] Montreal Port Authority, *Notice N-3: Grain Terminal Fees Tariff*, 2004, p. 5, www.port-montreal.com.

[38] Lake Carriers Association, Canadian Maritime Chamber of Commerce personal interviews and other sources.

understand that while water rates are often very low there are numerous other cost components that increase the total cost of a cargo movement.

The following sub-section develops the detailed traffic data by port and by commodity. Subsequent sub-sections then review the cost estimation calculations for each of the three major commodity moves described above, our cost estimates for the "all other" category, and a summary of the total cost comparisons for each of the categories. For each of the three major commodities, the sub-sections review the cost calculations for the current ocean vessel move, the costs for each of the modal/route options, our selection of the "most likely" alternative modal/route scenario and volumes, and development of the total costs for that scenario. Each sub-section concludes with a summary of the current cost, "most likely" alternative cost, and the cost penalty that would result if ocean vessels were not available for use.

6.1 Tonnage Moving in Ocean Vessels By Commodity And Great Lakes Port

A key early task was to determine the commodity type and volume of traffic moving in ocean vessels to and from the major U.S. and Canadian ports, and to assure this number correlated with the known Seaway MLO Section ocean vessel tonnage reported by the SLSMC/DC. This value is the 12.3 million metric tons of ocean vessel traffic. The tonnage by port by commodity must tie back to this number.

A number of ports were contacted to obtain this information, however, several differences in the way that different port agencies maintained their data were found.[39] A common problem was the fact that many ports did not distinguish the type (i.e. laker or salty) of vessel that cargo was moving in. Other problems with definitions were also found and it was determined that it would be difficult to develop a consistent and comprehensive database from local port reports alone.

Given these problems the researchers decided to also obtain the port traffic databases maintained by Statistics Canada and the U.S. Army Corps of Engineers. Detailed Statistics Canada reports were purchased and these reports indicated the commodities and volumes of traffic moving between Canadian ports and ports elsewhere in the Great lakes and the rest of the world. Their computerized report titled *International Commodity Movements: Great Lakes Ports To/From Foreign Ports* was especially useful and provided information on specific cargo shipments and tonnages.[40] The downside is that the level of specificity requires the user to manually categorize shipments by commodity type and manually add up the amounts for each port. Some ports such as Hamilton have over 150 different shipment records to and from ports throughout the world. In order to

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[39] Phone interviews were conducted with the Ports of Thunder Bay, Toronto, Hamilton, Goderich, Windsor, Duluth, Burns Harbor, Detroit, Chicago, Cleveland, and Toledo.

[40] Statistics Canada, *International Commodity Movements: Great Lakes Ports To/From Foreign Ports, 2003, Computer printouts.*

make the information manageable the researcher team classified the shipments into three categories:

- Agricultural Products
- Iron/Steel Products
- Other

The researchers also used the 2002 version of the report titled *Waterborne Commerce of the United States: Part 3—Waterways and Harbors in the Great* Lakes to help in estimating ocean borne volumes by port.[41] This report is prepared by the U.S. Army Corps of Engineers and provides detailed information on all traffic moving into and out of U.S. Great Lakes ports. The "foreign" classification provides information on traffic originating or terminating in foreign countries other than Canada. Canadian traffic to and from the U.S. is also included as a separate category. The short ton data reported in the document was converted to metric tons using the .907 conversion factor.

In order to assure the best estimates of ocean vessel port tonnages by commodity the research team wanted to calibrate the calculated port totals by commodity with summary commodity information maintained by the SLSMC/DC. In order to do so the calculated information for each port was totaled with subtotals for Canada and the U.S. These totals could then be compared to total foreign vessel tonnages by commodity for all Canadian and all U.S. ports maintained by the SLSMC/DC in Table M3.[42] The results of this comparison can be seen in Table 7.

The comparison shows a strong correlation for both the Canadian and the U.S. port totals. The correlation is also good for the three commodity categories.

Table 7
Validation of Port Data

Canadian ports	Agricultural	Iron/Steel	Other	Total
Calculated To/from Foreign*	2340	1898	1476	5714
SLSMC/DC Values**	2324	1875	1601	5800
US Ports				
Calculated To/from US Ports*	2359	2458	712	5529
SLSMC/DC Values**	2413	2317	983	5713

*Calculated from Statistics Canada and Army Corp of Engineers (COE) port data.
**Calculated from SLSMC/DC, *St. Lawrence Seaway Traffic Report, 2002 Navigation Season, Table M3, 2003, pp. 22-23.*

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[41] U.S. Army Corps of Engineers, *Waterborne Commerce of the United States: Part 3—Waterways and Harbors in the Great Lakes*, 2002, pp. 1-140.
[42] SLSMC/DC, *St. Lawrence Seaway Traffic Report: 2002 Navigation Season, 2003, pp.1-46.*

The next step in finalizing the estimates of Seaway MLO ocean vessel tonnage by port by commodity was to compare the numbers with SLSMC/DC Table M1, which shows the amount of traffic moving through the MLO in ocean vessels. This table shows 12.3 million metric tons of traffic moving in ocean vessels compared to the SLSMC/DC's Table M3 that shows 11.2 million tons. The research team believes that most of the difference is non-foreign cargo moving in ocean vessels between a non-Great Lakes U.S. (e.g. Baltimore) or Canadian ports, and a Great Lakes port. For example, an ocean vessel from Brazil may stop at a U.S. east coast port to pick up cargo for a Great Lakes port. Statistics Canada data indicates 163,000 metric tons of cargo moving from U.S. Gulf and east coast ports to Canadian Great Lakes ports. This includes 100,000 metric tons of chemicals from Texas and Louisiana ports to Sarnia and Marathon. There is also 22,000 metric tons of coal to Port Colburne from Baltimore. There could also be some traffic moving in ocean vessels from Halifax or Montreal to U.S. or Canadian ports. This would not show up as foreign traffic. The research team distributed the 1.044 million metric tons of U.S. to/from Canada cargo moving in ocean vessels into the three cargo commodity categories so that the total cargo universe is equal to the cargo that the SLSMC/DC shows moving in ocean vessels through the MLO section of the Seaway.

The results of these calculations are shown in Table 8. Table 8 shows the cargo baseline that will be utilized in the costing exercise. This table summarizes information on the three commodity categories of traffic at all of the major U.S. and Canadian Great Lakes ports moving on ocean vessels. As stated previously, the total cargo universe of 12.3 million metric tons ties out to the totals shown by the SLSMC/DC in their Table M1 for MLO traffic in ocean vessels.

Table 8 indicates that the ocean vessel cargo is almost evenly split between U.S. and Canadian ports. Following are some details on the three categories of commodities:

- Agricultural Products. Approximately 40 percent of the ocean vessel traffic moving through the MLO consists of agricultural products. This is primarily grain moving from Thunder Bay and Duluth although about a dozen other Great Lakes ports also ship agricultural products. Over half of this is wheat but there are also significant volumes of flaxseed, soybeans, and canola. Over 80 percent of down-bound traffic in ocean vessels is agricultural products.

Table 8
Ocean Vessel Traffic at Great Lakes Ports
2002
(Thousands of Metric Tons)

Cargo between	Agricultural Products	Iron/Steel Products**	Other Cargo	Total Metric Tons
Canadian ports & foreign ports				
Thunder Bay	2098	0	206	2304
Hamilton	71	1036	286	1393
Toronto	0	216	436	652
Sault Ste. Marie	0	292	28	320
Windsor	48	171	84	303
Oshawa	0	139	0	139
Valleyfield	0	44	81	125
Goderich	123	0	0	123
Other GL Canadian ports	0	0	300	300
Sub-total to/from foreign ports	2340	1898	1476	5714
SLSMC/DC MLO Values***	2324	1875	1601	5800
US ports and foreign ports				
Duluth/Superior LT	2042	25	54	2121
Burns Harbor	34	750	124	908
Detroit	2	561	2	565
Cleveland	0	403	51	454
Menominee	0	111	146	257
Milwaukee	129	34	90	253
Toledo	102	79	69	250
Chicago	48	196	0	244
Ashtabula	0	167	69	236
Other GL US ports	2	132	107	241
Sub-total to/from foreign ports	2359	2458	712	5529
SLSMC/DC MLO Values***	2413	2317	983	5713
Total to/from foreign ports	4699	4356	2188	11243
SLSMC/DC MLO Values***	4737	4192	2584	11513
Est. US/Canada cargo in Overseas Vessels*	200	200	642	1042
Grand Total	**4899**	**4556**	**2830**	**12285** ****

*Represents cargo moving in ocean vessels between a non-Great Lakes US or Canadian port (e.g., Baltimore or Gulf) and a Great Lakes port. About 200K of this traffic was identified from Statistics Canada data - all falling within "other" category (coal, petro and chemicals).

**Includes small amounts of other metal or plastic products

***Computed from 2002 SLSMC/DC Table M3, pages 22-23. Values are shown for validation purposes.

****From 2002 SLSMC/DC Table M1, page 20. Total traffic in ocean vessels for MLO.

Source: 2002 Canadian port data from Statistics Canada. 2002 US port data from U.S. Army Corps of Engineers. SLSMC/DC data from 2002 St. Lawrence Seaway Traffic Report, Table M1 & M3A & M3B.

7/19/2005

- Iron/Steel Products. Approximately 37 percent of the ocean vessel traffic consists of steel or iron products. This includes steel slab, flat rolled steel (coil), bars/rods, and other types of iron or steel products. Much of the steel slab (1.1 million metric tons) is destined to steel mills in Hamilton, Sault Ste. Marie, Detroit, and Burns Harbor. The other steel products move into 16 ports. A fair amount of this product is finished flat rolled steel in coils that is used in the automotive and other manufacturing industries. Much of the steel is manufactured in Europe or Brazil but many other countries are involved as well. About 60 percent of all up-bound ocean vessel traffic is iron and steel products.

- Other Cargo. About 23 percent of Seaway MLO traffic in ocean vessels falls into the 'Dry Bulk' and 'General Cargo' category. These categories are of relatively minor importance to ocean vessels. By contrast, this category dominates traffic for the lakers that move through the MLO with their cargoes of iron ore, coal, and stone. Significant MLO cargo for ocean vessels (in metric tons) includes chemicals and petroleum products (557,000 tons), sugar (456,000 tons), wood pulp (216,000 tons), coke (167,000 tons), mine products (297,000 tons) and aluminum ore (88,000 tons). There are also many very small movements of general cargo such as dishwashers, frozen meats, etc. moving to or from foreign destinations.

In conclusion, this table and other materials support the commonly held view that ocean vessel traffic in the Great Lakes largely consists of outbound grain and inbound steel. These two cargo categories comprise about 3/4 percent of all ocean vessel traffic moving through the MLO.

6.2 Canadian Grain Movement From the Prairies Through Thunder Bay to Europe.

Total grain movements out of Thunder Bay were 5.7 million metric tons in 2002. Of this amount, 2.1 million metric tons were handled in ocean vessels. The remaining 3.6 million metric tons moved in lakers to the St. Lawrence where they were offloaded into elevators and subsequently reloaded into ocean vessels for the onward trip. The reloading serves to top-off ocean ships that were restricted in the amount they could carry through the St. Lawrence Seaway (SLS) because of draft restrictions. In other cases, larger ocean vessels loaded directly out of the St. Lawrence.

Thunder Bay has served as the preeminent Canadian Great Lakes grain port for many years. Grain volumes typically ranged between 11- 17 million tons in the 1970's and 1980's. Subsequent changes in global trade patterns shifted grain exports away from European and Russian destinations to Asian and other destinations that favored a west coast port. The last few years have seen grain volumes in the 5-7 million ton range. As noted earlier in the subsection on Current Traffic Forecasts, Canadian forecasts do not suggest any large scale or quick increase in activity.[43]

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[43] See Footnote 19 - Ghonima, September 28, 2004.

Most of the grain handled at Thunder Bay originates in the Prairie Provinces, especially in western Manitoba and Saskatchewan. For purposes of this study, and based on conversations with the railroads, we assumed that grain would originate at Yorkton, SK (just west of the Manitoba border). Rail rate estimates were obtained from the railroads for moves to Thunder Bay and to Quebec City.[44] The move involved about 1070 miles from Yorkton to Thunder Bay and 2400 miles from Yorkton to Quebec City. We then obtained information from the Canadian Wheat Board (CWB) and other sources on elevation and other costs in Thunder Bay and St. Lawrence ports.[45] We also obtained rates for transportation by laker vessels from Thunder Bay to the St. Lawrence.[46] This was supplemented by information from Port of Montreal tariffs related to rail switching costs, elevator storage costs and other information. Appendix A-1 includes the detailed cost calculations and sources for the ocean and other modal options discussed in this and following paragraphs. All $ values are in US$ unless otherwise noted..

From various published and unpublished sources including the CWB and other trading organizations, International Grain Council, USDA and ship broker interviews we obtained ocean rates from Thunder Bay to Europe and from the St. Lawrence to Europe.[47] A significant problem encountered was the volatility in ocean rates during this period. As cited earlier, ocean rates from the St. Lawrence to Europe were as low as US$18/metric ton in mid-2003 and as high as US$63/metric ton in early 2004.[48] The rate at various times would seem to stabilize around US$35/metric ton and that value was used in the study.[49] The CWB and other grain trading organizations felt this was a reasonable value. CWB staff and other grain trading company sources also suggested that they generally assumed a US$15 additive for the ocean rate between Thunder Bay and the St. Lawrence.[50] Thus, an ocean rate of US$50/metric ton was used for movements from Thunder Bay to Europe and US$35/ton was used for movements from the St. Lawrence to Europe. It is of interest to note that ocean rates to Europe from the Gulf of Mexico are also in the US$35 range.[51] While distances to Europe are longer from the Gulf, larger tonnage ships are often used, thereby negating much of the distance

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[44] Interviews with Canadian National and Canadian Pacific railroads.

[45] Canadian Wheat Board, *2003-04 Statistical Tables. Table 20, 2004*; also Transport Canada, Research and Traffic Group, *Competitiveness of Great Lakes/Seaway System: Canadian Grain Through St. Lawrence Ports and New Orleans*, March, 1995; Montreal Port Authority, *Notice N-3: Grain Terminal Fees Tariff,* 2004, p. 5, www.port-montreal.com.

[46] Canadian Wheat Board, *2003-2004 Statistical Tables: Table 20*, 2004, pp. 1-37; and interviews.

[47] Interviews with CWB and other agricultural trading organizations, International Grain Council, www.igc.org.uk; U.S. Department of Agriculture, *Ocean Rate Bulletin,, Table 17,* www.ams.usda.gov/tmd0ocean/index.asp.

[48] Dry Baltic Index, www.balticexchange.com.

[49] U.S. Department of Agriculture, *Grain Transportation Report, Table 17*, June 12, 2004, p. 14; International Grain Council, *Ocean Freight Rates, Table 30 - 2004*, March, 2005, Computer Printout.

[50] Interviews with CWB and other grain trading organizations.

[51] International Grain Council, *Ocean Freight Rates, Table 30 - 2004*, March, 2005, Computer Printout; Park, Joon J. and Won W. Koo, "An Econometric Analysis of Ocean Freight Rates for Grain Shipments from the United States to Major Importing Countries, *Journal of the Transportation Research Forum*, Vol. 43, Iss. 2, 2004, pp. 85-100.

impact on rates. Based on the above estimates, we calculated that the total costs to a shipper/receiver for a move from Saskatchewan to Europe via an ocean vessel from Thunder Bay, to be US$78.39/metric ton.

The next step was to develop alternatives to the ocean vessel and compute the cost associated with each. Two alternatives were analyzed:

- "Laker Option." Rail to Thunder Bay/laker to the St. Lawrence/ocean vessel to Europe
- "Rail Option." All rail from Saskatchewan to the St. Lawrence/ocean vessel to Europe

Since most of the grain from Thunder Bay already moves by laker to the St. Lawrence this would be a logical alternative. The main issue with the laker movement is the additional costs associated with an extra handling and elevation in the St. Lawrence (i.e., the ocean vessel is loaded at Thunder Bay and moves directly to Europe without any additional handling and the costs associated with that handling). These handling costs add almost US$5 per metric ton to the move.[52] There should be sufficient elevator capacity at St. Lawrence elevators since they were built to handle the very high grain volumes experienced in the 1970's and 1980's.

The laker rate itself, from Thunder Bay to the St. Lawrence, was estimated at US$13.23/ metric ton, including bunker fuel and tolls.[53] This rate has held fairly steady in recent years. However, there have been questions about whether the laker industry would have the capacity to handle the additional volumes that might come from a modal shift. While, we address this issue more fully later in the section on modal shifts, we believe a combination of lakers and the rail mode could accommodate increased volumes from a modal shift. It is important to note that there have been significant changes in annual grain volumes over the years and the laker fleet has been able to accommodate these fluctuations. While the laker fleet has been reduced substantially in recent years there are several approaches to handling extra volume that are discussed in the modal shift section.

Another laker issue relates to the fact that many laker ships back-haul iron ore from the Sept-Iles area to Hamilton and other Lakes area steel mills. For most mills, however, these backhauls require the use of a self-unloader vessel, as opposed to a straight deck bulker ship, because most mills do not have shore based facilities for unloading iron ore. As such, straight deck bulkers can only carry iron ore backhauls if they are moving to one of the remaining mills with shore based facilities. That said, however, the consensus was that there would be little additional back-haul opportunity for any additional laker traffic given the demand from mills and availability of ore. It is also important to note that the vessels sometimes must travel considerable distances out the St. Lawrence to get this cargo, which may only be returned as far as Hamilton. This extra deadhead mileage

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[52] Canadian Wheat Board, *2003-04 Statistical Tables. Table 20, 2004*; also Transport Canada, Research and Traffic Group, *Competitiveness of Great Lakes/Seaway System: Canadian Grain Through St. Lawrence Ports and New Orleans*, March, 1995; and interviews with grain trading organizations and ports.
[53] CWB, *Table 20*, 2004; and interviews with grain trading organizations.

down-bound for a fairly short backhaul, coupled with the need to clean the vessels after carrying iron ore, has resulted in the iron ore backhaul opportunity having only a minimal impact on laker rates according to previous studies. For instance, the 1995 Transport Canada study found that the down-bound rate varied by just C$2.35/metric ton when comparing trips with or without an iron ore backhaul. [54] Factored into the overall weighted average laker rate per ton, this affect is modest and is reflected in the weighted average rate of US$13.23/metric ton currently being used.

Based on the above assumptions and cost estimates the total cost associated with the Laker option was calculated at US$81.65 per metric ton.

The rail option assumed an all rail move from the prairies to the St. Lawrence. This movement is currently occurring and has been as high as 1.1 million metric tons annually though it is rarely that high.[55] Rail has an advantage similar to the ocean vessel in that it only requires a single elevation (with rail at the St. Lawrence, and ocean vessel at Thunder Bay), as compared to the laker option which requires elevation and handling at both Thunder Bay and the St. Lawrence. We obtained rail rates from the railroads and added appropriate rail switching fees at the St. Lawrence port as well as higher handling costs associated with rail.[56] The calculated cost associated with the rail option is US$82.06/metric ton.

The question of whether the rail system has adequate capacity was raised with the railroads given current problems throughout North America where many railroads are capacity constrained. The railroads indicate that the rail lines in eastern Canada are not as capacity constrained as in western Canada, and that the lines that would be involved here have sufficient capacity to handle additional volumes.[57] As an example, the shift of all grain currently moving in ocean vessels at Thunder Bay would mean an additional 2.1 million metric tons annually. This amounts to 21,000 annual carloads or about 190 trains

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[54] Transport Canada, Research and Traffic Group, *Competitiveness of Great Lakes/Seaway System: Canadian Grain Through St. Lawrence Ports and New Orleans*, March, 1995.

[55] Interviews with Canadian National and Canadian Pacific railroads.

[56] Interviews with Canadian National and Canadian Pacific, and with various grain trading organizations; and comparisons with rates used in prior studies such as Transport Canada, Research and Traffic Group, *Competitiveness of Great Lakes/Seaway System: Canadian Grain Through St. Lawrence Ports and New Orleans*, March, 1995 and Wilson, Arthur G. and John Heads, "Thunder Bay: Grain Gateway to the East?," *31st Proceedings of the Canadian Transportation Research Forum*, Vol. 31, 1996, pp. 459-469.

[57] Interviews with Canadian National and Canadian Pacific; Lemieux, Yves, Canadian National Railway, presentation titled *Modal Competitive Dynamics Along the St. Lawrence Seaway and Great Lakes*, at a meeting of the Transportation Research Board and Royal Society of Canada's Committee on the St. Lawrence Seaway: Options to Eliminate Introduction of Non-Indigenous Species Into the Great Lakes, Montreal, Canada, September 28, 2004, pp. 1-7; Cairns, Malcom, Canadian Pacific Railway, presentation titled *Freight Movements By Rail: Current Status and Future Opportunities*, at a meeting of the Transportation Research Board and Royal Society of Canada's Committee on the St. Lawrence Seaway: Options to Eliminate Introduction of Non-Indigenous Species Into the Great Lakes, Montreal, Canada, September 28, 2004, pp. 1-7; Wilson, Arthur G. and John Heads, "Thunder Bay: Grain Gateway to the East?," *31st Proceedings of the Canadian Transportation Research Forum*, Vol. 31, 1996, pp. 459-469.

annually. Thus, less than one daily train movement in each direction would be involved (one EB loaded train and one WB empty). Both Canadian National and Canadian Pacific serve this corridor with heavy duty mainlines and could absorb this increased volume. Elevators on the St. Lawrence that regularly receive rail movements of grain exist at Montreal, Trois Rivieres and Quebec City.

The loss of ocean vessels would likely result in additional movements by both laker and rail. Given the costs for each modal option, and current mode selection both during the Seaway navigation season and in the off-season, we estimate that the current ocean vessel tonnage would be evenly split between lakers and rail with each mode carrying approximately one million additional metric tons. The additional cost of this "most likely" alternative scenario, as compared to the present ocean vessel move, was calculated to be US$3.47/metric ton, or US$7.3 million annually.

Table 9 which follows provides a summary of the costs for each mode and "most likely" alternative scenario. The results suggest that the laker and rail options have similar cost penalties as compared to the ocean direct routing. These cost penalties range form US$3.26-3.67 per metric ton. Given the "most likely" scenario in the case of non-availability of ocean vessels, we find an overall cost penalty of US$3.47/metric ton. For the 2.1 million metric tons involved, this would mean a cost penalty of US$7.3 million per year in total.

Table 9
Alternative Mode Costs to Move Thunder Bay Grain to Europe

	Ocean	Laker (L)	Railroad (R)	"Most Likely"
Modal Split	100%	100%	100%	50%L/50%R
Metric Tonnage (000's)	2098	2098	2098	1049/1049
US$ Cost per Metric Ton	$78.39	$81.65	$82.06	$81.86
Total Transportation Cost (Millions of US$)	$164.5	$171.3	$172.2	$171.7
Additional Costs Over Ocean (Millions of US$)	-0-	$6.8	$7.7	$7.3
Additional US$ Costs/ Metric Ton	-0-	$3.26	$3.67	$3.47

The penalty costs per ton for the non-availability of ocean vessels is in the same range as has been found in previous studies.[58] In fact some previous studies have actually found

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[58] Tennessee Valley Authority, *Soo Locks Navigation Study Update: Appendix B – Addendum 8 – Transportation Rate Analysis*, for the U.S. Army Corps of Engineers Sault Locks Navigation Study, post 2000, pp. 1-19; Heads, John and Arthur G. Wilson, "Grain Handling and Transportation: Capacity, Rates, and Tariffs," *31st Proceedings of the Canadian Transportation Research Forum*, Vol. 31, 1996, pp. 443-458.; Transport Canada, Research and Traffic Group, *Competitiveness of Great Lakes/Seaway System: Canadian Grain Through St. Lawrence Ports and New Orleans*, March, 1995: Acres Consulting Services Limited and Data Resources, Inc., *Seaway Commodity Flow Forecast 1980 to 2000*, for the Canadian Seaway Authority and the St. Lawrence Seaway Development Authority, February, 1982, pp. 1-196.

that rail is a cheaper alternative to movements via the Lakes. For instance, the TVA study referenced earlier, which examined U.S. grain from Duluth, found that an "all land" move was US$4.99/metric ton cheaper than a Lakes routing. Heads and Wilson in their 1996 paper also found the rail option to be slightly cheaper than the Lakes routing. The 1995 Transport Canada study on Seaway competitiveness also found rail to be cheaper for the movement of Canadian grain eastward. In 1982, Acres Consulting Services Ltd., showed the rail option as the lowest cost followed by lakers and than ocean vessel, although a follow-up study by the Quebec St. Laurent Project resulted in a restatement of costs and a report that suggested ocean rates were indeed the cheapest option.

6.3 U.S. Grain Movement from the Plains through Duluth to Europe

Total grain movements out of Duluth were approximately 3.3 million metric tons of which slightly less than 2.1 million metric tons were handled on ocean vessels passing through the MLO. The remaining 1.2 million metric tons presumably were moved by lakers, primarily to the St. Lawrence, where they were offloaded to elevators and subsequently reloaded into ocean vessels in a manner similar to the movements from Thunder Bay.

Duluth is the U.S. counterpart to Thunder Bay. It serves as the Great Lakes outlet for grain from the northern plains. Grain volumes have ranged from 3-5 million metric tons annually for the last decade or so. Most of the grain handled at Duluth originates in the Dakota's and western Minnesota. USDA sources have indicated that very little of this grain originates south of Minneapolis-St. Paul.

Costs were first calculated for the direct ocean option from Duluth, with a rail move from the Plains to Duluth. For purposes of this study, it was assumed that rail moves would be less expensive than that required to get to Thunder Bay from Saskatchewan. Duluth is further west and as such, the producing areas are closer to the lake head. Based on USDA reports we assumed a rail rate of US$15 per metric ton.[59] Duluth elevation charges of US$7 per metric ton were used - comparable to those at Thunder Bay. Ocean rates to Europe of US$35/metric ton from the St. Lawrence and US$50/metric ton from Duluth were used, again comparable to rates used for the Canadian grain movements. As can be seen in Appendix A-2, the total door to door costs for ocean vessel direct shipments to Europe were estimated at US$72.00/metric ton.

Three alternatives to the ocean vessel move were developed and costs for each were computed. These cost calculations are also contained in Appendix A-2. We did not develop an all rail move to the St. Lawrence since the railroads did not feel that was likely to occur. Such a move would involve new routings and would have to pass through Chicago unless it moved north through Canada. The three options studied were as follows:

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[59] Estimated based on U.S. Department of Agriculture, *Grain Transportation Report, Table 7,* November, 2004, p. 6.

- "Laker Option." Rail to Duluth/laker to the St. Lawrence/ocean vessel to Europe
- "Rail to Gulf Option." Rail from plains to the Gulf of Mexico/ocean vessel to Europe
- "Barge Option." Rail to St. Louis/barge to Gulf of Mexico/ocean vessel to Europe

Since much of the grain out of Duluth already moves by laker this would be a logical alternative. We assume a laker rate from Duluth of US$14.35/metric ton, including bunker fuel and tolls. The same issues discussed with the laker move out of Thunder Bay also apply for Duluth—most significant being the extra elevation involved with a laker move to the St. Lawrence. There is also the issue of whether the laker fleet has sufficient capacity. In this case, a U.S. flag laker could handle the movement to the St. Lawrence since it is an international move, and there are several U.S. flag lakers that are currently laid up.[60] However, U.S. flag vessels have seldom in the past moved through the Seaway—they typically stay within the Great Lakes even if the ship is small enough to transit the Seaway. This issue is further explored later in the section on modal shifts, however, we do believe capacity could be developed at the assumed costs if a market was present. The total cost for this laker option is US$76.75 per metric ton.

An all rail move from the plains to the Gulf of Mexico is commonplace and routes and rates exist for this movement. As an example, the USDA reports a rate of US$23.37/metric ton for Minneapolis to Houston.[61] A somewhat higher rail rate of US$30/metric ton was used to reflect higher costs from the Dakota's based on railroad information. An elevation and port charge would also occur at the Gulf port, and details of this charge are included in the Appendix. The combination of the rail rate, elevation and rail switching charges, and ocean rate, makes the cost for this option US$70.26 per metric ton - the least expensive option.

A considerable amount of grain moves by barge down the Mississippi River. The barge option assumes a rail move from the plains to St. Louis where the grain would be transferred to an elevator and subsequently to a barge. Some grain actually moves directly from rail to barge without elevation, which would reduce costs somewhat. In order to have as much comparability as possible among alternatives this assessment assumes an elevation is required. Larger barges can be utilized south of St. Louis and there are rate advantages associated with this option. Another option not shown would be to rail or truck the grain from the plains to the Twin Cities for transfer to a barge. The total cost of the rail/barge option is US$70.67/metric ton. This cost includes an estimated US$20/metric ton for rail shipments from the Plains to St. Louis.[62] Barge rates from St. Louis to the Gulf, while highly variable were estimated to be US$9/metric ton, based on mid to late 2004 rates.[63] The ocean rate from the Gulf was again estimated at US$35/metric ton, the same rate used in for the earlier mode/routing options.

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[60] The Lake Carriers Association in their *2003 Annual Statistical Report*, page 32, indicates four Seaway capable U.S. flag vessels were laid up during much of 2003.

[61] U.S. Department of Agriculture, *Grain Transportation Report*, June 17, 2004, p. 6.

[62] Estimated based on U.S. Department of Agriculture, *Grain Transportation Report, Table 7,* June 17, 2004, p. 6.

[63] U.S. Department of Agriculture, *Grain Transportation Report, Table 8,* 2004, p. 7.

Table 10 summarizes the costs for the Duluth grain tonnage. As with the Thunder Bay results, the cost penalties for no use of ocean vessels are in the range of other past studies findings. While we find an advantage for the ocean direct routing as compared to the laker routing, we find that the rail direct and barge options both offer cost advantages over ocean direct routings via the Lakes. Our results for the rail direct option compared to ocean direct moves show a rail advantage of US$1.74/metric ton. However, when comparing rail to laker rates, we found rail to have a US$6.49/metric ton advantage. Note that the TVA analysis did not distinguish between ocean and laker, and found a generic non-Seaway route advantage of US$4.99/metric ton when comparing to the "lakes" routing. Overall, given the combination of routings making up the "most likely" alternative, we find an additional cost of US$1.61/metric ton compared to the ocean direct routing. Given the tonnage involved this would result in total extra transportation costs of US$3.3 million for the Duluth grain if it could not move by ocean direct routings.

Table 10
Alternate Mode Costs to Move Duluth Grain to Europe

	Ocean Vessel	Laker (L) Vessel	Rail (R)	Barge (B)	"Most Likely"
Modal Split	100%	100%	100%	100%	50L/25R/25B
Metric Tonnage (000's)	2042	2042	2042	2042	1021/511/511
US$ Cost per Metric Ton	$72.00	$76.75	$70.26	70.67	$73.61
Total Cost (Millions of US$)	$147.0	$156.7	$143.5	$144.3	$150.3
Additional Costs Over Ocean (Millions of US$)	-0-	$9.7	($3.5)	($2.7)	$3.3
Additional US$ Costs/Metric Ton	-0-	$4.75	($1.74)	($1.33)	$1.61

6.4 Iron and Steel Movements into the Great Lakes

Our analysis indicates that about 4.6 million metric tons of iron and steel products move through the MLO Section into and out of the Great Lakes on ocean vessels. For purposes of this study the authors will use the term steel as shorthand for all iron and steel products.[64] Steel movements differ significantly from the movement of grain products in that: 1) almost all of the steel is inbound into the lakes and, 2) there is no significant movement of steel on laker vessels.[65] Steel products move through 16 Great Lakes ports with the top ten shown below:

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[64] This category also includes small amounts of other metal and plastic products.

[65] Laker vessels are unsuited to moving heavy steel products because of design and cargo hold floor strength.

Table 11
Steel Traffic at Great Lakes Ports

Port	2002 Metric Tonnage
Hamilton	1,036,000
Burns Harbor	750,000
Detroit	561,000
Cleveland	403,000
Sault Ste. Marie	292,000
Toronto	216,000
Chicago	196,000
Windsor	171,000
Ashtabula	167,000
Oshawa	139,000

Source: Compiled from Statistics Canada, *International Commodity Movements: Great Lakes Ports To/From Foreign Ports, 2003, Computer printouts; and* U.S. Army Corps of Engineers, *Waterborne Commerce of the United States: Part 3—Waterways and Harbors in the Great Lakes,* 2002, pp. 1-140.

Table 8 provides detailed information for all of the ports. A review of Canadian origin data indicates that most of the steel originates in Europe or Brazil with significant volumes also moving from Russia, Turkey, Southeast Asia and various other origins. Steel moving inbound is primarily specialty steel, as opposed to slabs. Most of the steel goes by truck from the port to distribution centers within 100 miles or so of the port although some goes directly into steel mills.

The authors contacted a number of steel brokers and shipbrokers in Montreal, Philadelphia, Chicago and elsewhere to obtain information on steel movements, rates, and business trends. These brokers provided information on ocean rates, East Coast and Gulf Coast ports used by steel importers and, rail, truck and barge rates from the various ocean ports to the Great Lakes area. The information obtained was generally consistent among the sources. In some cases, the authors made professional judgments as to which value to use when there were differences.

The fact that steel moves into many Great Lakes port destination areas required a somewhat different analysis approach than was the case with grain movements, which is dominated, by a single Canadian and single U.S. port. The approach selected was to determine costs for five geographic port destination groupings and an ‘other’ destination group containing the smaller ports. The five named destination groups represent about 85 percent of steel movements passing through the MLO. These destination groupings are:

- Hamilton/Toronto/Oshawa
- Detroit/Windsor
- Chicago/Burns Harbor
- Cleveland/Ashtabula
- Sault Ste. Marie
- Other

Estimates were made of the cost of moving a ton of steel between Europe or Brazil and these destination areas. The detailed calculations for the cost of direct ocean moves vs. the various alternative mode/options are shown in Appendix A-3. Ocean rates were obtained from brokers for moving steel from Europe to Montreal and to each of the ports beyond.[66] Brokers indicated there was little variation in rates by source, so we assumed the same rates for Europe and Brazil origins. The ocean rates to Montreal and each of the ports above Montreal began at US$42/metric ton and escalated with distance to a maximum rate of US$60/metric ton at the Sault. Rates were obtained to most destination ports, however, where no information was available a rate was interpolated based on distances. We then applied port handling charges of US$13 per metric ton, which included stevedoring, port charges and reloading charges to truck or rail.[67] The handling charges represent a weighted average rate for hot and cold rolled coil/other and slab with the bulk of tonnage being for the specialty coil and other product. Finally, we assumed that the steel would, on average, move by truck to a processing/distribution center within 25 miles of the port. This steel could also go direct to an end user. The cost per metric ton for the truck move was estimated at US$5.[68] The wide variance in truck weight limits in Great Lakes states may make this somewhat high or low in a given area but it was decided to apply this uniformly to assist in the comparability of values. This approach also was used for port charges, which could be higher or lower than shown in any given port.

The cost to move 4.6 million metric tons of steel into the Great Lakes by ocean vessel from a European or Brazilian origin was estimated to be US$340 million or US$74.56 per metric ton. Costs for individual destination regions ranged from US$60/metric ton at Montreal to US$83/metric ton at Chicago. Table 12 and Appendix A-3 summarize these cost details.

The next step was to determine alternative routes and modal options to accommodate ocean vessel traffic. It was decided to calculate costs by alternative modes from the ports of Montreal, Philadelphia and the Gulf of Mexico. These were deemed likely alternatives by the brokers given the relative experience of the port with the steel trade and/or their proximity to the Great Lakes. Details on each port are as follows:

- Philadelphia is a major steel port with good rail and highway connections into eastern Canada and the Midwest. It is only 500-800 miles from most of the Great Lakes ports. It is attractive for European traffic and even more so for Brazilian traffic.

- Montreal is a major gateway for the Midwest/Great Lakes region. The proximity of Montreal to the Great Lakes and to Europe results in a large volume of Canada-Europe traffic.

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[66] Ocean rates were based on interviews with steel brokers.

[67] Based on interviews with stevedore firms in Montreal and Philadelphia, and with steel brokers.

[68] Grain truck costs were used as a proxy for steel given the data availability for 25 mile trips and relevance to truckload steel rates. U.S. Department of Agriculture, *Grain Transportation Report, Table 10*, p. 9.

- Gulf of Mexico. Several brokers in Chicago utilize the Port of New Orleans and barge the steel up the Mississippi and Illinois River. This is viewed as a very competitive option for the Chicago area, but not for regions beyond that.

Ocean rates to the three ports were obtained from the same brokers and ranged from US$42/metric ton at Montreal, to US$45/metric ton at Philadelphia, to US$48/metric ton at the Gulf. Rail and highway mileage from the Atlantic port to the steel destination regions was determined and a rail/truck modal split was estimated with truck being used more for the shorter trips and rail for the longer moves. Rail[69] and trucking[70] costs were determined based on generic costs for these two modes and broker interviews. One costing issue related to the type of steel being moved. It costs considerably more to load and move coil steel than it does to move slab steel. Specialty coil steel typically moves in covered rail cars and is more susceptible to damage. For Philadelphia and Montreal, steel handling costs were estimated to total US$13/metric ton based on broker interviews. For Philadelphia and Montreal it was assumed that the rail car or truck would move directly to the steel distribution center or the end user. As such, it should be noted that there is only one port handling (i.e., unload ship, store, reload to truck or rail) for the two East Coast options, just like when steel moves directly to a Great Lakes port on ocean vessels. The end result was a range of total door to door costs, depending on the destination region, for the Montreal coastal port, and for the Philadelphia coastal port option. Costs for each destination region depend on the distance to the region from the coastal port, and the likelihood of a rail or truck move. The specific costs for each destination region can be seen in Appendix A-3.

For the Gulf option, an ocean rate of US$48/metric ton was used as mentioned earlier. A ship to barge transfer cost of US$5/metric ton was also assumed based on broker interviews. Barge costs to Chicago were also based on broker interviews, and were estimated at US$18/metric ton. An additional US$6/metric ton was estimated for unloading the barge and reloading to rail or truck.[71] Rail and truck percentages were then estimated for moving the steel to each destination area, and rail and truck costs were estimated using the rail and truck per ton-mile costs referred to earlier. Total costs varied for each destination region as can be seen in Appendix A-3.

The final step was to estimate the "most likely" mix of coastal ports for each steel destination region. As can be seen in Appendix A-3, for some destinations, such as Hamilton, a 50/50 mix of Montreal and Philadelphia coastal ports was assumed, with resulting costs calculated given the volumes moving through ach port, and the rail/truck mix and costs for delivery to the destination region. For Hamilton the average cost for delivery of their steel was calculated at US$73.56/metric ton. For Cleveland on the other hand, it was assumed that 70% of the steel would move via Philadelphia, with a

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[69] Rail costs were calculated at a steel generic level of 4c/ton-mile (US$20/metric ton minimum) based on the American Association of Railroads, www.aar.org; individual railroad annual reports for Canadian National Railroad, www.cn.ca, Burlington Northern Santa Fe Railroad, www.bnsf.com, CSX Railroad, www.csxt.com, and Canadian Pacific Railroad, www.cpr.ca; and with verification in broker interviews.

[70] Truck costs ere calculated at a generic steel level of 7c/ton-mile, or roughly $2/mile.

[71] Barge and handling rates per ton were based on interviews with steel brokers.

calculated cost of US$83.34/metric ton. For Chicago, it was assumed that 20% would move via Montreal, with 30% via Philadelphia, and 50% via the Gulf. Given these allocations, Chicago's cost was calculated at US$84.32/metric ton. The only destinations receiving steel via the Gulf were Chicago as noted here, Detroit, which was assumed to receive 10% of its demand via the Gulf, and the "all other" destination category, which was assumed to receive 20% via the Gulf as well.

Appendix A-3 then summarizes the costs for the ocean direct option, and for the "most likely" alternative mix of options. Table 12 summarizes the costs for the current ocean direct mode/routing, and for the various steel movement options, and the "most likely" combination of options. Current costs were estimated at US$74.56/metric ton, while the "most likely" option has a cost of US$80.34/metric ton. Overall, the "most likely" alternative has a cost penalty of US$5.78/metric ton, or US$26.4 million in total. It is interesting to note that the existing ocean vessel move into the Lakes represented the lowest cost for each Great Lakes destination port area, with the exception of Chicago where barging from the Gulf was slightly less expensive than the ocean direct routing to Chicago.

Table 12
Alternative Mode Costs to Move Great Lakes Steel

	Ocean	Montreal (M)	Phila. (P)	Gulf (G)	"Most Likely"
Mode/Port	100%	100%	100%	100%	40M/46P/14G
Metric Tonnage (000's)	4556	4556	4556	4556	1803/2082/671
US$ Cost per Metric Ton	$74.56	$84.86	$89.40	$95.99	$80.34
Total Cost (Millions of US$)	$339.7	$386.6	$407.3	$437.3	$366.1
Add'l Costs Over Ocean (Millions of US$'s)	-0-	$46.9	$67.6	$97.6	$26.4
Additional US$ Costs per Metric Ton	-0-	$10.36	$14.84	$21.43	$5.78

Table 12 may require some additional explanation in that the information is presented in a different format than was the case for grain. Column 2 shows the costs for moving steel by ocean vessel into the Great Lakes. The next columns than show the cost assuming all of the steel is moved via Montreal, Philadelphia, or the Gulf (columns 3-5), while the final column shows the "most likely" scenario. In the previous two tables for grain Columns 2-4 represented alternative modes rather than an alternative coastal port as is the case here. Appendix A-3 is also organized somewhat differently, in that there are four sets of calculations, first for the ocean direct mode, and then for each of the three coastal port options, followed by a set of "most likely" alternative calculations and final cost comparisons.

While Columns 3-5 in Table 12 show the costs for a given coastal port if all the tonnage moved through that port, it is unrealistic to expect that all ocean vessel traffic would shift to a single port. For instance, it would not make sense for steel bound for Toronto users to come in through Chicago by barge from the Gulf. Some ports have clear advantages in terms of distance and/or other attributes. As indicated earlier, in the "most likely" scenario, estimates of port share were developed based on rates and other considerations in order to assure the least cost mix of coastal port alternatives was picked for each destination area receiving steel. While cost was used as the basis for selecting the port mix for each destination, shippers and receivers have a variety of needs at different points in time that actually determine how a shipment will move. A shipload of a certain type of steel may be leaving Europe for Montreal with a schedule and price that better meets the needs of a buyer than one destined to the Gulf. As such, actual routings may differ from the least cost option, however, cost was used as the basis in this analysis.

6.5 Other Movements via Ocean Vessels

Grain cargo from Thunder Bay and Duluth, and steel traffic, accounts for over 70 percent of the traffic moving through the MLO section in ocean vessels. The remaining 30 percent was not reviewed in detail because of time and resource constraints. However, significant MLO "other" cargo for ocean vessels (in metric tons) includes chemicals and petroleum products (557,000 tons), sugar (456,000 tons), wood pulp (216,000 tons), coke (167,000 tons), mine products (297,000 tons) and aluminum ore (88,000 tons). In addition, there is some 559,000 tons of grain from ports such as Milwaukee, Toledo, and Hamilton.

In order to account for the full universe of ocean vessel cargo the authors assigned an US$80 per metric ton charge via ocean vessel and assumed a rate of US$85 per metric ton if these cargoes were to move by other modes (i.e., laker, barge, truck, rail). This US$5/metric ton cost penalty is in-between the cost penalty for grain, at US$1.61/metric ton at Duluth and US$3.47/metric ton at Thunder Bay, and the US$5.78/metric ton penalty estimated for steel. The US$5/metric ton cost penalty is however much closer to the steel penalty than it is to the lower cost penalties estimated for grain. While little information was available to estimate this cost penalty for the "all other" category," there were some points of reference that could be used and these are reviewed below. The support for this "all other" category cost penalty is not as detailed as in the earlier sections, and is based on more limited secondary sources, observations, and interviews, however, we believe the US$5/metric ton penalty estimate to be reasonable.

Grain, which represents one of the largest classes of goods in this category (16% of tonnage), is likely to have a cost penalty similar to that found in Duluth and Thunder Bay. By assuming US$5/metric ton in overall average penalty we believe we are being conservative and on the high side of potential grain costs. We also believe that sugar (12% of tonnage) bound for Toronto is likely to have a cost penalty somewhat similar to that seen for grain – in the US3-7/ton range. If sugar does not come to Toronto by ocean vessel it is likely to move to Montreal for transfer to rail or truck for a relatively short distance move to Toronto. We also believe Toledo bound sugar could move via New Orleans with rail transfer to Toledo at a cost very similar to that for ocean direct moves.[72] Overall, we believe the US$5/metric ton cost penalty being assumed should be in the range of extra costs for grain and sugar.

While there was little information available in secondary sources on mine products, aluminum, coke and pulp, we did find one interesting piece of information on petroleum and chemical cost comparisons. Chemicals and petroleum represent another 15% of the total tonnage in the "all other" category. This information is from a presentation at the Canadian Shipowners Association's 66th annual International Joint Conference by Petro Canada on the outlook for the petroleum sector.[73] In the presentation there is a slide indicating that the "typical freight costs" to move a barrel of petroleum product from Montreal to Toronto by water is about C$2.85/barrel. The presentation then indicates that the "potential" cost to move a barrel by rail is C$2.40. While this analysis does not account for handling costs and is just a possible indicator of cost differentials that might relate to an all ocean move to Toronto as opposed to one to Montreal with a transfer to Toronto by tanker or rail, it does suggest that the cost penalty for an alternative to ocean vessels might not be too great. Given this information, we believe the US$5/ton cost penalty being used may be in a reasonable range.

Overall, we estimate the cost penalty for this "all other" category at US$5/ton if ocean vessels were not available. Given the 3.589 million metric tons in this category, this would result in a total cost penalty of US$17.9 million per year if ocean ships were not available.

6.6 Summary of Costs Via Ocean Vessels and Alternatives

Table 13 summarizes the results of the above analysis. The analysis undertaken in this report indicates that there would be US$54.9 million in additional costs if ocean vessels did not pass through the MLO into or out of the Great Lakes. The largest impact would be associated with the importation of steel products with lesser impacts associated with the movement of grain. The "all other" category would see the second biggest impact.

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[72] Casual interview with a sugar industry transportation staff person.

[73] Stephens, Andrew, Petro Canada, *Industrial Outlook: Liquid Bulk*, a presentation at the 66th International Joint Conference, Canadian Shipowners Association, Niagara-On-The-Lake, Ontario, Canada, June 17, 2003, pp. 1-10.

Table 13
Summary of Cost Via Ocean Vessels and Alternative Modes

	Grain from Thunder Bay	Grain from Duluth	Steel	Other	Total
Tonnage	2098	2042	4556	3589	12285
% of Total	17.1	16.6	37.1	29.2	100.0
Ocean Vessel*					
US$ Cost per Metric Ton	$78.39	$72.00	$74.56	$80	$76.38
Total Cost (Mill's of US$'s)	$164.5	$147.0	$339.7	$287.1	$938.3
"Most Likely**					
US$ Cost per Metric Ton	$81.86	$73.61	$80.34	$85	80.85
Total Cost (Mill's of US$'s)	$171.7	$150.3	$366.1	$305.1	$993.2
Additional US$ Cost per Metric Ton	**$3.47**	**$1.61**	**$5.78**	**$5.00**	**$4.47**
Additional Cost (Millions of US$)	**$7.3**	**$3.3**	**$26.4**	**$17.9**	**$54.9**

*Represents costs associated with existing ocean vessel movements into the Great Lakes.
**Represents costs associated with alternative rail, truck, barge and laker vessel mode/routes to carry cargo previously carried by ocean vessels.

7.0 Other Factors Affecting Seaway Ocean Vessel Advantages/Disadvantages

While the above sections focused on estimating the transportation cost penalty that would be incurred by shipper/receivers if ocean vessels no longer passed into and out of the Great Lakes, there are also a number of other factors that need to be considered in any evaluation of the cost benefits to society of ocean shipping on the Lakes. Some factors are a potential positive for continued ocean shipping on the Lakes, while other issues are a possible negative in terms of costs to shippers and society.

For government and society, there are a number of factors that need to be considered, including environmental damage from different modes, the level of infrastructure subsidy and toll collection offsets to these costs, and other issues. From an environmental standpoint, the question is whether the costs to the environment are worth the benefits, as compared to the cost and benefits of using other modes. Another issue relates to the extent of infrastructure investment required by government to support ocean vessel shipping, as compared to the level of investment required to support other modes. Related to this question is the level of cost recovery through user fees or tolls available via the Seaway/ocean shipping system, as compared to the other modal options. The net cost to government, or subsidy level, becomes the issue. While, we address the environmental issues later in the Modal Shift and Perspectives Sections, it should be noted that estimates of past invasives environmental damage from ocean shipping seem to exceed the annual transportation cost savings that we have calculated. Also, the air quality benefits compared to rail do not seem to be favorable for ocean shipping on a "total tons" of pollutants basis, although marine does emit less CO2 than rail. These preliminary air emissions findings are our best estimates, however, we offer the caveat that the environmental impact science is not within our primary area of expertise and requires further study by experts in that field.

While simple shipping costs are probably the most important issue for shippers/receivers deciding what mode/route to use for their shipments[74], other factors may also come into play. For instance, overall cycle time speed, cycle time reliability, sailing frequency, and damage, can also come into play. Cycle times can also affect other logistics costs related to inventory carrying costs (ICC's) and warehousing, and could affect the choice of modes/routes and affect the overall benefit of ocean shipping as compared to other modes.

The following sections review potentially favorable and unfavorable factors affecting the value of ocean shipping on the Lakes.

7.1 Potentially Favorable Factors for Lakes Ocean Shipping

Table 14 summarizes the issues and factors that may potentially be favorable to ocean vessel operations on the Lakes.

It is important to note that the infrastructure and navigation aid costs of the Seaway would still have to be borne by government/industry if ocean ships quit using the System. This means that the tolls currently being paid by ocean vessels would have to be borne by government, or through increases in tolls to lakers. While the toll impact is somewhat difficult to calculate, we have made a rough calculation of the likely impact for illustrative purposes only and this estimate is shown following the table.

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[74] Legars, Anne, Shipping Federation of Canada, *The Great Lakes and the St. Lawrence Seaway System*, a brief to the Subcommittee on Marine Transportation of the Standing Committee on Transport, Montreal, Quebec, May 26, 2003, p. 6; and Savage, Robert W. Consulting, Inc., *Marketing the St. Lawrence and Great Lakes Seaway System*, for the Michigan-Ontario Maritime Advisory Committee, November, 1989, pp. 1-66.

Table 14
Potentially Favorable Factors for Lakes Ocean Shipping

Societal/Government - Seaway toll revenues are maintained at current levels - Preservation of port employment and infrastructure oriented towards ocean shipping
Shipper/Receiver General Issues - Effect of loss of ocean mode competition on rail and laker rates - Degree of capacity available in laker and rail modes
For Grain Movements - Possible cycle time, reliability, and ICC benefits of ocean shipping - Reduced damage with ocean shipping due to less handling - Cooler temperatures on northern routes as compared to movements to Gulf - Ocean shipping surge capacity to handle seasonal peak traffic - For trading companies with terminals only in Lake ports, ability to assure quality and protein mix in-house at lakehead terminals - Bio-security benefits of reduced handling with direct ocean vessel loading - Existing terminal infrastructure and need to recoup investment in facilities
For Steel Movements - Possible cycle time, reliability, and ICC benefits of ocean shipping - Reduced handling and damage with direct ocean shipping into Lakes, as compared to barge routings

We estimate these ocean vessel tolls at the MLO Section and the Welland of the Seaway totaled US$20.5 million in 2002 based on the SLSMC/DC web page toll rates.[75] Based on our "most likely" alternative to ocean shipping, we estimate that in 2002 the Seaway would have gained an additional 2.97 million metric tons of laker traffic diverted from ocean vessels, and that this cargo would have generated additional tolls of US$3.14 million. The net result would have been a toll loss of US$17.4 million for the Seaway System in 2002. We estimate some 46.9 million metric tons of cargo would be subject to tolls on lakers absent ocean vessels, requiring a combined MLO/Welland toll increase of some US$.37 per metric ton in order to make up the lost revenue. This in effect would be a "cost" of ocean vessels not using the Seaway while continuing to maintain the System for lakers.

On the U.S. side there currently are no tolls however the U.S. government is considering a plan to impose tolls that would total some US$8 million per year on all types of freight vessels.[76] This would help recover some of the costs of the System that users currently do not pay. In comparison to this situation where not all the costs are currently recovered from users, on either side, the rail mode covers almost all of its costs since the entire infrastructure is privately owned. One exception could relate to Canadian owned grain

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[75] St. Lawrence Seaway System, *Tolls Schedule*, 2004, www.greatlakes-seaway.com

[76] Barrett, Delvin, "U.S. Will Levy New Tolls On St. Lawrence Lock System," *Lansing State Journal*, February 10, 2005, p. B2.

cars which may be charged out at below full cost recovery.[77] In addition, tonnage which we assume would move by barge would not be paying its full economic costs in that the U.S. inland waterway system is subsidized.

One additional societal/government issue relates to economic dislocations that could occur in several port cities if product were to move from ocean vessels to lakers, rail and barge modes. Past studies have suggested that the Seaway System delivers considerable economic benefits to the region, however, these studies have looked at the Seaway as a whole, and not at ocean shipping specifically. One such study was conducted by Martin Associates and found that just for the 16 U.S. ports studied, that the GLSLSS was responsible for 43,968 direct jobs among manufacturers, other users, ports and carriers, and that these jobs generated US$1.6 billion in direct wages.[78] However, it should be noted that most of these benefits relate to laker traffic. As noted above, we estimate that some 2.97 million metric tons would switch to the laker mode if ocean vessels were not used. There would be minimal economic impact on the port cities from this switch to lakers. However, 9.3 million metric tons would switch to non-laker modes including rail and barge, thereby causing some economic disruption in specific Lakes ports. While there would be some job losses in these port cities on the Lakes, there would be gains at coastal ports and in the rail and barge sectors. Overall, there would be minimal economic impact for the Canadian and U.S. economies as a whole, but there would be some dislocations in Lakes ports if ocean vessels were no longer used.

For shipper/receivers, there are two general qualitative factors that come into play in assessing the overall value of ocean shipping on the Lakes, and the impact of any cessation of ocean shipping. These two factors relate to the impact on keeping laker and rail rates competitive, and the question of whether the laker and rail modes have sufficient capacity to haul the goods currently moving on ocean vessels without a large increase in rates. Would a loss of the ocean option cause other modes to increase their rates given the reduced competition? We do assume in our cost analysis that these other modes would charge more than ocean vessels charge but, given the various shipment options available to users, and general market forces, we don't believe there would be an opportunity for monopoly like rate increases by the other modes. As for capacity issues, we again do not believe that capacity constraints would prevent these goods from moving via other modes, or that such constraints would lead to significant price hikes for these modes. We discuss the issue of capacity more fully in the section on modal shifts.

For grain movements in particular, there are several possible non-transportation cost benefits to shippers of ocean shipments on the Lakes. One possible benefit relates to order cycle times and the reliability of the shipment times. While it is difficult to compare cycle times and reliability between ocean, laker and rail modes, there may be some small cycle time and reliability advantages for direct ocean shipments. Although,

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[77] Binkley, Alex, "Hopper Car Proposals Expected by Christmas," *Canadian Sailings*, November 29, 2004, www.canadiansailings.com

[78] Martin Associates, *Economic Impact Study of the Great Lakes St. Lawrence Seaway System*, prepared for the St. Lawrence Seaway Development Corporation, August 1, 2001, pp.1-29.

some prior studies have suggested that times via the Seaway are slower than through coastal ports, especially when the frequency of sailings is taken into account.[79] On the other hand, while ocean vessels and lakers have similar fairly slow movements to the coasts, laker moves require an additional handling which could slightly slow transit times. However, rail moves to the coasts are generally quite fast and don't require any more handling than an ocean move, but sometimes suffer from reliability issues as to car availability and actual transit times. These transit time and reliability issues are fairly well known but are not the norm and have generally improved over the last few years as U.S. railroads have recovered from post merger operations problems. Overall, we believe there may be some small cycle time advantages for direct ocean shipments, however, this is difficult to say with any certainty. Another issue is that the actual arrival date and time of empty rail cars for loading can vary considerably, whereas the arrival time of a ship, whether it be a laker or ocean vessel, is more precisely known. Overall, however, for most shipper locations, we don't believe there are enough differences in cycle times and reliability between modes to significantly affect the choice of modes. Nor are the product values high enough for the extra days of inventory possibly required by laker or rail to significantly affect overall ICC and total logistics costs for grain moves.

There may however be several other benefits for ocean shipping that could slightly affect the advantages of ocean vs. rail and laker modes. One of these benefits for ocean ships vs. lakers is that there is one less handling required when ocean ships are used direct form the Lakes. The extra handling with lakers could lead to somewhat more damage to grain although this is difficult to quantify. It should be noted however that rail does not require any such additional handling. Another potential benefit to the Lakes option, as compared to barging or railing grain to the Gulf, is that temperatures are cooler in the north and might lead to less grain damage. The extent of this benefit is again very hard to measure.

Ocean vessel availability may also be a factor in helping to move seasonal peaks in the fall. There is some seasonality in the grain shipments, with approximately 50% of all grain movements occurring in the four month September – December season, and the other 50% occurring in the five and a half months from mid March to August. To the extent that lakers are not available, ocean vessels can assist in moving cargo out before the end of the shipping season in December.[80]

Two other Lakes ocean shipping grain benefits relate to bio-security and export preparation quality assurance. A benefit of direct ocean shipping is that there is a reduction in handling and this may be a positive from a bio-security standpoint. In addition, for some shippers without in-house elevators in the St. Lawrence, the ocean vessel loading in the Upper Lakes allows for assurance of proper quality levels and protein mixes immediately prior to export loading. These particular companies would have to rely on St. Lawrence elevators for this service if they loaded lakers or rail for transfer to ocean vessels at the St. Lawrence.

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[79] Savage, Robert W. Consulting, *Marketing the St. Lawrence and Great Lakes Seaway System*, for the Ontario-Michigan Maritime Advisory Committee, November 1989, p.32.

[80] SLSMC/DC, *St. Lawrence Seaway Traffic Report: 2002 Navigation Seasons, Table S3*, pp. 7. The MLO Section opened on March 26, 2002 and closed on December 26, 2002.

While we found some transportation cost advantages for ocean shipping, some other studies have actually found a cost advantage for an all land move over the water mode. The recent TVA analysis speculated as to the reasons why any U.S. grain at all moves via water given their findings on the cost advantages of rail.[81] While they did not distinguish between ocean vessels and lakers, they did suggest several reasons why grain continues to move by water. First, they noted that in some situations there may not be available rail cars, and water shipments might be the only option. Secondly, they suggest long term contracts and large capital investments in facilities may lead to discontinuities in the relationship between rates and modal choice. Our interpretation is that this might mean that grain trading companies would offer a slightly higher price per bushel for shipments to their Lakes terminals, as compared to prices offered for grain delivered to other terminals. This might be necessary to achieve desired utilization rates for terminals, or to assure supply for a ship arriving under contract. The third reason suggested was that "salties" may occasionally offer very low rates to obtain a cargo out of the Lakes.

Overall, it appears there may be some qualitative factors that favor the Lakes move over rail. As noted in the much earlier Booz, Allen and Hamilton study, however, the benefit for the Lakes option may also be in a relatively small catchment basin near the water.[82] In terms of ocean vessels, as compared to lakers, the qualitative benefits again seem fairly modest. One possible qualitative advantage lies with non-wheat grain products where foreign orders are typically for smaller quantities that might suit direct shipment on smaller capacity ocean vessels, as compared to wheat orders which might be for far larger quantities.

For steel, there is one possible specific advantage for ocean vessel moves vs. rail, keeping in mind that lakers are not an option. This advantage relates to speed and reliability, and the perceived and actual problems with rail moves. The Martin study, while indicating that steel may actually move at less cost via rail as compared to ocean, suggests that steel delivery times and the reliability of those delivery times are very poor by rail, and that leads to a significant advantage for ocean shipment.[83] For instance, they note that "delays of up to six weeks are not uncommon when railings steel products from East Coast ports." While there probably have been instances of such delays, we note that the authors indicate delays of "up to" six weeks, and would suggest that the average delays are far shorter, and that reliability while not great or even good, is nowhere near as poor as suggested. It is also important to note that U.S. rail service was especially bad from East Coast ports in the one to two years following the spin-off of portions of Conrail to CSX and Norfolk Southern but that these problems have been significantly reduced in recent months. Overall, we believe there may some cycle time/reliability advantage for ocean

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[81] Tennessee Valley Authority, *Sault Locks Navigation Study Update: Appendix B – Addendum 8 – Transportation Rate Analysis,* for the U.S. Army Corps of Engineers Soo Locks Navigation Study, post 2000, pp. 1-19.

[82] Booz, Allen & Hamilton, Transportation Cost Analysis of the St. Lawrence Seaway, April 15, 1985, pp. 1-59.

[83] Martin Associates, *Economic Impact Study of the Great Lakes St. Lawrence Seaway System: Transportation Cost Savings*, prepared for the St. Lawrence Seaway Development Corporation, August 1, 2001, pp.1-3.

direct movements to the U.S., however, it is very difficult to make definitive determinations on this topic.

One other issue with respect to steel relates to handling and damage. Specialty steel coils, which make up the bulk of imported steel shipments to the Lakes, are susceptible to damage in handling, although this is not a common or frequent event when handling steel. However, the use of an East Coast port and rail move inland does not increase handling. Most of this steel is bound for processors, distribution centers or end users that have direct rail access, but are not immediately adjacent to a port. As such, the direct ocean shipping move is to a Lakes port where the steel must be handled onto a rail car or truck for movement to the processor. The same is true for a shipment to the Coast, where it is handled onto a rail car or truck at the Coast, and delivered to the processor/end user. In both cases there is one handling, and we don't believe there is any significantly greater chance of damage with use of coastal ports.

7.2 Potentially Unfavorable Factors for Lakes Ocean Shipping

Table 15 summarizes other issues that could potentially be unfavorable to Lakes ocean shipping.

Table 15
Potentially Unfavorable Factors for Lakes Ocean Shipping

Societal/Government - Environmental negatives of invasives and PM10/SO2 air pollution associated with ocean shipping - Use of foreign crews compared to domestic employment with other modes - National security issues related to foreign owned/crewed ocean ships moving in/out of mid-continent port cities and countryside
Shipper/Receiver General Issues - Continuing rail efficiency gains - Limitations on Seaway vessel size and constraints on future efficiency gains - Seaway navigation season which is limited to approximately nine months - Potential future cost increases to cover ballast water treatment and invasives liability insurance
For Grain Movements - Limited number of Lakes ocean ship sailings as compared to coastal ports - Access to more efficient 60-100000 ton vessels at coastal ports - Ability to divert grain to domestic feed lots en route when rail/barge options are used
For Steel Movements - Limited number of Lakes ocean ship arrivals as compared to coastal ports

With respect to broad societal/governmental interests, there are several issues that are potentially unfavorable for Lakes ocean shipping. First, as we discuss in the Modal Shift and Perspectives Sections, past invasives environmental damage costs from ocean vessels seem to, at least on preliminary review basis, exceed the transportation cost savings calculated for users of the ocean vessels. In addition, while we again cannot make definitive statements since the air emission estimates are not within our primary area of expertise, at least preliminarily, it appears that ocean vessels emit more tons of pollutants than rail when looking at a combination of five emission categories. The marine mode also appears to be substantially worse than rail on PM-10 and SO2 emissions. Marine is however superior on CO2 emissions, and on NOX. Both the invasives damage and air pollution issues are significant potential negatives for ocean movements as compared to rail. However, we emphasize more study is needed in that the environmental science is not within our area of expertise.

Two other potential negatives for the Lakes ocean mode relate to domestic job impacts and national security. It must be noted that ocean vessel shipments from the Lakes ports minimize domestic employment as compared to the use of lakers, rail and barge modes. The ocean vessel is loaded or unloaded in the Lakes, however, the ship is often foreign owned and crewed, but in some cases is Canadian owned. This minimizes Canadian and U.S. transportation employment. In contrast, when goods move by laker and barge, there is additional handling at U.S. and Canadian ports by domestic labor, and the transportation crews are Canadian and U.S. When rail to/from the coasts is used, there are no additional handlings, but again the crews are domestic as opposed to ocean vessel crews which are typically non-Canadian/U.S. Finally, it also should be noted that the Seaway ocean vessel System helps facilitate imported steel, at the expense of domestic steel jobs. On the other hand, the System helps somewhat lower costs for the manufacturers that must use imported steel in order to be competitive. The other potential negative relates to national security issues inherent in foreign owned and crewed ships moving far into the North American hinterland. While this is a theoretical potential negative, and we do not wish to overstate the impact, some experts have commented informally on the risks of the Seaway. For instance, Mr. Terry A. Breese, the U.S. State Department's Director of the Office of Canadian Affairs, said recently that "the cost of securing the Seaway may no longer be worth the risks, both of terrorism and invasive species such as zebra mussels."[84] He goes on to suggest that the "countries may want to consider shutting the system to ocean vessels."

For shipper/receivers there also are a number of potential issues that could be a negative for ocean shipping into the Lakes. The first such issue relates to relative efficiency gains of the Seaway System vs. the rail mode. The rail mode has made very significant progress over the last 30 years in decreasing costs/ton. This has been done through use of more powerful and efficient engines, longer trains, more tonnage per railcar, and smaller crew sizes. For instance, in 1974, the average U.S. train was around 66 cars and carried 1,800 short tons.[85] Today, a grain unit train might consist of 100 cars and carry 10,000 tons. Rail has also reduced costs considerably, and may have the potential to further reduce costs and increase tonnage. In contrast, the Seaway size has been fixed since the

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[84] Heller, Marc, "Seaway Security Focus Insufficient: Analyst Says Attack on Waterways Could Hurt Midwest Economy," *Watertown Daily Times*, March 15, 2005, p. D3.

[85] Hazard, John L., *Transportation: Management Economics Policy* (Cambridge, Maryland: Cornell Maritime Press, Inc.), 1977, p. 377.

1950's and is unlikely to increase, thereby limiting opportunities to increase tonnage per vessel. There are however a number of opportunities for the Seaway System to reduce costs, if the will can be found to implement some of the potential savings.[86] The past and possible future improvements in rail tonnage capacity per trip are however compelling when compared to the Seaway's inability to increase size from 1950's levels.

Another constraint that the Seaway faces is the approximate nine month navigation season. This has been a major negative for the Seaway, both for ocean vessels and laker transits, and is unlikely to change significantly. The limited season forces users to either stockpile inventories of goods, or shift to one of the alternative modes for the other three months of the year. Once firms use the alternative mode some decide to simply stay with that year long option, minimizing the amount of process change they must deal with during the year.

Long term, another issue ocean vessel users may face is cost increases required by new regulations designed to control invasive species. Potential regulations requiring ocean vessels to obtain federal water discharge permits, as discussed earlier, and the costs of ballast water treatment, could increase costs significantly. Air pollution regulations requiring cleaner fuel and more efficient engines could also drive up costs. While highly speculative, ocean carriers could be found in the future to be liable for invasives damages, and be forced to carry insurance against such liability, thereby also adding to costs.

For grain movements by ocean vessel from the Lakes there are two specific potentially unfavorable factors that should be considered. The first relates to the frequency of sailings. There are generally more sailings from the coasts than in the Lakes and this can be a potential negative. There is also some question about whether the ocean direct move or the coastal ocean options have the faster cycle times for users, however, we have not been able to determine a definitive answer on this point. The other issue for grain movements is the availability of large 60-100000 ton vessels for grain movements from the coasts. While this benefit has been factored into the cost analysis we have done considering options, it should be noted by the reader here. For steel, the cycle time issue is also an important one, and we believe ocean direct shipments to the U.S. may have some modest cycle time and reliability advantages over rail. However, we do find that there are more frequent arrivals of ocean vessels at coastal ports than in the Lakes and this could be a negative factor for the Lakes ports.

8.0 Perspectives

In order to more fully understand the implications of the transportation cost penalties that would be incurred if ocean vessels no longer were available, it is important to have some perspective on the significance of the numbers. The following subsections provide some perspective on what the calculated US$54.9 million in cost penalties to transportation users mean. The subsections examine the tonnages involved in terms of total U.S. and

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[86] Tower, Courtney, "Seaway Aims to Win Grain From Rail," *Journal of Commerce*, May 28, 1999, p. B1.

Canadian grain exports and steel imports, the ocean tonnages on the Lakes relative to total Lakes tonnage, transportation penalty costs relative to overall transportation costs and values for these goods, the costs relative to estimates of the costs of invasive species damage, and the penalty costs relative to other environmental regulation's cost impacts on industry. Table 16 summarizes the material discussed below.

Table 16
Summary of Perspectives Benchmarking and Comparison Information

Lakes Ocean Traffic As % of Total U.S. and Canadian Grain Exports/Steel Imports	
- All Lakes U.S. Ocean Grain -	1.9%
- All Lakes Canadian Ocean Grain -	10.9%
- U.S. Steel -	6.3%
- Canadian Steel -	21.4%
Ocean Tonnages	
- MLO Ocean Vessel Tonnage/Lakes & Seaway Tonnage -	6.8%
- MLO Ocean Vessel U.S. and Canadian O/D Split	
- Canadian -	50.4%
- U.S. -	49.6%
- MLO Ocean Vessel Tonnage/MLO Total Tonnage -	41.0%
- Thunder Bay Grain Ocean Tonnage/Total Lakes Thunder Bay Grain -	41.2%
- Duluth Grain Ocean Tonnage/Total Lakes Duluth Grain -	63.6%
Transportation Cost Penalties As A % of Total Transportation Costs and Value	
- Transportation Cost Penalty -	US$54.9M
- Total Penalty Costs As A % of Total Transportation Costs -	5.9%
- Grain Penalty Costs As A % of Total Grain Value -	2.1%
- Steel Penalty Costs As A % of Total Steel Value -	.9%
- Grain Penalty Costs As A % of All Grain Export Transportation Cost -	.1%
- Steel Penalty Costs As A % of All Steel Import Transportation Cost -	.7%
Invasives Great Lakes Economic/Environmental Cost Impacts	
- Utility Related Costs Per Year -	US$200-500 M

8.1 Ocean Lakes Traffic As A Percent of Total Grain Exports and Steel Imports

Grain exports from the Lakes, and steel imports into the Lakes, make up some 74% of the 12.3 million metric tons in total ocean borne traffic into and out of the Lakes. U.S. grain tonnages via all Lakes ports on ocean vessels total 2.3 million metric tons, while Canadian grain tonnages via all Lakes ports on ocean vessels total 2.2 million tons. Steel imports into the Lakes on ocean vessels totaled 4.6 million metric tons in 2002. But how significant are these tonnages in terms of all U.S. and Canadian grain exports and steel imports via all routes/modes?

For U.S. grain, the 2002 ocean tonnage represents 1.9% of total 2003 U.S. grain exports (2002 total data was not available in the needed format).[87] Laker tonnages represent another 1.8%, meaning the Lakes as a whole account for 3.7% of all U.S. grain exports. Figure 2 depicts the percentage of total grain exports moving through each of the major gateways. The bulk of U.S. grain is exported via the Gulf, with 69.4% moving via that Gateway, and 20.6% moving via the Pacific. Other routes and the Atlantic make up the remainder of the traffic. For Canadian grain, the 2002 Lakes ocean tonnage represents 10.9% of total 2002 grain exports.[88] Laker tonnages add another 20.1% to the total. Figure 3 depicts the percentages for various export routes. The Lakes route, for both lakers and ocean vessels, represents 31% of total Canadian exports. For Canada, the Pacific route carries 51% of grain exports, while Prairie Direct moves, for instance to Mexico and the U.S., account for another 15.8% of traffic.

For steel in 2002, ocean moves directly to U.S. Great Lakes ports represented 6.3% of total 2002 U.S. iron and steel imports.[89] In Canada, the Lakes direct steel imports represented 21.4% of total 2002 iron and steel imports.[90]

8.2 Ocean Tonnages As A Percent of Total Lakes Tonnages

The 12.3 million metric tons of cargo moved into and out of the Great Lakes on ocean vessels represents 6.8% of the total 180 million metric tons of goods moved on the GLSLSS above Montreal. This tonnage is split almost evenly between Canada and the U.S., with 50.4% of the traffic having a Canadian origin or destination. Focusing specifically on traffic transiting the MLO Section of the Seaway, ocean vessels in 2002 represented 41.0% of the total 30.0 million metric tons, and 50.4% of total transits. In terms of Thunder Bay grain specifically, the 2.1 million metric tons moving by ocean vessel represents 41.2% of the total 5.1 million metric tons moving by a combination of lakers and ocean vessels. At Duluth, the 2.1 million metric tons of ocean vessel movements of grain represent 63.6% of total laker/ocean tonnage. Finally, it should be noted that steel does not move on lakers so the ocean tonnage of 4.6 million metric tons represents 100% of the Lakes steel tonnage.

8.3 Transportation Cost Penalties As a Percent of Total Transportation Costs and Value

This study has estimated a transportation cost penalty of US$54.9 million if ocean ships no longer entered the Lakes. This penalty represents a 5.9% increase in the estimated US$938.3 million total door to door transportation costs for these goods. For Thunder

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[87] U.S. Department of Agriculture, Federal Grain Inspection Service, *Grain Statistics*, 2003.

[88] Canadian Wheat Board, *Statistics Table 17*, 2003, p. 16.

[89] U.S. Department of Commerce, Census Bureau, 2002 *U.S. Imports*, *Code 72: Iron and Steel*, 2003, Computer Printout.

[90] Statistics Canada, *2002 Canadian Imports, Steel Imports,* 2003, Computer Printout.

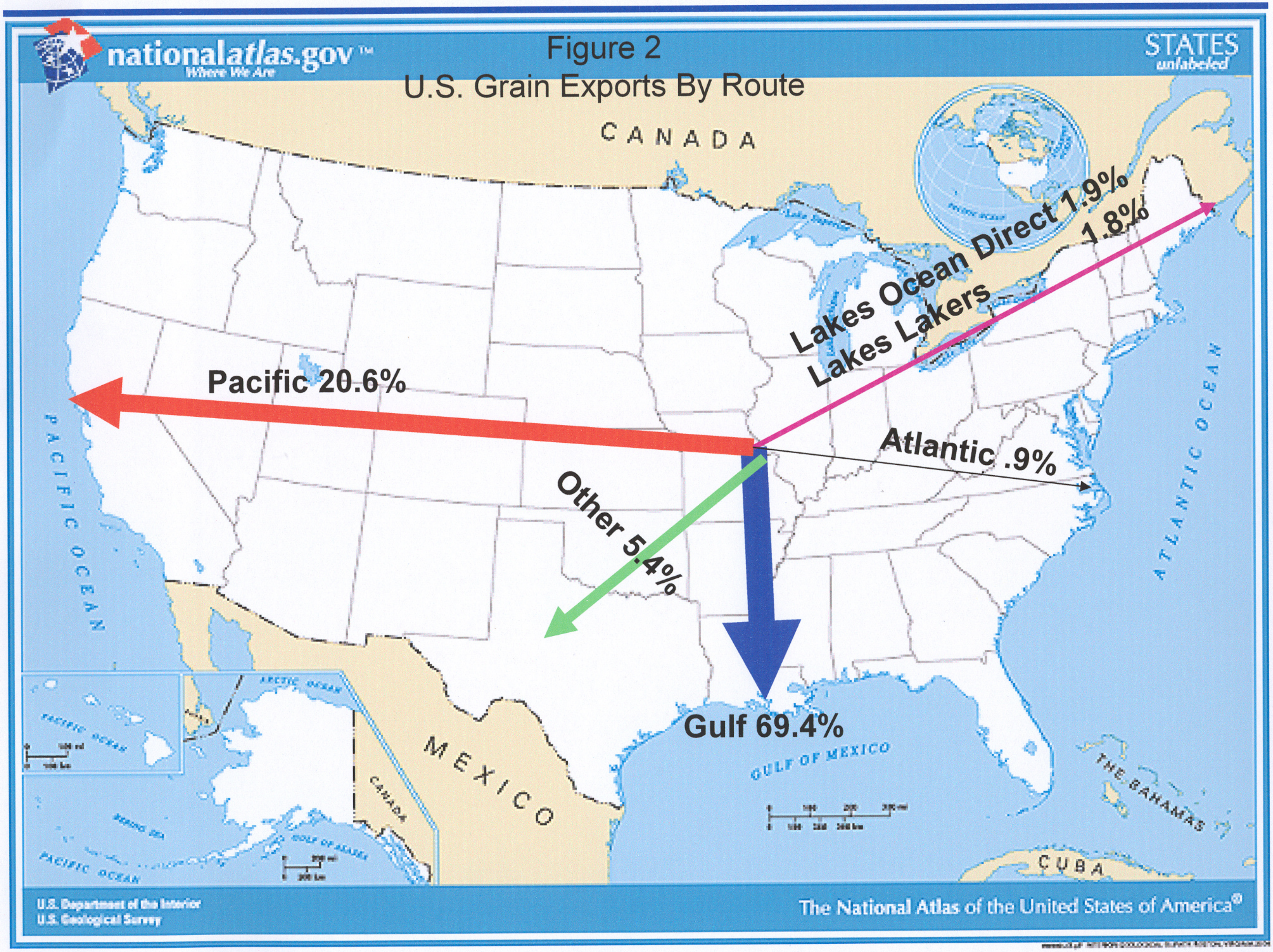

Figure 2
U.S. Grain Exports By Route

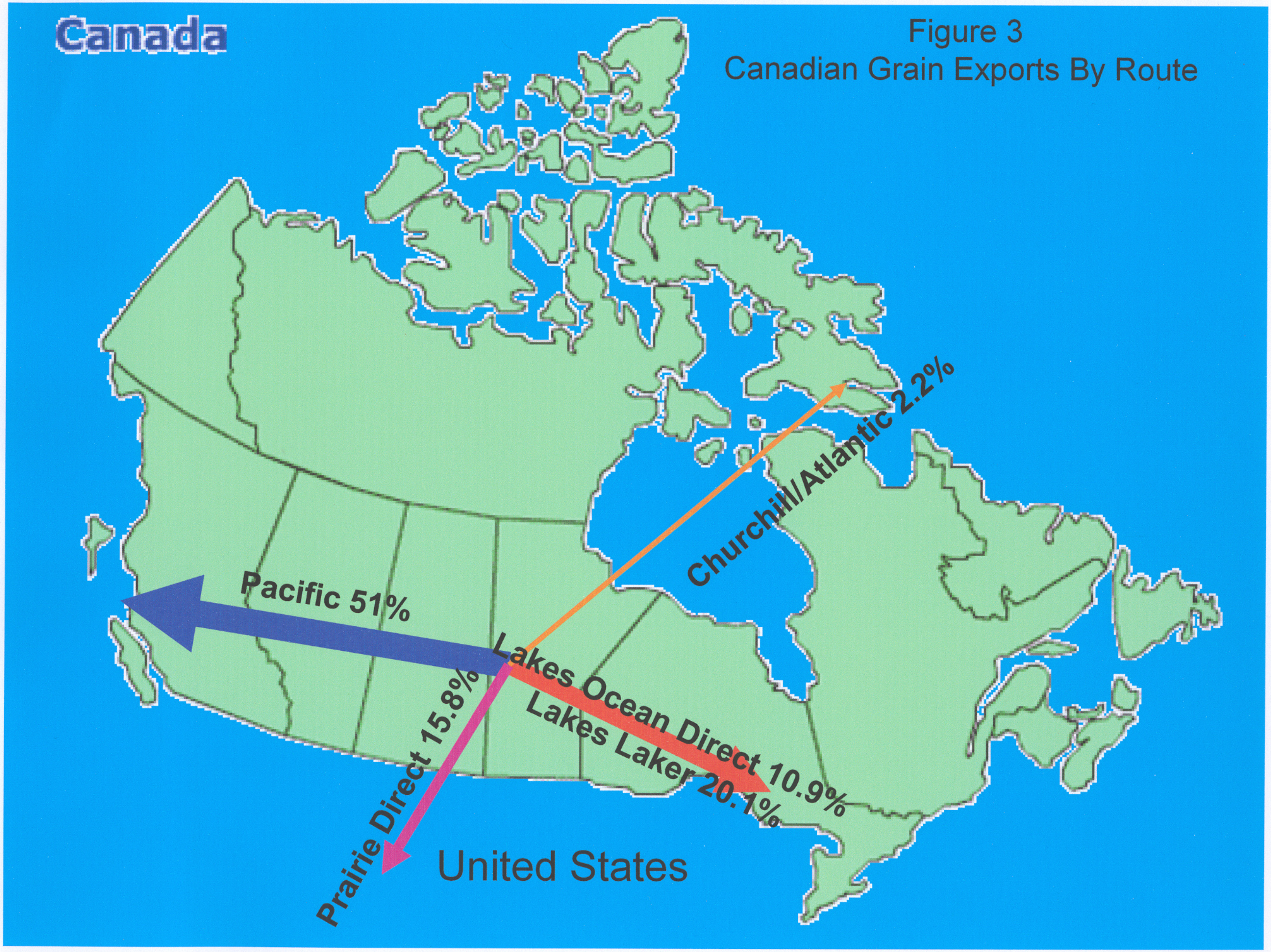

Figure 3
Canadian Grain Exports By Route

Bay grain, the cost increase represents 4.4% of the total US$164.5 million in costs, while at Duluth the transportation cost increase would be 2.3% if ocean vessels did not enter the Lakes. For steel, the transportation cost penalty would be 7.8%, and for the "all other" category, 6.3%.

Another interesting comparison might be to examine the transportation cost penalty as a percent of the value of the goods being moved by ocean vessels. For Duluth and Thunder Bay grain combined, assuming 60 pounds per bushel, and a price of US$3.35/ bushel, we estimate a value of US$123/metric ton, or a total value of US$509 million for the 4.14 million metric tons involved.[91] Given a transportation cost penalty of US$10.6 million, the penalty if ocean vessels were not available would represent 2.1% of the value of the grain. For steel, if one assumes a value of US$650/metric ton, the transportation cost penalty would represent .89% of the value of the steel.[92] By way of comparison, it is interesting to note that tariffs on steel have recently been in the range of 20-40% of the imported value.

One additional comparison that can be made is to relate the transportation cost penalty for non availability of ocean vessels to the total transportation cost for moving all U.S. and Canadian grain and steel exports and imports. For grain, the total Duluth and Thunder Bay transportation cost penalty is US$10.6 million. For illustrative purposes if one looked at the total U.S. and Canadian grain exports for 2002, some 131,455,000 tons of grain, and assumed an average door to door transportation cost equal to the rates used in this study for the "most likely" alternative, US$81.86/metric ton for the Canadian grain and US$73.61 for the U.S. grain, the total transportation cost for Canadian and U.S. grain exports could be calculated as US$9.885 billion. The US$10.6 million transportation cost penalty would then represent .1% of the transportation cost for all Canadian and U.S. grain exports. For steel, there were 46.1 million tons of U.S. and Canadian imports in 2002, and assuming for illustrative purposes a door to door transportation cost equal to the US$80.34/metric ton estimated for the "most likely" alternative for steel transportation costs in this study, the total transportation costs for all steel imports would equal US$3.7 billion. Based on these assumptions, the US$26.4 million in transportation cost penalties for non availability of ocean vessels would result in an increase equal to .7% of the transportation costs for all U.S. and Canadian steel imports.

8.4 Economic and Environmental Costs of Invasive Species In the Great Lakes

The following information is provided for benchmarking and cost-benefit analysis purposes, as are the other values reported in this Perspectives Section. However, it

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[91] Moore and Warner, *Weight of Grain per Bushel*, June 8, 2005, www.moorewarner.com; and Detroit News Staff, " Business Section Grain Quotations," *Detroit News*, June, 2005.

[92] Drajem, Mark, "Ford, Delphi Fight To Lift Import Duties From Steel," *Detroit News*, March 3, 2005, p. E3.

should be noted that the invasives cost information reported on here is not the focus of this study. Nor are the researcher's experts on invasive species ecological and/or economic damage costs. As such we are reporting on a range of cost estimates for invasives impacts in the Great Lakes, but cannot vouch for the accuracy of these figures. Indeed, most of the analyses are based on rough estimates of the cost of invasives, and it is clear that more work needs to be done on the detailed costs of current species, and more importantly, on the potential cost of new species.[93] It is also important to note that the current costs of invasives would not be eliminated by ending ocean shipping.

Before reviewing the cost estimate studies it is important to note that there have been some 170 invasive species introduced into the Great Lakes to date, with at least 43 introduced since the opening of the Seaway in 1959, and 73% of which have been attributed to discharge of ballast water.[94] It should also be noted that invasive species attached to ship's hulls and other surfaces are another vector for transmission. Scientists also seem to be indicating that the invasives continue to enter the Lakes. One source, Anthony Ricciardi, an aquatic ecologist at the Redpath Museum in Montreal, says "new invaders [are] being discovered on average every eight months, and many more are on their way."[95]

There are indeed a number of studies that have been done on the costs of invasives in the Great Lakes Basin, with the most detailed cost estimates being for the impact of zebra mussels and other mollusks. One comprehensive estimate of the costs of invasives in the Great Lakes is included in the GAO report mentioned above. This report includes an estimate that zebra mussels alone cost industry, recreation and fisheries US$300 million per year, although they do not cite a source, and we would guess do not endorse the specific figure. The most comprehensive estimate of Great Lakes Basin economic and environmental costs, while is based on a review of other studies, suggests annual costs of US$5.7 billion, including US$4.5 billion in damage to commercial and sport fishing.[96] This same source suggests that zebra mussels alone cause US$500 million per year in damage, with US$480 million of that damage being to the electric and water utilities industries. A second comprehensive estimate is included in the Lovell EPA study referred to above. This study reports on an estimate by Cataldo (2001) that the costs for utilities in the Great Lakes alone is in the range of US$300 million per year.[97] Another

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[93] General Accounting Office, *Invasive Species: Clearer Focus and Greater Commitment Needed to Effectively Manage the Problem*, GAO-03-1, October, 2002, pp. 1-101; and Lovell, Sabrina J. and Susan F. Stone, U.S. Environmental Protection Agency, National Center for Environmental Economics, *The Economic Impacts of Aquatic Invasive Species: A Review of the Literature,* Working Paper No. 05-02, January, 2005, pp. 1-61.

[94] Holeck, Kristen T., et al., "Bridging Troubled Waters : Biological Invasions, Transoceanic Shipping, and the Laurentian Great Lakes," *BioScience*, Vol. 54, No. 10, October, 2004, pp. 919-929.

[95] Leahy, Stephen, "An Erie Decline: Thanks to Invasive Species, the Shallowest Great Lake Is In Big Trouble," *Maclean'*, Vol. 116, Is. 22, June 2, 2003, p. 36.

[96] Pimentel, David, "Aquatic Nuisance Species In the New York State Canal and Hudson River Systems and the Great Lakes Basin: An Economic and Environmental Assessment," *Environmental Management*, Vol. 35, No. 1, 2005, pp. 1-11. The damage estimates are based on studies by Sea Grant 2002, the standing Committee on Fisheries 2003, Malta 2003, and World Press Review 2003.

[97] Cataldo, R., "Musseling In On the Ninth District Economy," *Fedgazette*, Vol. 13(1), 2001, pp. 15-17. The source for this estimate is said to be a U.S. Fish and Wildlife Services study

study reported on in the EPA review, by Sun (1994), suggests annual costs from 1990-2000 were in the range of US$500 million per year.[98] Finally, David Lodge of Notre Dame University estimates zebra mussels alone cost Great Lakes power plants and other facilities US$100-200 million per year.[99]

The EPA report by Lovell cited above also documents a number of other more industry specific estimates of invasives damage in the Great Lakes. Most of these studies relate to water plants, or electric utilities specifically. For instance, one study cites a figure of US$60 million per year for the power industry. Another study cites a cost to 46 power plants of US$100 million per year. A USGS study referred to by the authors found the average costs for electric plants at US$822,000 per nuclear plant and US$145,000 for fossil fuel plants. A study of water system costs indicated expenditures of US$154,000 per year for medium sized systems in 1993.

Based on this information we believe it is reasonable to estimate invasives costs are in the range of US$200-500 million per year for utilities, with an additional substantial cost impact related to Great Lakes fisheries. However, we wish to emphasize that these figures are presented for comparison purposes only, and we can not vouch for the accuracy of these estimates. We would also re-emphasize that this is not to suggest that an end to ocean shipping would eliminate this cost. It is indeed difficult to say what future costs of any newly introduced species might be. The current invasives cost figure is therefore simply provided for purposes of comparison and analysis.

8.5 Economic Costs of Other Environmental/Safety Regulations

Again, for benchmarking and comparison purposes, we believe it might be useful to consider the US$54.9 million cost penalty for the non-availability of ocean vessels in light of the costs of other environmental/safety regulations. The US$54.9 million impact on industry is in effect the potential cost of regulations or market forces that might cause the elimination of this transportation option. Given this figure, one might ask how this cost compares to the costs on industry of other environmental/safety regulations.

The researchers have reviewed the cost estimates provided for several other regulations and these are summarized here. One somewhat relevant transportation regulation relates to the Hours of Service rules which limit truck driver hours of operations. The Federal Motor Carrier Safety Administration of the U.S. DOT estimates the annual costs of these regulations at US$1-1.5 billion.[100] Another Department of Transportation cost impact analysis is for tire pressure monitoring systems, which are estimated to have a cost

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[98] Sun, J.F., “The Evaluation of Impacts of Colonization of Zebra Mussels on the Recreational Demand in Lake Erie,” *Fourth Annual Zebra Mussel Conference*, Madison, Wisconsin, March, 1994, www.sgnis.org/publicat/108.htm. A review of this study indicates the source for this estimate is a Michigan Department of Natural Resources, Office of the Great Lakes 1993 study.

[99] Eilperin, Juliet, “Battle Lines Drawn To Block Exotic Species,” *The Detroit News*, August 3, 2005, p. A8.

[100] U.S. Department of Transportation, Federal Motor Carrier Safety Administration, Hours of Service Regulations, *Federal Register*, Vol. 70, No. 23, February 4, 2005, www.fmcsa.dot.gov.

impact of US$749 million per year. An EPA regulation for control of emissions from non-road large spark ignition engines is estimated to have a cost impact of US$192 million per year.[101] Another EPA regulation, on water discharge permits for animal feeding lots, is estimated to have an industry cost of US$335 million per year.[102] One final reviewed regulation relates to air pollution regulations for the metal can manufacturing industry. The regulations have an estimated cost of US$52 million per year.[103]

9. 0 Transportation System Modal Shift Impacts.

Should ocean vessels not be available to shippers, this study concluded in the Transportation Cost Analysis Section that a combination of alternative modes would be used, including lakers, rail, truck and barge. The "most likely" alternative for each of the major shipment categories made assumptions about the number of tons of each product category that would switch to each of the three modes, and what the costs of transportation would be when using those modes. In addition, while detailed cost analysis was not conducted for the "all other" category, we have developed an analysis of the number of tons of the "all other" product that would switched to each mode. A total of 12.3 million metric tons of currently ocean borne product would need to shift to alternative modes.

The following subsections summarize the modal shift tonnages by mode, examine the capacity implications of the modal shift for each mode, and report on preliminary findings relative to the air emissions implications of the modal shift.

9.1 Modal Shift Tonnages

Table 17 summarizes our estimates of the tonnages that would shift to each mode if ocean shipping was not available in the Lakes.

For grain and steel the tonnages by mode tie back to the Cost Calculation Section detail. For the "all other" category, we assessed each of the principal products involved, and the volumes by origin or destination city in North America, and made a determination of the percent of that cargo that would likely move via each mode. After totaling this detail by mode for the "all other" category, we concluded that 25% of the tonnage would move by laker, 58% by rail, and 17% by truck.

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[101] Federal Register, "Summary of Agency Estimates for Final Rules," *Federal Register*, Vol. 68, No. 22, February 3, 2003, p. 5495-96.

[102] Environmental Protection Agency, *Concentrated Animal Feeding Operations Cost Impacts*, EPA-821-R-03-002, p.5.1-5.10.

[103] Environmental Protection Agency, *Air Pollution Regulations for the Can Manufacturing Industry*, EPA-452-R-03-10, p. 4.1-4.15.

Table 17
"Most Likely" Diversion of Traffic to Other Modes
(Thousands of Metric Tons)

Source/Mode	Laker	Rail	Barge	Truck	Total
Thunder Bay Grain	1049	1049	-0-	-0-	2098
Duluth Grain	1021	511	511	-0-	2042
Total Grain Above	2070	1560	511	-0-	4140
Imported Steel	-0-	2340	671	1545	4556
"All Other" Product	897	2082	-0-	610	3589
Total Tonnage	2967	5982	1182	2155	12285

9.2 Capacity Implications of the Modal Shift

Based on average tonnages per vessel, rail car, and truck; and the number of trips per year needed to move the tonnage, we have calculated the number of additional laker trips, trains, truck movements, and barge capacity that would be required. Information on the number of lakers, trains, trucks, and barge operations currently operating on the affected routes was also developed in order to assess the significance of the capacity requirements on each mode. This information is summarized in Table 18 which follows.

Table 18
Modal Shift Capacity Requirements and Significance
(Metric Tons)

Variable/Mode	Lakers	Rail	Barge	Truck
Tons (000's)/Year	2967	5982	1182	2155
Units Required	7.4 lakers at 25,000 tons/ laker at 400,000 tons/laker/yr	598 trains/yr at 100 tons/car and 100 cars/ train	1,182,000 tons/yr	71,833 trucks/yr at 30 tons/truck
# Trips/yr/week/ day	118.7 trips/yr at 16 trips/yr/ laker	598/yr at 11.5 trains/week or 1.6 trains/day	1,182,000 tons/yr	71,833 trucks/yr or 1381/week or 197/day
Significance	In 2002 Canadian fleet of 72 vessels including 53 bulkers and self-unloaders	Currently 100-150 trains/day in relevant regions	Currently over 40 million tons/yr	Currently 100's of thousands of trucks per day in relevant regions

The total capacity requirements for each mode shown in Table 18 are based on the following details by product category:

- Grain from Thunder Bay.
    - 2.6 laker vessel equivalents worth of capacity are required to handle this traffic (42.0 trips assuming each vessel carries about 400,000 metric tons annually, at 25,000 metric tons per vessel and 16 trips/year).
    - 10,490 rail cars of traffic are generated. This equates to about 105 loaded trains annually or about 2.0 per week.

- Grain from Duluth.
    - 2.6 laker vessels worth of capacity are required to handle this traffic (40.8 trips assuming above trip details).
    - 5,110 rail cars are required to handle this traffic or about 51 trains annually. This equates to .98 trains per week
    - Barge traffic units were not calculated but 511,000 metric tons represents a small portion of total movements on the Mississippi and related rivers.

- Inbound Steel Movements
    - 23,400 rail cars of traffic equal to 234 trains or the equivalent of 4.50 loaded trains per week. These cars would be dispersed over a number of rail routes connecting east coast and St. Lawrence ports to the Great Lakes area. There would be a similar number of empty moves back to the port. Steel would not tend to move in unit trains to the extent of grain traffic.
    - 51,500 additional truck moves are required at 30 tons/truck. This represents 990 additional truck moves per week, or 141 additional trucks each day spread over many different routes.
    - Barge traffic units were not calculated but 671,000 metric metric tons represents a small portion of total movements on the Mississippi and related rivers. Further, steel can represent an up-bound backhaul opportunity for the barges used to transport agricultural products downbound.

- "All Other" Products
    - An additional 2.2 lakers worth of additional capacity would be required for a total of 35.9 additional trips per year.
    - 20,820 additional rail cars would be required per year, or 208 trains per year. This equates to 4.0 additional loaded trains per week, or .57 per day.
    - An additional 20,333 trucks per year, or 391/week and 55.8 per day would be required. These trucks would be spread over a wide area of the North American mid-continent.

Given the most likely modal shifts and resulting capacity requirements, there is some question about whether the laker fleet and rail system could effectively handle the additional volume.   In studying this issue we would first note that there is some flexibility, from a cost perspective, for grain volumes to shift back and forth between laker and rail modes as necessary. For Thunder Bay grain, the rail mode is just US$.41/metric ton more expensive than the laker mode. For Duluth grain, the rail mode is actually US$6.49/metric ton cheaper than the laker option, so if laker capacity is not available this grain might well switch to rail instead of lakers. This Duluth rail finding is in line with the conclusions of the TVA study reported on earlier.

In terms of the laker capacity issue we would make several observations about the need for approximately 7.4 additional lakers worth of capacity to haul an additional 2.97 million metric tons as summarized in Table 18. First the requirement for 7.4 vessels worth of capacity is based on an assumption that only "one-way" capacity is used per round trip. To the extent that some of the "all other" product could be hauled as a backhaul on the up-bound return trip, the actual number of "ships worth of capacity" required could drop.

Secondly, the capacity required amounts to about 10% of the 2002 fleet numbers, and it should be noted that the capacity could be provided by a combination of additional vessels or better utilization of existing vessel capacity. Third, over the years, grain volumes have varied considerably from one season to the next, and the laker fleet has found a way to respond to the peak volumes in certain years.

That being said, the Canadian laker fleet has declined in numbers considerably over the last 10 years, from 108 vessels in 1994 to 72 in 2002.[104] However, there may be several options for adding the laker capacity that would be necessary if ocean ships were no longer available. First, a review of typical Lakes ship utilization rates from secondary sources and interviews suggests that there is some additional spare capacity with currently operating vessels. Interviews with maritime trade organizations and grain trading companies suggested the current fleet is not fully utilized and some additional volume could be carried. A 2003 article in Canadian Sailings seems to provide an example which supports this point, for instance, in making the comment that Canadian Steamship has "hopes for keeping five of its seven bulkers working for the entire season." [105] This suggests that there is at times some spare capacity in the fleet. The same article suggests another avenue for increasing laker capacity – the return of ships in international operations to the domestic Canadian fleet. The referenced article indicates that Canada Steamship Lines had "returned one of its self-unloaders to domestic service from international operations because of a pickup in business on the Great Lakes."

Industry sources also have indicated in presentations and/or in interviews that additional laker capacity could be purchased or built if long term demand was present.   Any additional capacity hauling cargo between two Canadian points would have to come from

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[104] Canadian Shipowners Association, *2003-2004 Report Statistics*, 2004, p. 22.

[105] Binkley, Alex, "CSL Returns Self-Unloader to Domestic Fleet To Handle Increase in Lakes Business," *Canadian Sailings*, June 2, 2003, www.Canadiansailings.com

Canadian crewed vessels given the Canadian Coastal Shipping Act, however these rules do allow foreign built ships in some circumstances and with payment of a substantial duty.[106] Another long term option would be for the U.S. fleet to be used into and/out of the Lakes for U.S. cargos, although such ships could not be used for Canadian cabotage cargos from say Thunder Bay to the St. Lawrence. Another option would be for some of any presently laid up U.S. ships to be used for Seaway business. In 2003, the Lake Carriers Association's Annual report indicates that there were four seaway capable vessels laid up for at least part of the season.[107]

One final laker capacity issue relates to seasonality. While there is year round demand for grain, and there is storage capacity both at the lake-head and in the St. Lawrence, the harvest is of course concentrated in the summer to fall season. Seaway statistics noted earlier indicate that about 50% of the grain shipments occur in the four months from September to December, while the other 50% moves over the remaining five months of the shipping season. The seasonality could result in a somewhat greater need for laker capacity in the Fall and may require some above average number of additional sailings in this time period. Lakers may or may not be available in these numbers. To the extent that they are not available, it is likely that the seasonal peak grain shipments would move by rail and barge. For Canadian grain, the rail mode costs US$.41/metric ton more than laker, and in the U.S. rail is estimated to be US$6.49/metric ton cheaper than laker movements.

The issue of Laker vessel availability is complicated, however, we believe that if demand was present, a way would be found to obtain the capacity and fill this need. On the other hand, no new vessels have been built since the 1980's. Various individuals have also indicated that laker rates cover operating costs but are insufficient to pay replacement costs. As such, this issue would require more investigation, but we believe capacity could be found at reasonable costs.

The rail system would need to carry an additional 5.98 million metric tons of product in the "most likely" alternative scenario. As summarized in Table 18, this would require an additional 598 loaded trains per year, or 11.5 trains per week and 1.6 trains per day. These trains would be spread over various regions of the United States and Canada. There are over 100-150 east-west trains per day north and south of Lake Erie and we believe the rail system could handle this capacity at the calculated costs.[108] While there is some question about car availability, and how the government owned fleet of 19,000 hopper cars will be privatized and distributed[109], we do not believe this policy would significantly hinder the ability of the rail system to handle the additional volume. In

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[106] Lanteigne, Rejean, Captain, Canadian Shipowners Association, *Introduction of Non-indigenous Species Into the Great Lakes*, presentation at a meeting of the Transportation Research Board and Royal Society of Canada's Committee on the St. Lawrence Seaway: Options to Eliminate Introduction of Non-Indigenous Species Into the Great Lakes, Montreal, Canada, September 28, 2004, pp. 1-10.

[107] Lake Carriers Association, 2003 Statistical Annual Report, 2004, pp. 32-33;

[108] Stats Canada indicates that Canadian railroads alone carried over 20 million tons of wheat and grain products in both 2002 and 2003. Volumes were over 30 million tons in 2000 and 2001.

[109] Brinkley, Alex, "Hopper Car Proposals Expected by Christmas," *Canadian Sailings*, November 29, 2004, www.canadiansailings.com.

addition, while the rail system has experienced a number of well known problems in recent years, these problems have been slowly improving as railroads have recovered from post merger operational problems and large increases in traffic as the economy has expanded. The train volumes required are simply not large enough to have a significant impact.

For the barge and truck modes the capacity requirements are fairly insignificant. For barges an additional 1.18 million metric tons would need to be carried in a system that annually carries over 40 million tons. For trucks, and additional 197/day would be required, spread over many states and Ontario, where hundred's of thousands of trucks operate daily.

Overall, we believe the existing transportation system has adequate capacity to handle the diversion of ocean vessel traffic. The primary question mark would be in the laker capacity, however we believe the industry would find a way to meet this demand. We would, however, suggest more research be done on this topic. Whatever the outcome of that research, to the extent that laker capacity was not available, the rail and barge system could probably pick up the necessary additional volume at current costs.

9.3 Air Pollution Impact of Modal Shift

The air pollution impacts of the modal shift described above is an important issue. As such, we have prepared some preliminary analysis of the air pollution impacts for comparative and benchmarking purposes. However, we would note that as with the invasive species environmental and economic impact material, this air pollution topic is not within our area of expertise. The following material should therefore be considered preliminary and the air pollution issues should be further researched by other investigators.

Marine transport has generally been perceived to be a fuel efficient and environmentally friendly mode on a per ton mile basis, and several sources we reviewed have made these points. For instance, the Great Lakes Commission has conducted a study of Great Lakes shipping (both ocean and laker) which finds that rail would require 44% more fuel than marine to move the equivalent tonnage, and that rail emissions would be 47% higher in such a scenario. They also found that the shifting of just one million metric tons to truck would increase pollutants by 517 metric tons.[110] In addition, the Seaway web page indicates that the marine mode creates considerably less pollution than rail and truck alternatives.[111]

However, other sources have indicated that there is still a very significant air pollutant load from marine vessels. For instance, a recent article in the Seattle Times indicates that

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[110] Thorp, Steve, Great Lakes Commission, *Great Lakes and St. Lawrence River Commerce: Safety, Energy, and Environmental Implications of Modal Shifts*, June, 1993, pp. 1-55.

[111] St. Lawrence Seaway System, *Website*, 2005, www.greatlakes-seaway.com.

"worldwide, ships also are a leading source of smog forming nitrogen oxides."[112] It goes on to say "the vessels are powered by low quality diesel fuel, so dirty that each particle of exhaust legally can be 3,000 times higher in sulfur than the fuel soon to be used by new diesel trucks." Some new controls on ocean vessels are planned, however, the Bush Administration substantially amended proposed EPA regulations in favor of International Maritime Organization (IMO) and other maritime organization regulations which will require improvements. However, this article also indicates the Administration has followed through with regulations that will require tractors, trains and small ships to use the same clean fuel as diesel cars by 2012.

Rail has according to many reports significantly improved its energy efficiency and air pollution rates. The 1993 Great Lakes Commission noted above makes the point that rail has improved its energy efficiency by introducing newer locomotives and reducing empty car miles. Since that report the new fuel regulations noted above have passed, and railroads have been introducing newer fuel and pollution efficient engines. For instance, BNSF Rail recently bought five new Rail Power "Green Goat" locomotives that cut nitrogen oxide (NOX) and particulates by 80-90%, and greenhouse gases by 40-70% compared to conventional yard locomotives, using a clean air grant program.[113] Generally speaking, compared to marine, rail has greater opportunities to increase power efficiency because it replaces its power at a much more frequent pace than is the case with marine.

In order to develop estimates of the air pollution impact of the modal shift we describe above, we sought information on the generic air pollution rates of each mode on a per ton mile basis. The only comprehensive useful source we were able to find was one in a 2004 article in *Marine Economics and Logistics*, an academic marine oriented journal.[114] The authors of this article used a number of EPA sources to develop air emission rates for each mode on five key pollutants. Their data is as follows:

Table 19
Air Emission Rates of the Three Transportation Modes
Short Tons per Million Ton Miles

Mode/Category	Carbon Monoxide	Nitrogen Oxide	Volatile Organic Compounds	Sulfur Dioxide	Particulate Matter (PM-10)
Truck	1.430	1.840	.220	.082	.160
Marine	.170	.570	.110	.940	.069
Rail	.110	.930	.049	.110	.026

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[112] Welch, Craig, "Bush Cuts Some Diesel Pollution, But Lets Big Ships Keep Spewing," *Seattle Times*, September 28, 2004, pp. A1.
[113] Canada Newswire, "RailPower Announces BNSF Order for Five Green Goats Under a California Clean Air Grant Program," *Canada Newswire*, June 26, 2005, www.individual.com.
[114] Perakis, An and Zhiyong Yang, "Evaluation of the Economic Impact of Proposed Non-Indigenous Species Control Measures for the St. Lawrence Seaway Using Multi-Attribute Decision Theory," *Maritime Economics & Logistics*, Vol. 6, Iss. 1, March, 2004, pp. 16-33.

This data suggests that marine emits more pollutants per million ton miles than rail on four of the five pollutant categories. Marine emits 55% more carbon monoxide, 100% more volatile organic compounds, 754% more sulfur dioxide, and 165% more PM-10 than rail according to this data. Marine also emits 1046% more sulfur dioxide than truck. Marine does show up as 64% better than rail on nitrogen dioxide, a key pollutant category.

In reviewing these numbers we would note that they are at odds with the findings of the Great Lakes Commission study from 1993. However, the Great Lakes study is some 10 years older and this may explain some of the difference. However, a more important reason for the differences may be that the Great Lakes Commission study did not consider sulfur dioxide or PM-10 pollutant categories. In fact, that earlier report specifically decided not to include sulfur dioxide, noting that "transportation vehicles contribute only a small percentage of another important pollutant, sulfur dioxide." The paper goes on to say that

> "Although bunker fuel, which accounts for about half of Great Lakes commercial fuel use, has a higher sulfur content than does diesel fuel, the variability of fuel sulfur content for the [modes] makes sulfur dioxide emission comparisons difficult. For this reason and the fact that diesel sulfur levels are being substantially reduced, sulfur dioxide emissions will not be examined in this paper."

While we cannot vouch for the accuracy of the Perakis and Yang data, they do seem reasonable given the above points, and given advances in rail efficiency in recent years. We also informally reviewed the data with several environmental experts who indicated the data seemed reasonable, especially as it related to sulfur dioxide and PM-10. Given this information, we calculated the millions of ton miles of freight that would be moved by each mode in our "most likely" alternative and compared it to the ton miles for each mode when the ocean mode was used to bring goods directly into Great Lakes ports with subsequent door to door delivery to end users via rail/truck in some situations. We then assigned the short tons of pollutants for each pollution category to the ton miles by mode and obtained total tons of pollutants for each mode and total pollutant tons across all modes for the current vs. most "likely alternative." In making this analysis one shortcoming is that we had to assume marine pollution rates for ocean vessels, lakers and barge were the same. This is a broad generalization and it may be that ocean vessels are somewhat more modern than lakers with better pollution rates than lakers as a result. Another limitation is that we did not have a source on greenhouse gas emissions for the modes, however, it is generally believed that these rates parallel fuel efficiency levels, and we would expect marine to be 40-50% more fuel efficient than rail on a ton-mile basis. At the same time it should be noted that much of the grain and "all other" product ocean tonnage switches to the laker mode so there would be little greenhouse gas impact on that portion of the volume.

The limitation noted above being said, we found that on a door to door basis, taking into account pollution for all ton miles between European/African ports and the North

American end use origin/destination, that there were an additional 14.1% ton miles required with the "most likely" alternative as compared to the current ocean direct mode/routings. This approach includes all mid-ocean ton miles but was necessary for an apples to apples comparison because a North American only approach results in all the ton miles from the Gulf of St. Lawrence being counted while with the alternative only the far fewer miles from the coastal ports are counted. Given the pollution rates above we found that in totaling the total short tons of all five pollutants for the current vs. alternative options, that the current direct ocean option resulted in 111,052 short tons of emissions, while the "most likely" alternative resulted in 116,952 short tons, with the alternative 5.3% worse than the current system. By looking just at NOX/VOX, two more critical pollutants, we found that the current direct ocean system developed 42,602 short tons of these two emissions, vs. 47,964 short tons for the "most likely" alternative, a total which is 12.6% worse than the current system.

In studying these results it is important to note that the primary comparison is between marine and rail. Very little of the freight in the "most likely" alternative moves by truck. The principal truck move is for some 40% of the steel moving to destinations from coastal ports. As such the higher pollutant rates for truck are not a significant factor in the total results. Given the difficulty in making these calculations and the uncertainty on rates of pollution for different specific engines, it may be more important to simply put into perspective the total pollutant tonnage generated by this 12.3 million metric tons of freight, as compared to the total short tons of these pollutants in the U.S. as a whole. For the U.S. in total, in 2004 there were 106.5 million tons of the five pollutants generated from transportation sources.[115] This compares to the total 116,952 short tons that would be generated in the "most likely" scenario. For NOX and VOX alone, there would be 47,964 short tons generated in the "most likely" alternative, compared to 18.7 million tons of these two pollutants in the U.S. in 2004.

11.0 Conclusions

The principal conclusion of this study is that a cessation of ocean shipping on the Great Lakes would result in a transportation cost penalty of US$54.9 million per year. In addition, if ocean vessels were no longer entering the System, a net toll loss of US$17.4 million would have to be made up through increased government subsidies or higher laker tolls. The relatively small cost penalty of US54.9 million is due to the fact that just 12.3 million metric tons of ocean vessel cargo passed into and out of the Lakes via the MLO Section of the St. Lawrence Seaway in 2002, or some 6.8% of total Great Lakes – St. Lawrence Seaway System tonnage. It is also due to the fact that the costs of the alternative modes, for lakers and rail primarily, are not substantially higher than the cost for the ocean direct routings into Great Lakes ports. While these other modes have some potential capacity constraints, we believe laker and rail capacity would be able to accommodate the extra volume. There are other factors besides cost that affect modal choices of shippers, such as time and reliability, however, testimony by the Shipping

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[115] Environmental Protection Agency, *Air Pollution Emission Trends Web Page, Average Annual Emissions*, 2005, www.epa.gov/ttn/chief/trends/index.html.

Federation of Canada suggests that “the main factor influencing competitiveness of a route [such as the Seaway] is door to door price to the client.”[116]

Whether the cost penalty for any non-availability of ocean shipping on the Lakes is the calculated US$54.9 million or in a range up to US$100 million, the basic conclusion remains the same. That conclusion is that ocean vessels on the Lakes make only a very modest contribution to transportation cost savings for users of the System. The calculated cost penalty represents a 5.9% increase in the current door to door transportation cost for the goods currently moving via ocean shipping in the Great Lakes. The transportation cost penalty for Duluth and Thunder Bay ocean shipped grain represents a roughly estimated .1% of the transportation cost for all U.S. and Canadian exported grain. For steel, the transportation cost penalty on the current Great Lakes ocean shipped product represents .7% of the transportation cost for all Canadian and U.S. imported steel. By way of comparison, we estimate the past costs of existing invasive species on Great Lakes utilities at US$200-500 million per year. Of course, these costs would not be eliminated if ocean vessels were to cease entering the system and no one knows what the future potential costs of invasives might be. It also should be noted that again, for comparative purposes, we estimate extremely minimal air pollution impacts from the anticipated modal shift if ocean ships were not available for whatever reason. We would note, however, that these invasives costs and air pollution impact figures are for illustrative comparison purposes only, and their estimation is not the primary purpose of our report or within our primary area of expertise.

The findings here are generally in line with prior studies on the competitiveness of the Seaway, although most of these studies have focused on generic Lakes shipping vs. rail, as opposed to a detailed examination of ocean shipping’s benefits. The most recent study, for the U.S. Army Corp of Engineers, found that for grain from Duluth, that rail was actually close to US$5/metric ton cheaper than the generic Lakes System. Other earlier studies in the 1980-90’s generally found modest differences in costs per ton for ocean, laker and rail options, with some advantages for the Lakes route in most cases. It also should be noted that the maritime industry is aware of the delicate nature of seaway competitiveness compared to other modes. For instance, Le Hir, President of the Shipping Federation of Canada was quoted in 2003 as stating that “the competitiveness of the GLSLSS is increasingly at risk as costs imposed by governments and other agencies continue to pile up.”[117] Testimony by the Federation before parliamentary bodies makes a similar point.[118] They stated in 2003 testimony that “the rewards for a round trip voyage into the Great Lakes are often not worth the effort,” and that “as far as the cargo

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[116] Legars, Anne, Shipping Federation of Canada, *The Great Lakes and the St. Lawrence Seaway System*, a brief to the Subcommittee on Marine Transportation of the Standing Committee on Transport, Montreal, Quebec, May 26, 2003, pp. 1-15.

[117] Binkley, Alex, “Government, Agency Costs Put Competitiveness of Seaway At Risk: Shipping Federation,” *Canadian Sailings*, June 2, 2003, www.canadiansailings.com.

[118] Legars, Anne, Shipping Federation of Canada, *The Great Lakes and the St. Lawrence Seaway System*, a brief to the Subcommittee on Marine Transportation of the Standing Committee on Transport, Montreal, Quebec, May 26, 2003, pp. 1-15.

owner is concerned, there exist a number of competitive transportation alternatives from which to choose, including moving the cargo by rail to the U.S. East Coast ports and Great Lakes destinations or moving the cargo by ship via the Mississippi route."

In conclusion, the transportation cost benefit that comes from ocean shipping into the Lakes is estimated at US$54.9 million per year. Weighed against this benefit is the unknown future cost of newly introduced invasives species. While future costs are unknown, the best estimates of the cost of existing invasives species in the Lakes is somewhere between US$200-500 million per year for utilities alone. If ocean shipping had to pay the full societal costs of existing or future invasive species, or in economic terms, the externality costs, it is not at all clear that the market would continue to favor ocean shipping in the Lakes.

APPENDIXES

Appendix A-1
Canadian Grain Movement rom the Prairies Through Thunder Bay to Europe

		2004 Costs per Metric Ton (US $'s)				
		Salty	Laker to St. Lawr.	Rail to St. Lawr.		
Rail (Yorkton SK to Thunder Bay)		21.39	21.39			$26.74 Cdn. Rate From Canadian National and Canadian Pacific
Rail (Yorkton SK to Quebec City)				41.17		$51.46 Cdn. Rate from Canadian National and Canadian Pacific
Elevation in Thunder Bay		6.27	6.49			$8.11 Cdn. From CWB, Table 20; and Transport Caanda - see foot.
Weighing, Inspection*		0.69	0.69			$.86 Cdn. From CWB, Table 20.
Lake Shippers Clearance Assoc. Charges		0.04	0.04			$.045 Cdn. From CWB, Table 20.
Lake Freight (including bunker fuel) TB-StL			11.88			$14.85 Cdn. From CWB, Table 20.
Other Lakes Charges (Tolls, Service Fees, etc.)		***	1.35			$1.69 Cdn. From CWB, Table 20.
Rail Switching at Port				0.59		$.74/ton Cdn. From Port of Montreal (POM) Tariff
Eastern Transfer Elevators Inward Elevation			2.14	2.63		$2.68 Cdn. From CWB, Table 20. Rail From POM Inward Tariff
Total Yorkton to St. Lawrence			**43.98**	**44.39**		
Storage @ 15 days			0.67	0.67		$.056/ton/day Cdn. at Port of Montreal
Out Elev. Est.(inclds stevedoring, wharfage, etc.)			2.00	2.00		$2.66 Cdn at POM = $2.13 US Rounded to $2
Ocean Rate St. Lawr. to Europe (mid-2004)**			35.00	35.00		International Grain Council. Also USDA ,Table 17, 6-17-04; Park
Ocean Rate TB to Europe (mid-2004)**		50.00				and Koo; Verified by shippers and brokers as a reasonable
Total Cost Yorkton SK-Europe		**78.39**	**81.65**	**82.06**		assumption given volatility of rates. See note below.
Additional Cost Compared To Ocean Vessel			3.26	3.67		
Summary	Tons	100%	100%	100%		
2002 Grain Traffic From TB (000's Tons)	2098	2098	2098	2098		
Cost Via Alt. Modes (000's $)		**164462**	171302	172162		
Additnl. Cost Via Alt. Modes (000's $)			**6839**	**7700**		
Most Likely Scenario - 50% laker/50% rail		0%	50%	50%		
Tons Via Mode (000's)		0	1049	1049		Cost/Ton
Total Costs (000's $)			85651	86081	**171732**	**81.86**
Add'l Costs For Most Likely Scenario (000's $)					**7270**	**3.46**

* This cost component includes sampling and grading of grain by an inspector and issuing an inspection certificate. It also includes cancellation by Cdn. Grain Commission of registration of Terminal Warehouse Receipts.

**Reflects typical rates in mid-2004. Ocean rates increased from $18/ton in January 2003 to $36/ton in December 2003 to $63/ton in April 2004. They declined to $35/ton in mid-2004.

***Tolls and fees included in salty rates per several individuals.

Notes: CWB estimated ocean vessel rate is about $15/ton more for TB-Europe compared to StL-Europe rate which was estimated at $50/ton. This fits with above rates and estimates.

Canadian currency values converted to US at $1.00Cdn=$.80US.

Source: Rail rates from CNR/CPR. Elevation and lake freight rates from CWB Table 20. Ocean rates from Int'l Grain Council and USDA, Grain Transportation Statistics. Park and Koo. Other. cost information from Port of Montreal tariff, Transport Canada, and telephone calls and meetings with port officials, ship brokers and grain shippers..

7/20//2005

Appendix A-2
US Grain Movement from the Plains Through Duluth to Europe

			2004 Costs per Metric Ton (US $'s)					
Trannsportation Alternatives		**Salty**	**Laker to St. Lawr.**	**Rail to Gulf**	**Rail/Barge to Gulf**			
Salty and Laker to St. Lawrence & Europe								
Rail/Truck (Plains to Duluth)		15.00	15.00			USDA, , Grain Transportation Indicators, 11-04, Est From Table 7.		
Elevation In and Out & Inspection etc.		7.00	7.00			CWB, Table 20 was used as a source.		
Lake Freight (including bunker fuel) Duluth-St. Lawr.			13.00			$14.85 Cdn. For TB. From CWB, Table 20. Added 10% for distance to Duluth.		
Other Great Lakes Charges (Tolls, service fees etc.)			1.35			$1.69 Cdn. From CWB, Table 20.		
Rail Switching at Port			0.59			From Port of Montreal Tariff.		
Eastern Transfer Elevators Inward Elevation			2.14			$2.68 Cdn. From CWB, Table 20.		
Total US Plains to St. Lawrence								
Elevator Storage (15 days)			0.67			$.056/ton/day Cdn. From Port of Montreal Tariff.		
Out Elev. Est. (inclds stevedoring,wharfage, etc.)			2.00			Est. Based on POM. $2.66 Cdn. at POM=$2.13US rounded to $2.		
Ocean Rate (St. Lawrence-Europe)			35.00			International Grain Council and USDA. See notes from Table 1.		
Ocean Rate (Duluth-Europe)		50.00				International Grain Council and USDA, Table 17, 6-17-04. See notes Table 1.		
Total Cost (Plains-Europe)		**72.00**	**76.75**					
Rail to Gulf and Salty to Europe								
Rail Plains to Gulf				30.00		USDA, Est. from Table 7 (e.g. Mnpl-Houston=$23.37).		
Rail Switching at Port				0.59		Est. Based on POM Tariff. $.74/ton Cdn.		
Inward Elevation				2.00		Based on Canadian examples above. Verified for reasonableness.		
Elevator Storage (15 days)				0.67		Based on Canadian examples above. Veri "		
Outward Elevation				2.00		Based on Canadian examples above. Veri "		
Ocean Rate (Gulf-Europe)				35.00		International Grain Council and USDA for Gulf Traffic. See notes from Table 1.		
Total Cost (Plains-Europe via Gulf)				**70.26**				
Rail/Barge to Gulf & Salty to Europe								
Rail/Truck(Plains to St. Louis on Miss.)					20.00	USDA, Est. From Table 7, June 17, 2004.		
Transfer to Barge					2.00	Based on Canadian examples. Verified for reasonableness.		
Barge From St. Louis to Gulf					9.00	Average of Mid/Late 2004 From USDA, Table 8, 2004.		
Elevation Inward					2.00	Based on Canadian examples. Verified for reasonableness.		
Elevator Storage (15 days)					0.67	Based on Canadian examples. Verified for reasonableness.		
Elevation Outward					2.00	Based on Canadian examples. Verified for reasonableness.		
Ocean Rate (Gulf-Europe)					35.00	International Grain Council and USDA for Gulf Traffic. See notes from Table 1.		
Total $ Cost/Ton (Plains-Europe)		**72.00**	**76.75**	**70.26**	**70.67**			
Addit. Cost/Ton Compared to Ocean			4.75	-1.74	-1.33			
Total Cost for Alt. Modes (000's $)		**147024**	**156724**	**143471**	**144308**			
Most Likely Scenario	Tons (000's)	Cost-Salty				Alt. Modes	Cost Difference	
2002 Grain Traffic in Ocean Vessels	2042	147024						
Shift 50 % to Laker	1021		78362			78362		
Shift 25 % to Rail to Gulf	510.5			35868		35868		
Shift 25 % Rail/Barge to Gulf	510.5				36077	36077		
Total Costs (000's $)		**147024**				**150307**	**3283**	
$ Cost/Ton		**72.0**				**73.61**		7/28/2005

Appendix A-3
Steel Into The Great Lakes

2004 Costs per Metric Ton (US $'s)

	Montreal	Hamilton/ Tor./Osh.	Detroit/ Windsor	Chic/BH	Cleveland/ Ashtabula	Sault Ste. Marie	Other	Total	
Ocean Direct With Inland Costs Via St. Lawrence (e.g., Europe and Brazil to Final User in US or Canada)									
Ocean Rate From Europe/Ton	42.00	50.00	55.00	65.00	55.00	60.00	60.00		Steel and Ship Broker Calls
Port Charges/Ton*	13.00	13.00	13.00	13.00	13.00	13.00	13.00		Mont/Phily Stv'dore & Broker Interviews
Movement to Inland Destination**	5.00	5.00	5.00	5.00	5.00	5.00	5.00		Based on USDA Truck Costs. See Note.
Total Cost/Ton	**60.00**	**68.00**	**73.00**	**83.00**	**73.00**	**78.00**	**78.00**	**74.56**	
2002 Steel Traffic (000's of Tons)		1391	732	946	570	292	625	4556	Stats Canada/Army Corps/SLSMC
Total $ Cost Euro. to Lakes (000's)		94588	53436	78518	41610	22776	48750	**339678**	
Costs Via Port of Montreal (All Steel Traffic Is Transloaded From Ocean Vessel To Rail Or Truck At Montreal)									
2002 Steel Traffic (000's of Tons)		1391	732	946	570	292	625	4556	
Ocean Rate to Montreal	42.00	42.00	42.00	42.00	42.00	42.00	42.00		Steel & Ship Broker Calls
Port Charges*	13.00	13.00	13.00	13.00	13.00	13.00	13.00		Port of Montreal and Broker Contacts
Rail/Highway Miles***		360	570	840	600	765	500		See note.
% Rail		0.4	0.6	0.8	0.6	0.6	0.6		Estimated Based On Calls
% Truck		0.6	0.4	0.2	0.4	0.4	0.4		"
Rail Costs/Ton At 4 cts/Ton-Mile ($20 Min)****		20.00	22.80	33.60	24.00	30.60	20.00		AAR; RR Annual Rpts; Broker Verif.
Total Rail Costs (000's $)		11128	10014	25428	8208	5361	7500	67639	Direct To End User
Truck Costs/Ton At 7 cts/Ton-Mile		25.20	39.90	58.80	42.00	53.55	35.00		Roughly $2/Mile Assumed
Total Truck Costs (000's $)		21032	11683	11125	9576	6255	8750	68420	Direct To End User
Total Costs To End User (000's $)		108665	61956	88583	49134	27676	50625	**386640**	
Total Cost/Ton		78.12	84.64	93.64	86.20	94.78	81.00	**84.86**	
Costs Via Port of Philadelphia (All Steel Traffic Shifts To The Port Of Philadelphia Where It Is Transloaded To Rail Or Truck)									
2002 Steel Traffic (000's of Tons)		1391	732	946	570	292	625	4556	
Ocean Rate To Philadelphia		45.00	45.00	45.00	45.00	45.00	45.00		Steel & Ship Broker Calls
Port Charges*		13.00	13.00	13.00	13.00	13.00	13.00		Adapted From Port Of Montreal/Calls
Rail /Highway Miles***		560	660	820	490	925	500		See Note.
% Rail		0.6	0.7	0.8	0.6	0.8	0.6		
% Truck		0.4	0.3	0.2	0.4	0.2	0.4		
Rail Costs/Ton At 4 cts/Ton-Mile****		22.40	26.40	32.80	19.60	37.00	20.00		See comments above.
Total Rail Costs (000's $)		18695	13527	24823	6703	8643	7500		Direct To End User
Truck Costs/Ton At 7cts/Ton-Mile		39.20	46.20	57.40	34.30	64.75	35.00		See comments above.
Total Truck Costs (000's $)		21811	10146	10860	7820	3781	8750		Direct To End User
Total Costs to End User (000's $)		121184	66129	90551	47584	29361	52500	**407308**	
Total Cost/Ton		87.12	90.34	95.72	83.48	100.55	84.00	**89.40**	

Appendix A-3
Steel Into The Great Lakes

	Hamilton/ Tor./Osh.	Detroit/ Windsor	Chic/BH	Cleveland/ Ashtabula	Sault Ste. Marie	Other	Total	
Costs Via Barge From Gulf Of Mexico (Traffic Moves By Barge To Chicago For Transload To Rail Or Truck)								
2002 Steel Traffic (000's of Tons)	1391	732	946	570	292	625	4556	
Ocean Rate To Gulf	48.00	48.00	48.00	48.00	48.00	48.00		Ship/Steel Brokers
Ship To Barge Transfer	5.00	5.00	5.00	5.00	5.00	5.00		"
Barge To Chicago	18.00	18.00	18.00	18.00	18.00	18.00		"
Unload Barge	3.50	3.50	3.50	3.50	3.50	3.50		"
Load Truck Or Rail	2.50	2.50	2.50	2.50	2.50	2.50		"
Rail/Highway Miles From Chicago***	480	280	25	300	490	300		See Note.
% Rail	0.6	0.5	0	0.6	0.6	0.6		
% Truck	0.4	0.5	1	0.4	0.4	0.4		
Rail Costs/Ton At 4 cts/Ton-Mile (Min. $20)****	20.00	20.00	20.00	20.00	20.00	20.00		See comments above.
Total Rail Costs (000's $)	16692	7320	0	6840	3504	7500		
Truck Costs At 7 cts/Ton-Mile (Min. $5)	33.60	19.60	5.00	21.00	34.30	21.00		See comments above.
Total Truck Costs (000's $)	18695	7174	4730	4788	4006	5250		
Total Costs to End User (000's $)	142494	70858	77572	55518	29994	60875	**437311**	
Total Cost/Ton	**102.44**	**96.80**	**82.00**	**97.40**	**102.72**	**97.40**	**95.99**	
Most Likely Scenario - No Ocean Traffic In Great Lakes (Steel Traffic Apportioned In Following Manner Based On Discussions With Brokers)								
2002 Steel Traffic (000's of Tons)	1391	732	946	570	292	625	4556	
Montreal Most Likely Share	0.5	0.4	0.2	0.3	0.7	0.4		
Philadelphia Most Likely Share	0.5	0.5	0.3	0.7	0.3	0.4		
Gulf Most Likely Share	0	0.1	0.5	0	0	0.2		
Montreal Most Likely Traffic (000's of Tons)	696	293	189	171	204	250	1803	40%
Cost/Ton Via Montreal	60.00	68.00	73.00	83.00	73.00	78.00	68.81	
Total Cost Via Montreal (000's $)	41730	19910	13812	14193	14921	19500	124066	
Philadelphia Most Likely Traffic (000's of Tons)	696	366	284	399	88	250	2082	46%
Cost/Ton Via Philadelphia	87.12	90.34	95.72	83.48	100.55	84.00	88.35	
Total Cost Via Philadelphia (000's $)	60592	33064	27165	33309	8808	21000	183938	
Gulf Most Likely Traffic (000's of Tons)	0	73	473	0	0	125	671	15%
Cost/Ton Via Gulf	102.44	96.80	82.00	97.4	102.72	97.40	86.48	
Total Cost Via Gulf (000's $)	0	7085.76	38786	0	0	12175	58047	
Total Costs To End User (000's $)	102322	60061	79763	47502	23729	52675	**366051**	100%
Total Cost/Ton	73.56	82.05	84.32	83.34	81.27	84.28	**80.34**	

Appendix A-3
Steel Into The Great Lakes

Cost Summary	Hamilton/ Tor./Osh.	Detroit/ Windsor	Chic/BH	Cleveland/ Ashtabula	Sault Ste. Marie	Other	Total **Most Likely Total Costs**	**Add'l Cost Over O.V.**	**Add'l Cost Cost/Ton**
Total Costs Via Saltie Into Great Lakes (000's $)	94588	53436	78518	41610	22776	48750	339678	**0**	74.56
Total Costs Via Port Of Montreal (000's $)	108665	61956	88583	49134	27676	50625	386640	**46962**	84.86
Total Costs Via Port Of Philadelphia (000's $)	121184	66129	90551	47584	29361	52500	407308	**67630**	89.40
Total Cost Via Gulf Of Mexico (000's $)	142494	70858	77572	55518	29994	60875	437311	**97633**	95.99
Most Likely Scenario Total Cost (000's $)	102322	60061	79763	47502	23729	52675	366051	**26373**	80.34

*Includes stevedoring, wharfage, port fees etc related to unloading ships and re-loading to truck/rail.

**Assumes 50 mile move @ $3.00/mile (USDA, GTR, Table 10 average for 25 mile trip) @ 30 tons= $5.00. Note Montreal & Philadelphia option moves diect to end user.

***Rough weighted average when multiple locations involved.

7/28/2005

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