ATTACHMENT 1

ECONOMIC EVALUATION of the PLACEMENT of NAVIGATION BEACONS in the DETROIT AREA

Economic Evaluation of Alternative 7 - Beacons.

1) INTRODUCTION

This alternative evaluates potential improvements to navigation aids in the Great Lakes system through replacing buoys, which are floating navigation aids, with permanent beacons. Lighted buoys are currently the primary marker system utilized in Great Lakes waterways. They must be removed in the fall prior to the onset of ice and reset in the spring after the thaw. Commercial shipping extends several weeks past the fall withdrawals and starts well before buoys can be placed in the spring. This practice increases risk to mariners and costs to shippers. The Coast Guard envisions a system in which ice resistant permanent structures replace a considerable number of buoys. Such an aid to navigation system would be more robust by providing more reliable aids and year round service.

2) THE APPROACH

This analysis utilizes two existing reports, the primary source being a masters thesis by Joseph C. McGuiness, "Buoys or Beacons; A Financial Analysis of Aids to Navigation Systems for the Commercial Channels of Lake St. Clair, the Detroit River, and Maumee Bay," Embry-Riddle Aeronautical University, 1999. The other source, "Buoys to Beacons Proposal, Ocean Engineering Cost Summary," LCDR D. C. Ressel, Chief, Ocean Design Section, CEU Cleveland, May 2001, served as a confirmation of the beacon cost data utilized in the primary source.

The McGuiness study, as well as this study, utilizes a benefit cost analysis approach. The analysis assumes a base year of 2010, a 50-year project life, a 5-year construction (beginning in 2005), and a Federal Discount rate of 6.125%. Benefits and construction costs in the McGuiness report were expressed in 1999 dollars and for this analysis were adjusted to 2002 utilizing the CWCCIS[1] indices.

3) BENEFITS

The McGuiness study was based on the placement of 29 beacons; this number was later reduced to 28 by the Ressel analysis. The benefits from the introduction of a beacon system of either 28 or 29 beacons into the Detroit, Michigan area, including Lake St. Clair, Detroit River, and Maumee Bay, would remain the same if buoys were gradually discontinued. The quantified benefits of the beacon system are: operating cost savings, personnel savings, and barge savings. Those benefits that are not quantified include decreased risks to mariners, cost savings to mariners, and increased reliability.

[1] Civil Works Construction Cost Index System, Tables Revised as of 30 September 2001, Composite Index (weighted average). Construction costs used an average of feature codes 10-Breakwater / Seawalls and 12-Navigation Ports / Harbors factors.

Benefits by category and in total are described below and are depicted in **TABLE 1.** The present worth of total benefits of the beacon system over the course of 50 years is $9,672,027 with average annual benefits of $622,430. These benefits understate the actual economic benefits of the project due to the unquantified effects elucidated in section **d) Other Benefits** below.

a) Operating Cost Savings

Several references were utilized by the McGuiness report in establishing the difference in operating costs between the buoy and beacon systems and in the varying costs as construction is completed over a 5-year term. The primary sources were: the Aids to Navigation Information System (ATONIS), the Waterways Analysis and Management System (WAMS), the Coast Guard's Aids to Navigation Manual (Vol. 3 – Technical), Buoy Mooring Selection Guide, Solar Sizing Guidelines, the Ninth Coast Guard District's Standard Operating Procedures, the Coast Guard web site, and the Federal Stock System. The numbers utilized in the calculation of operating cost savings include: the number of lighted buoys, the number of unlighted buoys, the number of moorings, amounts of chain, intervals for replacing chain, number of batteries, types and sizes of solar panels, lamps, flashers, lamp changes, and variations due to partial completion over 5 years. Operating Cost Savings increase to $64,287 annually once all buoys are replaced by beacons.

b) Personnel Savings

Personnel costs were determined in the McGuiness report utilizing the Commandant's Personnel Planning Office spreadsheet, G-CFS, which calculated all costs associated with a position of a given pay grade including salary, housing, travel, and training. Personnel costs were calculated for the current buoy system and for transitions to the final proposed beacon system. The resulting Personnel Savings is the difference in personnel costs between the current system and proposed system. Personnel Savings increase to $315,052 once all buoys are replaced by beacons.

c) Barge Savings (lay-up)

Various sources were consulted by McGuiness to determine the current and future costs of barges. These sources include the Coast Guard's Maintenance and Logistics Command contracts, the Naval Engineering Projects List, the Naval Engineering Support Unit of Cleveland, Ohio, files of barge Casualty Reports, Coast Guard Ships Budget, and Fuel Purchase Logs. As with the other quantified benefit categories, the difference between the costs with the current buoy system and the beacon system were then calculated. Barge Savings were estimated at $179,250 and are realized beginning in the fourth year of construction.

d) Other Benefits

Those benefits that are not quantified in this preliminary analysis include decreased risks to mariners, cost savings to mariners, and increased reliability. During the time of year when the buoys would be in place, beacons would offer savings to vessels due to increased reliability, particularly in terms of location. During those months when the buoys are not in place, beacons would offer savings to vessels through increased safety and reliability, reducing the time it takes to traverse the area and thereby reducing costs.

4) COSTS

The construction cost of this project was tabulated under the assumption that 29 beacons would be constructed. The Coast Guard now feels that only 28 would be constructed, but no attempt was made to separate the cost of a single beacon in order to avoid introducing error. Beacon costs were established in the McGuiness report by the Civil Engineering Unit in Cleveland, Ohio by a professional engineer and a reviewer assuming that water depth was the primary determining factor. The Ressel paper later corroborated the costs by assuming that bottom type would be more determinate.

TABLE 2 indicates the annual cost of constructing approximately six beacons per year for 5 years as was developed in the McGuiness study. Beacons require fewer visits compared to buoys and no heavy lifting equipment thus, smaller less expensive boats can accomplish the needed maintenance. The repair and maintenance costs of beacons are minimal compared to the repair and maintenance costs involved with the buoy system currently in place.

TABLE 1 - BENEFITS										
			Operating Cost Savings		Personnel Savings		Barge Savings (lay up)		TOTAL SAVINGS	
Year	n	Factor	Costs	P.W.	Costs	P.W.	Benefits	P.W.	Benefits	P.W.
2005	-4.5	1.3067	$12,176	$15,911	-	-	-	-	$12,176	$15,911
2006	-3.5	1.2313	$12,176	$14,992	-	-	-	-	$12,176	$14,992
2007	-2.5	1.1602	$28,917	$33,550	-	-	-	-	$28,917	$33,550
2008	-1.5	1.0933	$28,917	$31,614	-	-	$179,250	$195,968	$208,167	$227,582
2009	-0.5	1.0302	$42,367	$43,645	$295,690	$304,611	$179,250	$184,658	$517,307	$532,914
2010	0.5	0.9707	$42,367	$41,126	$315,052	$305,825	$179,250	$174,000	$536,669	$520,952
2011	1.5	0.9147	$42,367	$38,753	$315,052	$288,175	$179,250	$163,958	$536,669	$490,885
2012	2.5	0.8619	$42,367	$36,516	$315,052	$271,543	$179,250	$154,495	$536,669	$462,554
2013	3.5	0.8122	$42,367	$34,409	$315,052	$255,871	$179,250	$145,578	$536,669	$435,858
2014	4.5	0.7653	$42,367	$32,423	$315,052	$241,103	$179,250	$137,176	$536,669	$410,702
2015	5.5	0.7211	$64,287	$46,358	$315,052	$227,188	$179,250	$129,259	$558,589	$402,805
2016	6.5	0.6795	$64,287	$43,683	$315,052	$214,076	$179,250	$121,799	$558,589	$379,557
2017	7.5	0.6403	$64,287	$41,161	$315,052	$201,720	$179,250	$114,769	$558,589	$357,651
2018	8.5	0.6033	$64,287	$38,786	$315,052	$190,078	$179,250	$108,146	$558,589	$337,009
2019	9.5	0.5685	$64,287	$36,547	$315,052	$179,108	$179,250	$101,904	$558,589	$317,559
2020	10.5	0.5357	$64,287	$34,438	$315,052	$168,770	$179,250	$96,023	$558,589	$299,231
2021	11.5	0.5048	$64,287	$32,450	$315,052	$159,030	$179,250	$90,481	$558,589	$281,961
2022	12.5	0.4756	$64,287	$30,577	$315,052	$149,851	$179,250	$85,259	$558,589	$265,687
2023	13.5	0.4482	$64,287	$28,813	$315,052	$141,203	$179,250	$80,338	$558,589	$250,353
2024	14.5	0.4223	$64,287	$27,150	$315,052	$133,053	$179,250	$75,701	$558,589	$235,904
2025	15.5	0.3979	$64,287	$25,583	$315,052	$125,374	$179,250	$71,332	$558,589	$222,289
2026	16.5	0.3750	$64,287	$24,106	$315,052	$118,138	$179,250	$67,215	$558,589	$209,460
2027	17.5	0.3533	$64,287	$22,715	$315,052	$111,320	$179,250	$63,336	$558,589	$197,371
2028	18.5	0.3329	$64,287	$21,404	$315,052	$104,895	$179,250	$59,680	$558,589	$185,979
2029	19.5	0.3137	$64,287	$20,169	$315,052	$98,841	$179,250	$56,236	$558,589	$175,246
2030	20.5	0.2956	$64,287	$19,005	$315,052	$93,136	$179,250	$52,990	$558,589	$165,131
2031	21.5	0.2786	$64,287	$17,908	$315,052	$87,761	$179,250	$49,932	$558,589	$155,601
2032	22.5	0.2625	$64,287	$16,874	$315,052	$82,696	$179,250	$47,050	$558,589	$146,620
2033	23.5	0.2473	$64,287	$15,900	$315,052	$77,923	$179,250	$44,335	$558,589	$138,158
2034	24.5	0.2331	$64,287	$14,983	$315,052	$73,426	$179,250	$41,776	$558,589	$130,184
2035	25.5	0.2196	$64,287	$14,118	$315,052	$69,188	$179,250	$39,365	$558,589	$122,671
2036	26.5	0.2069	$64,287	$13,303	$315,052	$65,195	$179,250	$37,093	$558,589	$115,591
2037	27.5	0.1950	$64,287	$12,535	$315,052	$61,432	$179,250	$34,952	$558,589	$108,919
2038	28.5	0.1837	$64,287	$11,812	$315,052	$57,887	$179,250	$32,935	$558,589	$102,633
2039	29.5	0.1731	$64,287	$11,130	$315,052	$54,546	$179,250	$31,034	$558,589	$96,710
2040	30.5	0.1631	$64,287	$10,488	$315,052	$51,398	$179,250	$29,243	$558,589	$91,128
2041	31.5	0.1537	$64,287	$9,882	$315,052	$48,431	$179,250	$27,555	$558,589	$85,869
2042	32.5	0.1449	$64,287	$9,312	$315,052	$45,636	$179,250	$25,965	$558,589	$80,913
2043	33.5	0.1365	$64,287	$8,775	$315,052	$43,002	$179,250	$24,466	$558,589	$76,243
2044	34.5	0.1286	$64,287	$8,268	$315,052	$40,520	$179,250	$23,054	$558,589	$71,843
2045	35.5	0.1212	$64,287	$7,791	$315,052	$38,182	$179,250	$21,724	$558,589	$67,696
2046	36.5	0.1142	$64,287	$7,341	$315,052	$35,978	$179,250	$20,470	$558,589	$63,789
2047	37.5	0.1076	$64,287	$6,918	$315,052	$33,901	$179,250	$19,288	$558,589	$60,107
2048	38.5	0.1014	$ 64,287	$6,518	$315,052	$31,945	$179,250	$18,175	$558,589	$56,638
2049	39.5	0.0955	$64,287	$6,142	$315,052	$30,101	$179,250	$17,126	$558,589	$53,369

2050	40.5	0.0900	**$64,287**	$5,788	**$315,052**	$28,364	**$179,250**	$16,138	$558,589	$50,289
			Operating Cost Savings		**Personnel Savings**		**Barge Savings (lay up)**		**TOTAL SAVINGS**	
Year	**N**	**Factor**	**Costs**	**P.W.**	**Costs**	**P.W.**	**Benefits**	**P.W.**	**Benefits**	**P.W.**
2051	41.5	0.0848	**$64,287**	$5,454	**$315,052**	$26,727	**$179,250**	$15,206	$558,589	$47,387
2052	42.5	0.0799	**$64,287**	$5,139	**$315,052**	$25,184	**$179,250**	$14,329	$558,589	$44,652
2053	43.5	0.0753	**$64,287**	$4,842	**$315,052**	$23,731	**$179,250**	$13,502	$558,589	$42,075
2054	44.5	0.0710	**$64,287**	$4,563	**$315,052**	$22,361	**$179,250**	$12,722	$558,589	$39,646
2055	45.5	0.0669	**$64,287**	$4,299	**$315,052**	$21,071	**$179,250**	$11,992	$558,589	$37,362
2056	46.5	0.0630	**$64,287**	$4,051	**$315,052**	$19,855	**$179,250**	$11,293	$558,589	$35,199
2057	47.5	0.0594	**$64,287**	$3,818	**$315,052**	$18,709	**$179,250**	$10,647	$558,589	$33,174
2058	48.5	0.0560	**$64,287**	$3,597	**$315,052**	$17,629	**$179,250**	$10,038	$558,589	$31,264
2059	49.5	0.0527	**$64,287**	$3,390	**$315,052**	$16,611	**$179,250**	$9,446	$558,589	$29,447
2060	50.5	0.0497	**$64,287**	$3,194	**$315,052**	$15,653	**$179,250**	$8,909	$558,589	$27,755
TOTALS										**$9,672,027**
Average Annual Benefits				$69,117		$344,160		$209,153		**$622,430**

TABLE 2 – COSTS				
			Beacon Construction	
Year	**n**	**Factor**	**Costs**	**P.W.**
2005	-4.5	1.3067	**$ 2,028,000**	$ 2,650,011
2006	-3.5	1.2313	**$ 2,028,000**	$ 2,497,065
2007	-2.5	1.1602	**$ 2,028,000**	$ 2,352,947
2008	-1.5	1.0933	**$ 2,028,000**	$ 2,217,147
2009	-0.5	1.0302	**$ 2,028,000**	$ 2,089,185
Totals			**$ 10,140,000**	**$ 11,806,355**
Av. Ann. Beacon Construction				**$ 759,782**

5) BENEFIT-COST SUMMARY

TABLE 3 presents the summary of the average annual benefits and costs 29 Beacons. As was indicated in section **3) BENEFITS** above, the benefits are understated due to lack of quantification of the increase in safety and decrease in costs accrued to the shippers. Also stated above, in section **4) COSTS**, the costs are somewhat understated, resulting in indeterminate effects on the net annual benefits of -$138,101 and the BCR of 0.8.

TABLE 3
AVERAGE ANNUAL SUMMARY
(-0 @ 6.125% discount w/base year 2010)

Total First Costs for this PLAN		
Beacon Construction Cost	$	10,140,000
IDC	$	1,666,355
Total Cost	$	11,806,355
Avg. Ann. Costs for this PLAN	**$**	**759,782**

Av. Ann. Benefits for this PLAN		
Av.Ann. Operating Cost Savings	$	69,117
Av.Ann. Personnel Savings	$	344,160
Av.Ann. Barge Savings (lay up)	$	209,153
Savings	**$**	**622,430**

Net Benefits and BCR for this PLAN		
Average Annual Benefits	$	622,430
Average Annual Costs	$	759,782
Net Benefits		**-$137,352**
BCR		**0.8**

6) CONCLUSION

The preference for the beacon system is based on the financial benefits shown in the above sections and on the safety benefits and cost savings accrued to the vessel owners and operators. Mariners generally prefer fixed markers since buoys can move due to foul weather or vessel contact or sink. In addition, buoys are usually smaller than beacons since they need to be removed and replaced, size is limited, making the beacons more visible.

The McGuiness report concluded that the Beacon system would result in annual financial savings of $558,000 per year beginning in year 11 (1999 price level). This result was based on the annual inflation of the benefits by 7% over the life of the project. In other words, the McGuiness study incorrectly inflated cost savings through time and inadvertently used financial costs instead of economic costs in its analysis. Utilizing economic cost savings the beacon alternative's annual net benefits are actually -$137,352 with a Benefit-Cost Ratio of 0.8. Application of a high enough inflation index can make any alternative viable and is thus not used in sound economic analysis.

Neither this analysis or the McGuiness analysis quantifies the potential benefits from increased safety for both Coast Guard vessels and members and shippers vessels and crew, which may be significant. In addition, the direct savings to shippers in the form of reduced time due to the accuracy of beacon locations may be significant and should be added to the total benefits of this alternative. Further study to include the full quantification of economic benefits could result in a justified project.

ATTACHMENT 2

GREAT LAKES LEVELS ANALYSIS FOR SYSTEM TRANSPORTATION

ATTACHMENT 2. GLLAST DOCUMENTATION

1. INTRODUCTION

a. Model Selection. This attachment describes the Great Lakes Levels Analysis for System Transportation (GLLAST) computer model and how it was used in this study. A decision was required early in the study process regarding economic analysis of port and connecting channel improvements. There were two existing models that had potential. The Huntington District has a model with desirable features, such as the ability to have the model select the most efficient fleet and divert traffic based on alternative mode costs, but those models were more suited to inland navigation. The Buffalo District has the International Joint Commission (IJC) model that is more suited to the Great Lakes. It accounts for individual boat characteristics of the Great Lakes fleet, shipping season, lake levels, connecting channel depths, depths at the ports, and loading and unloading rates at ports. However, it is simply a costing model and does not have the ability to select the optimum boat for a given trip, or divert traffic onto an alternative mode such as rail. The modeling team debated the strengths and weaknesses of each model, and ultimately decided the IJC model would be used as a basis for a modified model herein referred to as GLLAST. As a result of this decision, it should be recognized that transportation cost savings shown for improvement plans are probably lower than what could be achieved with fleet optimization. This means Benefit-Cost ratios shown in Section 8 of the Economic Appendix are also probably low.

b. Model Construct. The GLLAST is a modified version of the IJC model which was developed in Buffalo District and used as part of the *Levels Reference Study: Great Lakes - St. Lawrence River Basin* and submitted to the International Joint Commission, March 1993. Section 3 of this Attachment describes how the IJC model was modified to create the GLLAST model.

The GLLAST model uses several input files to calculate the time required to transport a given amount of commodities in a given fleet of boats for a given set of monthly average water levels and a given set of port/connecting channel depths.

Calculations are made on a movement-by-movement basis. That is, if it takes 25 boat trips to move a given annual commodity tonnage from Port A to Port B, the time required to make each of the 25 movements is calculated separately. This way the monthly variations in lake levels and the boat's seasonal load line limits are included in the analysis. There are approximately 6300 individual movements identified in the shipment list.

The most important output from GLLAST is a file that lists 39 different pieces of information for each of the 6000+ movements per year. This file is then imported into a database where boat-operating costs are applied to calculate transportation cost.

c. Lake Levels. GLLAST is run on an annual basis, that is, one run moves one year's worth of commodities through one years worth of water levels data. The impact of yearly lake level variation can be analyzed by running the model several times, each time with a different set of monthly lake levels. Historic lake levels from 1900-2000 were used in this study. This means that transportation costs in this report are based on the average of 101 years of monthly water levels.

d. Commodity Flow and Fleet. In order for the model to calculate the time required to move a given set of commodities with a given fleet, commodity flow and fleet information must be defined. A detailed description of how this information was developed is provided in Section 4 of the Economics Appendix. The input file that defines the fleet and commodity flow information consists of a movement-by-movement list, called a shipment list, for each of the approximately 6300 movements that could be sufficiently identified in 1998.

2. ORIGINAL MODEL

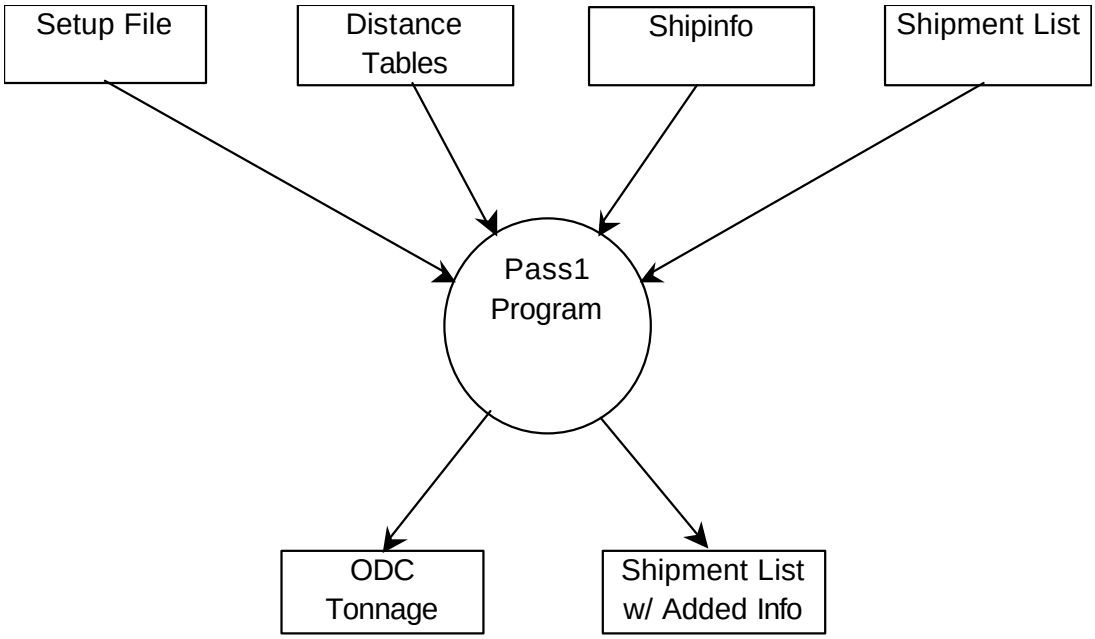
Two additional documents are available to provide documentation of the IJC model. These documents are not included in this report, but will be provided upon request. The first document[1] describes the IJC model in general terms along with the methodology and data development used in the Levels Reference Study. The second document[2] provides detailed descriptions of the calculations made by the IJC model.

The IJC model used three different programs to calculate annual transportation costs. This was primarily done because of computer memory limits in 1993.

a. Pass1 Program. The first program used in the IJC model was called Pass1. Pass1 served two main purposes. First, Pass1 added distance, connecting channel, and maneuvering time weighting information to each shipment listed in the shipment list. Second, it summed the tonnage for each origin-destination-commodity (ODC) group and wrote that information to summary files. **Figure Attachment 2-1** shows the main types of input needed by the Pass1 program, and the output it produced.

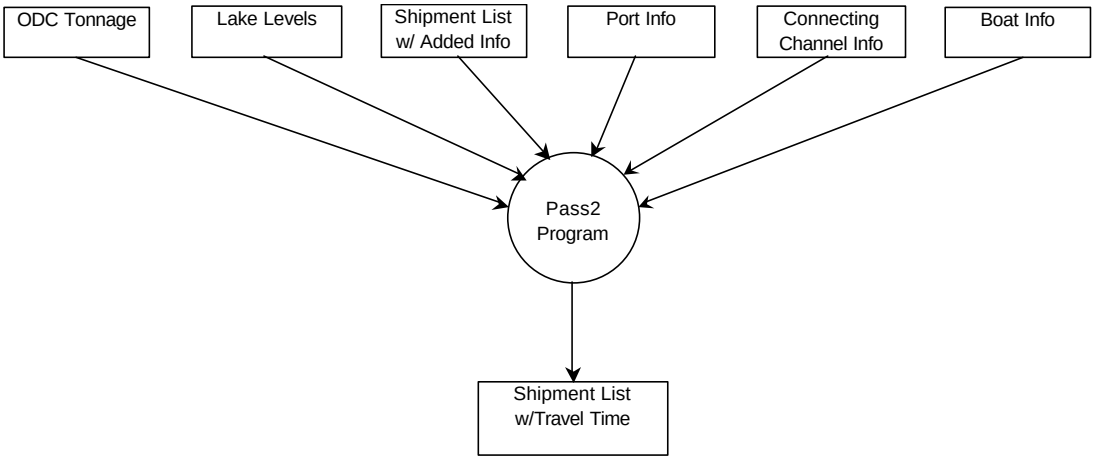
[1] Chapter 5, Transportation Cost Model, Levels Reference Study: Great Lakes - St. Lawrence River Basin, March 1993.
[2] IJC Transportation Cost Model

Figure Attachment 2-1
Pass1 Input and Output



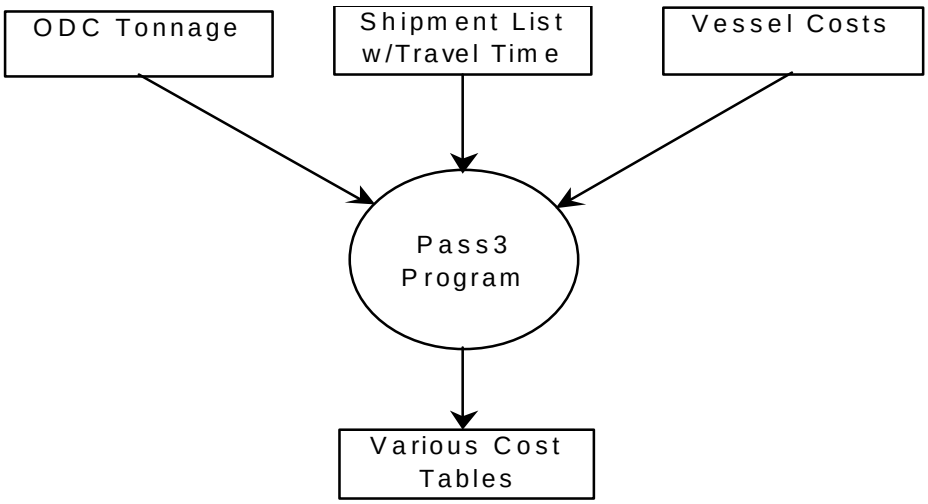
b. Pass2 Program. The second program used in the IJC model was called Pass2. Pass2 served several important purposes. It determined the maximum carrying capacity for each of the approximately 6300 shipments shown in the shipment list. It did this by considering the origin, destination and connecting channel depths given the water levels on the date of the shipment, the Coast Guard load line limits for the navigation season, and the individual boat's tons per inch (TPI) immersion factor. It also calculated the amount of time required for the boat to travel from the origin to the destination to the next origin for each movement in the shipment list. This includes average time in locks, port maneuvering times, and time spent unloading and loading. The model includes the time required to move from destination to the next origin so all boat operating time is accounted for, even if the boat is empty. **Figure Attachment 2-2** shows the input information needed by Pass2 and the output it produces.

Figure Attachment 2-2
Pass2 Input and Output



c. Pass3 Program. The third program used in the IJC model was the Pass3 program. The primary purpose of the Pass3 program was to calculate and summarize the cost of transporting all the tonnage shown in the ODC Commodity file. In order to do this, the program first determined the cost for each movement in the shipment list. It then calculated the cost for any "leftover" tonnage. Leftover tonnage occurs when the shipments shown in the shipment list are unable to move all the tonnage shown in the ODC tonnage file. This occurs when the water levels are low, or if the ODC tonnage file contains tonnages that are significantly higher than the tonnages in the shipment list. Leftover tonnage was moved in the most frequently used boat class for that ODC. These calculated tonnages were then summarized and written to tables that displayed the tonnages and costs in various ways. **Figure Attachment 2-3** shows the primary types of input needed by Pass3 and the output it produces.

Figure Attachment 2-3
Pass3 Input and Output



3. GLLAST MODEL

a. IJC versus GLLAST. The IJC model was a sophisticated model when it was written in the late 1980's. Some of the programming techniques used, such as user defined variable types, were cutting edge. One problem with the program, however, was that it produced output tables in ASCII format that were not conducive to post-run analysis. In addition, detailed data analysis was impossible because there was no detailed output to query. For this reason, it was decided to modify the IJC model so the primary form of output would be an enhanced version of the "Trace4" output from Pass2. Trace4 contains 39 output items, which are shown in Table Attachment 2-6. These data are then imported into a database, where the details of the system can be analyzed in great detail. Whereas the IJC model was run by making three "passes", the GLLAST model is run by making only two. The Pass3 is not used in the GLLAST model. Transportation costs are calculated in GLLAST within the database.

b. Leftovers. The GLLAST model processes leftover tonnage differently than the IJC model. In the IJC model, all leftovers were moved in the class of boat that made the most trips for the leftover origin-destination-commodity. In addition, it was assumed that the leftover movements would be made during the "Mid-Summer" navigation period. In GLLAST, leftovers are moved based on statistical probabilities. Leftovers are moved, proportionally, in the same class boats and during the same month as the movements in the shipment list. Shipments are generated for leftover tonnage until the tonnage left is less than one-half the capacity of a boat. When that happens, the leftover tonnage is

zeroed out and no more movements are made for that ODC. This is done to prevent very small amounts of tonnage causing a potentially expensive movement.

4. INPUT DATA DEVELOPMENT

a. Shipment List. The GLLAST model is driven by a list of shipments that describe the flow of commodities throughout the Great Lakes system. The list contains 8 pieces of information for approximately 6300 movements, and is based on the year 1998. Section 4 of the Economic Appendix describes how this list was developed. **Table Attachment 2-1** below displays the 8 items of data used by GLLAST.

Table Attachment 2-1
Shipment List Data Items

Data Item	*Description*
Vessel Number	Unique five digit number assigned to the boat
Trip Flag	One digit number that identifies whether this movement is part of a multi-origin or multi-destination movement
Origin Date	The date the boat departed the origin port
Origin Port	Five digit identifier for the origin port
Destination Date	Date the boat arrived at the destination
Destination Port	Five digit identifier for the destination port
Commodity Number	Five digit identifier for the commodity
Tons	Tons of the commodity moved

Significant problems arose during the creation of the shipment list. The problems were directly related to inaccurate, incomplete, or non-existent boat data. Boat information was usually sufficient for movements that traveled between US ports, or US and Canadian ports. Boat information for movements that traveled in foreign vessels was much less useful. Generally speaking, foreign flag vessels could not be identified. Therefore, those vessels were not included in this analysis. What that means from a modeling standpoint is that there is a disconnect between the projected traffic shown in Section 4, and the list of boats or ships available to move that tonnage. Essentially, GLLAST uses the Great Lakes fleet of boats to move traffic that, in some cases, moves on foreign flag ocean going ships.

b. Commodities Modeled. The original IJC model was configured for only four commodities, iron ore, coal, limestone and grain. Early in the study it was decided that more commodities needed to be modeled. **Table Attachment 2-2** shows the thirteen commodities modeled by GLLAST. The table also shows the number of movements that could be sufficiently identified in 1998 for each commodity.

Table Attachment 2-2
Commodities Modeled in GLLAST
And Number of Movements in 1998

Commodity	*Number of Movements*
Iron Ore	1996
Coal	1083
Limestone	1939
Salt	260
Cement	566
Stone	155
Gypsum	81
Clay	77
Soya	43
Maize	50
Wheat	57
Barley	11
Oats	6

c. Tonnage by Commodity. Section 4 of the Economic Appendix describes how projected future tonnage levels were developed. **Table Attachment 2-3** displays historic tonnage for 1998 and projected tonnage for the years 2000, 2030 and 2060. In many cases projected 2000 traffic is substantially higher than 1998. This is because the 1998 tonnage excludes boats that couldn't be fully identified. In essence, we know the tonnage is moving but we couldn't fully identify the boats. Therefore, transportation costs are calculated for all projected tonnage that is moved in boats that could be identified.

Table Appendix 2-3
Tonnage by Commodity
1998 Identified and 2000, 2030, 2060 Projected

Commodity	*1998 Identified Tons*	*2000 Projected Tons*	*2030 Projected Tons*	*2060 Projected Tons*
Iron Ore	70,429,568	71,102,736	63,998,751	62,893,999
Coal	34,062,650	39,422,080	56,773,296	78,925,263
Limestone	33,628,257	36,261,296	53,376,942	66,465,155
Cement	4,863,899	5,639,549	8,308,887	10,548,949
Salt	5,133,343	5,561,401	6,370,729	7,031,616
Wheat	729,782	847,083	1,220,349	1,642,478
Maize	1,018,158	1,277,263	2,005,703	2,921,260
Stone	2,135,300	2,297,556	3,390,904	4,221,741
Soya	1,097,772	1,186,303	1,858,933	2,693,997
Clay	1,140,869	1,299,779	1,782,598	2,029,938
Gypsum	1,207,255	1,260,712	1,691,938	1,936,157
Barley	198,393	202,637	331,854	530,151
Oats	78,607	94,353	154,520	246,853

d. Boat Information. GLLAST calculates transportation costs using a fleet that is as near as possible to the fleet of boats plying the Great Lakes. Section 5 of the Economic Appendix describes the Great Lakes fleet in general terms. The GLLAST model uses detailed information about each of the 143 boats that are modeled. **Table Attachment 2-4** displays the boat information that is used in the GLLAST Model.

Table Attachment 2-4
Boat Information Used by GLLAST

Information	*Description*
Vessel Number	Five digit boat identifying number
Length	Boat length
Beam	Boat width
Dense Com MS Draft	Draft at Mid-Summer[1] capacity for dense commodities [2]
Dense Com MS Cap	Mid-Summer capacity in tons for dense commodities
Coal MS Draft	Draft at Mid-Summer capacity for coal
Coal MS Capacity	Mid-summer capacity in tons for coal
Salt MS Draft	Draft at mid-summer capacity for salt
Salt MS Capacity	Mid-summer capacity in tons for salt
Wheat MS Draft	Draft at mid-summer capacity for wheat
Wheat MS Capacity	Mid-summer capacity in tons for wheat
Corn MS Draft	Draft at mid-summer capacity for corn
Corn MS Capacity	Mid-summer capacity in tons for corn
Barley MS Draft	Draft at mid-summer capacity for barley
Barley MS Capacity	Mid-summer capacity in tons for barley
Oats MS Draft	Draft at mid-summer capacity for oats
Oats MS Capacity	Mid-summer capacity in tons for oats
Soya MS Draft	Draft at mid-summer capacity for soya
Soya MS Capacity	Mid-summer capacity in tons for soya
Summer Draft	Maximum allowable draft for period 16 April-30 April and 16 September-30 September
Intermediate Draft	Maximum draft allowed for period 1 April-15 April and 1 October-31 October
Winter Draft	Maximum draft allowed for period 1 November – 31 March
Immersion Factor	Load carrying ability in tons per inch
Class	Boat class based on Corps of Engineer classification system
Type	Boat type, self-unloader, bulk freighter, etc.

1. Mid-summer is the period from 1 May-15 September
2. Iron ore, limestone, aggregates, gypsum, clay, and cement are considered dense commodities

e. Port Information. The GLLAST model uses 4 data items for each of the 13 commodities for 411 ports within the Great Lakes Navigation System (GLNS). Commodity specific port information used by the GLLAST model are:

- depth at the dock relative to Low Water Datum (LWD)
- additional maneuvering time, if needed

- commodity loading rate if the port has loading equipment
- commodity unloading rate if the port has unloading equipment

Under keel clearance is specified globally for all ports in the system, i.e. under keel clearance is not port specific. GLLAST uses an under keel clearance of 1 foot. This means that if the modeled commodity specific water depth is, say 25 feet, the boat can load to either 24 feet or the applicable load line limit whichever is less.

f. Connecting Channel Information. Section 3 of the Economic Appendix describes the connecting channels within the GLNS. GLLAST considers 9 connecting channels and their associated depths relative to LWD. **Table Attachment 2-5** shows the nine channels and their depths. GLLAST uses an under keel clearance of 1.0 foot at all connecting channels.

Table Attachment 2-5
GLLAST Connecting Channels
And Depths Relative to LWD

Connecting Channel	*Depth Feet*
St Lawrence River	27.25
Welland Canal	27.25
Detroit River	27.5
Lake St Clair	27.5
St Clair River	27.0
Straits of Mackinac	30.0
St Mary's River 1/	27.5
Soo Locks	32.0
Vidal Shoals	28.5

1/ St. Marys' controlling depth is currently 27 feet; however, improvements aimed at providing 25'6" minimum draft are expected to increase this depth to 27'6". This depth was used in the modeling as it was deemed reflective of the most likely without project condition for channel depth at LWD on the St. Marys.

g. Water Level Information. Water Levels for the GLLAST Model were developed from two sources. The first portion was derived from water levels generated for the International Joint Commission (IJC) Water Levels Reference Study (Mar 93). Because of existing control works and lake level regulation on Lakes Superior and Ontario and the St. Lawrence River, actual historical levels (which pre-date the construction of the St. Lawrence Seaway and associated control works) would not properly reflect the expected levels of the lakes in the future. Therefore, a lake level simulation plan, Basis of Comparison (BOC) was used to simulate historical levels as if they were regulated through existing Great Lakes control works (Regulation Plan 77A, (Criteria C) on Lake Superior and Regulation Plan 58D, with deviations on Lake Ontario/ St. Lawrence River) and existing diversions and consumptive uses. This portion of the water level data represents the monthly mean levels by lake for the period 1900 through 1989. Actual recorded mean monthly levels by lake for the period 1990 to 2000 were added to the BOC levels by lake to comprise the full set of historic average monthly lake

levels from 1900-2000 that were used in this study. **Table Attachment 2-6** presents the minimum and maximum levels under the BOC, for the period 1900-2000.

Table Attachment 2-6
Minimum and Maximum Levels (IGLD, 85)
By Lake for the BOC 1900-2000

Ontario	*Jan*	*Feb*	*Mar*	*Apr*	*May*	*Jun*
Minimum Level	242.2	242.1	242.6	242.9	243.1	243.4
Maximum Level	246.6	246.9	247.3	248.2	248.5	248.6
Difference	4.4	4.9	4.7	5.3	5.3	5.2
Ontario	Jul	Aug	Sep	Oct	Nov	Dec
Minimum Level	243.2	242.8	242.5	242.2	242.0	241.9
Maximum Level	248.2	248.0	247.4	246.8	246.7	246.7
Difference	5.0	5.2	4.9	4.6	4.7	4.8
Erie	Jan	Feb	Mar	Apr	May	Jun
Minimum Level	568.3	568.2	568.2	568.8	569.0	569.1
Maximum Level	573.7	573.4	573.8	574.1	574.0	574.3
Difference	5.4	5.2	5.5	5.2	5.0	5.2
Erie	Jul	Aug	Sep	Oct	Nov	Dec
Minimum Level	569.1	569.0	568.8	568.6	568.2	568.2
Maximum Level	574.2	573.9	573.6	573.9	573.7	573.8
Difference	5.2	5.0	4.8	5.4	5.4	5.6
Michigan-Huron	Jan	Feb	Mar	Apr	May	Jun
Minimum Level	576.1	576.1	576.0	576.1	576.6	576.6
Maximum Level	581.3	581.1	581.1	581.5	581.6	581.8
Difference	5.2	5.0	5.1	5.3	5.1	5.2
Michigan-Huron	Jul	Aug	Sep	Oct	Nov	Dec
Minimum Level	576.7	576.7	576.6	576.4	576.3	576.2
Maximum Level	582.0	582.0	582.0	582.3	582.0	581.6
Difference	5.3	5.3	5.3	5.9	5.7	5.4
Superior	Jan	Feb	Mar	Apr	May	Jun
Minimum Level	599.8	599.6	599.5	599.5	599.6	599.9
Maximum Level	602.7	602.5	602.4	602.6	602.8	602.9
Difference	2.9	2.9	2.9	3.1	3.2	3.0
Superior	Jul	Aug	Sep	Oct	Nov	Dec
Minimum Level	600.3	600.5	600.8	600.7	600.4	600.1
Maximum Level	603.1	603.2	603.2	603.4	603.3	603.0
Difference	2.8	2.8	2.4	2.7	2.9	2.9

h. Transportation Costs. The GLLAST model does not calculate transportation costs explicitly. Instead, it calculates the amount of time required to make each shipment. These operating times are then used to calculate transportation costs by multiplying the boat operating cost, which is contained in a table of the database, by the

operating time. This calculation is made in database queries. **Table Attachment 2-7** below shows the hourly costs used in this study. For a full explanation of how the costs were developed , see Section 5 of the Economic Appendix.

Table Attachment 2-7
Hourly Costs by Boat Class

Boat Class	*Hourly Cost*
1	$1,253
2	$1,253
3	$1,364
4	$1,460
5	$1,559
6	$1,674
7	$1,836
8	$2,108
9	$2,369
10	$2,369

5. OUTPUT DATA

The GLLAST model produces one output file that serves as the source of data for further economic analysis. The file contains 39 data items for each of the 6000+ shipments modeled in a given year. These data items are shown in **Table Attachment 2-8**. GLLAST is executed 101 times for each plan considered, one time for each of the 101 water level years. These 101 output files were copied into 1 large ASCII formatted file and imported into a database. Queries were then executed to produce the tables and statistics needed to develop benefit-cost ratios.

TABLE Attachment 2-8
GLLAST Outputs

Output Item	*Description*
Shipment Date	Date the shipment begins
Vessel Number	Five digit identifying number of the boat
Class	Boat class
Commodity	Commodity number
Origin Port	Origin Port Number
Origin Depth	Depth of the origin port on the shipment date
Destination Port	Destination Port Number
Destination Depth	Depth of the destination port on the shipment date
OD Limit	Minimum depth of either the origin or destination
MS Draft	Coast Guard allowed mid-summer draft for the boat
Sum Draft	Coast Guard allowed summer season draft for the boat
Inter Draft	Coast Guard allowed intermediate season draft for the boat
Win Draft	Coast Guard allowed winter season draft for the boat
St Law Node	Depth of the St Lawrence on shipping date if trip uses St Lawrence
Well Node	Depth of the Welland on shipping date if trip uses Welland
Detroit Node	Depth of the Detroit River on shipping date if trip uses Detroit R.
LStCl Node	Depth of Lake St Clair on shipping date if trip uses Lake St Clair
StClR Node	Depth of the St Clair River on shipping date if trip uses St Clair R.
Mack Node	Depth of Straits of Mackinac on shipping date if trip uses Mackinac
StMary Node	Depth of the St Mary's River on shipping date if trip uses St Mary's
Sault Node	Depth of the Soo Locks on shipping date if trip uses Soo
Vidal Node	Depth of Vidal Shoals on shipping date if trip uses Vidal Shoals
Depth Limit	Minimum depth encountered during the entire trip
Immersion Factor	Immersion factor in tons per inch for the boat
MS Cap	Mid-Summer Capacity of the boat
CapReduce	Difference between Max Ton and ActTon, the next two Output Items
Max Ton	Maximum tonnage the boat could have carried if no depth restriction
ActTon	Actual tonnage the boat was able to carry
LoadMin	Minutes needed to load the cargo
OmanMin	Minutes need to maneuver at the origin port
TranMin	Minutes needed to travel from origin to destination
DmanMin	Minutes needed to maneuver at the destination port
UnLoadMin	Minutes needed to unload the cargo
WellMin	Minutes spent at Welland Locks and Canal (if appropriate)
SaultMin	Minutes spent at Soo Locks (if appropriate)
StLawMin	Minutes spent in SLS system (if appropriate)
Total Min	Total minutes needed to travel from origin to destination to next origin
TotalHr	Total hours needed to travel from origin to destination to next origin
Leftover	A flag indicating that this was leftover tonnage

6. GLLAST VERIFICATION AND VALIDATION

a. Pass1 Program. The Pass1 program was used without extensive modification. Except for adding more commodity types, which was accomplished with a simple format

change, Pass1 was used as it was in the IJC study in 1989. Therefore, only minor effort was taken to verify Pass1. The following statistics were checked to verify Pass1.

- The number of shipments in the output file equals the number of shipments in the input file
- The total tonnage for all ODC groups was equal in the input shipment list and output summary files
- Spot checks were made of the distances calculated
- If movements had more than one origin or destination, checks were made to insure distances and maneuvering time ratios were calculated correctly

b. Pass2 Program. The Pass2 program was modified in several ways. The biggest change was including leftover traffic in Pass2 instead of Pass3. The other significant change was adding more commodities types

i. Leftovers. The IJC model used the pass3 program to account for tonnage that is leftover. It assumed that all leftover traffic would move in only one boat class, that is the class most often used for the ODC triplet. It also assumed that leftover tonnage would move during the Mid-Summer navigation season. It was decided that GLLAST would account for leftover tonnage in the pass2 program, and that both boat class and navigation season would be selected stochastically based on statistics derived from the input shipment list. After these modifications, GLLAST output was reviewed to insure boat type and shipping season were being selected properly. **Table Attachment 2-9** shows an example ODC triplet. The percentages shown indicate that GLLAST does select boats based on the historical distribution of boats serving the ODC.

Table Attachment 2-9
Leftover Tonnage Boat Selection Verification

Commodity	*Origin*	*Destination*	*Proxy Vessel Number*	*Historic Vessel Percent*	*Leftover Vessel Percent*
32100	79283	72620	1	27.27%	27.36%
32100	79283	72620	2	9.09%	9.23%
32100	79283	72620	3	9.09%	7.63%
32100	79283	72620	4	9.09%	9.81%
32100	79283	72620	5	18.18%	20.73%
32100	79283	72620	6	9.09%	7.63%
32100	79283	72620	7	9.09%	9.43%
32100	79283	72620	8	9.09%	8.18%

ii. Additional Commodity Types. The IJC model differentiated tonnage into 4 groups. That means the input data for port depths and boat capacities was also provided for 4 commodity types. Since GLLAST differentiates 13 different commodity types, much more commodity specific input data was required. For a

description of how commodity specific port and boat information were developed, see Sections 3 and 4, respectively. This verification effort focused on insuring that the model was reading the correct commodity specific information, and then using it correctly. GLLAST output cannot be used to verify port depth selections due to monthly variations in lake levels combined with seasonality of specific movements. Therefore, port depth selection verification was performed by stepping through the code in debug mode, and monitoring key variable names as the program executed. Verification of proper boat draft selections was made by comparing GLLAST output to the input file that describes each of the boats.

7. SCENARIOS ANALYZED

a. GLLAST Application. The GLLAST model was applied in 3 distinct phases. Phase 1 consisted of running the without project condition and using the results to identify potential improvement plans. In Phase 2, the plans identified in Phase 1 were run for year 2000 commodity flows only. The year 2000 transportation cost savings were then compared to the cost of the improvement. All improvement plans with positive net benefits were then run with 2030 and 2060 commodity flows in Phase 3.

During Phase 1, the Without Project Condition was run for year 2000 commodity flows. The results of that run were then analyzed by 2 groups of people, one group in Buffalo, NY and one in Louisville, KY. The Buffalo group identified most of the improvement plans shown in this report. They used a structured methodical approach that took a while to develop, but once developed, served as a very thorough, all encompassing method. In Louisville, the person responsible for running GLLAST analyzed the output database. That person identified possible improvement plans through ad hoc queries. This method could best be described as informed hunt and peck, but it identified potential improvements quickly. Only a few plans were analyzed, but they showed that substantial transportation cost savings could be realized.

In Phase 2, plans identified by the Buffalo group were run with year 2000 commodity flows. Most plans were identified and run with GLLAST before construction costs were completed. After the construction costs arrived, formal Benefit-Cost procedures were applied to identify plans with positive net benefits. Every plan with a benefit-cost ratio in excess of 1.0 was then run using 2030 and 2060 commodity flow and tonnage.

Table Attachment 2-8 below shows the results for each potential improvement plan identified in Phase 1. **Bold Plan ID** indicates Transportation Cost savings based on 2000, 2030, and 2060 commodity flow years, non-bold Plan ID's are based on 2000 only.

Table 2-8
Benefit-Cost Results

Plan ID	Average Annual Improvement Cost	Average Annual Transportation Rate Savings	Net Benefit	B/C Ratio
E16	$ 20,618	$ 2,294,662	$ 2,274,045	111.30
E15	$ 103,785	$ 10,163,131	$ 10,059,346	97.92
S6	$ 18,231	$ 813,947	$ 795,716	44.65
E17	$ 38,219	$ 1,384,697	$ 1,346,478	36.23
E18	$ 38,219	$ 1,099,766	$ 1,061,547	28.78
SD4	$ 189,803	$ 3,228,322	$ 3,038,519	17.01
SD7	$ 352,823	$ 5,979,242	$ 5,626,419	16.95
S4	$ 412,721	$ 4,436,293	$ 4,023,573	10.75
SD1	$ 31,634	$ 300,140	$ 268,506	9.49
SD2	$ 94,902	$ 869,792	$ 774,890	9.17
SD5	$ 379,606	$ 3,477,758	$ 3,098,152	9.16
SD3	$ 158,169	$ 1,370,849	$ 1,212,680	8.67
M1	$ 154,004	$ 959,046	$ 805,043	6.23
E2	$ 103,785	$ 634,164	$ 530,379	6.11
E1	$ 48,462	$ 276,418	$ 227,956	5.70
S7	$ 825,441	$ 4,388,240	$ 3,562,799	5.32
E3	$ 159,108	$ 687,864	$ 528,756	4.32
E4	$ 227,061	$ 782,619	$ 555,558	3.45
M4	$ 1,363,093	$ 4,034,043	$ 2,670,950	2.96
S2	$ 54,694	$ 130,680	$ 75,986	2.39
H9	$ 261,866	$ 468,631	$ 206,765	1.79
S8	$ 7,139,609	$ 12,750,226	$ 5,610,617	1.79
M2	$ 774,991	$ 1,360,392	$ 585,401	1.76
H4	$ 245,292	$ 395,633	$ 150,340	1.61
H3	$ 239,077	$ 355,402	$ 116,325	1.49
H1	$ 116,431	$ 166,437	$ 50,006	1.43
H5	$ 116,431	$ 144,184	$ 27,753	1.24
H2	$ 232,862	$ 284,699	$ 51,837	1.22
H7	$ 239,077	$ 275,710	$ 36,633	1.15
H8	$ 245,292	$ 282,446	$ 37,154	1.15
H6	$ 232,862	$ 245,039	$ 12,177	1.05
S11	$ 1,998,131	$ 1,726,935	$ (271,197)	0.86
M3	$ 1,896,771	$ 1,521,931	$ (374,840)	0.80
S9	$ 12,430,515	$ 9,670,717	$ (2,759,798)	0.78
S1	$ 412,721	$ 292,978	$ (119,742)	0.71
E5	$ 20,618	$ 11,550	$ (9,068)	0.56
S10	$ 19,314,638	$ 10,373,802	$ (8,940,836)	0.54
E8	$ 3,886,453	$ 1,625,925	$ (2,260,528)	0.42
E9	$ 4,935,790	$ 1,833,647	$ (3,102,143)	0.37
E7	$ 2,842,200	$ 1,034,029	$ (1,808,171)	0.36
E10	$ 6,054,277	$ 1,898,954	$ (4,155,323)	0.31
E6	$ 1,130,786	$ 352,948	$ (777,838)	0.31
E13	$ 54,163	$ 14,607	$ (39,557)	0.27
H10	$ 5,432,365	$ 1,045,712	$ (4,386,653)	0.19
M5	$ 1,363,093	$ 201,238	$ (1,161,855)	0.15
SD6	$ 3,860,740	$ 553,113	$ (3,307,627)	0.14
E14	$ 73,488	$ 8,235	$ (65,253)	0.11

8. CONCLUSIONS

The GLLAST model has the ability to provide a detailed look at how port and connecting channel depths interplay with the Great Lakes fleet and water levels. It is well suited to compare transportation costs for various improvement plans. Analysis of many different improvement plans shows that GLLAST gives consistent results. This fact, along with the verification and validation process strengthens the argument that GLLAST can be used as a valuable tool when identifying transportation costs savings realized from port or connecting channel dredging.

ATTACHMENT 3

CRUISE SHIP ANALYSIS

SECTION 1. INTRODUCTION

A Business Research Economic Advisors (BREA) and WEFA, Inc. (formerly Wharton Economic Forecasting Associates) study concluded that in 1999 the cruise industry: generated 214,901 full-time jobs for U.S. citizens, purchased $8.1 billion of U.S. goods and services, generated over $7 billion in wages for U.S. employees, and made expenditures resulting in $15.5 billion in total economic impact on the U.S. economy. This same study projected that the industry will have $18.8 billion in economic impact in 2002.[1.]

The number of cruise passengers increased at an average annual rate of 7.8 percent per year from 1995 to 1997, and is expected to continue growing at an annual rate of 7.5 percent over the next 5 years. Increases are also expected in other leisure boating areas such as dinner and gambling vessels, and local harbor excursions. This popularity has led to a record number of new vessel orders with cruise operators building increasingly larger vessels. Even with the considerable number of vessels recently added to cruise fleets, the estimated occupancy rate for 1998 was still more than 90 percent.[2.]

Once a declining industry, the cruise industry on the Great Lakes is experiencing a recent resurgence. This resurgence has been promulgated by the formation of new coalitions, resources, and entrepreneurs to capitalize on an area that is expected to experience continued growth see (**TABLE 1-1**). The Great Lakes offer a new destination for seasoned ship travelers and a perceived safer alternative for the new comer. Price levels for Great Lakes cruises are starting to vary, broadening the available consumer base.

TABLE 1-1
MAJOR CONTRIBUTORS TO THE CRUISE INDUSTRY ON THE GREAT LAKES[3.]

COALITIONS	RESOURCES	ENTREPRENEURS	MAJOR OPERATORS
Cruise Michigan	Mariport	Ann Arbor Cruise Co.	Hapag Lloyd, Hamburg
Cruise Ontario	St. Lawrence Development Corporation	*Great Lakes Cruising Inc., WI	Compagnie Des Iles du Ponant
Cruise Wisconsin			
Cruising the Great Lakes	St. Lawrence Seaway Management Corporation		Cunard Cruise Line
			Delta Queen Coastal Voyages(U.S. Lines)
Great Lakes Cruising	Waterways Management Forum		Golden Sun Cruises

*Great Lakes Cruising Inc., WI filed for bankruptcy early in the 2001 season, the full explanation is included in Section 4. Benefits.

These various groups and organizations have acted to ameliorate the negative perception that the Great Lakes are an industry dominated area without appeal to cruise vessels. Ship owners are gradually adjusting to the rigorous safety requirements and the negative perceptions are diminishing as ships add cruises and the word of a positive sailing experience moves through the network of consumers and cruise lines.

The passenger cruise ship industry has grown from two vessels in 1995 to seven in 2001. From Delta Queen Coastal Voyages (U.S. Lines), the vessel Cape May Light began its Great Lakes career in 2001 and its sister ship, the Cape Cod Light will come on board in 2002. John Jamian, Director, Port Authority of Detroit-Wayne County stated, "This is the reverse of "build it and they will come," they came, and now we're scrambling to build it." Harbors and the associated towns/cities throughout the system are experiencing increased commerce; not only due to passengers coming ashore, but also to the influx of residents from surrounding areas who come to the harbor to view the ships.

The navigation season on the St. Lawrence Seaway typically runs from the first part of April through the end of December, but cruise vessels generally operate from mid May to mid October when weather conditions are most favorable.

a. Authority. Planning Guidance Letter No.97-6, Cruise Ships and Benefits to Navigation based on WRDA 1996 for revision of ER 1105-2-100 directs the U.S. Army Corps of Engineers to categorize all benefits generated by cruise ships as commercial navigation benefits.

b. Cruise Ships.

i. Definition. The vessels classified as cruise ships for the purposes of this evaluation involve those which offer over-night accommodation on the open water with a minimum passenger capacity of 50. The 2001 season saw 7 passenger vessels of this description and will have an additional vessel in 2002, The Cape Cod Light. **TABLE 1-2** The Niagara Prince is the smallest of the considered vessels carrying a maximum of 84 passengers.

ii. Requirements. Vessel requirements vary significantly as shown in **TABLE 1-2**. The c. Columbus, chartered by Hapag-Lloyd requires the deepest draft, 19'6", of the existing fleet. Several of the harbors frequented by the shallower draft vessels are not accessible to the c. Columbus. The Arcadia, chartered by the former Great Lakes Cruises, Inc., was also restrained from utilizing certain harbors due to having the second deepest draft of 18'6".

As an example, Le Levant called on Saugatuck Harbor 8 times in 2001 and will be increasing calls to 16 for 2002. In addition, the harbor is scheduled to receive 14 visits by Cape May Light, with a draft of 13'6" in 2002. Since Saugatuck Harbor has an outer depth of 16' and a channel depth of 12' in the Kalamazoo River, Le Levant can generally traverse the area. Although, due to some need for maintenance early in the 2001 season, Le Levant did hit and damage a private dock while trying to avoid a shallow area. Cape May Light and Cape Cod Light will be limited to the outer harbor unless depths are increased. At current project depths, the c. Columbus is unable to access even the outer harbor.

TABLE 1-2

GREAT LAKES CRUISE SHIPS TECHNICAL INFORMATION [4.]

NAME:	c. COLUMBUS	* ARCADIA	LE LEVANT	NANTUCKET CLIPPER	NIAGARA PRINCE	GRANDE MARINER	CAPE MAY LIGHT	CAPE COD LIGHT**
OWNER:	Conti Reederei	Attika Shipping	Cie des Iles du Ponant	New World Ship Mgt.	American Canadian Cruise Line	M/P Leasing	Delta Queen Coastal	Delta Queen Coastal
BUILDER:	MTW Wismar	Union Navale de Levante	Alstom Leroux - St. Malo	Jeff Ship	Blount Industries	Blount Industries	Atlantic Marine	Atlantic Marine
YEAR BUILT:	1997 / 2000	1968/1989/ 2001	1999	1984	1994	1998	2001	2001/2002
CLASS:	GL	HR	BV	ABS	Load Line Only	Load Line Only	AB	AB
CHARTERER 1:	Hapag-Lloyd	Great Lakes Cruises Inc.	None	None	None	American Canadian Cruise Line	None	None
CHARTERER 2:	The Great Lakes Cruise Company	N/A	See note 1	N/A	N/A	N/A	N/A	N/A
FLAG:	Bahamas	Greece	French Overseas	USA	USA	USA	USA	USA
PORT OF REG.:	Nassau	Piraeus	Mata Utu	Wilmington, DE	Boston, MA	Falling Waters, WV		
PASSENGERS / VOYAGE:	423	230	90	102	84	100	226	226
OUTSIDE CABINS:	142	103	45	51	40	49	101	101
INSIDE CABINS:	63	24	0	0	2	1	13	13
SINGLE CABINS:	2	0	0	0	0	0	2	2
CREW:	150	100	50	31	15	17		
GRT:	14,903	5,113	3,504	96	687	829		
NRT:	5,042	1,945	1,051	65	206	248		
POWER HP:	14,356	6,240	4,038	1,066	nd	1,400		
FUEL:	HVF	MGO	MGO					
SPEED:	18.5 kts	16.0 kts	16.0 kts	nd	10.0 kts	10.0 kts	10.0 kts	10.0 kts
LENGTH:	475'8"	359'5"	328'11"	207'0"	174'	183'	300'	300'
BREADTH:	70'6"	59'6"	45'7"	37'0"	40'	40'	50'	50'
DRAFT FWD:	14'6"	15'0"	11.0'	8'6"	6'6"	7'0"	13'6"	13'6"
DRAFT AFT:	19'6"	18'6"	11.0'	8'6"	6'6"	7'0"	13'6"	13'6"
CPP:	Yes	Yes	Yes	nd	nd	nd	nd	nd
BOW THRUSTERS:	Yes	No	Yes	Yes	nd	nd	nd	nd
STABILIZERS	Yes	Yes	Yes	nd	nd	nd	No	No

*Arcadia left the Great Lakes after the bankruptcy of Great Lakes Cruises, Inc., full explanation included in Section 4. Benefits

**Same owner and number of cabins as Cape May Light, to begin service in 2002

NOTE 1: There are several Great Lakes Charterers including: - The Great Lakes Cruise Company, - Travel Excellence, - High Country Passage, - Tauk Tours (from 2002)

c. Other Types of Passenger Ships. Vessels offering day cruises, dinner cruises, gambling cruises, and overnight cruises with a passenger capacity of less than 50 are not included in the benefits summary. However, this is not intended to be an indication that the contribution made by these vessels is insignificant. There are a number of vessels in these categories on the Great Lakes system contributing to their local economies and to

both local and federal taxes. Due to time and fund restraints, the benefits of these vessels were not calculated or verified.

i. Gaming Vessels. The article "Gaming comes to the Lakes"[5.] includes a description of the four Indiana based casino vessels that were introduced into Lake Michigan in 1996 and the associated expected benefits. The four vessels, The *Trump Princess*, the *Majestic Star Casino*, the *Empress III*, and a Showboat vessel, have a combined capacity of almost 10,000 passengers per voyage. The boats were expected to employ some 4,500 persons for maritime operations alone. The introduction of these vessels was expected to generate a shore-side boom in the construction of hotels, restaurants, and parking facilities with a corresponding increase in employment. At the time of the article, the Indiana Gaming Commission was scheduled to hold hearings to award a certificate of suitability for a fifth gambling vessel at Michigan City, Indiana.

In East Chicago, the Showboat operators pledged an ongoing contribution of 3.75% of revenues for community redevelopment, predicting a local economic impact of $535 million over 5 years. The *Casino Aztar*, a gambling riverboat in Evansville, Indiana which is significantly smaller than any of the four vessels introduced in Lake Michigan, brought in $1.7 million in state and local tax revenues during her first full month of operation in December of 1995.

The impacts documented by the gaming industry are significant. An analysis of the area could confirm or refute the expected benefits of these and other Great Lakes gambling vessels.

ii. Day/Dinner Cruises and Tour Vessels. These vessels are spread throughout the Great Lakes system and are frequently local, small businesses. Although some advertise on line and through other travel sources, a larger number rely on local advertising, such as pamphlets in local hotels and in local news media. These qualities intensify the difficulty in compiling data and analyzing benefits. Ultimately, the benefits, whether regional or national, vary significantly from one vessel to another depending on various other factors such as the passengers and the services offered.

iii. Small Passenger Vessels. The Georgian Clipper, a Canadian flagged vessel, and the Denis Sullivan, a USA flagged vessel based in Wisconsin, each hold 18 passengers. The Georgian Clipper has overnight cruises ranging from 2 – 6 nights with prices from $339 - $1,149, stopping at several Canadian ports. The Denis Sullivan is an educational vessel with cruises ranging from 2 – 3 hours in length and prices from $25 for children under 12 to $55 for adults, except for the fireworks cruises where all tickets are $100. This vessel also offers a three-night cruise with single bunk, co-ed sleeping areas and shared toilets and showers for $510, and voyages between Milwaukee and Muskegon for $170. These vessels operate throughout the season, ending by late September. Both are widely advertised on various Internet sites and with travel agencies, thus reaching a broad consumer base. It is likely that there are other vessels of this type on the Great Lakes, but information is not readily available. The benefits generated from these vessels would vary significantly from one to another depending on type of services offered, length of stay, number of passengers, and ports of call.

SECTION 2. REGULATIONS[6.]

Both U.S. and Canadian regulations require the registration of a vessel upon entry into a Great Lakes port.

a. U.S. Regulations.

i. U.S. Customs. Cruise Ships are regulated by the "Passenger Services Act, 46 U.S.C. App. 289" (PSA), which was enacted in 1886 to reserve the right of U.S. vessels to transport passengers between one U.S. port and another U.S. port. This type of transport is referred to as "coastwise trade". Coastwise trade involves transporting passengers between one U.S. port and another U.S. port by a U.S. built, owned, and flagged vessel and the vessel must never have been foreign documented or owned. The U.S. Customs Service is responsible for promulgating these regulations. Other applicable regulations include: 19 U.S.C. sections 1433, 1434, 1437, 1447, 1448, and 1454; 46 U.S.C. sections 91, 121, 132, 141, 1436, 1441. Corresponding regulations are found in Title 19, part 4 of the Code of Federal Regulations, with parts 4.1 – 4.12, 4.20-4.24, 4.30-4.51, 4.60-4.69, 4.80-4.91, and 4.98 applying to cruise vessels. These regulations cover: arrival and entry requirements, payment of tonnage taxes, cargo and passenger unlading requirements, clearance requirements, coastwise procedures, and navigation fees.

Further, in interpreting these regulations, it is important to make the distinction between "nearby foreign ports" and "distant foreign ports". Travel between U.S. ports and nearby foreign ports is subject to more restrictions than itineraries that include travel to a distant foreign port. Nearby Foreign Ports include all ports in North America, Central America, the Bermuda Islands, and the West Indies which includes the Bahamas, but not the Leeward Islands of the Netherlands Antilles. Thus, Nearby Foreign Ports include all Canadian Ports. Any itinerary beginning at a U.S. port with travel to a Canadian port must terminate in either the foreign port or the original U.S. port.

Foreign ships may embark passengers at a U.S. port on a "voyage to nowhere". This means that foreign vessels may embark passengers, sail to a place in or out of U.S. territorial waters and return to the original point of departure with no intermediate stops without violating the PSA. They may also cruise between U.S. and Canadian ports. This includes temporary stops at additional U.S. ports as long as all passengers going ashore in U.S. ports re-board the vessel and the final destination is the original port of departure or the Canadian port. Thus, an itinerary of Duluth to Toronto with a final destination of Chicago violates the PSA. If a foreign vessel includes stops at a *distant* foreign port, they are allowed to originate in one U.S. port and end in another U.S. port without violating the PSA.

Various requirements include:

- The maximum permitted air draft (height above water) is 35.5 meters, or 116.5 feet in the Montreal to Lake Erie section.

- Ballast water exchange at least 200 miles from shore and in depths of at least 2,000 meters is mandatory for any vessel entering the Great Lakes from a foreign port.
- Any ships stores not required for immediate use must be placed under seal unless the requirement is waived by the Customs officer.
- Vessels must have a complete manifest including: Customs Forms 1300 (Masters' Oath of Entry of Vessel in Foreign Trade) and 1301 (General Declaration), and any of the following which apply: CF 1302 (Cargo Declaration), CF 1303 (Ships Store's Declaration), CF 1304 (Crew's Effects Declaration), Crew List, Customs and Immigration form I-418 (or Form 5129 listing crewmembers declarations added to Form I-418 crew list), and Passenger List Customs and Immigration form I-418.
- Payment of tonnage taxes. Vessels entering from a port on the Great Lakes in the province of Ontario, Canada are exempt from the tonnage tax. The tax is 9 cents/ton not to exceed 45 cents/ton in any one year, payable upon each entry into the Great Lakes system through the year 2002. Thereafter, the tax will be 2 cents/ton, not to exceed 10 cents/ton in any one year. For non-reciprocating ports, the tax is 27 cents/ton with a maximum of $1.35/year through 2002. Thereafter, the tax will be 6 cents/ton not to exceed 30 cents/ton (see **TABLE 2-1)**

ii. U.S. Department of Agriculture. The United States Department of Agriculture (USDA) has promulgated numerous regulations pursuant to its authority to prevent the importation and spread of animal and plant pests. These regulations affect the cruise industry in three primary ways. Vessels must:

- meet notification requirements relating to arrivals
- follow certain rules governing importation of foreign fruits, vegetables, meats, meat products or other plant or animal material by disembarking passengers
- follow specific procedures in the disposal of regulated garbage.

These regulations are enumerated in 7 CFR 330.111, 330.400, and 9 CFR 94.5.

iii. U.S. Coast Guard. Cruise vessels are subject to safety and competency requirements promulgated by the U.S. Coast Guard. Each ship is subject to the vessel inspection laws of the country in which it is registered. However, as a condition of permitting the vessels to take on passengers at U.S. ports, the U.S. Coast Guard requires the ships to meet the International Convention for the Safety of Life at Sea (SOLAS). SOLAS and other international regulations also require compliance with stringent regulations regarding structural fire protection, firefighting and lifesaving equipment, watercraft integrity and stability, vessel control, navigation safety, crewing and crew competency, safety management and environmental protection.

To insure compliance with SOLAS, the Coast Guard examines the ship when it first goes into service at a U.S. port, with quarterly checks thereafter. The examinations emphasize structural fire safety and proper lifesaving equipment. Fire and abandon ship drills conducted by the ship's crew are witnessed, and operational tests are made on key equipment such as steering systems, fire pumps, and lifeboats. The Coast Guard has the

authority to require correction of any deficiencies before allowing the ship to take on passengers at the U.S. port. The records of these Control Verification Examinations are open to the public at the Coast Guard Marine Safety Office (MSO) which conducted the examination.[7.] Specific information can be obtained on-line at http://psix.uscg.mil.

TABLE 2-1, TAXES

Classes of vessels	Rate per net ton		
	Regular Tax	Special Tax	Light Money
Vessels of the United States;			
1 Under provisional register, without regard to citizenship of officers	$0.09 or $0.27		
2 All others:			
(i) If all the officers art citizens	0.09 or .27		
(ii) If any officer is not a citizen	0.09 or .27	0.50[(1)]	0.50[(1)]
Undocumented vessels which are owned by citizens[2]	0.09 or .27	0.50	0.50[(3)]
Foreign vessels:			
1 Of nations whose vessels are exempted from special tax or light money	0.09 or .27		
2 All others:			
(i) Built in the U.S.	0.09 or .27	0.30	0.50
(ii) Not Built in the U.S.	0.09 or .27	0.50	0.50
(iii) In addition to (I) or (ii) of 2., Foreign Vessels, when entering from a foreign port or place where vessels of the U.S. are not ordinarily permitted to enter and trade[3a]	0.09 or .27	2.00[(4)]	0.50[(4)]

[1] This does not apply on the first arrival of a vessel in a port of the United State from a foreign or inter-coastal voyage if all the officers who are not citizens are below the grade of master and are filling vacancies which occurred on the voyage.

[2] This special tax and light money do not apply if the vessel is documented as a vessel of the United States before leaving the port.

[3] This does not apply if the vessel is under a certificate of protection and the owner or master files with the port director the oath required by 46 U.S.C. App. 129. An unrecorded bill of sale is not such a document as will exempt a vessel from the payment of light money under 46 U.S.C. App. 128, and the recording of such bill of sale after the arrival of the vessel is not sufficient to relieve it from the payment of the tax.

[3a] The democratic People's Republic of Korea (North Korea), does not ordinarily permit vessels of the United States to enter and trade.

[4] This is to be collected on each entry of a vessel from such a port or place.

19 CFR Ch. I (4-1-00 Edition), Section 4.20, Tonnage Taxes

b. Canadian Regulations. Foreign-registered vessels in Canada are governed by the Coasting Trade Act, R.S.c. C-33.3 (the Act). This Act reserves the transportation of passengers, cargoes, and marine-related activities in Canadian waters to Canadian-registered, duty-paid vessels. Licenses may be issued to foreign registered ships to enter Canada's coasting trade when no Canadian ship is available or capable of providing a particular service. The Canada Customs and Revenue Agency (CCRA) is responsible for promulgating the Act and the Canadian Transportation Agency (CTA) determines whether a Canadian vessel is available or able to perform the particular service in question. The Act distinguishes between passenger vessels originating from a lake or river and those originating from other coastal places in Canada. The St. Lawrence River, northeast of the St. Lambert locks (from Montreal downriver) does not fall under the rules applicable to rivers and lakes.

In interpreting these regulations, it is important to make the distinction between vessels termed to be moving "coastwise" and those termed to be "coasting". Coastwise shipping involves dropping off or picking up passengers at more than one location in Canada and vessels must meet the following conditions:

- the vessel must be cleared by customs at the time of its initial arrival in Canada,
- all passengers disembarked must have originated outside of Canada, and
- all passengers embarked or cargo laden on board must be destined to a point or points outside of Canada.

Coasting refers to the transportation of goods or people between points in Canada.

Anything that constitutes Coasting Trade is governed by the Act. This means foreign ships may not embark passengers on a "voyage to nowhere" from a Canadian port without a license, because this is considered coasting trade. However, cruise vessels may travel between a Canadian and a U.S. port without a license, even with temporary stops at additional Canadian ports, when the port of origin is not in a lake or river since this is not considered coasting trade.

The only type of voyage allowable for foreign ships without a coasting trade license from a port on a lake or river is to a foreign port. Thus, if passengers board in Toronto, they could travel to Chicago, but could not stop at any other Canadian port without a license. For those vessels embarking on the applicable portion of the St. Lawrence or on another port not on a lake or river, no license is required. Thus, a cruise Montreal-Toronto-Chicago or Montreal-Quebec City-New York is permissible without a license.

Forms must be filed with the CTA in order to obtain a license. The purpose of such a filing is to ensure there is no Canadian vessel that can perform the proposed service. The Ship Safety Branch of the Canadian Coast Guard is responsible for administering provisions that regulate vessel safety and competency requirements in Canadian waters.

Cruise ships that accommodate at least 100 passengers are eligible for duties reduction or removal on the condition that no suitable Canadian vessel is available. Applications for this relief must be submitted prior to each cruise season for re-evaluation.

Cruise ships are required to have the following documentation available for review by customs inspector:

- Form A6 – General Declaration
- Form E1 – Ships Stores Declaration
- Form Y14 – Crew's Effects Declaration
- Certificate of Registry
- Passenger Ships Safety Certificate
- Load Line Certificate Officers' Certificates of Competency; and/or
- Certificate of Insurance or other financial security

Vessels may be reviewed at Montreal, but this is not a requirement. In the absence of information to the contrary, Canadian ports west of Montreal will process vessels from the St. Lawrence Seaway as foreign arrivals.

SECTION 3. CURRENT TRAFFIC AND TRENDS

a. Current Traffic. The Great Lakes had a total of 56 cruises originally scheduled for the 2001 season on seven vessels. The chartering company for Arcadia, Great Lakes Cruises, Inc. has discontinued cruises for the 2001 season after completing five of its 24 scheduled cruises. An explanation for this cessation of business is included in **SECTION 4. BENEFITS**. The Great Lakes Cruise Company, chartering agent for the c. Columbus, is offering discounts to passengers who were scheduled on the Arcadia. Le Levant is now booked for the season.

i. By Vessel. **TABLE 3-1** shows the number of passengers handled by each vessel, the total number of voyages scheduled, and the country of origin and final destination for the 2001 season.

TABLE 3-1 - Great Lakes Voyages, 2001

	c. Columbus	* Arcadia	Le Levant	Nantucket Clipper	Niagara Prince	Grande Mariner	Cape May Light
Passengers/voyage	423	230	90	102	84	100	226
G.L. Voyages	4	24	2	2	10	6	8
U.S. Origin	2	0	1	1	10	3	4
U.S. Destination	3	24	1	1	10	3	4
Can. Origin	2	24	1	1	0	3	4
Can. Destination	1	0	1	1	0	3	4
Total Passengers for 2001 Season	1,692	5,520	180	204	840	600	1,808

ii. Traffic by Port-of-Call (by ship). **TABLES 3-2a** and **3-2b** indicate the number of stops each cruise ship was scheduled to make at particular ports in the U.S. and Canada respectively for the 2001 season.

Table 3-2a – U.S. Ports of Call with Number of Calls, 2001

	c. Columbus	Arcadia	Le Levant	Nantucket Clipper	Niagara Prince	Grande Mariner	Cape May Light
U.S. Ports							
Alexandria Bay						6	
Alpena		2					
Apostle Islands		2					
Bay City		6					
Buffalo					3		8
Charlevoix		4					
Chicago	5	4	4	4	18		
Clayton, NY						6	
Cleveland		3			3		
Detroit	2	23					
Duluth	1	2					
Erie		9			3	2	
Fonda Terminal, NY						1	
Grand Haven	1						
Green Bay		2					
Holland					7		
Houghton		4					
Kingston					2	6	
Little Falls					1	3	
Mackinac Island	5	16	8	2	13		
Manistee					10		
Manitowoc				2	1		
Marquette	4	2					
Milwaukee		4			7		
Munising		2					
Muskegon		2					
Niagara Falls	1				3		8
Northport				2			
Oswego		1			3	6	
Rochester					3		
Rome						2	
Saugatuck			8				
Sault Ste Marie	6	8	1				
Sturgeon Bay			2	2	7		
Sylvan Beach						2	
Thousand Islands				*1*			*4*
Traverse City	3	2	1				
Troy					3	6	
Warren, RI					3	6	
West Point					2	6	
Wyandotte					4		
Total U.S. Calls	**28**	**98**	**24**	**13**	**96**	**52**	**20**

Table 3-2b - Canadian Ports of Call with Number of Stops, 2001

	c. Columbus	Arcadia	Le Levant	Nantucket Clipper	Niagara Prince	Grande Mariner	Cape May Light
Canadian							
Cabot Trail							2
Charlottetown			3				
Gaspe							2
Georgian Bay	1						
Goderich	1	3					
Halifax							2
Little Current	4	9	4				
Lunenburg							2
Midland	2		2				
Montreal			4	4		6	10
Ottawa							3
Pt. Au Pic, QUE						4	
Port Colborne	1	13					
Port Hawkesbury							2
Port Weller		4					
Prescott							8
Quebec City			3	4		6	8
Tadoussac			3				2
Thousand Islands				*1*			*4*
Thunder Bay	3	4					
Tobermory	1	6					
Toronto	1	5	6				10
Upper Canada Village						6	
Welland Canal	1		8	2	3		8
Windsor	2	24	7	4			
Total CN Calls	**17**	**68**	**40**	**15**	**3**	**22**	**63**
Total Stops	**45**	**166**	**64**	**28**	**99**	**74**	**83**

b. Trends.

i. Past. In 1994, there were two cruise vessels on the Great Lakes. By the 2001 season, seven vessels were on the Great Lakes, with an additional vessel, the Cape Cod Light, set to begin service in 2002. The growth in the number of vessels has not yet reached a peak, with existing vessels running at or near capacity.

ii. Present. Each year roughly 40% of cruise vacationers are first-time cruisers. The average cruise passenger is married, 50 years old, and has a household income of $79,000. Almost ¼ of passengers are single, 30% are 39 or younger (not including the estimated ½ million children on cruises each year), and almost half earn less than $60,000 annually.[8.] U.S. cruises, on average, are booked to 90% of capacity.

The rates charged by cruise vessels for the 2001 season are shown in TABLE 3-3. The rate per passenger per day varies from $211 on the Niagara Prince to $719 on Le Levant. The wide range of prices and variety of ships serve to broaden the consumer appeal.

TABLE 3-3, Rates by Vessel - 2001 Season

C. Columbus

Cabin Grade	Cabin Category	Deck	7 Nights
1	Inside Quad	2	$1,098
2	Inside	2	$1,854
3	Inside	3	$1,924
4	Inside	4	$1,975
5	Inside	5	$2,085
6	Outside	1	$2,193
7	Outside	2	$2,282
8	Outside	2	$2,585
9	Outside	4	$2,393
10	Outside	3	$2,722
11	Outside	4	$2,943
12	Outside	5	$3,272
13	Outside (Single)	4	$3,184
14	Outside Suite	2	$3,944
15	Outside Suite	4 & 5	$4,345
16	Outside Suite	4	$4,696
Avg.			$2,718
1 night avg.	per person		$388

Le Levant

Cabin Grade	Cabin Category	Deck	7 Nights
E	Deluxe Stateroom	Champlain	$4,043
D	Deluxe Stateroom	Champlain	$4,673
C	Deluxe Stateroom	La Perouse	$5,224
B	Deluxe Stateroom	La Perouse	$5,408
A	Deluxe Stateroom	Bougainville	$5,801
Avg.			$5,030
1 night avg.	per person		$719

Niagara Prince

Cabin Grade	15 Nights	6 Nights
70s / 60s / 50s	$3,370	$1,560
40s	$3,130	$1,455
30s	$2,970	$1,420
10s	$2,730	$1,315
20s	$2,430	$1,080
Avg.	$2,926	$1,366
1 night avg.	$195	$228
Overall 1 night avg.	per person	$211

Cape May Light

Cabin Grade	7 Nights	14 Nights
B	$2,985	$5,585
A	$2,385	$6,385
AA	$3,685	$6,985
AAA	$4,285	$8,185
Single	$3,385	$6,385
Avg.	$3,345	$6,705
1 night avg.	$478	$479
Overall 1 Night avg.	per person	$478

Grande Mariner

1 Night Average	per person	$230

Nantucket Clipper

1 Night Average	per person	$315

iii. Future. The cruise industry has experienced more than 2 decades of spectacular growth, averaging 8.4% per year. Nearly 7.5 million North Americans will vacation on cruise ships in 2001, 69 million Americans would like to take a cruise in the next five years, and 43 million say they will definitely or probably cruise in that time. These numbers are significant, but would increase with consideration of the increased number of foreigners on U.S. cruises. To meet the expected increases in consumer demand for cruises, cruise lines will invest over $15 billion to add more than 50 new ships to their fleets during the first half of this decade.[9.]

According to the U.S. Industry & Trade Outlook 2000; The McGraw-Hill Companies Water Transportation (SIC 44) Trends and Forecasts, the number of passengers taking cruises in North America increased by 7.4% between 1998 and 1999 and is expected to increase by 7.9% per year from 1999 to 2004.

SECTION 4. BENEFITS

As previously indicated, this analysis does not include day vessels such as day/dinner cruise vessels, gambling ships, and cruise vessels handling 50 or less passengers. The quantification of these other benefits would necessitate a study of greater proportion since the ships are widely dispersed and the benefits vary significantly based on vessel size, location, and utilization.

Nationally, in 1999, cruise lines:

- directly employed 24,000 Americans in support and shipboard positions,
- paid $678 million in wages, salaries, benefits, and wage taxes,
- supported an estimated 214,900 American jobs with total wages of $7 billion,
- invested $627 million on domestic capital expenditures, including $98 million to U.S. shipyards for vessel maintenance and repairs,
- experienced an increase of foreign tourists by some 50% over the last half of the past decade, and
- together with their passengers had direct spending on American goods and services totaling $8.1 billion.

Expenditures by passengers averaged $90 at each port visited. Of the crew, 80% reported going ashore during a typical port-of-call visit spending an average of $72 per visit at non-home ports and $112 per visit at a homeport.[10.]

The national data presented by The International Council of Cruise Lines in "A Partner in U.S. Economic Growth" reflects a different estimation of benefits than those presented by Cruising the Great Lakes Inc., Economic analysis of the benefits of cruise vessels on the Great Lakes, 2001. It is the Cruising the Great Lakes, Inc. analysis that is utilized in this report since it reflects research done specifically for the Great Lakes region and is considered reliable.

Great Lakes Cruises, Inc., which was based in Wisconsin and was the primary chartering agent for the Arcadia, had difficulty from the beginning of the season. The Arcadia had engine problems while in transfer to the U.S. and arrived in need of repairs and maintenance in a variety of areas. The chartering company was not prepared for the immediate need to invest in bringing the boat up to expectations and continued having difficulties until finally shutting down operations in early July after completing only five of 24 scheduled cruises. The benefit analysis was not adjusted after this incident, primarily because the chartering agency for Columbus, The Great Lakes Cruise Company, offered the passengers who had scheduled cruises on the Arcadia a discount equivalent to the usual deposit of $250. In addition, in the interim, Le Levant became booked for the season, increasing the possible benefits. The 2002 season will see the addition of the Cape Cod Light, bringing the capacity back to where it began at the start

of the 2001 season. Thus, in spite of the removal of Arcadia from the Great Lakes, it is not expected to significantly decrease the benefits from the current level, nor is it expected to decrease the future benefits with additional vessels entering the industry.

a. Direct Benefits. The benefits tabulated by the referenced analysis involve those which are directly associated with expenditures. **TABLE 4-1** summarizes the benefits as determined by the Cruising the Great Lakes, Inc. study.[11.] Accommodations and Baggage Handling can be assigned to the ports of origin and destination (O-D), shown delineated in **TABLE 4-2**. US Customs are considered "other benefits" for the United States, and Institutional Canadian MNSF and Welland Canal Tolls are considered "other benefits" for Canada, these are included in separate categories in the final benefits table, **TABLE 4-4**. The remaining benefit categories are divided among the harbors as a percentage of the 10,844 passengers visiting all harbors over the course of the season (TABLE 3-1, Great Lakes Voyages, 2001, Total Passengers for 2001 Season), and are shown in **TABLES 4-3a (U.S.) and b (Canada).**

i. Impact. As presented in **TABLE 4-1**, total direct benefits to the Great Lakes area are $8,769,076.

TABLE 4-1
2001 Impact of Cruise Ships on the Great Lakes

		Total
Accommodation pre/post cruise	O-D	$653,513
Discretionary Spending and Shorex		$2,484,300
Crew Spending		$88,299
Victualling		$1,094,385
Consumables		$254,250
Deck and Engine Stores		$556,063
Fuel		$750,000
Institutional Canadian MNSF	CN	$21,333
US Customs	US	$33,150
Pilotage		$520,227
Welland Canal Tolls	CN	$105,116
Port and Related		$1,048,000
Baggage Handling	O-D	$195,440
Shore Management and Cost of Sales		$965,000

TOTAL	**$8,769,076**

*Based on percentage booked (mid-June 2001), final season numbers would be expected to be higher based on additional bookings after mid-June, but are now expected to be lower due to the bankruptcy of Great Lakes Cruises, Inc.

ii. Origin-Destination Benefits by Harbor. Particular benefits accrue to the homeports of the cruise ships. Passengers frequently stay over-night before or after a cruise near the homeport, spending money on hotels, transportation, and food. The benefits attributed directly to the ports of origin and destination, Accommodations and Baggage Handling, total $848,953, and are presented in **TABLE 4-2**.

TABLE 4-2
ORIGIN-DESTINATION PORT BENEFITS

NAME:	c. COLUMBUS	* ARCADIA	LE LEVANT	NANTUCKET CLIPPER	NIAGARA PRINCE	GRANDE MARINER	CAPE MAY LIGHT	TOTAL
Buffalo							$70,030	**$70,030**
Chicago	$81,921	$4,454	$6,972	$7,902	$48,804			**$150,052**
Detroit		$204,898						**$204,898**
Milwaukee		$4,454			$6,507			**$10,961**
Other U.S.					$9,761	$23,240		**$33,001**
TOTAL U.S.								**$468,942**
Halifax							$17,507	**$17,507**
Montreal							$8,754	**$8,754**
Toronto	$16,384	$8,909	$6,972					**$32,265**
Quebec City				$7,902			$43,768	**$51,670**
Windsor	$32,768	$213,807						**$246,575**
Other CN						$23,240		**$23,240**
TOTAL CN								**$380,011**
TOTAL	**$131,073**	**$436,523**	**$13,944**	**$15,803**	**$0**	**$46,480**	**$140,059**	**$848,953**

iii. Other Benefits. The benefits for:

- Discretionary Spending and Shorex
- Crew Spending
- Victualling
- Consumables
- Deck and Engine Stores
- Fuel
- Pilotage
- Port and Related and
- Shore Management and Cost of Sales

are divided among all harbors visited over the course of the season. The number of passengers scheduled to arrive at each port determined the division as shown in **TABLES 4-3a** for U.S. ports, and **TABLE 4-3b** for Canadian ports, accounting for direct benefits of $7,760,524.

TABLE 4-3a – IMPACTS BY PORTS, U.S.
OTHER BENEFITS

	c. Columbus	Arcadia	Le Levant	Nantucket Clipper	Niagara Prince	Grande Mariner	Cape May Light	Total Other Benefits by Harbor
Capacity/Voyage:	**423**	**230**	**90**	**102**	**84**	**100**	**226**	
Season Capacity:	**1692**	**5520**	**180**	**204**	**840**	**600**	**1808**	
U.S. Ports								
Alexandria Bay						$46,538		$46,538
Alpena		$35,680						$35,680
Apostle Islands		$35,680						$35,680
Bay City		$107,039						$107,039
Buffalo					$19,546		$140,236	$159,782
Charlevoix		$71,359						$71,359
Chicago	$164,048	$71,359	$27,923	$31,646	$117,277			$412,253
Clayton, NY						$46,538		$46,538
Cleveland		$53,519			$19,546			$73,065
Detroit	$65,619	$410,314						$475,934
Duluth	$32,810	$35,680						$68,489
Erie		$160,558			$19,546	$15,513		$195,617
Fonda Terminal, NY						$7,756		$7,756
Grand Haven	$32,810							$32,810
Green Bay		$35,680						$35,680
Holland					$45,608			$45,608
Houghton		$71,359						$71,359
Kingston					$13,031	$46,538		$59,569
Little Falls					$6,515	$23,269		$29,785
Mackinac Island	$164,048	$285,436	$55,846	$15,823	$84,700			$605,853
Manistee					$65,154			$65,154
Manitowoc				$15,823	$6,515			$22,338
Marquette	$131,239	$35,680						$166,918
Milwaukee		$71,359			$45,608			$116,967
Munising		$35,680						$35,680
Muskegon		$35,680						$35,680
Niagara Falls	$32,810				$19,546		$140,236	$192,592
Northport				$15,823				$15,823
Oswego		$17,840			$19,546	$46,538		$83,924
Rochester					$19,546			$19,546
Rome						$15,513		$15,513
Saugatuck			$55,846					$55,846
Sault Ste Marie	$196,858	$142,718	$6,981					$346,557
Sturgeon Bay			$13,962	$15,823	$45,608			$75,392
Sylvan Beach						$15,513		$15,513
Thousand Islands				*$7,912*			*$70,118*	$78,030
Traverse City	$98,429	$35,680	$6,981					$141,089
Troy					$19,546	$46,538		$66,085
Warren, RI					$19,546	$46,538		$66,085
West Point					$13,031	$46,538		$59,569
Wyandotte					$26,062			$26,062
Total U.S.	**$918,670**	**$1,748,296**	**$167,539**	**$102,850**	**$625,477**	**$403,333**	**$350,590**	**$4,316,754**

TABLE 4-3b – IMPACTS BY PORTS, U.S.
OTHER BENEFITS

	c. Columbus	Arcadia	Le Levant	Nantucket Clipper	Niagara Prince	Grande Mariner	Cape May Light	Total Other Benefits by Harbor
Canadian								
Cabot Trail							$35,059	$35,059
Charlottetown			$20,942					$20,942
Gaspe							$35,059	$35,059
Georgian Bay	$32,810							$32,810
Goderich	$32,810	$53,519						$86,329
Halifax							$35,059	$35,059
Little Current	$131,239	$160,558	$27,923					$319,719
Lunenburg							$35,059	$35,059
Midland	$65,619		$13,962					$79,581
Montreal			$27,923	$31,646		$46,538	$175,295	$281,403
Ottawa							$52,588	$52,588
Pt. Au Pic, QUE						$31,026		$31,026
Port Colborne	$32,810	$231,917						$264,726
Port Hawkesbury							$35,059	$35,059
Port Weller		$71,359						$71,359
Prescott							$140,236	$140,236
Quebec City			$20,942	$31,646		$46,538	$140,236	$239,363
Tadoussac			$20,942				$35,059	$56,001
Thousand Islands				*$7,912*			*$70,118*	$78,030
Thunder Bay	$98,429	$71,359						$169,788
Tobermory	$32,810	$107,039						$139,848
Toronto	$32,810	$89,199	$41,885				$175,295	$339,188
Upper Canada Vill.						$46,538		$46,538
Welland Canal	$32,810		$55,846	$15,823			$140,236	$244,715
Windsor	$65,619	$428,154	$48,865	$31,646				$574,285
Total CN	**$557,764**	**$1,213,103**	**$279,231**	**$118,673**	**$0**	**$170,641**	**$1,104,358**	**$3,443,770**
TOTAL Benefits	**$1,476,433**	**$2,961,399**	**$446,769**	**$221,523**	**$625,477**	**$573,975**	**$1,454,948**	**$7,760,524**

NOTES: the Georgian Clipper has not published an exact itinerary
Thousand Island divided between U.S. and Canada

iv. Summary. Those benefits specifically accrued to Canada, but not attributable to particular ports, Institutional Canadian MNSF and Welland Canal Tolls, total $126,450 and are shown in **TABLE 4-4** under "Other Benefits" to Canada. Similarly, those benefits specifically accrued to the U.S. but not attributable to particular ports, US Customs, for $33,150 are shown in **TABLE 4-4** as "Other Benefits" to the U.S.

TABLE 4-4 - Total Benefits by Port								
	Total Other Benefits by Harbor	**O-D Benefits**	**Comprehensive Benefits, U.S.**			**Total Other Benefits by Harbor**	**O-D Benefits**	**Comprehensive Benefits, CN**
U.S. Ports					**Canadian**			
Alexandria Bay	$46,538		$46,538		Cabot Trail	$35,059		$35,059
Alpena	$35,680		$35,680		*Charlottetown*	$20,942		$20,942
Apostle Islands	$35,680		$35,680		*Gaspe*	$35,059		$35,059
Bay City	$107,039		$107,039		Georgian Bay	$32,810		$32,810
Buffalo	$159,782	$70,030	$229,812		Goderich	$86,329		$86,329
Charlevoix	$71,359		$71,359		*Halifax*	$35,059	$17,507	$52,566
Chicago	$412,253	$150,052	$562,306		Little Current	$319,719		$319,719
Clayton, NY	$46,538		$46,538		Lunenburg	$35,059		$35,059
Cleveland	$73,065		$73,065		Midland	$79,581		$79,581
Detroit	$475,934	$204,898	$680,832		Montreal	$281,403	$8,754	$290,156
Duluth	$68,489		$68,489		Ottawa	$52,588		$52,588
Erie	$195,617		$195,617		Pt. Au Pic, QUE	$31,026		$31,026
FondaTermNY	$7,756		$7,756		Port Colborne	$264,726		$264,726
Grand Haven	$32,810		$32,810		Port Hawkesbury	$35,059		$35,059
Green Bay	$35,680		$35,680		Port Weller	$71,359		$71,359
Holland	$45,608		$45,608		Prescott	$140,236		$140,236
Houghton	$71,359		$71,359		Quebec City	$239,363	$51,670	$291,033
Kingston	$59,569		$59,569		Tadoussac	$56,001		$56,001
Little Falls	$29,785		$29,785		*Thousand Isl.*	$78,030		$78,030
Mackinac Isl.	$605,853		$605,853		Thunder Bay	$169,788		$169,788
Manistee	$65,154		$65,154		Tobermory	$139,848		$139,848
Manitowoc	$22,338		$22,338		Toronto	$339,188	$32,265	$371,453
Marquette	$166,918		$166,918		Upper Canada Vill	$46,538		$46,538
Milwaukee	$116,967	$10,961	$127,928		Welland Canal	$244,715		$244,715
Munising	$35,680		$35,680		Windsor	$574,285	$246,575	$820,860
Muskegon	$35,680		$35,680		Other Canadian	$126,449	$23,240	$149,689
Niagara Falls	$192,592		$192,592		**Total CN**	**$3,570,219**	**$380,011**	**$3,950,230**
Northport	$15,823		$15,823					
Oswego	$83,924		$83,924					
Rochester	$19,546		$19,546					
Rome	$15,513		$15,513					
Saugatuck	$55,846		$55,846					
Sault Ste Marie	$346,557		$346,557					
Sturgeon Bay	$75,392		$75,392					
Sylvan Beach	$15,513		$15,513					
Thousand Isls	$78,030		$78,030					
Traverse City	$141,089		$141,089					
Troy	$66,085		$66,085		NOTES: The Georgian Clipper has not published an exact			
Warren, RI	$66,085		$66,085		itinerary.			
West Point	$59,569		$59,569		Thousand Islands divided b/w U.S. and Canada			
Wyandotte	$26,062		$26,062					
Other U.S.	$33,150	$33,001	$66,151					
Total U.S.	**$4,349,904**	**$468,942**	**$4,818,846**					
					TOTAL	**$8,769,076**		

b. Indirect Benefits. The indirect benefits of the cruise industry were not calculated at this time. Some indications of significant effects are obvious at various locations throughout the Great Lakes system. Port authorities, city officials, and local businesses take great interest in attracting and retaining cruise ships. The local impacts are more significant than the direct expenditures by the vessels, their passengers and crew. Many areas experience a significant inflow of ship watchers when the cruise ships arrive. For example, Saugatuck, Michigan often experiences between 2,000 and 3,000 in visitors when a cruise ship arrives in port, contributing significantly to the local impacts.

i. Infrastructure and Services. As stated previously, national studies have indicated that those areas frequented by cruise ships see development in harbor facilities, local restaurants, hotels, and shopping.

Specifically, the Detroit Harbor has a funded passenger terminal to be built in the near future. The planned passenger terminal is expected to be located at the foot of Clark Street in Southwest Detroit, adjacent to Detroit Marine Terminal. There is currently a vacant ten-story warehouse on the parcel. Authorities expect to begin the environmental work on the property around August 1, 2001 with demolition of the warehouse proceeding in January of 2002. Development on the passenger terminal would begin sometime around April of 2002, and be complete toward the end of 2002 or near the spring of 2003. The terminal is being funded through a $6 million federal TEA-21 grant matched 20%, or $1.5 million, equally by the City of Detroit and State of Michigan. The State of Michigan is funding the demolition through a $3 million CMI grant. The current Port Authority is aggressively seeking improvement and growth in the Harbor. Thus, with continued expansion and improvement in Harbor facilities, growth in use of the harbor is expected to exceed area growth.

Other improvements throughout the system could be evaluated with further study.

ii. Jobs. The cruise ships increase employment both on-board and in those harbors visited by the vessels. Further, employment in those industries affected by the visits, hotels, restaurants, and other tourist related businesses, would be expected to increase. Again, further study could quantify these effects.

SECTION 5. NATIONAL INTEREST

Planning Guidance Letter No.97-6, Cruise Ships and Benefits to Navigation based on WRDA 1996 for revision of ER 1105-2-100 directs the U.S. Army Corps of Engineers to categorize all benefits generated by cruise ships as commercial navigation benefits.

a. Without Project Condition. Certainly, cruise vessels are utilizing the Great Lakes system and increasing their business without significant improvements. The primary limitation faced by the vessels is the depth of particular harbors. Some harbors that are currently not accessible due to depth limitations would likely be visited if this were no longer a concern.

In 1998, the Columbus, with the deepest draft of 19’6”, visited the Detroit Harbor by docking at Hart Plaza, currently the most attractive location in the area. However, shallow areas along the sheet pile limited the segments suitable for disembarking and a reef extending parallel to the berthing area limited the angles at which the vessel could approach. This limitation and similar problems throughout the system decrease or eliminate stops particular ports receive. A survey of the cruise ship companies could clarify which harbors they would likely add to their itineraries if current limitations were eliminated.

Other vessels, such as the Cape May Light and the Cape Cod Light, are specifically designed for cruising in the Great Lakes system and maximizing the number of harbors which are accessible by drawing a draft of only 13’6”.

b. Potential Increases. There are many existing cruise ships that are too large to serve the current system that might take advantage of increased channel depths. Further evaluation might be able to determine if currently available deeper draft cruise vessels would utilize a deeper system or if owners are interested in building vessels requiring deeper drafts. Generally, deeper draft vessels have a higher capacity; the Columbus has a passenger capacity of 423 compared to that of 226 on the Cape May Light.

Benefits that could be achieved with a deeper system and harbors would fall under the following categories:

1) Vessels utilizing the same harbors under more efficient conditions (Detroit, MI, Saugatuck, MI)
2) Vessels utilizing new harbors (perhaps Sheboygan, WI)
3) New vessels entering the system due to increased accessibility, particularly larger vessels

Specific benefits could be better established with surveys of cruise vessel owners to determine interest in specific harbors and in new vessel introduction. Owners and Captains could be asked to elucidate the benefits that would be achieved from specific harbor improvements.

SECTION 6. SUMMARY

It should be emphasized that this analysis is only a partial treatment. The indirect impacts must be sizable to explain the enthusiasm that is held by authorities in the areas surrounding affected ports.

a. Expanding Industry. The rapid revival in cruising on the Great Lakes has been characterized as nothing short of “amazing”[12.] and the growth is expected to continue over the next several years at an annual rate above 7-½ %. The number of ships has increased from two in 1994 to seven in the year 2001, with more expected.

b. Regulations. Foreign cruise vessels are subject to unusual restrictions in the Great Lakes system, often forcing vessels to alternate between the U.S. and Canada, and

increasing safety standards. As to whether the cruise owners/operators find these regulations restrictive, further investigation would be required.

c. Primary and Secondary Impacts. The total primary benefits of cruise vessels on the Great Lakes has been determined to be $8,770,000 for the 2001 season and is expected to grow steadily with the growth in the industry as a whole. Each non-home port receives nearly $80 per passenger per stop in primary benefits, while each port of origin or destination receives nearly $110.

The secondary benefits are significant and development of a model to determine an appropriate multiplier is recommended. Port and other local authorities are willing to go to great expense to secure a place on cruise ship itineraries. For example, even small ports such as Saugatuck, Michigan with a city population of 954 and a township population of 2,916 in the 1990 census, receives an influx of 2 – 3,000 ship watchers when cruise vessels arrive. These ship watchers spend money on local services having an economic impact well above the expenditures made by cruise passengers. Thus, if 2,500 ship watchers were to spend just over half of the amount spent by passengers, $50 each, the additional benefit would be $125,000 per visit. Another indication that cruise vessels have considerable effects on local economies can be seen in Detroit, which has obtained funding of over $12 million to build a cruise passenger terminal. The justification for such an expense is in the expected economic impacts to be achieved from the additional cruise vessels attracted. The induced economic activity generated by these shore-side activities not only increases regional economic benefits, but also adds to the national economy through increases in employment and income.

d. National and Regional Benefits. The national and regional benefits of the cruise industry and the other vessels including: gambling vessels and dinner and day cruises are significant and should be analyzed more thoroughly at the feasibility level. The majority of the $8,770,000 in economic benefits accrued during the 2001 season can be classified as NED. Many of the passengers traveling on the Great Lakes cruise vessels are foreign. Certainly, benefits accrued through the expenditures of foreign passengers are NED. The foreign vessels, Le Levant and c. Columbus, cruise outside the U.S. when not in the Great Lakes system. Thus, benefits attributable to these vessels are NED. Both the U.S. flag vessels, Niagara Prince and Grande Mariner, would be expected to cruise outside the U.S. if they were not in the Great Lakes system since the American Canadian Caribbean Line, Inc. serves areas outside the U.S. such as Trinidad, Orinoco, Panama, and Belize, justifying the classification of benefits accrued from these vessels as NED. And, although Nantucket Clipper, Niagara Prince, and Cape May Light do not currently cruise outside the U.S., they might choose to do so if the Great Lakes were no longer on their itineraries. And, viewed from the passenger perspective, Great Lakes cruise passengers are equally likely to cruise outside the U.S., making this portion of the accrued benefits NED.

Once the secondary benefits are determined, it would be necessary to establish the portion attributable to NED and that to RED. The gambling vessel owners' statistics indicate a significant amount of induced economic activity due to their services. The

same is expected from the activity of the other types of vessels mentioned in this study. These impacts vary significantly depending on the port, type of vessel, number of passengers, and the local draw. It is worth noting again, considering the enthusiasm with which port authorities and local businesses and authorities seek to be among those on cruise itineraries, it is expected that these benefits are much larger than has been calculated to this point. In the next phase of study, the cruise vessel analysis would be carried to specific sites to determine if projected annual benefits for specific Federal harbors are adequate to cover the costs of improvement to authorized channels to service more or larger cruise vessels.

ENDNOTES

[1.] International Council of Cruise Lines, "A Partner in U.S. Economic Growth", www.iccl.org/whoweare/index.html

[2.] An Assessment of the U.S. Marine Transportation System, A Report to Congress, September 1999

[3.] David Knight, Editor, Great Lakes/Seaway Review, Trade and the Great Lakes Conference, April 19 & 20, 2001.

[4.] Cruising the Great Lakes, Inc., Economic analysis of the benefits of cruise vessels on the Great Lakes, 2001

[5.] Beck, Bill; "Gaming Comes to the Lakes", Seaway Review / January-March, 1996

[6.] Great Lakes / St. Lawrence Seaway System, Cruise Vessel Information and Reference Guide, Produced by U.S. Saint Lawrence Seaway Development Corporation and Canadian St. Lawrence Seaway Management Corporation

[7.] U.S. Coast Guard, Cruise Ship Consumer Fact Sheet, July 1998

[8.] International Council of Cruise Lines, "Guide to Cruising", www.iccl.org/cruising.htm

[9.] International Council of Cruise Lines, "A Partner in U.S. Economic Growth", www.iccl.org/whoweare/index.html

[10.] International Council of Cruise Lines, "A Partner in U.S. Economic Growth", www.iccl.org/whoweare/index.html

[11.] Cruising the Great Lakes, Inc., Economic analysis of the benefits of cruise vessels on the Great Lakes, 2001

[12.] David Knight, Editor, Great Lakes/Seaway Review, Trade and the Great Lakes Conference, April 19 & 20, 2001.

OTHER REFERENCES

[13.] http://www.saugatuck.com/cruise-great-lakes.html, no longer available.

[14.] http://www.great-lakes.net/tourism/rec/cruise.html, GLIN, Great Lakes Information Network.

[15.] http://www.greatlakescruising.com/, Great Lakes Cruise Company.

[16.] http://www.cruise2.com/CruiseFinder/ShipMenu.phtml, The Cruise Ship Company.

ATTACHMENT 4

GREAT LAKES and ST. LAWRENCE SEAWAY POTENTIAL CONTAINER TRANSPORTATION SAVINGS

Great Lakes and St. Lawrence Seaway

Potential Container

Transportation Savings Analysis

Prepared for:
U.S. Army Corps of Engineers
Huntington District
Navigation Planning Center
Huntington, West Virginia

Prepared by:
Tennessee Valley Authority
Knoxville, Tennessee

20 November 2001

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I. Study Purpose

The purpose of this reconnaissance study is to estimate potential transportation cost savings for existing eastern U.S. container traffic if it were to re-route via an improved Great Lakes St. Lawrence Seaway Navigation System (GLSLS).

The Tennessee Valley Authority (TVA) conducted this reconnaissance level study under contract with the Huntington District of the U.S. Army Corps of Engineers (USACE) out in order to facilitate the estimation of National Economic Development (NED) benefits attributable to expanded navigation on the GLSLS. Toward this end, the study provides a container flow analysis from and to the Great Lakes region and a range of transportation rates for container movements between Atlantic ports and the Great Lake harbor cities.

II. Study Basis and Assumptions

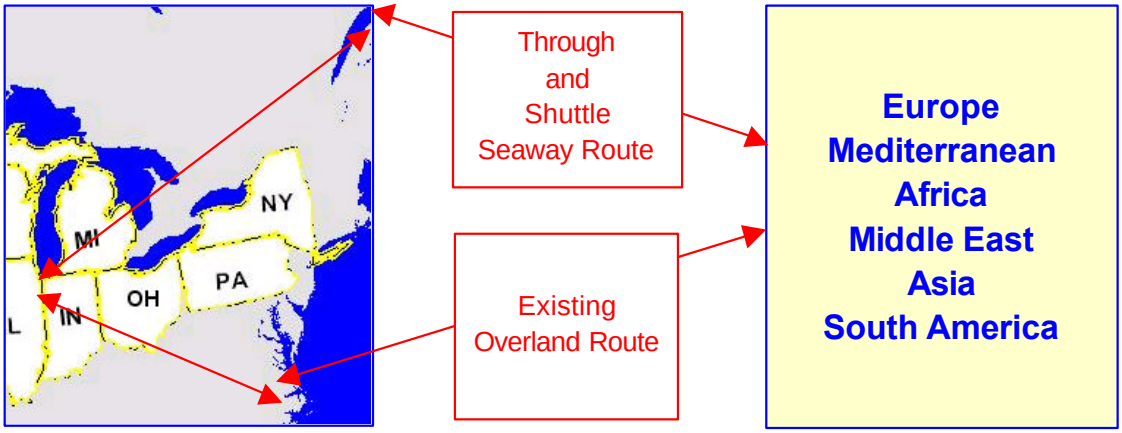
This study is based on a survey of Atlantic Port Authorities, the 1999 Surface Transportation Board (STB) Waybill Sample, and current published container vessel charter rates. Eastern U.S. container traffic move to and from deep water Atlantic ports and to and from Great Lake ports by rail and truck. This study costs these movements as they currently move and then re-routes each through a GLSLS with larger locks and a deeper draft through out. Specifically, the container movements are defined by origin and destination Great Lake ports[1]; origin and destination Atlantic Coast ports[2]; four vessel sizes: 500, 1,500, 2,500 and 3,500 TEU capacity; three navigable drafts for the seaway, connecting channels, and ports of 30', 32' and 35'; and two types of shipping service: shuttle and through.

This study estimates transportation costs for the existing overland container movements to/from major Great Lakes ports and the transportation costs for moving by way of an improved St. Lawrence Seaway. The difference in cost between these two routings is presented in this report. Existing overland container moves that show a cost savings for using an improved seaway routing represent potential shift-of-mode benefits. Figure 1 displays the alternative routings considered.

[1] Chicago, Cleveland, Toledo, Buffalo, Detroit/Flint, and Syracuse/Oswego

[2] Charleston, Norfolk, New York/New Jersey, Baltimore/Philadelphia, Boston, Halifax, Montreal and Toronto

Figure 1
Shipping Alternatives



Freight rates for each origin destination pair are calculated based on the existing overland routing and the water-inclusive seaway alternative. All computations reflect those rates and fees which were in effect on August 1, 2001, in U.S. dollars, and the rates are computed on a per forty foot equivalent unit (FEU) box basis. Results are documented on a movement-by-movement basis in an electronic spreadsheet format for each origin/ destination pair[3].

III. Methods

The estimating of shipper savings for modal shifting of containers in the Great Lakes region results from analysis of data from the Surface Transportation Board (STB) Waybill Sample for 1999, interviews with Atlantic Coast Port's Authorities, and literature reviews for confirmation of vessel charter rates.

Table 1 below shows the flow of containers into and out of the Great Lakes area, Appendix 1 shows these flows by mode. Of the 1.7 million containers in this analysis, 47 percent moved by truck. The flow of container commodities was derived from the STB Waybill Sample and interviews with port authorities. First, sample movements, in which a container on freight car or trailer on freight car (COFC/TOFC) initial had a letter other than "X" as the last letter, were retrieved from the waybill sample (COFC/TOFC initials ending in "X" are trailers on wheels). This data set was then constrained to those shipments that originated or terminated within 40 miles of the Great Lakes in the states of Illinois, Indiana, Ohio, and New York and in the port areas of Charleston, Norfolk, Baltimore/Philadelphia, New York/New Jersey, Boston, Halifax, Montreal, and Toronto. The final sorting of the data was by port, commodity, and inland terminal. The next step was to add the truck container component from the percentage modal split given through interviews with each port authority. Appendix 2 gives a summary of the interview responses.

[3] This information was obtained from confidential STB Waybill data and cannot be disclosed in this report.

Table 1
Container Flow Into and Out of the Great Lakes Area
(in FEUs)

Container Receipts

Container Shipments

Ports	Buffalo	Chicago	Cleveland	Detroit/Flint	Toledo	Syracuse	Total
Charleston	200	7,728	240	667	200	200	9,235
Norfolk	200	98,259	3,140	21,185	200	200	123,184
New York/New Jersey	38,490	185,689	44,400	18,981	867	21,200	309,627
Baltimore/Philadelphia	200	262,102	200	8,667	5,200	200	276,569
Boston	200	37,511	2,400	1,245	2,400	7,000	50,756
Halifax	-	19,240	-	4,200	-	-	23,440
Montreal	200	66,800	1,760	67,733	200	200	136,893
Toronto	240	32,432	200	22,800	200	200	56,072
Total	39,730	709,761	52,340	145,478	9,267	29,200	985,776

Container Receipts

Container Shipments

Ports	Charleston	Norfolk	New York/ New Jersey	Baltimore/ Philadelphia	Boston	Halifax	Montreal	Toronto	Total
Buffalo	200	200	200	240	200	-	200	200	1,440
Chicago	7,428	110,716	160,089	375,255	60,444	-	200	1,000	715,132
Cleveland	200	3,729	200	364	400	-	200	200	5,293
Detroit/Flint	280	16,949	200	5,067	360	-	200	200	23,256
Toledo	200	200	200	485	560	-	200	200	2,045
Syracuse	200	200	200	200	200	-	200	200	1,400
Total	8,508	131,994	161,089	381,611	62,164	-	1,200	2,000	748,566

It should be noted that the modal split given by the port authorities is for loaded container movements only, whereas the rail component contains both loaded and empty container shipments. There could be a slight under counting of total movements with the elimination of the truck empty movements back to port. The study used one method to offset the undercounting of truck movements by placing a 200 container minimum on truck shipments with the exception of Halifax that had a zero truck minimum and of Chicago that had a 1000 truck shipment minimum to Toronto.

As shown in the container flow analysis of Appendix 1, the dominant Great Lakes container port is Chicago. On the Atlantic coast, the Port of New York/New Jersey is the largest rail served port and the port of Baltimore/Philadelphia the largest truck served port. One observation of note is that the Canadian ports of Halifax, Montreal, and Toronto originated container shipments to the Great Lakes, but these ports did not receive container shipments from the Great Lakes region with the exception of the imposed minimum truck container shipments.

The next step in the study process was the development of the transportation rates for the prevailing land route alternative and the six water route alternatives.

Vessel Rates

The vessel rates for the study were based upon two different operating service patterns (through and shuttle), four vessel sizes, current transit times on the Great Lakes, vessel dwell time at port to load or discharge, and the current vessel charter rates for the North Atlantic container trades. One point of clarification needs to be made in terms of definition. FEU is defined as a forty-foot container equivalent, and TEU is defined as a twenty-foot container equivalent. Thus, two TEUs equate to one FEU.

The vessel operating service patterns consist of a through service and a shuttle service. The through service can be described as container vessels originating in Europe, transiting the North Atlantic, entering the Bay of St Lawrence, and transiting to a Great Lake harbor such as Chicago. For this study, the vessel cost or rate would be based upon the transit time for the vessel segment from the entrance of the Bay of St Lawrence to the Great Lake harbor point plus discharge time. The shuttle service vessel operating scheme can be described as a two vessel method whereby the first container vessel would move the containers from Europe to Halifax, and the second vessel would move the containers from Halifax to the Great Lakes harbor such as Chicago. The vessel costs for the shuttle service would be based on transit time from Halifax plus both container loading and discharge time. For both vessel service options, an estimated toll was added for transiting the Seaway and Welland Canal locks (see Appendix 3 for vessel parameters).

The four vessel sizes selected for this study reflect the currently available vessels on the North Atlantic trade that would meet the proposed channel, harbor, and lock development specifications. The vessel sizes are 500; 1500; 2500; and 3500 TEUs. For this study, it was assumed that the empty draft of the vessel was 30 percent of the maximum draft, and the operating capacity of the vessel would be 90 percent of the number of containers at maximum draft. The next vessel assumption was to constrain the number of containers on the vessel by the draft restriction of the proposed project. As an example, a 3500 TEU vessel would normally draft 41 feet when fully loaded; however, if the proposed project draft is restricted to 35 feet, then the number of containers would be reduced to 2750 TEUs or 79 percent of vessel capacity for rate and cost computations.

Transit time on the Great Lakes and Seaway was computed by dividing the number of miles traveled with currently observed speed, plus adding the reported processing and delay times for the Seaway and Welland Canal, and adding vessel dwell time at port or harbor to load and/or unload. (See Appendix 5). Vessel speed was assumed to be the same for each class of vessel for the Great Lakes and Seaway transit, and vessel dwell time at origin and destination was adjusted for size of vessel (500 TEU=12 hours, 1500 TEU=18 hours, 2500 TEU=24 hours, 3500 TEU=24 hours).

The vessel charter rates for the North Atlantic trade were obtained from a literature search and interviews with vessel charter brokers. The vessel charter rates are expressed as a daily rate that includes fuel costs for each class or vessel size. As an example, the daily

charter rate for a 3500 TEU vessel would be $20,500 on the North Atlantic for the first of August 2001.

The last vessel assumption is that the vessel operators would pay Welland Canal and Seaway tolls at the following rates: 500 TEU=$6,000; 1500 TEU=$7,000; 2500 TEU=$8,000; 3500 TEU=$9,000; per direction and for each section (Welland Canal or Seaway).

Rail Rates

The rail rates for this study came from the 1999 STB Waybill Sample as reported by the Class 1 railroads serving the Great Lakes region. The rail rates are the average rate per container for all commodities from the port of origin to the Great Lakes harbor or the reverse trip whether empty or loaded. Once the average rate was determined from the 1999 sample, the rail rate was increased by 8 percent to bring the rate level to the end of the second quarter 2001. The source for the rate escalation was the Reebie RCAM model forecast of inflation on rates for U.S. Class 1 railroads between the fourth quarter 1999 and the second quarter 2001. It should be noted that the reported rates are the rates charged by the railroad to a shipper that includes vessel operators, NVOC's, freight forwarders, as well as product owner. Frequently, vessel operators, NVOC's and freight forwarders will mark up the rail rate in their price to the freight bill payer.

Truck Rates

The truck rates used in this study were obtained from regional truck operators, steamship lines, and truck brokers. The truck rates used were based on a rate per loaded mile times the number of miles for the fastest route to or from the Atlantic port. For trips less than 100 miles, the rate is $2.25 per loaded mile; for trips from 100 to 500 miles, the rate is $1.55 per loaded mile in the U.S. and $1.75 to or from Canada; for trips from 500 to 900 miles, the rate is $1.25 per loaded mile in the U.S. and $1.75 to or from Canada; and for trips over 900 miles, the rate is $1.15 per loaded mile in the U.S. and $1.55 to or from Canada. When both truck and rail were used to move containers, the rail rate was used to the exclusion of the truck cost.

Other Costs

An other cost category was added to this study in order to adjust for the difference in vessel transit time via the Seaway and Great Lakes compared to the land route time from or to the Atlantic port. An inventory cost was computed per container based on an average value of $2.00 per pound of cargo, 20,000 pounds cargo per container, a 6.25 percent interest rate, and the average transit time difference (see Appendix 4). The daily cost per container is $6.85.

Container Transfer

The handling rates for containers at ports and inland terminals were obtained from terminal tariffs and literature search. The handling charge at the Atlantic port assumed a charge to pick the container from the vessel to the ground then picking from the ground to rail or truck. At the inland rail terminal, it was assumed that the railroad picks the container from the train, places the container on a chassie, and a truck operator would dray the container up to 30 miles.

IV. Results

The results of this study suggest that container shippers in the Great Lakes region could potentially save up to $686 million in transportation costs for the movement of 1.7 million containers. Table 2 summarizes the results by Great Lake port.

Table 2
Summary of Potential Container Shipments

Great Lake Port	Total Containers*	Potential (Latent) Transportation Savings Range**			
		Low***		High****	
Chicago	1,364,773	$	90,814,428	$	579,612,135
Cleveland	57,633	$	6,131,248	$	23,456,129
Detroit	168,734	$	12,324,810	$	74,329,050
Toledo	11,312	$	441,564	$	3,959,148
Syracuse	30,400	$	(837,788)	$	5,034,902
Buffalo	41,170	$	(12,706,206)	$	162,520
Total	**1,674,022**	**$**	**96,168,056**	**$**	**686,553,884**

* includes inbound and outbound traffic
** scenarios include vessels of different size, different drafts and service
*** all involved 500 TEU ship,shuttle service, 30'-35' draft
**** all involved 3,500 TEU ship, through service and 35' draft

Shippers would benefit from the development of navigation opportunities in the Great Lakes region. In order to realize these shipper benefits, harbors and docks would need to be upgraded to project depths to accommodate appropriate container vessels. Port facilities would need to be able to handle and store waterborne containers, locks and channels would need to be sized for container operations, and the seaway shipping season lengthened significantly.

The quantity of containers that would shift modes is a question of Atlantic port congestion; Seaway transit time improvements and the willingness of the Great Lakes region to build harbor infrastructure and accommodate a longer shipping season. With a 20 percent modal shift, shipper savings for 1500 TEU shuttle service could be as much as $69 million

(see Appendix 6). Whereas a 20 percent modal shift of 500 TEU shuttle service could produce benefits of $20 million, requiring only harbor dredging and no Seaway or Welland Canal improvements.

Two points should be noted regarding the methodological standards applied within this study. First, the standards described above reflect essentially the same processes TVA has applied (or will apply) in developing transportation rates for other recent (or ongoing) Corps studies. Specifically, the outlined methodology was used in the 1996 Ohio River Study and the Upper Mississippi Navigation Feasibility Study and is being applied in the Missouri River Master Manual Review process and Port Allen Cutoff assessment. Thus, inter-project comparison is facilitated by this uniform approach. More importantly, recent methodological improvements enable TVA to produce transportation rate/cost materials that are, simultaneously, more complete and more reliable than the transportation data TVA (or any other agency) has produced for similar studies in the past. Each rate study for every District of the USACE is integrated into a series of databases for quick accessibility and data manipulation.

APPENDIX 1

CONTAINER FLOWS IN FEUS

	Destination											
	Buffalo			Chicago			Cleveland			Detroit/Flint		
Origin	**Rail**	**Truck**	**Total**	**Rail**	**Truck**	**Total**	**Rail**	**Truck**	**Total**	**Rail**	**Truck**	**Total**
Charleston	-	200	200	3,640	4,088	7,728	40	200	240	360	307	667
Norfolk	-	200	200	46,280	51,979	98,259	2,160	980	3,140	11,440	9,745	21,185
New York/ New Jersey	3,840	34,650	38,490	167,120	18,569	185,689	4,440	39,960	44,400	10,440	8,541	18,981
Baltimore/Philadelphia	-	200	200	87,280	174,822	262,102	-	200	200	2,600	6,067	8,667
Boston	-	200	200	33,760	3,751	37,511	240	2,160	2,400	1,120	125	1,245
Halifax	-	-	-	19,040	200	19,240	-	-	-	4,000	200	4,200
Montreal	-	200	200	60,120	6,680	66,800	1,560	200	1,760	40,640	27,093	67,733
Toronto	40	200	240	10,800	21,632	32,432	-	200	200	2,280	20,520	22,800

	Origin											
	Buffalo			Chicago			Cleveland			Detroit/Flint		
Destination	**Rail**	**Truck**	**Total**	**Rail**	**Truck**	**Total**	**Rail**	**Truck**	**Total**	**Rail**	**Truck**	**Total**
Charleston	-	200	200	3,840	3,588	7,428	-	200	200	80	200	280
Norfolk	-	200	200	57,240	53,476	110,716	2,200	1,529	3,729	10,000	6,949	16,949
New York/ New Jersey	-	200	200	144,080	16,009	160,089	-	200	200	-	200	200
Baltimore/Philadelphia	40	200	240	124,960	250,295	375,255	120	244	364	1,520	3,547	5,067
Boston	-	200	200	54,400	6,044	60,444	40	360	400	160	200	360
Halifax	-	-	-	-	-	-	-	-	-	-	-	-
Montreal	-	200	200	-	200	200	-	200	200	-	200	200
Toronto	-	200	200	-	1,000	1,000	-	200	200	-	200	200

	Destination								
	Toledo			Syracuse			Rail	Truck	Total
Origin	Rail	Truck	Total	Rail	Truck	Total	Total	Total	Grand
Charleston	-	200	200	-	200	200	4,040	5,195	9,235
Norfolk	-	200	200	-	200	200	59,880	63,304	123,184
New York/ New Jersey	520	347	867	2,120	19,080	21,200	188,480	121,147	309,627
Baltimore/Philadelphia	80	200	5,200	-	200	200	89,960	181,689	271,649
Boston	480	1,920	2,400	1,400	5,600	7,000	37,000	13,756	50,756
Halifax	-	-	-	-	-	-	23,040	400	23,440
Montreal	-	200	200	-	200	200	102,320	34,573	136,893
Toronto	-	200	200	-	200	200	13,120	42,952	56,072
								Total	**985,776**

	Origin								
	Toledo			Syracuse			Rail	Truck	Total
Destination	Rail	Truck	Total	Rail	Truck	Total	Total	Total	Grand
Charleston	-	200	200	-	200	200	3,920	4,588	8,508
Norfolk	-	200	200	-	200	200	69,440	62,554	131,994
New York/ New Jersey	-	200	200	-	200	200	144,080	17,009	161,089
Baltimore/Philadelphia	160	325	485	-	200	200	126,800	254,811	381,611
Boston	360	200	560	-	200	200	54,960	7,204	62,164
Halifax	-	-	-	-	-	-	-	-	-
Montreal	-	200	200	-	200	200	-	1,200	1,200
Toronto	-	200	200	-	-	-	-	1,800	1,800
								Total	**748,566**

APPENDIX 2

PORT AUTHORITY INTERVIEW

Friday, June 08,2001

Mr. Chris Dager,

Reference to your inquiry concerning import export container traffic between Ports of Charleston, Norfolk, New York/New Jersey, Baltimore/Philadelphia, Boston and the Great Lake region cities of Buffalo, Chicago, Cleveland, Detroit/Flint, and Toledo.

The following brief synopsis of the feedback we got from each Port regarding this matter:

- **CHARLESTON** – I have been playing phone tag with Tommy Alexandria (843-577-8707) of the Charleston Port Authority and when we connect, I will supplement this report.
- **NORFOLK** – Marty Schlosser, (757-683-8000), Marketing and Sales Office of the Virginia Port Authority, gave us the following breakdown:
  Cleveland, OH, Truck 31.2 percent imports and 42.8 percent exports; Rail 68.8 percent imports and 51.7 percent exports
  Detroit, MI, Truck 46 percent imports and 41 percent exports; Rail 54 percent imports and 59 percent exports
  Buffalo, NY, Truck 0 percent imports and exports; Rail 100 percent imports and exports
  Chicago, IL, Truck 52.9 percent imports and 48.3percent exports; Rail 47.1 percent imports and 51.7 percent exports
- **NEW YORK/NEW JERSEY** – Ron Lotz, (212-435-6650), Marketing and Sales Port Authority of New York, advises the largest international intermodal market is Chicago with 10percent truck and 90 percent rail, Buffalo is 100 percent truck, Cleveland is 90 percent truck and 10 percent rail, Detroit is 40 percent truck and 60 percent rail,. Overall breakdown of international intermodal traffic is 55 percent import and 45 percent export. There is a large movement of auto parts inbound from Chrysler to their plant in Austria. As your records verify, Chicago is a huge market
- **BOSTON** – Unfortunately I was unable to develop specific information on intermodal traffic from this Port. We contacted Ed Chrisom, Conley Terminal (617-464-8200), and he advised they have no direct rail connection. In Transit Container, Worchester, MA, (508-752-2012) is larger player in mini land bridge from Chicago. Of interest is the movement of import containers via double-stack train from Kearney, NJ to Worchester. I would estimate that breakdown of rail versus truck from Boston would mirror that of New York.
- **PHILADELPHIA** – Mr. Dominic O'Brien, Philadelphia Regional Port Authority, advised that within the USA it is estimated that 90 percent of intermodal containers move by truck and between USA and Canada 80 percent. The heavier rail movement to and from Canada is because a lot of steel moves to the latter.
- **BALTIMORE** – Mr. Bassard, Marketing and Sales, Maryland Port Admin. (410-633-1000) advised that the ratio is 67 percent truck from and to the Port. They serve a 17 state area.

Attached are the records you compiled on rail intermodal to aforementioned points and fax from the Virginia Port Authority.
Charles F. Beasley

APPENDIX 3

VESSEL PARAMETERS

Vessel Dimensions

Vessl Size TEUs	Length Meters	Length Feet	Beam Meters	Beam Feet	Draft Metters	Draft Feet
500-1000	142.0	465.9	22.0	72.2	8.1	26.6
1000-2000	180.8	593.2	26.9	88.3	10.0	32.8
2000-3000	228.0	748.0	32.0	105.0	11.7	38.4
3000-3500	272.0	892.4	32.0	105.0	12.5	41.0

Vessel Charter
1-Aug-01

Vessel Size TEUs	Average North Atlantic Daily Charter Dollars per Day
500	5,500
1000	7,500
1500	11,000
2000	13,500
2500	16,500
3000	18,500
3500	20,500

Source: Charter Broker Survey

APPENDIX 4

TRUCK AND RAIL LINEHAUL

CONTAINER RATES

Origin	Destination	Average Linehaul Truck/Rail Rate per Container	
Charleston	Buffalo	$	993.00
Norfolk	Buffalo	$	709.00
New York/New Jersey	Buffalo	$	116.39
Baltimore/Philadelphia	Buffalo	$	584.00
Boston	Buffalo	$	615.00
Halifax	Buffalo		na
Montreal	Buffalo	$	723.00
Toronto	Buffalo	$	350.00
Buffalo	Charleston	$	993.00
Buffalo	Norfolk	$	709.00
Buffalo	New York/New Jersey	$	567.00
Buffalo	Baltimore/Philadelphia	$	108.00
Buffalo	Boston	$	615.00
Buffalo	Halifax		na
Buffalo	Montreal	$	723.00
Buffalo	Toronto	$	250.00
Charleston	Chicago	$	760.54
Norfolk	Chicago	$	670.30
New York/New Jersey	Chicago	$	419.43
Baltimore/Philadelphia	Chicago	$	508.28
Boston	Chicago	$	559.26
Halifax	Chicago	$	793.01
Montreal	Chicago	$	587.73
Toronto	Chicago	$	372.28
Chicago	Charleston	$	924.25
Chicago	Norfolk	$	776.92
Chicago	New York/New Jersey	$	661.85
Chicago	Baltimore/Philadelphia	$	650.64
Chicago	Boston	$	910.08
Chicago	Halifax		na
Chicago	Montreal	$	1,351.00
Chicago	Toronto	$	830.00

Origin	Destination	Average Linehaul Truck/Rail Rate per Container	
Charleston	Cleveland	$	914.76
Norfolk	Cleveland	$	626.98
New York/New Jersey	Cleveland	$	515.41
Baltimore/Philadelphia	Cleveland	$	577.00
Boston	Cleveland	$	373.68
Halifax	Cleveland		na
Montreal	Cleveland	$	988.20
Toronto	Cleveland	$	541.00
Cleveland	Charleston	$	901.00
Cleveland	Norfolk	$	721.40
Cleveland	New York/New Jersey	$	567.00
Cleveland	Baltimore/Philadelphia	$	563.76
Cleveland	Boston	$	406.08
Cleveland	Halifax		na
Cleveland	Montreal	$	1,052.00
Cleveland	Toronto	$	541.00
Charleston	Detroit/Flint	$	581.88
Norfolk	Detroit/Flint	$	595.41
New York/New Jersey	Detroit/Flint	$	428.91
Baltimore/Philadelphia	Detroit/Flint	$	560.40
Boston	Detroit/Flint	$	460.74
Halifax	Detroit/Flint	$	923.59
Montreal	Detroit/Flint	$	490.99
Toronto	Detroit/Flint	$	379.57
Detroit/Flint	Charleston	$	1,341.72
Detroit/Flint	Norfolk	$	738.20
Detroit/Flint	New York/New Jersey	$	784.00
Detroit/Flint	Baltimore/Philadelphia	$	672.49
Detroit/Flint	Boston	$	238.68
Detroit/Flint	Halifax		na
Detroit/Flint	Montreal	$	1,050.00
Detroit/Flint	Toronto	$	448.00

Origin	Destination	Average Linehaul Truck/Rail Rate per Container
Charleston	Toledo	$ 920.00
Norfolk	Toledo	$ 841.00
New York/New Jersey	Toledo	$ 468.31
Baltimore/Philadelphia	Toledo	$ 345.06
Boston	Toledo	$ 548.91
Halifax	Toledo	na
Montreal	Toledo	$ 1,137.00
Toronto	Toledo	$ 550.00
Toledo	Charleston	$ 920.00
Toledo	Norfolk	$ 841.00
Toledo	New York/New Jersey	$ 714.00
Toledo	Baltimore/Philadelphia	$ 571.32
Toledo	Boston	$ 822.96
Toledo	Halifax	na
Toledo	Montreal	$ 1,137.00
Toledo	Toronto	$ 550.00
Charleston	Oswego/Syracuse	$ 1,030.00
Norfolk	Oswego/Syracuse	$ 658.00
New York/New Jersey	Oswego/Syracuse	$ 158.71
Baltimore/Philadelphia	Oswego/Syracuse	$ 507.00
Boston	Oswego/Syracuse	$ 190.41
Halifax	Oswego/Syracuse	na
Montreal	Oswego/Syracuse	$ 464.00
Toronto	Oswego/Syracuse	
Oswego/Syracuse	Charleston	$ 1,030.00
Oswego/Syracuse	Norfolk	$ 658.00
Oswego/Syracuse	New York/New Jersey	$ 386.00
Oswego/Syracuse	Baltimore/Philadelphia	$ 507.00
Oswego/Syracuse	Boston	$ 516.00
Oswego/Syracuse	Halifax	na
Oswego/Syracuse	Montreal	$ 464.00
Oswego/Syracuse	Toronto	

APPENDIX 5

RAIL/TRUCK AND VESSEL TRANSIT TIME

Vessel Transit Time Comparison
Average Number of Days
(Includes Dwell Time at Port)

Rail and/or Truck

			Destination			
Origin	**Buffalo**	**Chicago**	**Detroit**	**Toledo**	**Cleveland**	**Oswego**
Charleston	6	6	6	6	6	6
Norfolk	6	6	6	6	6	6
New York/New Jersey	5	6	5	5	5	5
Baltimore/Philadelphia	5	6	5	5	5	5
Boston	5	6	5	6	6	5
Halifax	5	5	5	5	5	5
Montreal	4	4	4	4	4	4
Toronto	3	4	4	4	4	3

Container Vessel

			Destination			
Origin	**Buffalo**	**Chicago**	**Detroit**	**Toledo**	**Cleveland**	**Oswego**
Sydney (Through Service)	15	18	16	15	15	10
Halifax (Shuttle Service)	19	22	18	18	18	13

APPENDIX 6.

SHIPPER SAVINGS

Shipper Savings
Percent Conversion
To Great Lakes Ports

		Through Service			Shuttle Service		
		30' Draft	32' Draft	35' Draft	30' Draft	32' Draft	35' Draft
500 TEU							
	100%	418,477,181	418,477,181	418,477,181	98,208,024	98,208,024	98,208,024
	50%	209,238,590	209,238,590	209,238,590	49,104,012	49,104,012	49,104,012
	20%	83,695,436	83,695,436	83,695,436	19,641,604	19,641,604	19,641,604
	10%	41,847,718	41,847,718	41,847,718	9,820,802	9,820,802	9,820,802
1500 TEU							
	100%	631,725,144	643,671,997	643,671,997	329,509,078	343,523,036	343,523,036
	50%	315,862,572	321,835,999	321,835,999	164,754,539	171,761,518	171,761,518
	20%	126,345,029	128,734,399	128,734,399	65,901,816	68,704,607	68,704,607
	10%	63,172,514	64,367,110	64,367,110	32,950,908	34,352,304	34,352,304
2500 TEU							
	100%	536,643,187	615,688,642	675,217,279	247,811,093	305,248,974	372,602,368
	50%	281,821,594	307,844,321	337,608,640	123,905,547	152,624,487	186,301,184
	20%	112,728,637	123,137,728	135,043,456	49,562,219	61,049,795	74,520,474
	10%	56,364,319	61,568,864	67,521,728	24,781,109	30,524,897	37,260,237
3500 TEU							
	100%	570,285,651	624,143,735	686,553,884	254,792,304	314,265,955	383,173,748
	50%	285,142,826	312,071,868	343,276,942	127,396,152	157,132,978	191,586,874
	20%	114,057,130	124,828,747	137,310,777	50,958,461	62,853,191	76,634,750
	10%	57,028,565	62,414,374	68,655,388	25,479,230	31,426,596	38,317,375

500 TEU Total (100%) Shipper Savings

Port	Through Service			Shuttle Service		
	30' Draft	32' Draft	35' Draft	30' Draft	32' Draft	35' Draft
Buffalo	(5,896,890)	(5,896,890)	(5,896,890)	(12,706,206)	(12,706,206)	(12,706,206)
Chicago	345,104,400	345,104,400	345,104,400	90,814,428	90,814,428	90,814,428
Cleveland	15,440,267	15,440,267	15,440,267	6,131,248	6,131,248	6,131,248
Detroit/Flint	58,579,077	58,579,077	58,579,077	12,324,810	12,324,810	12,324,810
Toledo	2,315,119	2,315,119	2,315,119	441,564	441,564	441,564
Oswego/Syracuse	2,935,208	2,935,208	2,935,208	1,202,180	1,202,180	1,202,180
Total	418,477,181	418,477,181	418,477,181	98,208,024	98,208,024	98,208,024

1500 TEU Total (100%) Shipper Savings

Port	Through Service			Shuttle Service		
	30' Draft	32' Draft	35' Draft	30' Draft	32' Draft	35' Draft
Buffalo	(1,209,095)	(797,773)	(797,773)	(8,893,041)	(7,698,287)	(7,698,287)
Chicago	532,418,120	542,628,645	542,628,645	291,510,607	302,354,042	302,354,042
Cleveland	21,879,178	22,213,258	22,213,258	12,710,408	13,062,545	13,062,545
Detroit/Flint	70,364,172	71,196,156	71,196,156	32,354,760	33,306,883	33,306,883
Toledo	3,631,971	3,696,475	3,696,475	1,835,934	2,044,477	2,044,477
Oswego/Syracuse	4,640,798	4,735,236	4,735,236	(9,590)	453,376	453,376
Total	632,934,239	643,671,997	643,671,997	329,509,078	343,523,036	343,523,036

2500 TEU Total (100%) Shipper Savings

Port	Through Service			Shuttle Service		
	30' Draft	32' Draft	35' Draft	30' Draft	32' Draft	35' Draft
Buffalo	(2,575,550)	(1,513,943)	(265,754)	(9,620,926)	(8,468,168)	(7,112,026)
Chicago	473,443,071	518,539,928	571,412,080	221,291,880	270,336,697	327,845,378
Cleveland	19,988,599	21,452,101	21,672,686	10,399,785	11,995,067	13,865,834
Detroit/Flint	65,551,568	69,259,402	73,608,071	25,251,521	30,087,438	35,756,900
Toledo	3,212,075	3,499,292	3,836,136	1,326,621	1,645,280	2,018,916
Oswego/Syracuse	4,023,424	4,451,862	4,954,060	(837,788)	(347,340)	227,366
Total	563,643,187	615,688,642	675,217,279	247,811,093	305,248,974	372,602,368

3500 TEU Total (100%) Shipper Savings

Port	Through Service			Shuttle Service		
	30' Draft	32' Draft	35' Draft	30' Draft	32' Draft	35' Draft
Buffalo	(2,140,863)	(1,062,745)	162,520	(9,170,115)	(8,001,298)	(6,667,390)
Chicago	478,776,917	525,479,804	579,612,135	226,863,211	277,674,896	336,565,723
Cleveland	20,189,280	21,702,125	23,456,129	10,607,027	12,257,636	14,170,475
Detroit/Flint	66,058,616	69,888,504	74,329,050	25,838,339	30,842,989	36,642,377
Toledo	3,317,967	3,615,005	3,959,148	1,434,544	1,764,176	2,146,409
Oswego/Syracuse	4,083,734	4,521,042	5,034,902	(780,702)	(272,444)	316,154
Total	570,285,651	624,143,735	686,553,884	254,792,304	314,265,955	383,173,748

ATTACHMENT 5

Maritime Input/Output Model

Development of the Maritime Input-output Model

Phase 1

Application in the Great Lakes/St. Lawrence Seaway Navigation Reconnaissance Study

February 12, 2002

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1.0 Introduction

This is the initial effort of a three-phase process to ultimately produce a Corps-wide regional economic impact capability for application in national, basin, system and project level analysis. The overall process will progress from a general reconnaissance level input-output analysis involving state-to-state commodity flows and 2-digit industrial classification to a detailed feasibility level input-output analysis involving county-to-county commodity flows and 4- or 5-digit industrial classification.

This report describes the first phase of what is envisioned as a three-phase development process. Phase I forms the basis of generating state level input-output analysis. Phase I development concludes with a demonstration analysis for the reconnaissance level Great Lakes/St. Lawrence Seaway Navigation System (GL/SLS) analysis. Phases II and III efforts will involve more detailed implementations, possibly involving the use of IMPLAN[1] data, to develop county level trade flows and more detailed commodity classification. Phases II and III will conclude with demonstration analysis on the Upper Mississippi River system and ports on the Upper Tennessee River, respectively.

2.0 Background

The U.S. Army Corps of Engineers is interested in estimating the direct and indirect regional economic development (RED) impacts of water resource investment. Although RED effects cannot currently be included as part of traditional National Economic Development (NED) benefits computations according to documentation guidelines, they can have a material bearing on Federal water resource decision-making. RED effects can contribute to the development of supporters and sponsors of water resource projects. RED analysis will contribute to a more informed Federal decision-making. RED effects are indicators of project-related economic development. RED effects provide key ingredients for determining the social and economic impacts required for filing appropriate environmental documentation, and RED effects could possibly be used as a basis for a cost-sharing allocation procedure.

2.1 Identifying the direct and indirect regional economic benefits of water borne transportation

The examination of regional benefits derived from water transportation has typically focused on the direct and indirect benefits from increased economic activity due to construction on the waterway infrastructure. But other benefits may be present as well. The presence of water transportation can lower the transportation cost to market and thus bestow a productive advantage to a region that may induce expanded production. The producers in the region may share this cost savings benefit with consumers outside the production regions though lower prices. Other transport modes may also offer lower rates due to the presence of water transportation. These benefits are often hidden from

[1] IMPLAN State Data Packages, Minnesota IMPLAN Group, 1725 Tower Drive West, Suite 140, Stillwater, MN 55082

casual observation due to the complexities of the market and the indirect manner in which these benefits arise. As such, residents in localities with water transportation infrastructure may underestimate its benefit to their communities. A model that clearly and simply can identify and highlight such indirect streams of impacts and benefits can be useful in local decision-making and ensure that choices on investment in waterway infrastructure fare appropriately with other local options. To that end, the U.S. Army Corps of Engineers (USACE) has developed and used a multi-region, input-output model to estimate the direct and indirect benefits of water transportation. Dennis Robinson of The USACE's Institute for Water Resources has used the Dynamic Multi-regional Variable Input-output model (MRVIO)[2] to estimate impacts of water transportation savings on local development. The data supporting the model, however, is dated and needs to be replaced. As the process of updating a multi-regional model is quite extensive, it is opportune to review the current approach versus other alternative prior to undertaking such a task. The MRVIO model incorporates four particular features useful for USACE's assessment needs: user definition of region, interregional impacts, flexible prices, and simplicity.

The first feature is that the model provides a general and flexible multi-regional framework that may be modified to fit specific case study needs. The model and data structure permits the user to define economic study regions germane to the problem at hand. For example, the user might define three analysis major regions; (1) the region of interest (ROI), (2) the major trading partner of the ROI and (3) the rest of the U.S. Similarly, the selection of the level of industrial detail is flexible as well. The maximum detail for the selection is constrained primarily by the availability of data. A more complex regional specification can be developed as well.

The second key feature is the nature in which the model captures the interregional impacts. The regional interactions are captured by base estimates of industry specific trade flows. The use of trade coefficients, constructed similar to the basic input-output purchase coefficients, maintain consistency with the input-output model structure and its implicit solution mechanism.

The third key feature is use of an implicit production function formulation that permits price changes in the input-output solution. It is this feature that permits examination of the potential impact of changes in transportation cost on the direct and indirect demand for input commodities. Although, the MRVIO relaxes the constant price assumption of the basic input-output model, it does so in a fairly restrictive way, moreover the demand of the approach currently limits the applied model to small dimensions on the regions and sectors considered. Due to the expanded regional sector detail used in this study, along with the lack of empirical information regarding the price elasticities required to implement a MRVIO version, other approaches are used to capture the impacts of price changes. Nonetheless, the structure developed in the formulation of MIO can in the future incorporate information on induced price impacts similar to the MRVIO.

[2] Matheny, Marianne N and Robinson, Dennis P. , Regional Economic Development Impacts of the Ohio River Basin Due to Commodity Savings along the Ohio River System, September 1999

The fourth feature is the simplicity of the algorithm, i.e., the choice of the input-output formulation of the problem provides a simple but straightforward analysis of the interactions one activity has on another, given the assumption of constant structure of the input-output coefficients. The model, much as the basic multiplier model used in single region impacts provides an assessment tool that not only identifies the likely first round impacts but also is consistent with common sense explanation of ripple effects. It is the simple "common sense" formulation of the single region input-output multiplier analysis, such as RIMS II[3] and IMPLAN that has found acceptance in business, local and national government reviews as a first level assessment tool.

The multi-region input-output framework using trade flow coefficients is a straightforward extension of the single region model. Nonetheless, considerable changes have taken place recently in data availability, data distribution, modeling strategies, computational hardware and software strategies for the implementation of economic models. In particular, multi-regional modeling is gaining a renewed interest among economic impact assessment practitioners.

2.2 Project Goals

The Corps' pre-existing model[4] that has been used for regional economic impact analysis of inland waterway transportation was reviewed. This model offered a starting point and conceptual framework for model refinement and data base updates that would utilize current computer software and hardware capabilities. This phase I work can serve as a template to build other basin/system input-output models. The goal of the project is the development of a portable, application flexible, computationally simple, and cost-responsive I-O model. To that end, procedures were designed to develop key data transaction flow tables to be used in multi-regional I-O model. The first step was to develop a base case analysis framework for the GL/SLS analysis. As it turned out a more detailed regional framework was implemented than used in the earlier MRVIO model, albeit at the sacrifice of the simplifying analytics model previously used to capture price effects. Using transportation scenarios provided by the Corps related to potential containership and bulk freight transportation-cost savings from an improved GL/SLS, the model was used to estimate output, income and employment impacts by state (province) and industrial sector.

[3] U.S. Department of Commerce, *Regional Multipliers: A User Handbook for the Regional Input-output Modeling System (RIMS II),* Third Edition, March 1997

[4] Robinson, An Operational Guide for Using the Multi-Regional Variable Input-Output Modeling System, U.S. Army Corps of Engineers, Institute for Water Resources

3. Approach

The Maritime Input-Output (MIO) model was developed to investigate economic development benefits from reduced transportation costs and increased traffic on the GL/SLS. Input-output analysis is used to track the interrelationships between different industrial sectors within the economy. It does so by looking at the relationship between a sector's purchases (inputs) and its sales (outputs)—which sectors supply a particular sector with its inputs and which sectors use its outputs, the latter including final consumption by households and government institutions. Water transportation activities are allocated to specific industrial sectors within these accounts. As such they have "direct effects" on local or regional economies in terms of the jobs created and income generated. They also have "indirect effects" through the jobs and income generated from the increased output of industries that supply inputs to the sector. A multi-regional version of the input-output provides a regional context for the industries and thus captures the ripple effects on output, employment and income in other regions if businesses in those regions also supply input to the sector be investigated.

Models currently exist to investigate local area impacts from increased spending in an area, i.e. those related to port expansions. Similarly, aggregate, e.g., state level models are available as well. However, when the direct impacts are spatially targeted but the consequent indirect impacts are expected to occur over a large spatial area, the use of multi-region model can assist in identifying not only the net impact, but also the regional gains and losses that may reflect policy tradeoffs that need to be considered.

3.1 Overview of the MIO model

Reduced waterway cost has both an income and substitution effect. The most direct is the income effect. The lower transportation cost passed on to consumers brings about a lower delivered price of water-transported goods. This provides a real income gain to those consumers. Income that was spent for transportation can now be used for the purchase of other goods. In addition the lowered cost of goods transported by water may be preferred to similar goods or substitutes transported by other means. This substitution effect may induce an increase level of traffic to provide those demands. In the current context this means that a greater level of commodity trade may arise than implied by the direct water savings. The former (income) impact can directly be estimated from the input-output framework, by introducing the income effect as a change in final demand.

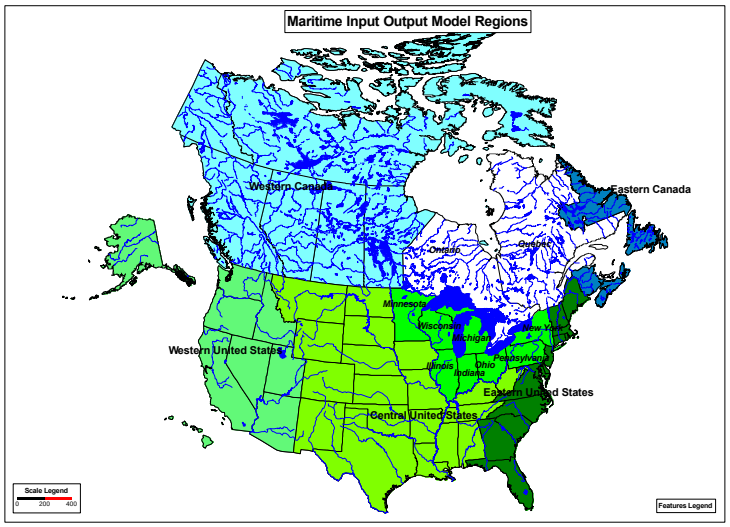
The substitution impact is more difficult to estimate in the standard input-output framework as it implies price changes. Moreover, lowered transportation costs may bring about both the substitution of water transported commodities as well as water served supply locations. The MRVIO approach addresses this issue by imposing simplifying assumptions on the process leading to a new economic equilibrium and changed commodity prices. The MIO model, in order to retain the spatial detail maintains rigid prices and uses a less sophisticated approach to gain insight to the potential magnitude of these impacts. The first is to directly enter by assumption the changes in supply source that give rise to indirect port impacts. A second strategy is to estimate the more

important first round impact of any regional advantage from lower-cost-water transport by estimating induced demand external to the model and determining the indirect benefits by adjustment to the final demand. The MIO maintains the linear model as a first cut approximation, allowing the impacts to be segmented into individual streams for incremental analysis.

3.1.1 Estimate the Economic Impacts of improved waterway access for the GL/SLS

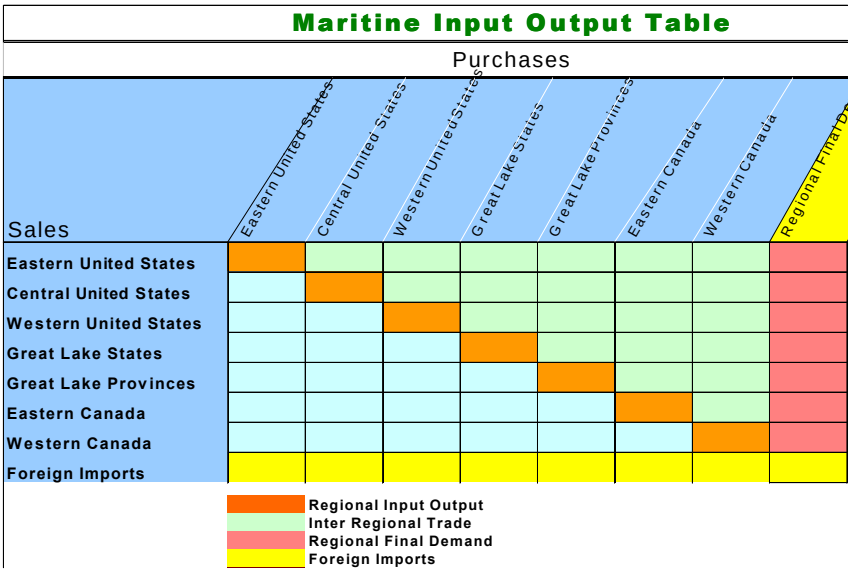
The multi-regional modeling framework is ideally suited to investigate the immediate tradeoffs that may occur from different spatial economic activities. For example, a key result of the further development of the GL/SLS is to increase port activity in the Great Lakes ports, perhaps at the expense of other east cost ports. Examining the direct and indirect spending streams that ensue from alternative scenarios involving different levels of activities at each of the ports, provide insight to the nature of the economic tradeoffs that may occur by changing port capacities. The reconnaissance level analysis pursued in this study requires only a much aggregated view of the potential impacts be considered. As such the focus of the analysis was the estimated changes for broad regional areas. The core areas of interest are the U.S. States and Canadian provinces bordering the Great Lakes and Saint Lawrence Seaway. Since positive impacts in these states may imply impacts in the other areas of the two countries, the study also considers broader multi-state and multi-province regions to capture these impacts. The broad regional definitions used for the analysis are depicted in Figure 1.

FIGURE 1. Regions modeled by the MIO model for the GL\SLS Reconnaissance Study



The input-output tableau of Figure 2 represents the MIO of flow of purchases from one region to another. The intra-regional purchases (the orange blocks) represent inter-industry transactions within the region (i.e. a region specific input-output table) and the light blue and light green blocks reflect the interregional inter-industry trade (i.e. the components of a trade share matrix). The externally given demand of consumers in each region (indicted in pink and labeled as regional final demand) initiates the money flows of the input-output model. The local demand generates purchase from industries in one or more regions; those industries then purchase input materials from industries in their own region or import from other regions, including foreign sources. Purchases from foreign sources leak out of the country. The level of total money in each round becomes smaller and smaller as money leaks out of the domestic economy. When all money has leaked out of the domestic commodity flow, the process comes to a halt. The initiating expenditure is

FIGURE 2. MIO Regional Tableau

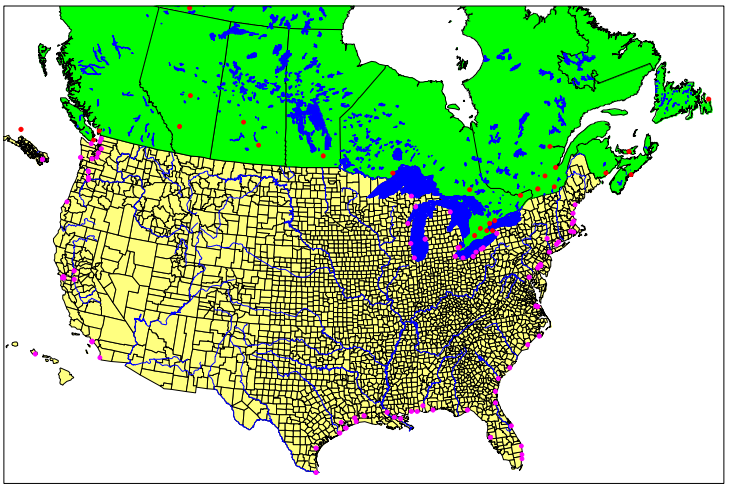


the "direct effect" and the sum of the subsequent rounds provides the "indirect effect" of the input-output ripple effects. A functional input-output model involving a small number of industries and regions has a large amount of data. The MIO databases are structured such that analysis may be conducted at a fine level of sector and spatial detail yet aggregated to provide a general overview of the findings.

3.1.2 The MIO maintains spatial detail to better address impacts of system changes

In order to capture the implications of changes in the *transportation system* on regional economies the analysis scale needs to reflect accessibility of local activities to the transportation network. In the past, state-to-state models were the most feasible, although in most applications aggregates of states were used. The development of the ORNL multi-model network and greater ease of processing large-scale databases permits flow modeling at the sub-state level for the core analysis.

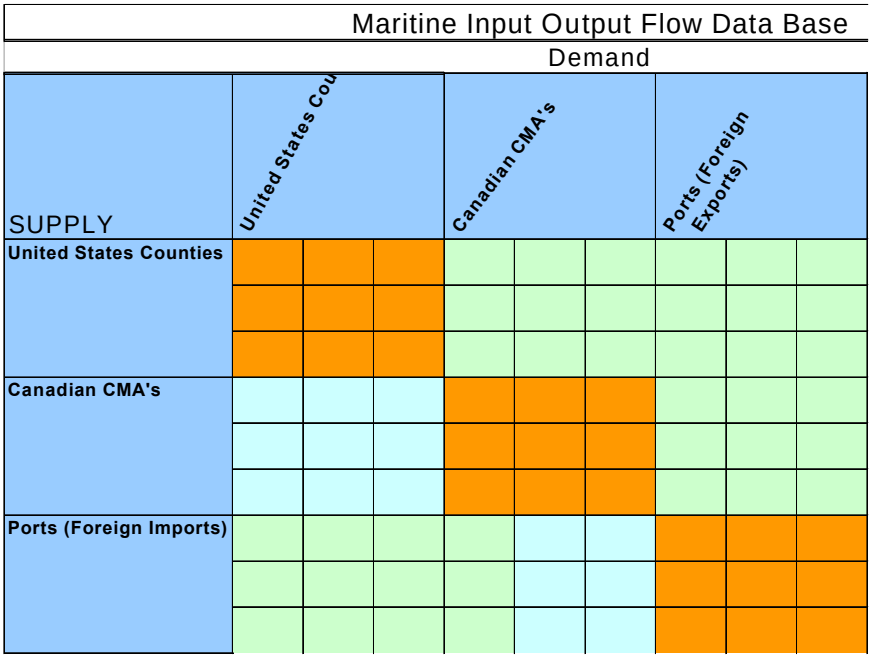
FIGURE 3. Analysis regions of the MIO model



To maintain spatial detail the MIO databases for the U.S. have been constructed on a county-to-county flow model. The center of each county is associated with a node on the ORNL multi-modal network. For the GL/SLS analysis the data has been extended to Canada using large cities (Consolidated Metropolitan Areas, CMA) in each Province

proxies for the location of local economic activity. The spatial impact of foreign imports and exports is incorporated into the MIO by adding the location of the major U.S. ports to the network. *At this time only U.S. ports have been identified, and Canadian exports and imports assigned to the CMA's.* The expanded tableau for the regional definitions used in computing the analysis results are is shown in Figure 4. This strategy follows the general modeling rule, that computations should be conducted at least one level of detail below the desired reporting level.

FIGURE 4. Regions use for computation in MIO



3.1.3 MIO retains sector detail with 57 industries/commodities

For the purposes of the reconnaissance level study the focus is on changes in total output, employment and earnings in a region. However to facilitate initiating impacts at the proper point in the economy and relating activity to transportation impact, both by location and industry, a detailed characterization of industries is desirable. However, the greater the number of industries identified the more effort is required to estimated the interregional influence. The 57 sectors selected for this analysis (see Table 1) are a compromise between specificity and cost appropriate for the study. These particular sectors were partly determined by the process of data integration and will be discussed in more detail below.

TABLE 1. Industry definitions for the MIO model GL/SLS study

naics	shrttext	naics	shrttext
111///	Crop Production	332///	Fabricated metal product mfg
112///	Animal Production	333///	Machinery mfg
113///	Forestry and Loging	334///	Computer & electronic product mfg
114///	Fishing, Hunting and Trapping	335///	Electrical equipment, appliance, & component mfg
115///	Support Activities for AG and For	336///	Transportation equipment mfg
2111//	Oil & gas extraction	337///	Furniture & related product mfg
2121//	Coal mining	339///	Miscellaneous mfg
2122//	Metal ore mining	42////	Wholesale trade
2123//	Nonmetallic mineral mining & quarrying	44////	Retail Trade
213///	Support activities for mining	481///	Air transportation %%
2211//	Electric power generation, transmission, & distribution	483///	Water transportation
2212//	Natural gas distribution	484///	Truck transportation
2213//	Water, sewage, & other systems	485///	Transit & ground passenger transportation
233///	Building, developing, & general contracting	4861//	Pipeline transportation of crude oil
234///	Heavy construction	4862//	Pipeline transportation of natural gas
311///	Food mfg	4882//	Support activities for rail transportation
312///	Beverage & tobacco product mfg	4885//	Freight transportation arrangement
313///	Textile mills	493///	Warehousing & storage
314///	Textile product mills	51////	Information
315///	Apparel mfg	52////	Finance & insurance
316///	Leather & allied product mfg	53////	Real estate & rental & leasing
321///	Wood product mfg	54////	Professional, scientific, & technical services
322///	Paper mfg	56////	Administrative & support & waste management & remediation serv
324///	Petroleum & coal products mfg	61////	Educational services
325///	Chemical mfg	62////	Health care & social assistance
326///	Plastics & rubber products mfg	71////	Arts, entertainment, & recreation
327///	Nonmetallic mineral product mfg	72////	Accommodation & foodservices
331///	Primary metal mfg	81////	Other services (except public administration)
332///	Fabricated metal product mfg		

3.1.4 The MIO model flow diagram

The MIO embeds the trade flows model in a round-by-round simulation of the input- output process. Typically, the input-output modeling process utilizes calculation of an inverse matrix of the direct purchase coefficients. This simplifies calculation of the indirect impact by multiplying the changes in consumption (final demand) implied by the economic activity being investigated. The county-by-county trade share model used here means a very large matrix for inversion. An alternate approach that is sometimes used is a simulation of the round-by-round purchases[5]. This approach facilitates the integration of the input-output "make" and "use" tables with the commodity share tables, while maintaining considerable flexibility such that changes in the input-output structure or the interregional trade infrastructure can be incorporated in scenario alternatives.

Another advantage of the linear model employed here is the additive nature of impacts. Those scenarios that have more than one impact chain can be analyzed in separate steps and the results added at reporting step. This partial approach in the multi-regional environment helps to analyst keep clear about the series of indirect impacts associated with each chain. The steps in the model solution may perhaps best be explained by example.

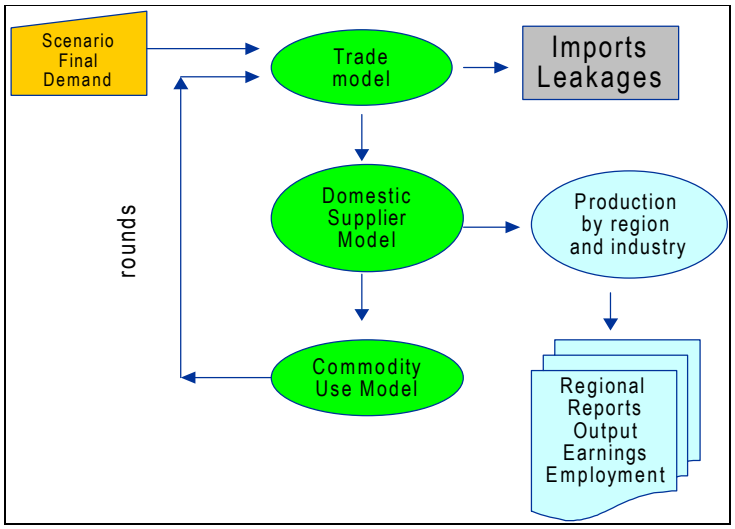
The first and perhaps most time consuming step in an analysis is identifying the incremental expenditures that will initially take place from the anticipated economic change. For example, additional activity at a port will imply increased demand for docking services with a corresponding increase in direct expenditures to those firms that supply them. In modeling terms this is the initial "input" change in final demand that must be identified by commodity (i.e., water transportation services) and location (i.e.

[5] Miller and Blair, p22-24

port) of the activity. This step is depicted as the block labeled scenario final demand in Figure 5.

The MIO process then determines the production locations for this increase in demand though the trade shares data. This step is shown as the Trade Model in Figure 5. The trade share table indicates the percentage of consumption of a specific commodity that comes from the potentially different supply locations for the region of interest. While there are over 3,000 possible supply locations, the typical set is around 300 potential sites. Using the MIO shares, the model allocates the marginal increase in demand to the most likely suppliers based on the percentages of their trade shares.

FIGURE 5. MIO model flow diagram



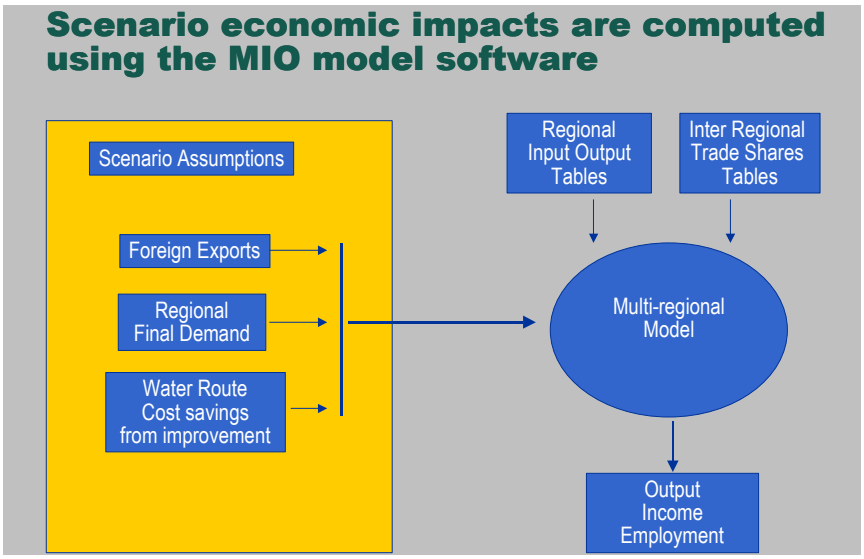
With the locations of the supplier of the service or commodity identified the actual providing industry or industries (note shifting form commodity to industry) are then identified using the input-output make table. The make table allocates the regional commodity demand to the industries that supply that commodity. For the input-output structure currently used in the MIO, typically 90% or more of the commodity is made in the industry with the same name as the commodity. This step is indicated as the Domestic Supplier Model block in Figure 5. Note that foreign purchases leak out of the system at this point, as we now focus only on domestic (i.e., U.S. and Canadian) production. With the producing industry identified and the amount of production to be supplied identified, the MIO analysis now addresses what commodities are required as inputs to production (including earnings and returns to capital). The input-output use table provides information on the dollar value of all commodities inputs for each dollar of output. Using the use table, then the initial set of indirect demands can be calculated. This is shown as the Commodity Use Model block in Figure 5. At this stage a second round of demand for a variety of commodities is generated by the increased local production. Not all of these input commodities will be produced in the counties where the production took place. Again, the most likely production function for the incremental demand has to be determined. To do this, the MIO re-iterates though the trade, supplier and use models again. This second round will be smaller in dollar amount that the first impact, as some of the demand has leaked out of the inter-industry production cycle to households or foreign suppliers. This iteration continues until there are no more incremental demands. In the MIO model, it takes around 50 cycles to clear the system.

The MIO accumulates the incremental production at each region and industry as shown by the production block in Figure 5. This information is then used in computing earnings and employment by location. The information in the base production and commodity tables can be aggregated by industry and/or region though database tools to facilitate reporting and further analysis.

3.1.5 Scenario economic impacts are computed using the MIO model software

Analysis using the MIO model is conducted with a FORTRAN program. To establish the economic base for an analysis, the program requires as input commodity specific data tables that contain the (1) regional production structure – i.e., the make and use table, and (2) the inter-regional interrelationships, i.e., the trade shares table. Currently, the model uses the national input-output make and use table for the 57 sectors noted above. *Future developments will refine the production structure to the state level*, for those commodities that show regionally variability such as fuel choice. Inter-county trade shares have been computed by the ORNL methodology explained below for each of the 57 commodities. Future developments will refine the trade share estimates by examining finer sector definitions, particularly with those commodities most relevant to water transportation.

FIGURE 6. Analysis Flow for the MIO model



A scenario is defined with a text file. The file contains records that identify the direct impacts for the scenario, indicating the increase in spending by commodity and location. After the FORTAN program is exercised generating the round-by-round solution to the estimated spending streams, a set of results tables is generated. One table provides the level of commodity production that takes place by location and the other table provides the level of production by industry and location. Currently, the FORTRAN program generates these tables as excel files. The computation of earnings and employment is done using a Standard Query Language (SQL) routines programmed in FOXPRO. As the system is in the development phase, a user-friendly interface for either model execution or report writing has not yet been constructed.

3.2.0 Data Sources for the base MIO Analysis

The databases necessary to exercise the MIO model are developed in a series of sequential steps. The first step is to construct the national level input-output database[6] [7] that sets the economic account framework for the analysis. The next step is to estimate the industrial employment and output for each commodity at all of the locations. The third step is to estimate the production and consumption of each of the commodities at all of the production/consumption location for a recent year to act as the base representation of the regional economies. Part of this regional consumption is that used by households and government institutions.

With the supply and demand of commodities at each location available, the trade of commodities among the regions can be estimated. This is done using the ORNL Spatial Interaction Model. The SIAM allocates the supply to the demand notes using an economic potential model that uses transportation cost as factor. The ORNL multi-modal network is used to estimate least cost transportation routes for each of the production/consumption locations.

The development of each of these databases for the current implementation of MIO is described in the next sections.

3.2.1 The core of the MIO database is the input-output tables and the industry output at each county and CMA

The core economic activity data bases used for the MIO are the (1) County Business Patterns (CBP, 1998)[8] which provides county level employment data by industries, (2) The Economic Census (1997)[9] which provides the relationship between employment, earnings and output for each industry selected for analysis, and (3) the detail backup for the 1997 Annual Input-output table[10]. U.S. economic data systems have been converting to the North American Industrial Classification System (NAICS), but under different implementations plans. The first two CBP (1998) and Economic Census, data systems

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[6] Industry Economics Division (IED), Bureau of Economic Analysis BE-51,
U.S. Department of Commerce, ***Documentation for the 1997 Annual Input-output Accounts***, (unpublished detailed data)

[7] Statistics Canada, ***Gross domestic product at basic prices by industry,*** http://www.statcan.ca/english/econoind/gdpm.htm

[8] 1998 County Business Patterns, Department of Commerce, U.S. Bureau of the Census,

[9] 1997 Economic Census, Department of Commerce, U.S. Bureau of the Census, Washington, D.C.,1999

[10] The 1997detailed backup for the annual 1997 Input-output contains 482 sectors similar to the 1992 Benchmark Input-output. The official Annual Input-output series is released with only 97 sectors. But using the SIC definitions. When the work for this project was started, the detailed table was available on the Bureau of Economic Analysis (BEA) web site (http://www.bea.doc.gov/bea/dn2/i-o.htm). As the detailed tables for the Annual series are less reliable than the Benchmark series, a recent policy change has caused the withdrawal of the detailed 1997 table in anticipation of the release of the official Benchmark 1997 table. Although not available on the BEA website, the detailed background table for the 1997 annual table is still available upon request from the Industry Economics Division. As this project uses the detailed table as a template to develop our aggregated MIO table, the use is similar to that of the BEA's use in their development of the annual table.

which are from the Bureau Census have been reported by NAICS, however the input-output table was not switched from the U.S. Standard Industrial Classification (SIC) to NAICS at the time of this study, the schedule release of the NAICS input-output format is in 2002. In preparing the annual 97 sector order input-output, the Bureau of Economic Analysis "updated" the 498 sector 1992 Benchmark table to reflect economic activity in 1997. For the MIO analysis, each of the 498 industries in the updated 1997 table was associated with a NAICS sector (see Appendix 1). Then the "make" and "use" tables were aggregated to the 57 NACIS industry definitions used in this study. The "make" table indicates the amount of each of the 57 commodities that are produced in a given industries. The "use" table indicates the amount of the 57 commodities along with earnings that each industry uses in its production.

The County Business Patterns employment by industry data was also aggregated to the same 57 industry categories to provide the core regional economic activity database. The national output fore each industry is then allocated to the counties based on the level of employment in the county. *We implicitly assume that each location has the same wage and labor productivity within the industry*. This is, at best, a heroic approximation at this time as it ignores important potential regional variation. It's not likely to impact the results on the current aggregate analysis, but will need to be addressed in future work. One refinement will refine the level of industry detail so that the assumption on national production structure is less burdensome. The second strategy will be to use earnings information in the Economic Census to estimate earnings at the regional level.

Estimates of 1997 Canadian production for each of the 57 industries were compiled from the Statistics Canada website[11]. Statistics Canada, similar to the U.S. Census Division, has already converted its national data to the NAICS format. In most instances a match of industrial output could be made form available data. In a few instances approximations were required to fill the gaps. The total was constrained to fit the national GNP. The information presented in Canadian dollars was then converted to U.S. dollars using the 1997 exchange rate. Finally, the national production was allocated to the CMA's based on employment in each of the sectors.

The dollar value of U.S. imports and exports for each of the 57 commodities levels were then allocated to individual ports based on the respective value of port total imports and exports. Several commodity specific allocations were considered, but sufficient commodity by port wasn't easily manipulated. The estimation process used here is sufficient for the level of analysis, but would need to be further refined for more extended studies. Similarly, as an expedient, the U.S. (Canadian) total of final demand (consumption by individuals, government and investment) for each commodity in the input-output data was allocated to counties (CMA's) based on personal income.

This set of economic output and employment data for the 57 sectors indicated in Table 1 organized by U.S. counties and Canadian CMA's provide the base line characterization of the economy for the MIO.

[11] Statistics Canada, http://www.statcan.ca/

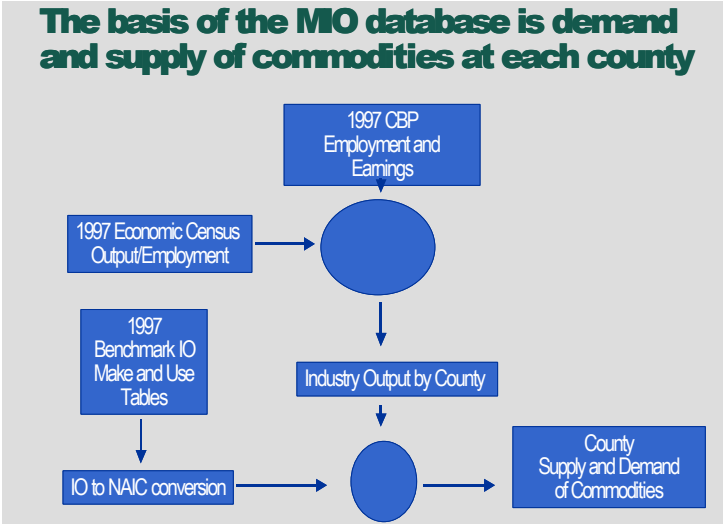
3.2.2 The key to the MIO multi-regional capability is the commodity production / consumption and the regional trade-share (trade-flows) tables.

As commented above there are two parts to determining the commodity trade flows. The first is the estimation of commodity use and production at each location. The second is to use this information to estimate the most likely transportation involved in matching production with consumption over the regions system. Note the method used here is an alternative to other ad hoc strategies used in the development of regional input-output modeling to estimate the share of local purchases such as location quotients or econometric equations. Our goal is to estimate the most likely economic flows and not necessarily the actual commodity transportation flows. Because of the fundamental difference in how economic data and transportation data are defined and collected, only approximate flows are feasible.

Using the base set of economic output by industry, an estimate of the base year commodity production at each location can be determined by using the make table. Similarly, the estimate of the base year intermediate consumption (i.e. those used in the production of other goods) of commodities can be determined by applying the "use" table to the industry output. Finally, the local consumption of commodities by households and government (Federal, state and local) are then estimated by allocating national totals to counties by personal income. This is a short strategy that provides approximate patterns of regional demand adequate for the aggregate analysis pursued in this report, but will need to be refined for studies that focus on specific locations. A variety of additional sources of information are available to improve this estimate. One alternative approach is to use proprietary sources such as the IMPLAN database.

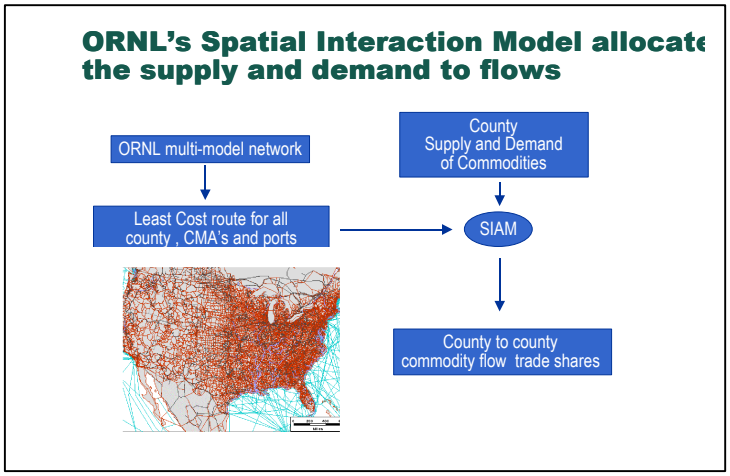
This base of commodity production and consumption by location can then be used with the network cost information and the ORNL Spatial Interaction model to develop the MIO trade flows matrix. The development of which, we turn to next.

FIGURE 7. MIO supply and demand database



3.2.3 ORNL's Spatial Interaction Model allocates the supply and demand to flows to develop the MIO trade shares data

FIGURE 8. SIAM model flow



Spatial Interaction Models. To capture the effects of trading between different regions a set of spatial interaction (SIA) models were developed. If we let Vi refer to the annual dollar valued production, or output, of a particular commodity in region i, as generated by the input-output model, then this production is allocated to destination regions using the following general SIA model (see Wilson, 1971; Alonso, 1978):

$$S_{ij} = V_i A_i W_j B_j f(c_{ij}) \qquad (1)$$

where Sij = the dollars of economic activity allocated from origin region i to destination location j, Wj = the dollar valued demand for the commodity of interest by industries located in region j, f(cij) = an inverse function of the costs, cij, of transporting a unit of the commodity from i to j; Ai and Bj = balancing factors that ensure a more or less exact compliance to the input-output model generated, regional specific production $\{V_i\}$ and consumption $\{W_j\}$ totals. Specifically,

$$A_i = [\sum_j W_j B_j f(c_{ij})]^{-1} \qquad (2)$$

and

$$B_j = [\sum_i V_i A_j f(c_{ij})]^{-1} \qquad (3)$$

These (two sets of) balancing factors are used to create an iterative proportional fitting procedure which ensures, respectively, that:

3j Sij = Vi for all i and 3i Sij = Wj for all j

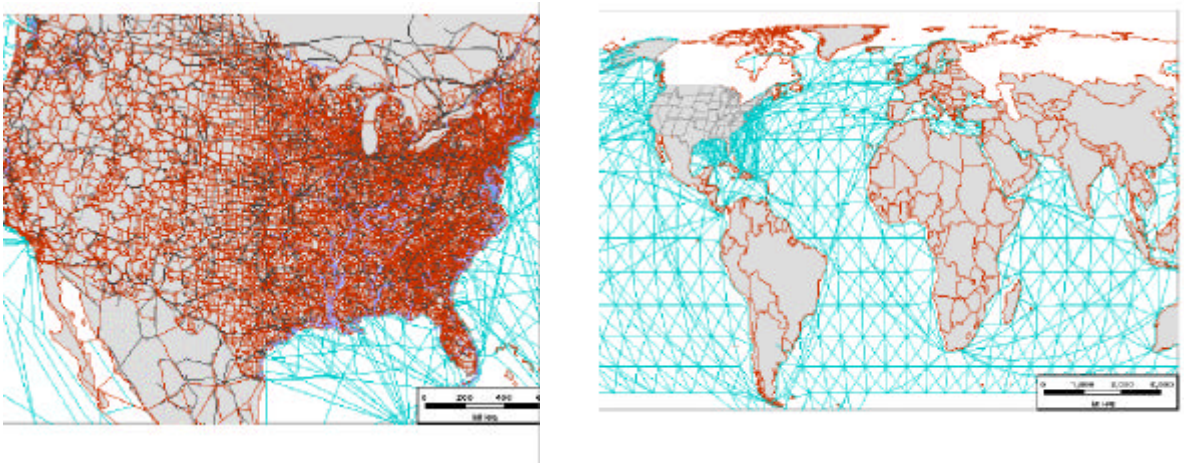
That is, all SIA model estimated flows sum back to the input-output model generated set of regional economic activity production and demand totals used to allocate them. This sort of model is termed a *doubly constrained* SIA model (Wilson, 1970). Setting all Ai values = 1.0 produced a *demand or attraction constrained* model, in which the constraints on model generated production totals are relaxed. Setting all Bj values = 1.0 produces a *production constrained* SIA model, in which the interaction model's freight shares exactly match the amount of commodity produced in each region (i.e. the amount estimated by the MIO model), but in which the regional demands are allowed to vary from the MIO model estimated values for Wj. In the present study both doubly and production constrained versions of the SIA model were calibrated depending on commodity (see below). Model calibration in this case consists of iterating through equations (1) through (3) using different ∃ values until the equality in (4) is established.

Freight Transportation Costs. Ideally the origin-to-destination transportation costs, cij, in such a model would be derived either directly from empirical data, or via econometric modeling from sampled data on observed freight rates: costs that can vary a good deal in practice by type of commodity moved. Given the time and resources available to the present study, an approximation to these costs had to be used. This is no simple task for a nationwide input-output model fitted to a reasonably detailed level of spatial disaggregation. To support the necessary detail required these transportation costs were approximated by using the latest version of the ORNL North American Intermodal Freight Transportation Network Database to compute a set least cost single or intermodal travel impedance functions, based on mode and distance traveled (see Southworth and Peterson, 2001 for details).

This network database (see Figure 1), constructed to support shipment distance computations within the 1997 US Commodity Flow Survey (US Census, 2001) is really a link-and-node based computer model of the US truck-rail-water transportation network, with highway and rail network extensions into Canada and Mexico. For import/export modeling the network is also connected for traffic routing purposes to a trans-oceanic (or "Deep Sea") network of links and nodes from major US seaports to principal cities around the world. The database includes network links and nodes for all major US highways, railroads and waterways, distinguishing between inland and intra-coastal barge, Great Lakes and Deep Sea vessel links in the case of waterborne commerce (based on Corps of Engineers definitions). Network links and nodes are also used to represent

intermodal transfer points such as inland ports, seaports, and major truck-rail intermodal terminals, allowing any combination or sequence of intermodal as well as single mode routings between, for example, zip codes, counties or other more aggregate geographic regions.

Figure 9. ORNL Intermodal Freight Transportation Network.



The network was constructed to support multimodal, including intermodal, freight traffic routing. By applying a shortest path algorithm to this network database a "least impedance" route between any pair of regions is found. Not strictly transportation costs per se, these impedances represent the approximate time costs of travel on specific routes through the U.S. and Canadian highway, rail, and waterway networks, with equivalent time cost impedances added to path computations where intermodal (e.g. truck-rail, truck-water, rail-water) transfers of goods are involved. To accommodate rail routings the network's rail links carry specific railroad company attributes, notably ownership and trackage rights that allow railroad-to-railroad interlining costs to also be computed as part of the least impedance path-finding process. The reader is directed to the journal article by Southworth and Peterson (2001) for further details. In this present study a matrix of single, least cost impedance routes, by whatever mode or modal combination, was selected as the base case {cij} cost matrix used in equations (1) – (3).

Model Calibrations. For the purposes of this present study two different versions of the SIA model represented by equations (1) – (3) were developed, depending on commodity. In both cases a standard "gravity model" form of SIA model was used in which f (cij) = $cij^{-\exists}$.[12] The ∃ here is an SIA model estimated parameter that represents the sensitivity of movement to additional movement costs, and is typically highly correlated with distance moved. Without the time or resources to develop or otherwise acquire actual transportation cost functions (i.e. freight shipment rates) the present study had to guestimate these ∃ values. Given the strong correlation between trip distance and cost for

[12] The entropy maximizing form f(cij) = exp(-∃.cij) was also experimented with, and could be used in future applications—see Wilson, 1970.

most commodities, where empirical data on the average distance shipped was available from the 1997 US Commodity Flow Survey (US Census, 2001) an appropriate value for ∃ was selected which ensures that:

(3ij Sij * dij) / (3ij Sij) = Dbar (model) = Dbar (obs) (4)

where dij = the distance along the minimum impedance path between i and j. Note that distance, dij, and not cost or impedance, cij, is used in (4). Here dij is the distance that results from finding the least impedance modal or intermodal path through the ORNL intermodal freight transportation network. This was done to remain consistent with the distances reported in the 1997 US Commodity Flow Survey CFS, which were similarly based on these least impedance path distances (and using the same ORNL intermodal freight network database described above).[13] *The resulting share values can and should be replaced in future, more detailed studies, by more carefully developed SIA models, where possible tied to more detailed derivations of commodity specific, freight rate based transportation costs.*

All models were calibrated on the basis of a 3229 x 3229 inter-regional flow matrix, where a geographic region of freight production and/or consumption is either one of 3115 US counties, one of 87 major US seaports, or one of 27 Canadian Consolidated Metropolitan Areas (CMAs). Problems with using the 1997 CFS average distance statistics.

FIGURE 10. Coal flows in MIO

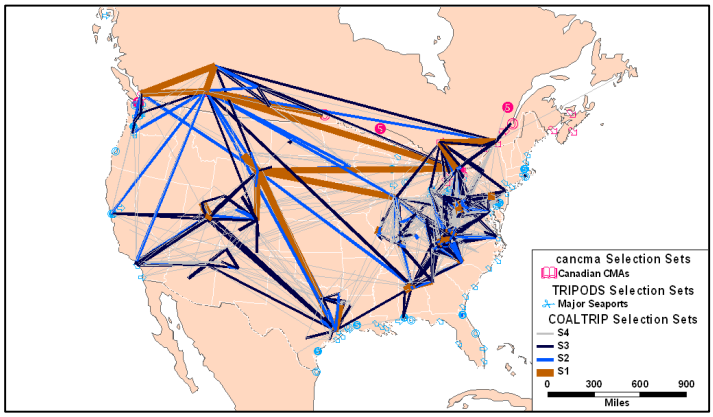


Figure 10, shows the estimated coal flows that were developed

[13] In carrying out these computations commodities were divided into two classes: those that are, according to the 1997 CFS, dominated by truck transportation, and those where multiple modal options (i.e. water, truck and or rail) were used. It should be noted that these are considered to be only very rough average distance statistics, with a number of problems associated with their use in the present study. Of the 56 commodity classes modeled, 28 were calibrated to an approximate mean shipment length statistic drawn from the 1997 CFS, using a production constrained SIA model. The other 28 commodities were calibrated using doubly constrained models, setting high values for ∃ that ensure a limited number of longer distance shipments.

using the SIAM approach on the coal NAICS commodity sector 2121 “Coal mining” provides a most likely flow. The minimum cost flow however may not reflect institutional or historical factors. Only the large flows are depicted to make the display manageable. In future work, the SIAM CFS data can be supplemented by actual known flows and thereby improve the regional estimates. The current approach provides a general minimum cost estimate and in the demand analysis that have had evolved the actual trade among firms. Again, this is not as great a limitation for region-to-region aggregate analysis, but will need to be addressed for local analysis.

Model Run Times. Using a three-point linear interpolation routine to find the best-fitting ∃value, and where necessary to iterate through the proportional fitting routing required to fit a doubly constrained model, each commodity specific spatial interaction model was usually solved in under three minutes, running on a 1 Gigahertz Pentium 3 personal computer with 512 megabytes of RAM.

Table 2. Data sources for key MIO databases

Development of core MIO data bases

Data Set	U.S	Canada
National Production	1997 Input-output data aggregated to 60 sectors	GNP originating by major industry from Stat-Canada - converted to U.S. dollars - many sectors estimated
Local Production	National totals allocated to counties based on 1998 County business patterns employment, 1962 Census of Agriculture	National totals allocated to CMA's based on employment shares
Local Intermediate Consumption	National make and use table used to compute intermediate demand by county commodity based on local production estimate	U.S> input-output table used to compute intermediate demand using CMA production estimates
Local Final Demand	National Final Demand allocated to counties based on 1997 total personal income.	National GNP allocated to CMA's based on employment.
Local Foreign exports/imports	Input-output commodity totals allocated to ports using total value of exports/imports	Exports allocated as part of Final Demand
Local Production and demand	Local production and demand for each commodity is computed for each county, CMA and port.	
Transportation cost	ORNL multi-modal network modified for ports and CMA's used to determine minimum cost routes for Highway only and least cost mode.	
Trade Flows matrix	The ORNL SIAM model is used to allocate local production to the demand locations	

3.2 The county-to-county flows can be aggregated to regional tables

The MIO provides a flexible framework for economic impact analysis related transportation projects. Because of the detailed model structure, the MIO model can address the (1) impact of spending changes, (2) the impact of shifts in production technology, (3) the impact from changes in location of production, (4) the impact from changes in the transportation network, and the impact from changes in transportation costs. For the current Great Lakes/Saint Lawrence Seaway analysis, the focus has been limited to changes in the location of final demand spending.

The model maintains considerable detailed economic production and flow data during processing. This information can be summarized a variety of ways using standard data base management tools, such as Microsoft's Visual FoxPro or Access.

In addition the base trade flows data by county and commodity can be aggregated to industry and regions to provide region-to-regions trade-flows data for other multi-regional modeling systems such as the Institute of Water Resources' MRVIO model.

4.0 Great Lakes/ Saint Lawrence Seaway Analysis

4.1 Development of the direct impacts to be evaluated

Regional economic development benefits add several new concepts to the Corps of Engineers (Corps) analysis framework. The economic paradigm as described above considers both income and substitution impacts. Increases in production capabilities that are brought about by investments in waterways translate into income benefits. The direct effects are consistent with waterway savings traditionally analyzed by the Corps as the National Economic Development (NED) benefit. The Corps maintains a distinction between cost reductions attributed to existing traffic (strictly an income effect) and shift-of-mode savings brought about by substitution of the now cheaper waterway transport for other modes. This latter savings is potentially both an income and a substitution effect – the use of 'net' savings over the foregone alternative mode is an attempt to isolate out the income effect.

This direct impact however can generate a series of additionally impacts not typically covered in the Corps analysis. The shift-of-mode as well as other changes in the location of economic activity can generate important impacts that may net out in the aggregate but be viewed as significant from a region specific perspective. Simply put - the gain or loss of economic activity in the form of earnings and employment is of considerable local interest. The regional economic development or RED benefit is the focus of the multi-regional modeling. From the multi-regional modeling perspective three economic streams are of interest. The first is the location of the direct expenditures generated by the projects under study. Also associated with the regional direct expenditures are the indirect economic activity generated. Alternative locations and choice in commodity demand can generate quite different regional patterns of secondary activity. It is often this total set of direct and indirect benefits that local development proponents seek to gain for their

communities. In exploring the regional impacts it needs to be recognized that these often imply shifts of activities, i.e., income and employment, from one location to another – a sometimes contentious result.

The direct and indirect benefits may come from the traditional impacts generating transportation cost reductions, shift-of-mode and commodity traffic shifts. In addition, in the broader investigation conducted here additional regional benefits are considered as well. The reduction in transportation cost from improved waterway access in a region may provide a production "comparative advantage "to that location. Such an advantage can induce a generative investment in capacity and increase the direct and indirect expenditures in the region. This study uses a simplified model to estimate short-term capacity expansion that may indicate longer-term regional growth potential.

The input-output model requires assumptions about the direct expenditures associated with a water project and then provides the level and location of the likely indirect impacts. Envisioned GL/SLS waterway improvements that may induce major shifts in the direct regional economic expenditures have been identified by the GL/SLS study team. Each of the major threads of direct impacts will be discussed in turn, followed by a discussion of the indirect impacts generated.

Waterway Savings. The waterway savings associated with the improved seaway have been estimated by Martin Associates. The cost reduction attributed to existing traffic on the GLS/SLS is estimated to be $197 million. In most studies, the focus on NED benefits doesn't differentiate between imports and exports. However, as indirect benefits may be shifted it is important to make such a distinction in the input-output analysis. Martin study identified $ 87.256 million of savings for imported traffic with destinations to GL/SLS ports. This increased savings is treated as a direct income benefit to consumers in the port areas and thus generates increase final demand spending in GL/SLS port areas.[14]

If we assume that the nature of the transportation market shifts the benefits of gains to consumer for imports then symmetry would suggest that the direct savings would be shifted abroad for exports. Even under this assumption, a "user fee" could recapture some portion of the exported benefits. Of the total $110.577 million savings, it is assumed that Canada can apply a user tax that captures half of savings. This is seen as a general "income" windfall to all Canadians and is treated as a proportionate increase in final demand for all in all of the Canadian cities based on total regional income.

[14] Other assumption on the incidence of the savings can be explored. Depending on the nature of the markets the incidence may accrue quite differently. For example, it could happen that the benefit is captured not by consumers but by landholder in the production site as a spatial land rent. In that case the threats indicated above would be swapped. A more sophisticated analysis would require much more detailed specification of the underlying transportation and production markets and might be different for different commodities.

Shift-of-Mode Savings. A TVA study commissioned by the GL/SLS study examined potential shifts in container traffic from Atlantic ports to seaway ports. TVA explored a variety of scenarios related to such shifts of container traffic. The most aggressive scenario is used, in which all container traffic that currently goes by rail is shifted to the seaway. For this scenario, imports arriving in 985,576 FEUs containers accounted for $322.4 million in savings. This savings was also treated as an income windfall for residents in the ports and the direct impacts are treated as increase final demand spending in GL/SLS port areas. Exports leaving the GL/SLS ports in 748,366 FEUs containers accounted for $364.1 million in savings. Using the same approach as above, it is assumed this savings would be exported unless captured. It is assumed that Canada can apply a user tax and capture half of savings. This windfall is allocated to all Canadian cities proportionate to the distribution of income.

Martin Associates also identified potential shifts-in-mode savings from grain exports and iron ore. At the time of the analysis, although we did have a scenario for potential shift in these flows we did not have estimates of the value of water savings; consequently savings from these flows were not included in the analysis.

*Economic Development Benefits – Port Activity Relocations***.** Economic development benefits (which also include regional redistribution of activity) come from two sources. The first source is the change in port activity that accompanies changes in transportation modes or routes. The second avenue is from the improved comparative advantage (or production cost benefit) that arises to producers that benefit from the cheaper water transportation.

The TVA container study shifts port activity from the Atlantic cost ports of Charleston, Norfolk, New York/New Jersey, Baltimore/Philadelphia, Boston, Halifax, Montreal, Toronto to the Great Lakes ports of Buffalo, Chicago, Detroit/Flint Toronto and Syracuse. Using information in the TVA study, the port earnings of about $208 million of unloading charges are shifted -- 1,734,042 FEUs at $120 per FEU unloading charge. The increased spending for water transport industry in GL/SLS port areas is added to final demand for each port based on the container traffic share in the TVA study. A second analysis entering the foregone unloading charges of $208 at the Atlantic ports is also conducted. The port specific final demand changes are estimated proportional to the lost traffic as indicated in the TVA study. While the net national impact is zero, the direct and indirect regional impacts are of different and of interest. Decrease port activity at East Coast ports. The major changes of this port shift are assumed to be the port unloading charges. The mode shift also implies a change in mode specific operating charges from rail to water at the final destination. In this analysis the impacts from the shift in operating expenses is assumed to be small.

Port charges also shift in the case of the bulk commodity traffic shifts. The Martin Associates Economic Impact Study provides port charges for the bulk commodities that are used to estimate these regional expenditure changes. Grain exports loadings are increased at The Great Lakes ports with an associated increase in port handling fee. Thunder Bay sees an increase of one million tons with port fees of $18/ton giving $18

million in increased local spending. Duluth has an increase of 5 million tons at the $18/ton handling fee giving $90 million of spending. Iron ore imports of 100 thousand tons are also expected to increase at Detroit. At $11 per ton for port handling this provides a $1.1 million spending increase. Complementary decreases are assumed for New Orleans for the Grain movements and Halifax for the ore.

Economic Development – Capacity Expansion. The changing cost of a primary input such as transportation cost impact producers choices on all inputs and even can impact the economic level of capacity output. Bjornstad [15] develops an easy to use approximation to this short run capacity impact. The change in capacity output is proportional to the importance of the input factor in the total production mix (i.e., the use coefficient of the input-output) times the percentage change in the factor costs. For this analysis, it is assumed that the decrease in water transportation cost of the GL/SLS improvement increases the economic capacity for producers adjacent to the Great Lakes (see appendix 2 for a definition of the locations involved). It is also assumed, that the increase in capacity is utilized by the producers, consequently generating an increase in direct and indirect spending in the local areas. This short-term capacity adjustment also provides an indication of the direction of long- term investment that may enhance this growth, after the firm adjusts other factor inputs to the new price of water transportation. A more comprehensive treatment of potential long- term economic development benefits associated with improved transportation infrastructure is beyond the scope of the reconnaissance study. [16]

In analysis of production changes the capacity expansion is applied to all existing industries that use water transportation. The input-output table provides a national average of the amount that each industry purchases from water transportation. This value was used in the estimate, albeit most likely under estimating the relatively greater use of water transportation by producers adjacent to the Great Lakes. In future work in would be anticipated to improve this estimate with local area data. Using the input-output data a measure of the economic capacity expansion for industries adjacent to GL/SLS benefit from lower transportation cost can be computed given the ratio of transportation saving relative to total cost. The Martin Associates study identifies the current level of traffic and also provides estimates of the savings that are used to compute the water transport savings as a percent of the total commodity value. This calculation provides a capacity increase of $37.6 million that is incorporated in the analysis as a set of final demand changes proportionate to the production locations experiencing the capacity growth[17]

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[15] Bjornstad (1982)

[16] A variety of more aggregate analysis tools such as Computable General Equilibrium models or the MRVIO attempt to explore potential growth consequences, but do not retain the regional or commodity detail considered here. It is argued that for the reconnaissance study presented here, an estimate of the likely short term impacts are of first priority of interest.

[17] The influence of "water compelled" rates on rail may increase the benefit substantially – an issue that is not addressed in the current study. In the analysis it was assumed that only water transportation costs would decline giving $37.6 million. If the decline in water rates forces rail rates to decline by the same amount (the case of water compelled rates) and the capacity model is applied to both water and rail use in the GL/SLS producers then the potential capacity expansion increases by a factor of ten because of the greater base of rail over water. This would come about if because of competition forces rail has to lower the

Industries in GL/SLS port cities benefit from lower transport costs. Import savings account for half the direct impacts, while the shift to GL/SLS' ports has a zero sum national impact. Additional savings also comes from the growth in output associated with lower transportation cost. These direct impacts are used in the MIO to estimate the level and regional location of the ensuing changes in economic activity (i.e. the indirect impacts).

4.2 Summary of direct and indirect impacts from the examined paths.

Given direct impacts and using them as final demand changes, the MIO FORTRAN code is executed separately for each of the impact streams. The resulting indirect impacts by commodity and location are then aggregated to Output, Earnings and Employment totals at the GL/SLS study region level. Individual states in the Great Lakes are aggregated to a U.S. Great Lakes to simplify the presentation. As the results of the regional economic analysis are discussed elsewhere, only highlights for each major stream are pointed out here.

Import savings account for half the impact, while the shift to GL/SLS' ports has a slight negative national impact (Table 3). A traditional NED analysis would address only the water savings amounting to $982 million. The enlarged scope of the regional economic analysis includes and additional $354 million of direct impacts and $560 net million of indirect impacts. The analysis also looks below the net changes to identify locations that have increases and those that have decreases. Identifying the redistribution of activity may assist in formulating offsetting policies to any declines that may be seen to have a negative policy impact. The total net impact identified by the multi-regional analysis is $1,481 million.

average cost to all consumers not knowing which would switch. This suggest that a key analysis issue for further study is the economic interaction between the alternative modes – in particular the response of rail to any change in water transportation cost and availability.

TABLE 3. Summary Results of MIO GL/SLS MIO analysis

Summary of Impact Streams thousands of 1999 U. S. dollars				
		Direct	Indirect	Total
NED	Import Savings	408,529	364,598	773,127
	Export Savings -taxed	237,400	196,995	434,395
	Export Savings -exported	237,400	0	237,400
	Capacity Expansion	37,643	40,328	77,971
RED	GL/SLS Growth	317,200	294,758	611,958
	East Coast Loss	-317,200	-336,307	-653,507
Total		**920,972**	**560,372**	**1,481,344**

As discussed above, the typical use of input-output is based on inversion of the input-output tables to provide multipliers that are then applied to the final demand changes. While the simulation used approach here doesn't provide those multipliers upfront the implicit multiplier for any impact can be developed ex post and is a useful summary of the economic changes involved. The impact streams involve different economic sectors and generate different multiplier impacts. In Table 4, it can be seen that the total output multipliers (direct and indirect) range from 1.83 to 3.07 for the different streams. The 1.83 multiplier means that for every $1 of increase in final demand expenditure from the recaptured taxes, output in Canada increase by $1.80, (i.e., $1 direct plus $0.80 indirect expenditures. The capacity expansion stream has the largest multiplier. This is most likely because it is applied to the broadest list of industries, including industries at the upper end of the production cycle and thus inducing a longer stream of indirect purchases.

TABLE 4. MIO multipliers

MIO Implicit Output Multipliers		
Impact Stream	Sector	Implicit Multiplier
Port Shift - Great Lake	Water Transport	1.9293
Port Shift - East Coast	Water Transport	2.0596
Capacity Expansion	All water transportation using sectors	3.0713
Import Savings	Great Lake Port Final Demand	2.0713
Export Taxaton	Canada CMA Final Demand	1.8298

The short-term impacts of GL/SLS' port expansion are at the expense of ports on the East Coast. Table 6 summarizes the port shift analysis. The "With Project" column presents the regional result for the shift of activity to the Great Lakes Ports. The total gain in output for the Great Lakes region is $457 million. Table 6 also indicates that much of the gain gets distributed throughout the U.S, reinforcing the need to consider a multi-regional analysis. The compensating direct and indirect loss in activity associated from the decline in the Atlantic ports is shown in the "Without Project Column" with the net effect shown in the last column. From the perspective of individuals in the Great Lakes area the net benefits of $173 million is the relevant measure. From the point of view of the nation as a whole the -$14 million is of interest. It can be seen that the port switch doesn't net to zero because the spatial distribution of activity in the project case generates more exports than the without project. This provides a clear example of the distributional issues (who gains and who losses) that can be associated with viewing from a regional perspective versus a national perspective.

TABLE 6. Comparison of Port Impacts in MIO GL/SLS analysis
$1,000 dollars

	Net Benefits from shift of port activity to GL/SLS due to Improvement		
	With Project	Without Project	(RED) Net Regional Benefit
Direct Impact	**317,200**	**317,200**	**0**
Direct and Indirect Impacts			
U.S. Great Lakes	420,638	239,776	**180,862**
Ontario	31,510	21,831	**9,678**
Quebec	5,324	22,684	**-17,360**
Total GL/SLS	**457,472**	**284,292**	**173,181**
Eastern United States	23,061	137,545	**-114,484**
Western United States	2,455	8,118	**-5,663**
Central United States	80,944	194,256	**-113,311**
Eastern Canada	340	9,042	**-8,702**
Western Canada	47,686	20,055	**27,631**
US, Can.(includes GL/SLS)	**611,958**	**653,307**	**-41,349**
Imports	**95,396**	**54,048**	**41,348**
Total US/Can Direct & Indirect	**707,355**	**707,355**	**0**
		Indirect savings	**-41,349**

Of particular interest a significant impact stems from economic capacity adjustments to the lower transportation costs. The direct impact in the Great Lakes Region of $37 million generates another $31 million in the Great Lakes. The total of $68 million minus

the $37 million direct impacts gives the indirect in the GL region. A small amount of the impacts leak out of the region.

Much of the benefit from transportation cost savings leak to other regions. Increases in the final demand in the Great Lakes states generate activity in Central and Eastern United States.

TABLE 7. Growth benefit summary

Regional Growth Benefit from lowered water transportation costs	
Direct Impact	37,643
Direct and Indirect Impacts	
U.S. Great Lakes	35,089
Ontario	20,799
Quebec	12,189
Total GL/SLS	**68,077**
Eastern United States	3,365
Western United States	532
Central United States	4,559
Eastern Canada	400
Western Canada	1,037
Total US and Canada (includes GL/SLS)	**77,971**
Imports	6,020
Total Direct and Indirect	**83,991**

Table 8 provides the direct and total benefits generated by the import savings and the recaptured export benefits. Some benefits accrue to Eastern Canada as well. These benefits will offset partially offset the loss associated with the port activity shifts as seen in Table 9 which summarizes the impacts form all streams. The total impacts for Eastern Canada are slightly positive and the negative impact on Eastern United States drops to $34 million.

TABLE 8. Transportation cost savings summary

Economic Impacts from Income Benfits derived from Transport Savings			
	Reg Distribution of Growth in Demand from Import savings	Regional Distribution of Benefits from Taxation of 1/2 export savings by Canada	Total Benefit from Transport Savings
	(NED)	(NED)	(NED)
	Change in Production		Benefit
Direct Impact	408,529	237,400	645,929
Direct and Indirect Impacts			
U.S. Great Lakes	194,271	54,955	249,226
Ontario	57,842	110,037	167,879
Quebec	16,080	62,307	78,386
Total GL/SLS	**268,192**	**227,299**	**495,491**
Eastern United States	20,920	46,548	67,468
Western United States	5,879	37,970	43,850
Central United States	475,997	27,003	503,000
Eastern Canada	511	14,765	15,275
Western Canada	1,628	80,810	82,438
US, Can.(includes GL/SLS)	**773,127**	**434,395**	**1,207,522**
Imports	25,487	29,630	55,117
Total US/Can Direct & Indirect	**798,614**	**464,025**	**1,262,639**
U.S. Indirect			561,593

TABLE 9. Estimate of Regional Benefits from modernization of the Saint Lawrence Seaway	
Thousand 1997 U.S. dollars	
	Total all impact streams
Direct Impact	683,572
Direct and Indirect Impacts	
U.S. Great Lakes	465,177
Ontario	198,357
Quebec	73,215
Total Great Lakes	**736,749**
Eastern United States	-43,651
Western United States	38,719
Central United States	394,248
Eastern Canada	6,973
Western Canada	111,106
US, Canada (includes Great Lakes)	**1,244,144**
Imports	102,485
Total US/Can Direct & Indirect	**1,346,630**

Table 10 provides a summary of the changes in earnings and employment that are brought about by the direct and indirect output changes. The table also summarizes the results from the perspective of the Great Lakes. Note: The regional economic development (RED) benefits can be added to national Economic Development (NED) benefits only from a regional perspective. The key to regional benefits analysis is that it is indeed from a regional perspective, and the gains may come from changes elsewhere. From the point of view of the GL/SLS benefit there are $1,285 million of national output gains combined with another $180 million of indirect regional benefits in the GL/SLS.

TABLE 10. Summary of Regional Benefits for GL/SLS region

Summary of Impact Streams from perspective of GL/SLS Region Thousands of 1997 U.S. Dollars					
Benefit Class	Input-Output type	Impact Stream	Output	Earnings	Employment
			thousands of U.S. $		Jobs
NED	Direct	Import Savings	408,529	90,449	2,729
		Export Savings - Taxed	237,400	53,008	1,430
		Capacity Expansion	*37,643*	*6,479*	*116*
	Indirect	Import Savings	364,598	80,722	2,436
		Export Savings - Taxed	196,995	43,987	1,187
		Capacity Expansion	40,328	6,942	124
	Total		1,285,493	281,587	8,022
RED	Direct	GL/SLS Port Expansion	0	0	0
	Indirect	GL/SLS Port Expansion	180,862	29,643	636
Total			1,466,355	311,230	8,658
GED	Direct	Export Savings - Exported	237,400	49,854	779

While the analysis of current traffic, indicates the gains come at the expense of current activity of the Atlantic cost ports in the long term this may not be the case. Container shipments are expected to double the next decade as well as the following one. Port congestion in the Atlantic may not adequately support this growth, and this could be the source for the Great Lakes expansion. Traffic projections indicate that the only major growth will be in container shipments, which currently cannot move on the GL/SLS. Without improvement, the ports on the Great Lakes cannot maintain its current market share in water born traffic

5.0 St Lawrence Seaway Analysis: Cautions, Caveats and Extensions

The Great Lakes/Saint Lawrence Seaway Reconnaissance study is the first use of the MIO modeling framework. To a certain extent implementation of the study scenarios in the MIO required a learning-by-doing approach. With further development the system can deal with more complicated and region specific activity. As experience is gained with the tool expanded analyses can be considered as well. However, to push the capabilities beyond the aggregated reconnaissance level presented here will require developing input-output and trade flows data on an extended list of commodities.

5.1 Cautions…

It is important to recognize that this study is a reconnaissance level to explore the possibilities of the likely magnitude of impacts. It is similar to the "Issues identification" stage of environmental impact assessment in which the key issues related to anticipated action are identified. In the current analysis, the type of commodity flow information was identified and limitations in data sources noted. It also was found that an important source of economic impacts may come from the port activities, and that these activities also imply losses in other regions. Another important element that was identified for further study is the response from rail to the decline in water transportation cost. A competitive cost, even if it cuts into the direct port activity gains may have a positive economic capacity benefit.

It also needs to be remembered that the flows discussed in MIO refer to economic (dollar) flows and not specific commodity movements. The model indicates most likely supply sources, but may not map well with actual flows based on past institutional anomalies.

Finally, the focus of the MIO is on initial impacts and not economic equilibrium solutions. An impact analysis tool seeks to identify those sectors or institutions that will be affected by a change and attempts to provide a first round estimate of the typical response. In the marketplace a variety of repercussions effects can take place that are likely to alter or moderate the initial impact. The study of this equilibrium requires a more complex and complete model of the behavioral elements of the key actors than is provided by the basic input-output model. Nonetheless, the impact model provides a simple and efficient vehicle to identify where the initial benefits and cost may appear.

5.2 Caveats….

Several caveats on the results developed for the Great Lakes study are in order as well. As this was undertaken as a reconnaissance level not all issues were pursued. Rather the study focused on the most obvious and potentially largest impacts for which data to generated direct impacts could be calculated. Other possible economic choices and scenarios could be developed.

The data used for this first analysis for inclusion of then Canadian economy and calculation of direct impacts based on current transportation flows used highly aggregated and readily available data. The Canadian data can and will eventually be replaced with more detailed and complete data from primary Canadian sources. Additional effort needs to be done to reconcile transportation data from the dispirit sources. The measures tabulated by transportation agencies and economic accounts differ considerably. As a minimum they often require conversion from tons to dollar value. In particular port level activity by commodity and value needs to be developed more fully. The data used in this analysis is sufficient for the highly aggregated assessment of the reconnaissance study, but will need to be improved for a more comprehensive and regionally refined assessment such as a feasibility level study.

Finally, a few caveats are in order on the model structure. As noted, this is the first and novel attempt to integrate the input-output model with the SIAM in a consistent framework. As such it incorporates all the limitations and benefits of the static input-output framework. It also needs to be stressed that the MIO uses a static trade-flows matrix generated by the SIAM model allied to the ORNL multi-model network. Changes in transportation costs and networks system can be explored by developing alternative trade-flow matrices. The system is not an integrated economic transportation model at this stage of development. The model addresses long term economic development related to investment in transportation infrastructure only in a very limited way with the use of the short-term capacity expansion model. It is often a common perception that large regional economic gains can be made from infrastructure development. Appeal to this perception is often the primary rational for such investment.

5.3 Extensions ….

The cautions and caveats give rise to a natural set of extensions that can be pursued to improve both the reconnaissance level analysis and required to pursue feasibility level analysis. First it is desirable to expand the number of scenarios based on additional flow information. The assumed increases in container traffic may be debate and benefits may only accrue from other sources of traffic. The savings from other bulk commodity flows needs to be added to the analysis when savings rates for these flows are available.

Several data issues require attention for future development of the MIO framework. It is desirable to incorporate more detailed and specific information on specific commodity movements to improve the trade-flow estimates. Of key importance in this regard are commodities that are important sources of water traffic, such as coal, grains and stone. The software of MIO has been expanded to allow for regional variation in the input-output coefficients. Information on regional variations in purchases needs to be developed to implement this capability. Important variations to consider in future work are regional variations in fuel consumption and the use of water transportation. As discussed earlier primary Canadian input-output and regional economic data need to be incorporated. Finally, the final demand sectors for both Canada and U.S. counties need to be improved and expanded. Possible sources are IMPLAN or BEA REIS data. It also is desirable to include households and local government as “industries” within the input-output table and thus estimate the “induced” impact form income expansion in a region.

The modeling software needs to be extended as well. The current system is a development model and requires a user interface and report generator to be useable by other potential users.

Appendix 1. Documentation of the IO to NAICS Conversion
Authors**: Julie L. Marshall and R.S. Thomason**

BACKGROUND

According to the NAICS Association, [18] the Standard Industrial Classification (SIC) was instituted in the 1930's in order to classify establishments by types of activities. The SIC system was also used in order to encourage comparability of data among the various sectors of the United States economy. The SIC system comprehensively covers economic activities using industry definitions in accordance with the structure of the economy.

The SIC has been criticized in recent years due to economic changes that have taken place in the United States as well as internationally. These criticisms led to the 1991 International Conference on the Classification of Economic Activities in order to investigate new approaches to the classification of economic activities. Then in 1997, the Office of Management and Budget (OMB) made the announcement that there would be a new industry classification system[19]. The North American Industry Classification System (NAICS) was to replace the SIC as the method of classification. The NAICS was developed by the Economic Classification Policy Committee (ECPC) in cooperation with Statistics Canada and the Instituto Nacional de Estadística, Geografía e Informática (INEGI) of Mexico. While previously comparisons of production between the United States, Canada, and Mexico were often impossible, with the implementation of the NAICS cross-country comparisons are now possible. The new NAICS system also allows for better comparability with the United Nation's International Standard Classification System (ISIC), unlike the SIC.

The NAICS system reflects the different structure of the economy of the 1990's as compared with the economy of the 1930's , when the SIC system was originally developed. The 1999 Economic Census data are the first set of data to be published using the new NAICS system.

Because establishments that use similar production processes to produce goods and/or services are grouped together, the NAICS is based on a consistent, economic concept. In the SIC system, some industries were based on demand while others were based on production, and therefore was not based on a consistent economic concept.

The NAICS system contains 1170 industries of which 565 are service-oriented, whereas the SIC had 1004 industries of which 416 were service-oriented.[20] While the (4-digit) SIC was not comparable to the systems of Canada or Mexico, the NAICS system is comparable among the three countries to the 5-digit level. The sixth digit of the NAICS

[18] http://www.naics.com/info.htm

[19] http://www.census.gov/epcd/www/econ97.html

[20] http://www.census.gov/epcd/www/naicsdev.htm

is used to identify subdivisions of NAICS industries that can accommodate each of the countries individually. Therefore, at the six-digit level the codes for the United States may vary from those of Canada or Mexico, but they are directly comparable at the 5-digit level.

Table 1 below shows the structure of the NAICS system compared with the SIC system.

Table 1

NAICS		SIC	
2-digit	Sector	Division	Letter
3-digit	Subsector	Major Group	2-digit
4-digit	Industry Group	Industry Group	3-digit
5-digit	NAICS Industry	Industry Group	4-digit
6-digit	National	N/A	N/A

Table 2, shown below contains the 2 digit NAICS sectors.

Table 2

Code	NAICS Sectors
11	Agriculture, Forestry, Fishing, and Hunting
21	Mining
22	Utilities
23	Construction
31-33	Manufacturing
42	Wholesale Trade
44-45	Retail Trade
48-49	Transportation and Warehousing
51	Information
52	Finance and Insurance
53	Real Estate and Rental and Leasing
54	

	Professional, Scientific, and Technical Services
55	Management of Companies and Enterprises
56	Administrative Support and Waste Management and Remediation Services
61	Education Services
62	Health Care and Social Assistance
71	Arts, Entertainment, Education
72	Accommodation and Food Services
81	Other Services (Except Public Administration)
91	Public Administration

APPROACH

The 1997 Annual Input-output (I-O) Tables (at the 6-digit level), were downloaded from the Bureau of Economic Analysis (BEA) website.[21] These files **c**ontain the Make and Use tables, estimates of commodity transportation costs and wholesale and retail trade margins. These tables are defined on a 1987 SIC basis (498-industry detail). The tables originally used to match the I-O codes to the NAICS codes were the IO Code table and the SIC-IO table, both downloaded from the BEA website.

The tables contained the SIC codes as well as the I-O Codes. The goal was to coordinate the I-O codes and the SIC codes with the new NAICS codes. For each I-O code, the NAICS code that most closely matched the I-O description was used. This correspondence was achieved using the County Business Patterns[22] definitions of the NAICS code and then checked against the LogLink website[23]. The LogLink site provides an easy to use NAICS/SIC lookup. The NAICS codes were then checked against the SIC codes to ensure that there was correspondence. The codes were aggregated to the three or four digit NAICS level to best retain the industrial production mix.

The next step was to use the SIC-IO table from the BEA website[24]. The set of tables that were downloaded were the Annual I-O tables defined at the six-digit SIC level that gave details for the 498 industries. The 1987 SIC definitions were used to construct this table. Table 1 located in the appendix contains the SIC-IO table that was used.[25] After the table creating the correspondence between the IO codes and the NAICS codes was completed,

[21] www.BEA.doc.gov

[22] County Business Patterns-1998 CD. U.S. Department of Commerce, Economics and Statistics Administration. U.S. Census Bureau, Washington, DC 20233.

[23] http://www.loglink.com

[24] http://www.bea.doc.gov/bea/dn2/i-o.htm

[25] The government sector has been excluded from this table.

the next step was to bring in the rest of the information from the IO Code table. This information contained: the commodity output, defined by SIC, the industry output and final use sums, defined by SIC, the commodity output, defined for the IO codes, and the industry output and final use sums, defined by the IO codes.

The SQL join IO Code table and the SIC-IO table resulted in the IO_NAICS crosswalk table, which is available upon request from the authors.

The crosswalk table created at this stage was then used to aggregate the input-output data and the CBP employment data to the desired level. This U.S. table generated a set of national output for the aggregate sectors. The U.S. NAICS national output by commodity data was then used as a template to estimate an equivalent national data set for Canadian sectors using data from Statistics Canada on Gross Product Originating in each of aggregate sectors.

Appendix 2. Identification of United States counties and Canadian cities for impact analysis of the Great Lakes

Author: Rachel Thomason

SUMMARY

Waterways offer many businesses natural advantages such as potentially lower production costs and transportation advantages. For these reasons (as well as other valid reasons) agglomeration around waterways or ports by firms is not an uncommon observation. These agglomeration tendencies can have large effects on the spatial organization and economic well being of not only the city the firms are located in but also on nearby cities or towns. It could therefore be important in an economic growth study, such as an input-output model, to be aware of which cities are likely to generate such an effect. The Regional Studies Laboratory was tasked with identifying those counties from an existing list of port cities and US counties that would likely feel the effect of economic change in the port cities of the Great Lakes. The list included cities from both Canada and the United States. Since Canada is not organized into counties, Canadian cities were used to capture the effect of Canadian ports on the Great Lakes. These cities are referred to as *Canadian Great Lakes*. Table 1 lists the US cities given that were considered to be Great Lake port cities and the Canadian port cities that were chosen as Great Lake cities. A list of the US counties selected can be found in the appendix. The method section provides a map.

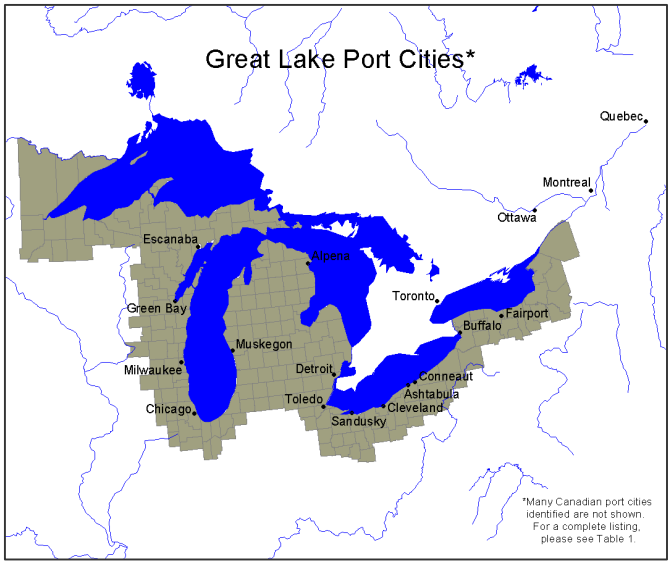

***Table 1* – US and Canadian Port Cities.**

Region	Port City
US Great Lakes	Chicago
US Great Lakes	Detroit
US Great Lakes	Cleveland
US Great Lakes	Toledo
US Great Lakes	Ashtabula
US Great Lakes	Sandusky
US Great Lakes	Fairport
US Great Lakes	Alpena
US Great Lakes	Milwaukee
US Great Lakes	Green Bay
US Great Lakes	Muskegon
US Great Lakes	Buffalo
US Great Lakes	Escanaba
US Great Lakes	Conneaut
Canadian Great Lakes	Quebec
Canadian Great Lakes	Montreal
Canadian Great Lakes	Ottawa
Canadian Great Lakes	Toronto
Canadian Great Lakes	Windsor
Canadian Great Lakes	London
Canadian Great Lakes	Sudbury
Canadian Great Lakes	St. Catherine
Canadian Great Lakes	Hamilton
Canadian Great Lakes	Thunder Bay
Canadian Great Lakes	Trois- Rivieres
Canadian Great Lakes	Chicoutimi
Canadian Great Lakes	Kitchener
Canadian Great Lakes	Oshawa

METHOD

A detailed or precise analysis of which counties in the US and which cities in Canada to include was not needed so several "rules of thumb" were used to determine which counties to label as *Great Lake counties* and which Canadian cities to consider as *Great Lake cities*. First, concerning the US counties, counties two deep from the Great Lakes were chosen. If there was a large cluster of cities right on the Great Lakes, such as in the Chicago area, more counties were included. Counties were not included, however, if it appeared a large influence could be coming from another city and/or port not on the Great Lakes, for example counties were not included that bordered Albany. All of the counties in Michigan were included. The above map shows all the US Great Lake port cities and a few of the Canadian Great Lake port cities[26]. The shaded area outlines the counties that were selected. The light grey lines outline the counties.

In considering which Canadian cities to include, cities further out than what was considered in the US were chosen. This was because the Canadian dataset did not include a county like area. Therefore, fewer points would be capturing the effect of the Great Lakes. A complete list of the Canadian Great Lake cities can be found in table 1.

[26] The map was drawn in ArcView and data was not available to map all of the cities included.

Table 2 - US counties of the Great Lakes

County	State	FIPS
Boone	Illinois	17007
Cook	Illinois	17031
De Kalb	Illinois	17037
Du Page	Illinois	17043
Grundy	Illinois	17063
Kane	Illinois	17089
Kankakee	Illinois	17091
Kendall	Illinois	17093
Lake	Illinois	17097
McHenry	Illinois	17111
Will	Illinois	17197
Jasper	Indiana	18073
Lake	Indiana	

18089

La Porte
Indiana
18091

Newton
Indiana
18111

Porter
Indiana
18127

St. Joseph
Indiana
18141

Starke
Indiana
18149

Alcona
Michigan
26001

Alger
Michigan
26003

Allegan
Michigan
26005

Alpena
Michigan
26007

Antrim
Michigan
26009

Arenac
Michigan
26011

Baraga
Michigan
26013

Barry
Michigan
26015

Bay
Michigan

26017

Benzie
Michigan
26019

Berrien
Michigan
26021

Branch
Michigan
26023

Calhoun
Michigan
26025

Cass
Michigan
26027

Charlevoix
Michigan
26029

Cheboygan
Michigan
26031

Chippewa
Michigan
26033

Clare
Michigan
26035

Clinton
Michigan
26037

Crawford
Michigan
26039

Delta
Michigan
26041

Dickinson
Michigan
26043

Eaton
Michigan

26045

Emmet
Michigan
26047

Genesee
Michigan
26049

Gladwin
Michigan
26051

Gogebic
Michigan
26053

Grand Traverse
Michigan
26055

Gratiot
Michigan
26057

Hillsdale
Michigan
26059

Houghton
Michigan
26061

Huron
Michigan
26063

Ingham
Michigan
26065

Ionia
Michigan
26067

Iosco
Michigan
26069

Iron
Michigan
26071

Isabella
Michigan

26073

Jackson
Michigan
26075

Kalamazoo
Michigan
26077

Kalkaska
Michigan
26079

Kent
Michigan
26081

Keweenaw
Michigan
26083

Lake
Michigan
26085

Lapeer
Michigan
26087

Leelanau
Michigan
26089

Lenawee
Michigan
26091

Livingston
Michigan
26093

Luce
Michigan
26095

Mackinac
Michigan
26097

Macomb
Michigan
26099

Manistee
Michigan

26101

Marquette
Michigan
26103

Mason
Michigan
26105

Mecosta
Michigan
26107

Menominee
Michigan
26109

Midland
Michigan
26111

Missaukee
Michigan
26113

Monroe
Michigan
26115

Montcalm
Michigan
26117

Montmorency
Michigan
26119

Muskegon
Michigan
26121

Newaygo
Michigan
26123

Oakland
Michigan
26125

Oceana
Michigan
26127

Ogemaw
Michigan

26129

Ontonagon
Michigan
26131

Osceola
Michigan
26133

Oscoda
Michigan
26135

Otsego
Michigan
26137

Ottawa
Michigan
26139

Presque Isle
Michigan
26141

Roscommon
Michigan
26143

Saginaw
Michigan
26145

St. Clair
Michigan
26147

St. Joseph
Michigan
26149

Sanilac
Michigan
26151

Schoolcraft
Michigan
26153

Shiawassee
Michigan
26155

Tuscola
Michigan

26157

Van Buren
Michigan
26159

Washtenaw
Michigan
26161

Wayne
Michigan
26163

Wexford
Michigan
26165

Carlton
Minnesota
27017

Cook
Minnesota
27031

Lake
Minnesota
27075

Pine
Minnesota
27115

St. Louis
Minnesota
27137

Cattaraugus
New York
36009

Cayuga
New York
36011

Chautauqua
New York
36013

Erie
New York
36029

Genesee
New York

36037

Jefferson
New York
36045

Lewis
New York
36049

Livingston
New York
36051

Madison
New York
36053

Monroe
New York
36055

Niagara
New York
36063

Oneida
New York
36065

Onondaga
New York
36067

Ontario
New York
36069

Orleans
New York
36073

Oswego
New York
36075

St. Lawrence
New York
36089

Seneca
New York
36099

Wayne
New York

36117

Wyoming
New York
36121

Yates
New York
36123

Ashland
Ohio
39005

Ashtabula
Ohio
39007

Crawford
Ohio
39033

Cuyahoga
Ohio
39035

Erie
Ohio
39043

Fulton
Ohio
39051

Geauga
Ohio
39055

Hancock
Ohio
39063

Hardin
Ohio
39065

Henry
Ohio
39069

Huron
Ohio
39077

Knox
Ohio

39083

Lake
Ohio
39085

Lorain
Ohio
39093

Lucas
Ohio
39095

Mahoning
Ohio
39099

Marion
Ohio
39101

Medina
Ohio
39103

Morrow
Ohio
39117

Ottawa
Ohio
39123

Portage
Ohio
39133

Richland
Ohio
39139

Sandusky
Ohio
39143

Seneca
Ohio
39147

Stark
Ohio
39151

Summit
Ohio

39153

Trumbull
Ohio
39155

Wayne
Ohio
39169

Wood
Ohio
39173

Wyandot
Ohio
39175

Crawford
Pennsylvania
42039

Erie
Pennsylvania
42049

Mercer
Pennsylvania
42085

Venango
Pennsylvania
42121

Warren
Pennsylvania
42123

Ashland
Wisconsin
55003

Bayfield
Wisconsin
55007

Brown
Wisconsin
55009

Burnett
Wisconsin
55013

Calumet
Wisconsin

55015

Columbia
Wisconsin
55021

Dodge
Wisconsin
55027

Door
Wisconsin
55029

Douglas
Wisconsin
55031

Florence
Wisconsin
55037

Fond Du Lac
Wisconsin
55039

Forest
Wisconsin
55041

Green Lake
Wisconsin
55047

Iron
Wisconsin
55051

Jefferson
Wisconsin
55055

Kenosha
Wisconsin
55059

Kewaunee
Wisconsin
55061

Langlade
Wisconsin
55067

Manitowoc
Wisconsin

55071

Marinette
Wisconsin
55075

Menominee
Wisconsin
55078

Milwaukee
Wisconsin
55079

Oconto
Wisconsin
55083

Outagamie
Wisconsin
55087

Ozaukee
Wisconsin
55089

Racine
Wisconsin
55101

Rock
Wisconsin
55105

Sawyer
Wisconsin
55113

Shawano
Wisconsin
55115

Sheboygan
Wisconsin
55117

Vilas
Wisconsin
55125

Walworth
Wisconsin
55127

Washburn
Wisconsin

55129

Washington
Wisconsin
55131

Waukesha
Wisconsin
55133

Waupaca
Wisconsin
55135

Waushara
Wisconsin
55137

Winnebago
Wisconsin
55139

Appendix 3: Canadian Central Metropolitan Areas and Associated Latitude and Longitude

s_node	longitude	latitude	fips	place
238767	-123.344	48.4421	380001	Victoria
238768	-123.026	49.2444	980002	Vancouve
238769	-66.1456	45.2953	381001	StJohn
238770	-114.061	51.0404	582001	Calgary
238771	-113.508	53.5555	582002	Edmonton
238772	-106.653	52.143	283003	Saskatoo
238773	-104.616	50.4477	983002	Regina
238774	-97.1244	49.9211	884001	Winnipeg
238775	-89.2476	48.4410	385001	ThunderB
238776	-82.9314	42.3149	285002	Windsor
238777	-81.2356	42.9883	185003	London
238778	-80.4934	43.4570	285004	Kitchene
238779	-80.9848	46.4849	585005	Sudbury
238780	-79.2441	43.1647	885006	StCathar
238781	-79.8806	43.2502	985007	Hamilton
238782	-79.4126	43.7207	885008	Toronto
238783	-78.8966	43.8716	985009	Oshawa
238784	-75.6508	45.3742	285010	Ottawa
238785	-73.6535	45.5410	286001	Montreal
238786	-72.5795	46.3609	486002	TroisRiv
238787	-71.8992	45.3799	686003	Sherbroo
238788	-71.2449	46.8020	786004	Quebec
238789	-71.2262	48.4382	286005	Chicouti
238790	-134.772	60.7089	387001	Whitehor
238791	-115.819	60.5513	688001	Yellowkn
238792	-63.6457	44.5910	389001	Halifax
238793	-63.0875	46.2640	290001	Charlott
238794	-52.7401	47.5814	791001	StJohns

Appendix 4: U.S. Ports used in the analysis

s_node	longitude	latitude	fips	Place
235236	-90.6179	30.03341	102046	SouthLou
235237	-95.2885	29.75167	105301	HoustonT
235238	-74.051	40.69971	101001	NewYorkN
235239	-91.1993	30.4227	102004	BatonRou
235240	-146.346	61.12452	103107	ValdezAK
235241	-97.3979	27.81269	105312	CorpusCh
235242	-90.0854	29.91406	102002	NewOrlea
235243	-118.21	33.7395	102709	LongBeac
235244	-82.5223	27.78529	101801	TampaFL
235245	-93.2222	30.22356	102017	LakeChar
235246	-76.3118	36.86622	101401	NorfolkH
235247	-93.9607	29.83122	102101	PortArth
235248	-88.0411	30.72519	101901	MobileAL
235249	-94.9146	29.36223	105306	TexasCit
235250	-118.241	33.77711	102704	LosAngel
235251	-76.5172	39.20882	101303	Baltimor
235252	-75.2034	39.91873	101101	Philadel
235253	-122.665	45.47862	102904	Portland
235254	-88.5588	30.34781	101903	Pascagou
235255	-87.64	41.88998	103901	ChicagoI
235256	-75.2266	39.82671	101105	Paulsbor
235257	-122.374	37.92498	102812	Richmond
235258	-122.371	47.60632	103001	SeattleW
235259	-94.0944	30.08592	102104	Beaumont
235260	-81.665	30.32111	101803	Jacksonv
235261	-71.043	42.36008	100401	BostonMA
235262	-83.11	42.26999	103801	DetroitM
235263	-80.1179	26.09336	105203	PortEver
235264	-122.451	47.28943	103002	TacomaWA
235265	-95.3707	28.96112	105311	Freeport
235266	-66.1668	18.66676	104909	SanJuanP
235267	-81.0955	32.08467	101703	Savannah
235268	-76.4583	36.98502	101402	NewportN
235269	-81.67	41.47999	104101	Clevelan
235270	-70.2515	43.64933	100101	Portland
235271	-83.51	41.66	104105	ToledoOH
235272	-122.603	48.50633	103010	Anacorte
235273	-122.308	37.82132	102811	OaklandC
235274	-157.872	21.311	103201	Honolulu
235275	-79.9191	32.78902	101601	Charlest
235276	-80.79	41.91999	104108	Ashtabul
235277	-94.8127	29.31033	105310	Galvesto
235278	-87.36	46.56998	103842	PresqueI
235279	-72.9048	41.29863	100412	NewHaven
235280	-87.02	45.73	103808	Escanaba

235281	-77.9541	34.23926	101501	Wilmingt
235282	-71.3985	41.81163	100502	Providen
235283	-80.1832	25.78349	105201	MiamiFL
235284	-122.929	46.09514	102905	Longview
235285	-122.681	45.62239	102908	Vancouve
235286	-73.9416	41.74999	101002	AlbanyNY
235287	-75.122	39.96387	101107	Camden-G
235288	-80.54	41.96999	104109	Conneaut
235289	-82.71	41.47	104107	Sandusky
235290	-122.863	46.02031	102909	KalamaWA
235291	-75.5071	39.71573	101103	Wilmingt
235292	-122.229	47.98461	103006	EverettW
235293	-71.1587	41.72169	100407	FallRive
235294	-76.7242	34.71688	101511	Morehead
235295	-124.199	43.37233	102903	CoosBayO
235296	-80.6082	28.41392	101816	PortCana
235297	-70.7382	43.07382	100131	Portsmou
235298	-97.3982	25.95216	102301	Brownsvi
235299	-73.179	41.17183	100410	Bridgepo
235300	-81.29	41.76999	104111	Fairport
235301	-80.0527	26.76899	105204	PalmBeac
235302	-83.42	45.06	103843	AlpenaMI
235303	-87.9	42.99001	103701	Milwauke
235304	-149.895	61.23763	103126	Anchorag
235305	-84.1798	30.08176	101818	PanamaCi
235306	-88.02	44.51999	103703	GreenBay
235307	-86.35	43.19	103815	Muskegon
235308	-89.0853	30.35192	101902	Gulfport
235309	-131.65	55.34174	103102	Ketchika
235310	-122.399	37.80663	102809	SanFranc
235311	-123.453	48.13031	103007	PortAnge
235312	-78.9	42.87998	100901	BuffaloN
235313	-124.132	46.92353	103003	GraysHar
235314	-81.4999	31.15861	101701	Brunswic
235315	-121.316	37.95252	102810	Stockton
235316	-75.3293	39.85028	101102	ChesterP
235317	-121.517	38.56063	102816	Sacramen
235318	-122.909	47.06813	103026	OlympiaW
235319	-87.2143	30.36889	101819	Pensacol
235320	-122.5	48.74062	103005	Bellingh
235321	-70.8802	42.52172	100408	SalemMA
235322	-117.178	32.70802	102501	SanDiego

Appendix 5: Gross Product Originating for U.S. and Canada for NAICS industry

Industrial Production			
thousand of U.S. 1997 dollars			
naics	Industry	United States	Canada
111///	Crop Production	123,725	14,117
112///	Animal Production	100,418	13,860
113///	Forestry and Loging	45,077	12,325
114///	Fishing, Hunting and Trapping	3,084	1,307
115///	Support Activities for AG and Forestry	19,194	4,161
2111//	Oil & gas extraction	112,799	13,305
2121//	Coal mining	22,973	2,428
2122//	Metal ore mining	12,879	10,177
2123//	Nonmetallic mineral mining & quarrying	14,279	2,044
213///	Support activities for mining	31,253	5,128
2211//	Electric power generation, transmission, & distribution	232,885	34,231
2212//	Natural gas distribution	101,535	28,607
2213//	Water, sewage, & other systems	65,740	13,485
233///	Building, developing, & general contracting	653,551	67,485
234///	Heavy construction	260,366	24,125
311///	Food mfg	485,922	48,412
312///	Beverage & tobacco product mfg	41,557	7,513
313///	Textile mills	44,404	4,598
314///	Textile product mills	48,518	3,703
315///	Apparel mfg	71,752	10,676
316///	Leather & allied product mfg	9,534	1,069
321///	Wood product mfg	97,176	17,149
322///	Paper mfg	152,490	16,956
324///	Petroleum & coal products mfg	175,402	6,453
325///	Chemical mfg	397,812	27,345
326///	Plastics & rubber products mfg	156,844	13,457
327///	Nonmetallic mineral product mfg	84,919	6,798
331///	Primary metal mfg	14,071	1,460
332///	Fabricated metal product mfg	222,626	21,126
333///	Machinery mfg	377,386	17,446
334///	Computer & electronic product mfg	431,590	19,852
335///	Electrical equipment, appliance, & component mfg	60,519	2,971
336///	Transportation equipment mfg	507,776	80,500
337///	Furniture & related product mfg	60,223	6,002
339///	Miscellaneous mfg	49,697	7,486

42////	Wholesale trade	804,290	63,100
44////	Retail Trade	694,876	63,828
481///	Air transportation %%	137,175	8,959
483///	Water transportation	37,136	8,090
484///	Truck transportation	194,244	21,458
485///	Transit & ground passenger transportation	36,215	6,680
4861//	Pipeline transportation of crude oil	8,047	3,398
4862//	Pipeline transportation of natural gas	9,641	6,167
4882//	Support activities for rail transportation	42,147	8,594
4885//	Freight transportation arrangement	11,450	5,273
493///	Warehousing & storage	17,622	2,211
51////	Information	442,098	26,402
52////	Finance & insurance	976,717	73,288
53////	Real estate & rental & leasing	1,272,758	18,152
54////	Professional, scientific, & technical services	722,204	78,209
56////	Administrative & support & waste management & remediation serv	604,737	23,591
61////	Educational services	99,490	67,680
62////	Health care & social assistance	822,737	81,829
71////	Arts, entertainment, & recreation	131,077	13,843
72////	Accommodation & foodservices	435,798	39,543
81////	Other services (except public administration)	676,706	46,415
		13,467,141	1,234,469

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Attachment 6

The Chicago Sanitary and Ship Canal and the Calumet-Sag Channel Connecting Channels

U.S. Army Corps of Engineers, Chicago District
LRCPM-PL July 1, 2002

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EXECUTIVE SUMMARY

The Chicago Sanitary and Ship Canal (CSSC)
and the Calumet-Sag Channel (CSC) Connecting Channels

This economic appendix examines the role of the two navigation channels which serve, in part, as the navigation connection between the Great Lakes and the Inland Waterway System. These two channels can be considered the "back door" to the Great Lakes ports, much as the "front door" can be considered the St. Lawrence Seaway.

Usage profiles of the commercial traffic on the two waterways for the latest five year period for which information is available, 1994 – 1999, shows the connecting channels to be heavily used by commercial barge traffic. The CSSC averaged 15,500 commercial vessel trips per year, and the CSC averaged 7,200 commercial vessel trips per year. For the same period, freight short tons averaged 19,900,000 and 10,650,000, respectively for the CSSC and CSC.

The evaluation of shipping and receiving detail data for the 1999 year revealed the multiple functions of these channels as a connecting through way, as an internally independent commercial center, and as an importer and exporter of goods. In 1999, 91% of the freight movements on the CSC were through movements, compared to 41 % on the CSSC. Additionally on the CSSC, 34 % of the movements were inbound, 22% of the movements were outbound, and only 4 % were intra movements. Of all the vessels received along these two channels in 1999, 42% were from Great Lakes Harbors; and of all the vessels shipped from these two channels, 22 % were to Great Lakes Harbors. The dominant destination of shipments in 1999, at 47 %, was the internal Chicago Harbor waterway. The dominant sources of received goods in 1999, at 41%, were the internal waterways and harbors. Basically, between the through movements and the shipping and receiving navigation activity profiles, these two connecting channels are shown to be multi-service commercial navigation operations, having the Great Lakes Harbors as a significant but relative minority interest.

The navigation problems and opportunities in the area were discovered to also be multiple. Chief among the problems, based on user's dominant feedback, was the congestion, delays, and navigation risks presented in a 10 mile reach of the CSSC - two miles upstream of the Lockport Lock through Lemont preceding upstream to the confluence of the CSC channel. The combination of a narrow 160 ft wide rock cut channel, and a large concentration of barge servicing, staging, and loading/unloading facilities makes this stretch of waterway a source of risk and delay in navigation. The opportunities consist of **recommendations to alleviate the transit time** over this reach of the waterway through providing for additional areas for tow and barge staging (which would remove barges currently congesting the narrow, heavily used channel).

Summary of Average Annual Benefits by Category
Lemont Reach, Chicago Sanitary and Ship Canal

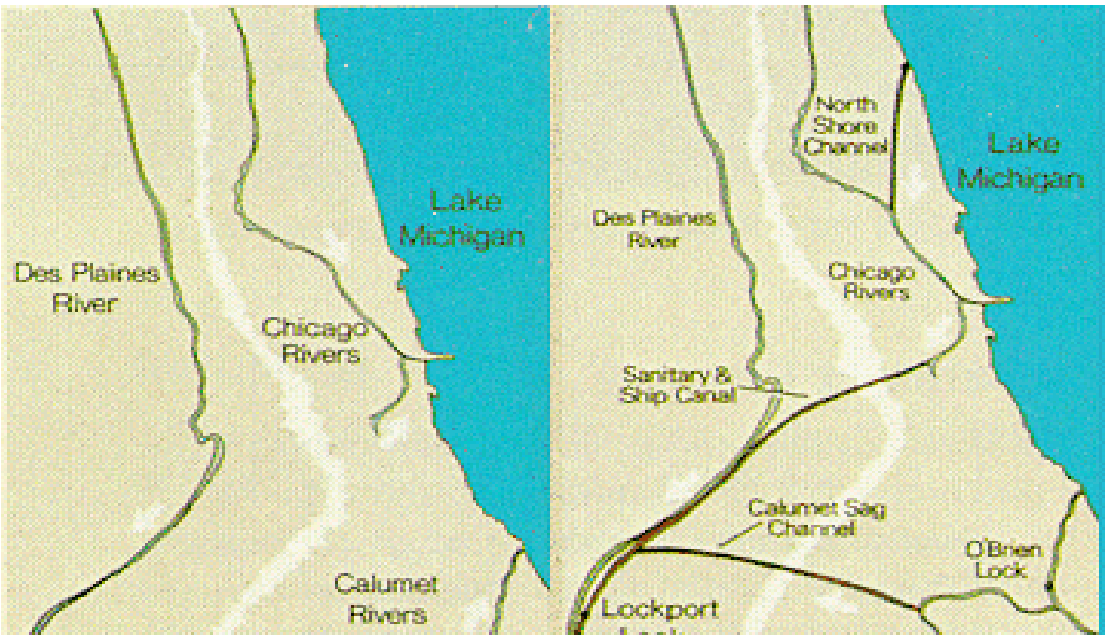
Alternative	First Cost	AAEC	AAEB	Net Benefit	BCR
Quarry site	n.a	n.a	$ 741,000	n.a	n.a
3 mile wall	$ 3,381,000	$ 225,820	$ 284,000	$ 58,180	1.26
Canal widening	n.a.	n.a.	$ 298,000	n.a.	n.a.
Lemont RR bridge	$ 3,016,000	$ 201,436	$ 34,000	$ (167,436)	0.17

Great Lakes Navigation Study, The Chicago Sanitary and Ship Canal and the Calumet Sag Channel - Connecting Channels

SECTION 1. INTRODUCTION AND HISTORY[i]

The Chicago Sanitary and Ship Canal (CSSC) and the Cal Sag Channel (CSC) are two man made converging channels of commerce which connect the Great Lakes (at the southwest extreme of Lake Michigan, at two different points in Chicago) with the Illinois Waterway and thereby, the Mississippi River and the Gulf coastal ports, and vice versa[ii]. These two canals serve our times as the Illinois and Michigan canal (I&M) served the area from our heritage times[iii]. The Corps, Chicago District, has undertaken a review of these two modern day channels as a part of the Great Lakes Navigation Study (GLNS) due to the level of commerce in these waterways participating in Great Lakes commerce. The DOT, Maritime Administration was a strong proponent of their inclusion in the study. The CSSC is a 160 ft wide canal between 20 and 28 feet deep depending on canal fill since construction. The CSSC extends from the South Branch of the Chicago River SW through Cook, Will, and DuPage counties, to a juncture with the Des Plaines River N of the City of Joliet. The CSC is a 9 foot deep 225 ft wide canal extending 16 miles W from a juncture with the Little Calumet River in South Cook County to a juncture with the CSSC near the Village of Lemont[iv] in Southwest Cook County.

Figure 1 Connecting Canals



In the early 1960's the Corps of Engineers widened the CSC to its current width of 225 ft. from the original width of 60 ft. as shown in figure 2. Figure 2 is an image at the confluence of the CSSC and the CSC during canal widening construction. In subsequent

years, through the 1970's narrow road and rail crossings along the CSC were eliminated or widened. Also in the period through 1975 many slips for barges and tows were constructed on the CSSC downstream of this juncture. It is just downstream of the CSSC and the CSC juncture, for a length of roughly 10 miles, that most of the constraints to commercial navigation are found today. These constraints - due to congestion created by the narrow and curving canal, the use of the canal banks for fleeting, and the concentrated customer and barge and tow service industry in the reach - have been identified as the worst on the Illinois Waterway, and have also been recognized in the ongoing Upper Mississippi River Basin Study, as evidenced by figure 4.

Figure 2 Widening of the Cal-Sag Navigation Channel 1962.

SECTION 2. STUDY AREA

The evaluation reported in this attachment focuses on the CSSC and the CSC. These waterways belong to a larger grouping of navigation features which combined are monitored and reported under the title of Port of Chicago, IL by the USACE, Water Resources Support Center. In particular the Port of Chicago, IL is constituted by the following: Chicago Harbor; Chicago River – Main, North, and South Branch; CSSC; CSC; Lake Calumet, IL; Calumet Harbor; and Calumet River, IL and IN. The illustration in Figure 14a shows the location of current interest in the perspective of the regional waterway structure. The Lemont reach, roughly a 10 mile reach of the CSSC from RM 293.5 to 303.5 is the area of greatest navigation transportation congestion.

Mr. Al Ames[v], Great Lakes Regional Director for the DOT Maritime Administration, has drafted a paper entitled "Port of Chicago – Vision of the Future" which clearly presents the unique role of the Port of Chicago waterways in the Great Lakes and Inland Waterways navigation framework. Portions of this draft paper dealing most directly with the two connecting channels under focus are reproduced below:

> The Port of Chicago is unique to the Great Lakes Region and the Nation in the numerous types of vessels and cargoes handled through the port facilities on the maze of local waterways. Chicago maritime trades continue to be strong even though there have been no major infrastructure improvements in the waterways for over forty years. Chicago maritime operators deal with winter operating conditions, varying Lake and river water levels, numerous bridge and channel navigation challenges, ongoing new regulations, increasing environmental awareness, and strong competition for space from rapidly growing recreational craft and waterfront residential development. The Port of Chicago will play an increasingly important role in transportation throughout the region in future years. As land transportation modes continue to experience congestion and growing pains, waterway transportation offers an opportunity to handle more traffic without the sociological and environmental impacts associated with truck or rail service.

- page 1-2, …

> Chicago has three major waterway trade patterns. The most popular and best promoted is international trade through the St. Lawrence Seaway, including trade with Canada. Next, is the U.S. domestic traffic within the upper Lakes. And finally, the Illinois Waterway trades connecting Lake Michigan with the Mississippi River Basin – Gulf of Mexico – and Intra-Coastal Waterway.
>
> Of the three trade patterns, the traffic that declined the most are the Seaway and domestic Lake traffic. The Seaway traffic has declined from 3.9 million tons in 1969 to 2 million tons in 1998. Domestic Lake traffic dropped from 22.8 million tons in 1969 to 8.1 million tons in 1998. The Illinois Waterway trade by river barge has been the least affected by Chicago port history in that in 1969 - 19.4 million tons moved by river barge as compared to 15.8 million tons in 1998. The river barge trade remains strong today and provides a major low cost transportation advantage for Chicago users, in that it is available year-round, with only a few winter icing exceptions. The Seaway trade and Lake trade is impacted by winter ice conditions and offer an operating season from 9 to 10 months long.

- page 4, …

There is a point in time when the maritime community must assert its interest in modernizing a waterway system that is generally between forty and seventy years old. …
In the case of the Port of Chicago, particular focus is needed on the segment of the waterway traffic that has been historically the most stable. That focus should be directed toward the river barge traffic on the Illinois Waterway.

- page 7, …

Chicago's "best kept secret" may be the year-round waterway operation serving traffic between the city's South-side Lake Calumet port facilities and other Inland Waterways, including the Upper and Lower Mississippi River, Ohio River, and Missouri River, and Gulf Intracoastal Waterway. There may be occasional severe winter conditions, with ice cover, that closes the Upper Mississippi and Missouri Rivers to commercial navigation, but the Illinois Waterway and southern rivers are generally ice free and navigable yearend[sic].

This man-made waterway of locks and dams are of uniform dimensions between Lockport and Grafton, Illinois. These locks were built in the 1929 – 1933, paddle wheel era, and continue to serve a steady flow of cargo in river barges carrying dry bulk, liquid, and manufactured goods. The entire Illinois Waterway handled nearly 42 million tons in 1998 and regularly handles between 40 and 60 millions tons each year. This level of traffic is generally higher than the annual traffic through the St. Lawrence Seaway. Also, consider the fact that a single 200-foot by 35-foot river barge holds only 1,500 tons. The eight (8) locks between Chicago and Grafton are all 600 feet long by 110 feet wide and have a standard 9-foot draft through this section of the river. A tow of fifteen barges – 3 wide and 5 long – with a towboat pushing must be split in two sections to transit the 600-foot lock. Two newer locks have been built on the Mississippi River near Alton and Granite City, Illinois. These locks have 1,200 by 110-foot chambers that allow the entire tow of fifteen barges and towboat to transit without stopping to split the tow as required in the Illinois locks. This through lockage operation is a major time saving advantage for the river operators. The Illinois Waterway tows of up to 15 barges carrying 22,500 tons are then re-grouped at St. Louis and joined with other barges headed to the Gulf in tows of up to 30 barges carrying 45,000 tons. About ten years ago a record tow of 72 barges, carrying 108,000 tons, pushed by a 10,500 towboat, was tried as an experiment but is not a typical practice. Again, the vessel owners are maximizing their use of the waterway dimensions for the most efficient and competitive transportation price to their customers.

- page 19-20, …

The Illinois Waterway has a proven record of being the most stable trade at the Port of Chicago in spite of operating in a system that is basically seventy (70) years old. River tonnage in 1998 was 15.8 million tons, or 61 percent of the total port tonnage. One commodity group that has grown significantly on the Illinois Waterway is the movement of chemicals. River traffic in 1969 was 115,728 tons and had grown to 1.9 million tons in 1998.

- page 21-22, …

Barge traffic from the Lockport, Illinois lock eastward becomes somewhat more complicated to describe, except to say that traffic splits into two separate systems – one Northward through the central city, or "Loop", and the other toward Lake Michigan – south of the city. Barge operations through this area is considerably more restricted by river width, bridges height clearance, water level fluctuations, various depths, and competition for surface space with recreational craft.

The Corps of Engineers maintains the Chicago area locks as they do on the Illinois Waterway. The most important lock to commercial traffic volume is the Thomas J. O'Brien Lock connecting Lake Calumet and Calumet River with the Cal-Sag River. This lock controls the water flow between the Calumet River and Lake Michigan. The O'Brien Lock was completed in 1960, with a dimension of 1,000 feet by 110 feet, allowing six barges and a towboat to transit into Lake Calumet. Annual cargo tonnage through the O'Brien Lock averages about 10

> million tons carried by 11,300 barges. This traffic includes cargo moving to and from Indiana's northern ports – local Chicago traffic – and import and export commodities transferred at Gulf Ports for customers throughout the Chicagoland area.
>
> The Chicago Rivers – South – North and Main Branch are more difficult to examine because of the lack of specific Corps statistics for these sections of the river. Corps statistics are kept on lock transits rather than by river section. Data is kept for the Federal Lock on the Main Branch, where traffic is said to be the "second largest volume in the United States" following a recreational lock in Seattle. WA. The Federal Lock was built in 1939 with a dimension of 600 feet by 80 feet. The largest allowable vessel and draft is 596 feet by 76 feet by 21 feet draft. While the majority of this traffic is recreational craft, there is an important level of commercial "capability" that serves the construction and other commodity trades in the downtown Chicago "Loop" area. This lock is also critical to Indiana ports and eastern Lake Calumet users in the event that the O'Brien Lock was damaged or closed for maintenance. An estimated 2,500 barges move through the O'Brien that are destined for Indiana ports. In addition, the O'Brien Lock traffic in 1998 included about 10,000 barges carrying 8.8 million net tons of cargo for South Chicago. Obviously this total traffic serving Indiana and South Chicago, 11,300 barges, would have to be rerouted through the "Loop", and Federal Lock, then south to the Calumet River or on to Indiana ports.

- page 25-27, …

> There is an urgent need to develop improved barge fleeting facilities to improve the operation of over 21,000 barges per year through South Chicago.

- page 36.

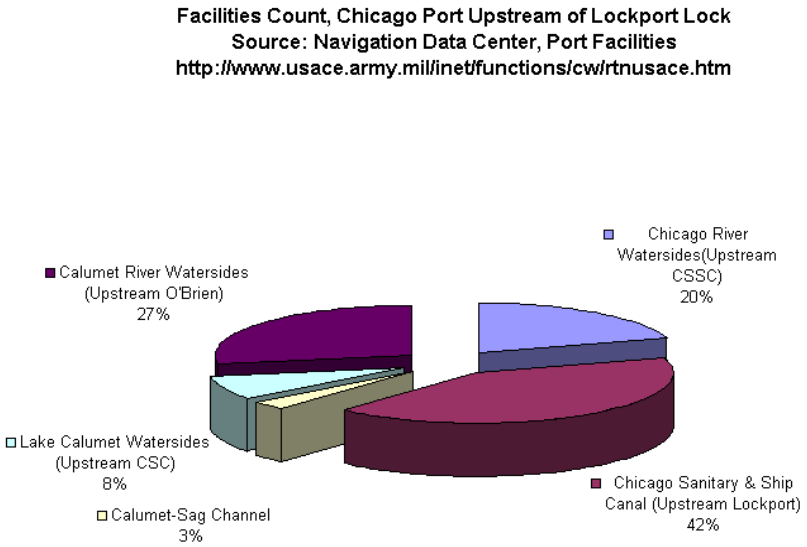
As should be clear from the excerpts above, senior personnel within the Maritime Administration have considered the importance of the Port of Chicago and have concluded that the movement of goods by barge in both directions along the Port waterways is of principal importance to the continued welfare of the region and the nation, and is in need of improvement.

SECTION 3. CHANNEL USERS PROFILED

The story told in narrative in the previous section is borne out by a review of the traffic on the connecting channels as measured by an analysis of waterway trips and tonnage, lock traffic and tonnage, and waterway facility inventory profiles.

Figure 3 presents the distribution a total of 182 waterway and port facilities listed in the latest facilities index maintained by the Navigation Data Center. The preponderance of facilities are on the CSSC. Of the 75 facilities on the CSSC, roughly 50% (i.e., 37) are between the Lockport lock and the CSC juncture. In contrast the CSC has a total of 6 facilities. This contrast indicates the differing functions of the two waterways perhaps reflecting the lands available in the periods in which they were constructed. The CSSC, built in 1900's is highly utilized with commercial waterside facilities while the CSC, built in the 1920's, is principally a connecting passage for mostly tow and barge traffic.

Figure 3 Chicago Port - Waterway and Port Facilities Inventory



1. Freight Traffic by Waterway

Figure 4 and figure 5 displays the total freight movements in the CSSC and the CSC in tonnage (short tons) for the years 1999 and-1994, respectively, reported by the Navigation Data Center for the CSSC and the CSC. These two years were selected because of the five latest years where data was readily available; these were the high and low years. Consideration should be to the fact that in 1995 Lockport lock and the three subsequent downstream Locks on the Illinois Waterway were closed for two summer months for major rehabilitation. This would have induced increased shipments of some commodities in the prior year, 1994.

Figure 4 Freight Moved on the CSSC and the CSC in 1999

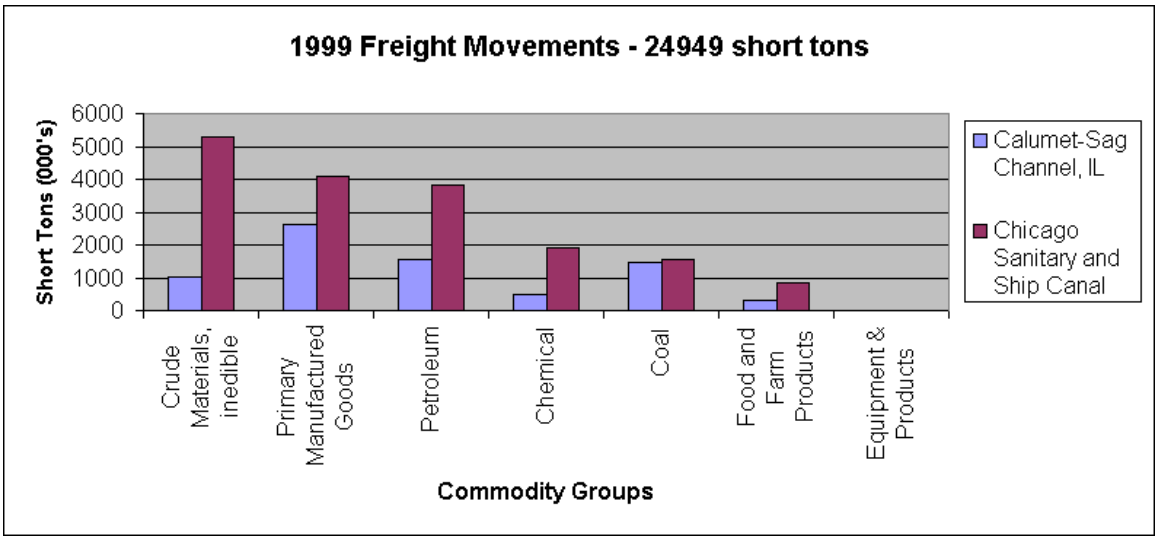
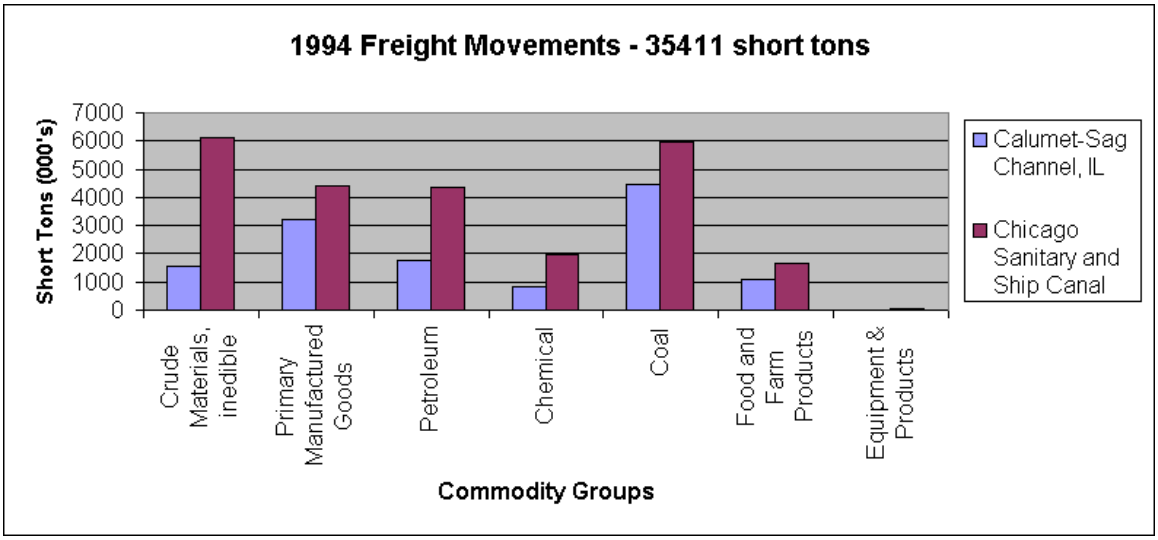


Figure 5 Freight Moved on the CSSC and the CSC in 1994



Comparing and contrasting the two figures above indicated the spike in coal shipments in the waterways in 1994, perhaps related to the scheduled lock closures previously mentioned. Overall there is a good diversity in the type of commodities being shipped in the waterways and the level of freight movements is high at between 25 and 35 million short tons moved.

A more thorough listing of freight traffic by waterway, available from the Navigation Data Center, is contained in a table in the addendum exhibit B. At the bottom of the table the mean values for the five years available for study indicate that the CSSC will move about twice as many tons as the CSC. However commodity movements on the CSC may also be rolled into the CSSC as the juncture of the two would suggest.

Available from the addendum exhibit B is the data needed to create the analysis shown in figures 6 and 7. As is dramatically shown in the two pie charts below, the CSC is used almost exclusively as a through canal. This information is consistent with that contained in the waterway facilities inventory and the barge aerial photo inventory discussed earlier. The data in addendum exhibit B also indicate that the through movements of the CSC favor the upstream direction over the five year period, with this favoritism being extreme in the latest two years for which data is available 1998 and 1999, suggesting that some change is industry has occurred in the users of this canal. The freight movements for the CSSC reflect the highly diverse usage of this channel. Since 1994-1999 for the CSSC the "through" percentage and the "inbound" percentage has diminished while the "outbound" percentage has increased by the fact of its nominal value staying level over these time periods as reported in exhibit B of the addendum exhibits to this appendix.

Figure 6 CSSC 1999 Freight Movements

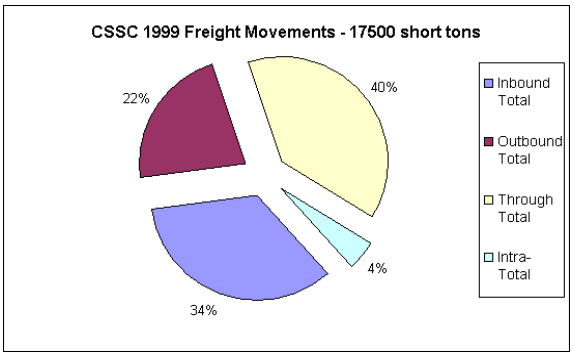
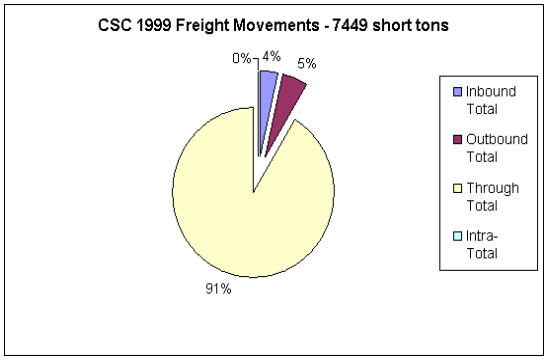


Figure 7 CSC 1999 Freight Movements



2. Vessel Trips by Waterway

In addition to the freight moved on the waterways, another perspective on the significance of these waterways can be obtained from the vessel trips by waterway data available from the Navigation Data Center and summarized in the addendum exhibit C for the CSSC and the CSC. This data reflects the type of vessels involved in the tonnage movements discussed previously and covers the same 5 year period for which data was

readily available 1994 – 1999. Similar to the tonnage statistics, the vessel statistics indicate nearly twice as much traffic moved on the CSSC compared to the CSC. In the later years, 1998 and 1999, this proportion is even more skewed in favor of the CSSC relative traffic levels. Similar to the tonnage statistics, 1994 was a peak year for vessel trips also, the 1995-1999 period does not reveal any significant trend in vessel utilizations.

Figure 8 CSSC 1994 and 1999 Vessel Traffic Patterns

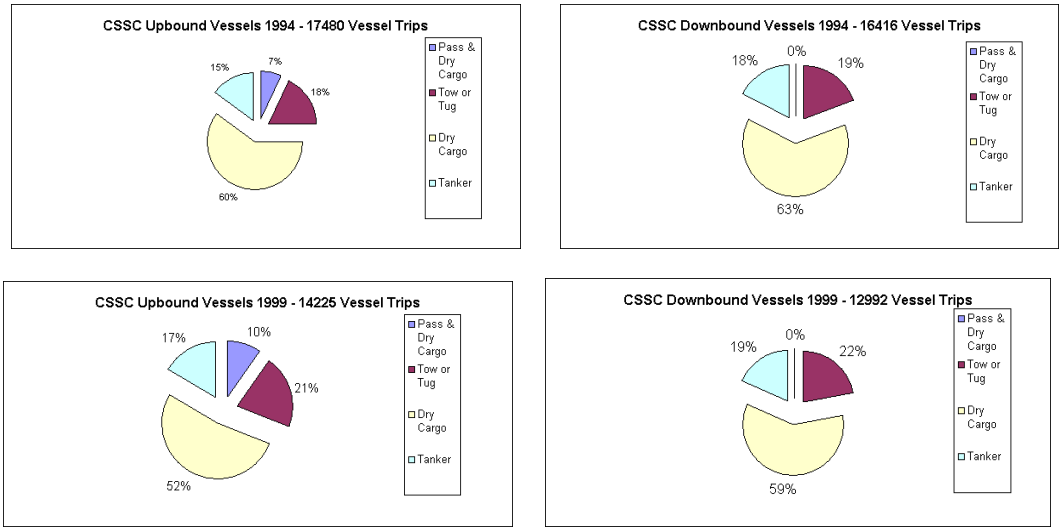
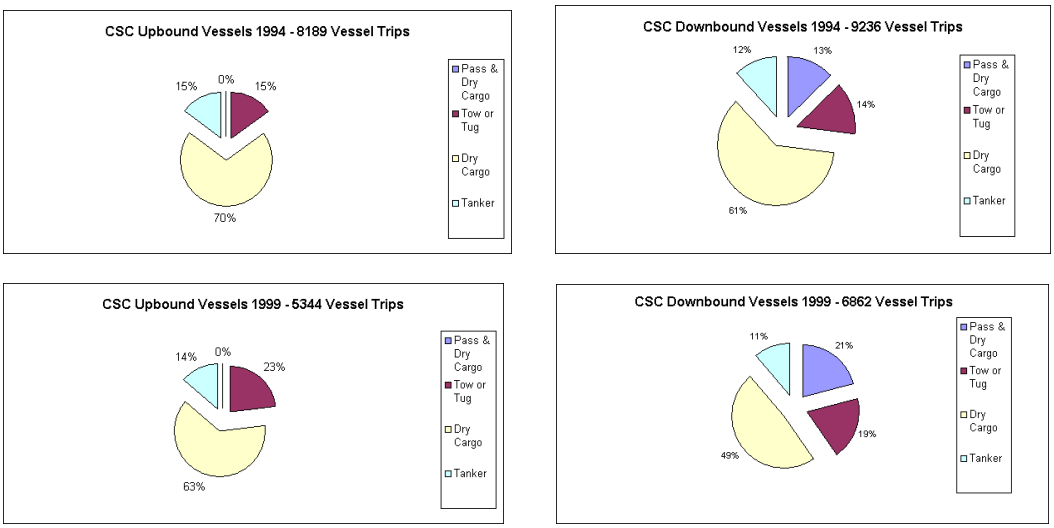


Figure 9 CSC 1994 and 1999 Vessel Traffic Patterns



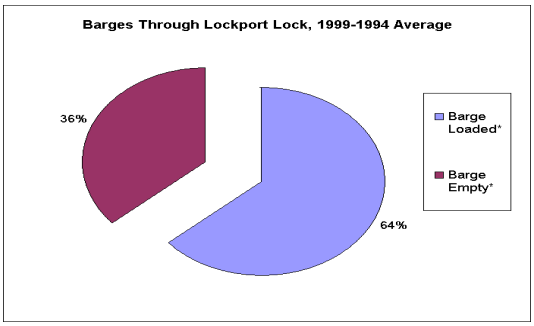
Figures 8 and 9 above, charted from the data in addendum exhibit C, show some of these patterns illustrated as a set of pie charts. All the charts in all the figures at first glance are roughly similar, but a closer examination reveals a few interesting differences.

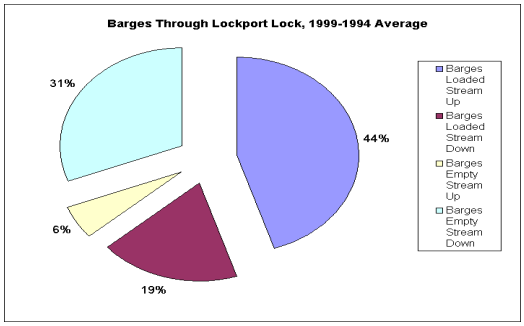
All the passenger and dry cargo (self-propelled) trips registered are going upbound on the CSSC and downbound on the CSC. This reflects the recreational and commercial tour boat industry routing of circuiting between Lake Michigan by way of entering the waterway through the Calumet River on the south, and exiting through the Chicago Harbor lock on the north. This is reinforced by the fact the difference in vessel counts for upbound and downbound traffic on the same waterway is roughly equivalent to the number of self-propelled passenger vessel trips. On both the waterways the relative number of non-self propelled dry cargo barge trips has diminished from 1994 to 1999, perhaps reflecting a shift in the movement of grain from local elevators to elevators further south along the Illinois waterway; places like Morris, Seneca, Ottawa, and Spring Valley IL, as remarked by one contact in the tow and barge industry. Finally, the percentage of tanker barges as a percent of all vessel movements is between 14 and 24 percent (considering both waterways), and the percentage upstream and downstream is roughly comparable for both waterways.

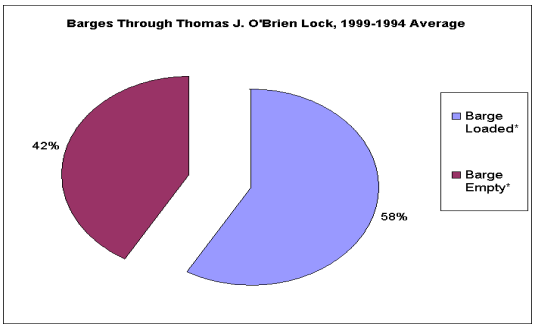
3. Lock Traffic Profiles for Lockport and O'Brien Locks

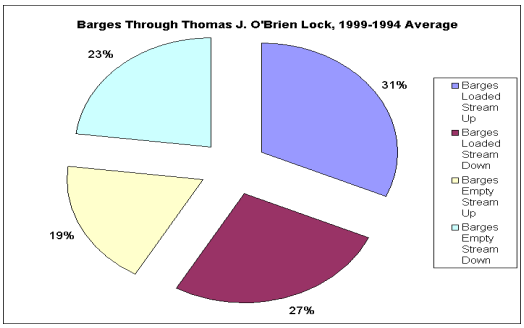
Another perspective on the significance of these waterways can be obtained from the lock data available from the Navigation Data Center and summarized in the addendum exhibit D for the Lockport and the O'Brien locks. This data reflects the tonnage, number and type of vessels, and direction of vessel movement through the locks. The tabled data show that the number of lockages at O'Brien is 2.5 times that at Lockport; and the number of vessels served is 5 times the number served at Lockport. The data indicate that this differential is due to the far greater number of recreational craft using O'Brien. A comparison of "bottoms" - the combined total number of vessels and barges which have passed through a lock chamber - shows a difference less then 2 times in favor of O'Brien. And a comparison of tonnage locked reveals that O"Brien has served 60 percent less tonnage than has Lockport.

Figure 10 Barge Status Through the O'Brien and the Lockport Locks





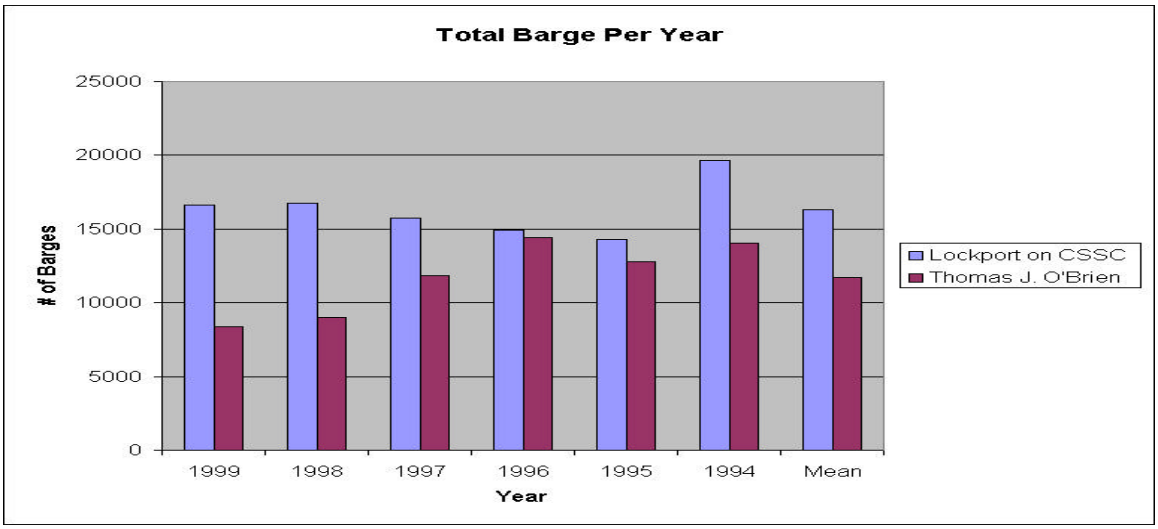


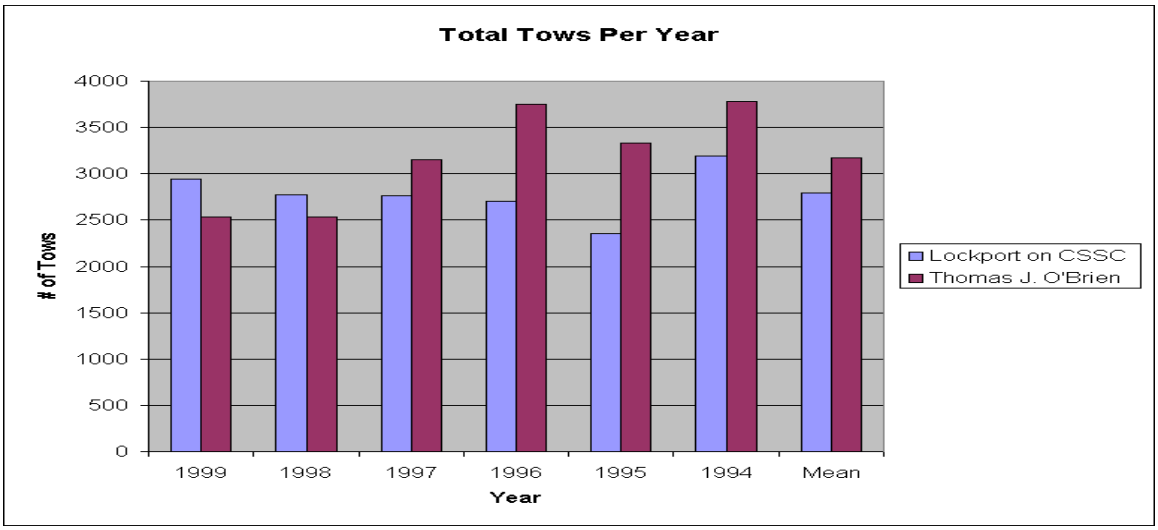


The pie charts in figure 10 above, charted from the data in addendum exhibit D, focus on the status of the barge movements through the locks. There is a greater percentage of loaded barges being served by Lockport in comparison to O'Brien, and these percentages show no evident trend over the 5 year time line presented in addendum exhibit D. Through Lockport most of the loaded barges are transiting upstream, verse downstream, by a factor of over 2:1, 44 percent to 19 percent. For O'Brien the loaded barge traffic is more level between the upstream and downstream barge loads, 31 percent to 27 percent, respectively, still favoring the upstream direction for loaded barges.

The time trend of the number of tows and barges using the two locks is further illustrated for five years by figure 11 below. The O'Brien lock shows a greater variability in the yearly number of total tows served. The Lockport lock shows a greater stability in the number of total barges served. On average, Lockport serves roughly 5,000 more barges per year, while O'Brien serves roughly 400 more tows per year. This comparison leads to the question of the combined tow assembly transiting the waterways in question. From the vessel trips by waterways data summarized in the addendum exhibit C, some simple ratio factors were derived to estimate a "generic" tow and barge configuration, which when applied in an economic evaluation as a mean tow and barge configuration should adequately reflect the activity on the waterway. The derivative factors and the ratio results are contained in the addendum exhibit E for the two years 1999 and 1994. A ratio somewhat greater than 3 barges per tow is shown to reflect the numbers of tows and barges employed in the commercial barge activity of these two waterways as monitored by the lock staistics. A sharp reduction in the ratio of short tons per barge is also revealed by summary data in addendum exhibit E. This nearly 50 percent reduction in mean barge tonnage between the two years is lacking an insightful explanation at this time.

Figure 11 Barge and Tow Numbers Served by the O'Brien and the Lockport Locks

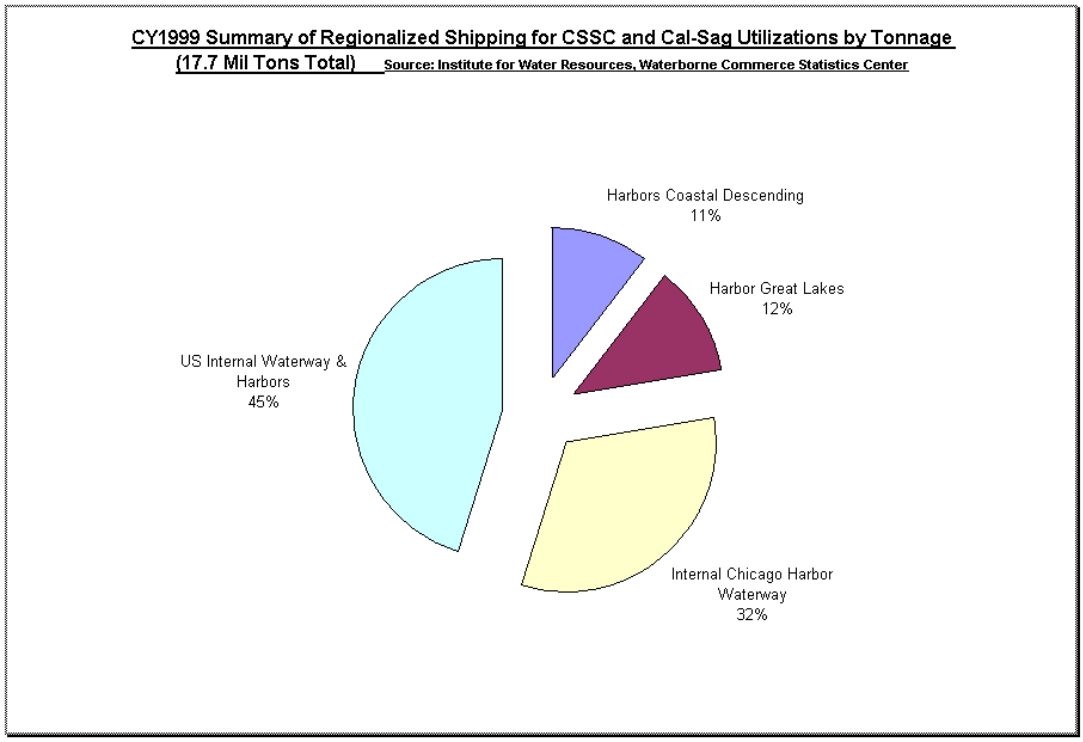




4. Origin and Destination Profiles for the CSSC and the CSC for CY 1999

In the prior three report sections the lock, vessel movement, and tonnage profiles for the subject waterways was profiled. A final understanding of the services from these waterways is captured in a summary of the detail data of shippers and receivers using the subject waterways. The Chicago District requested and received a detail data listing containing the domestic origin and destination traffic through the CSSC and the CSC for the latest year available, calendar year 1999 from the Institute for Water Resources, Waterborne Commerce Statistics Center, in New Orleans. This data was provided with the confidentiality statement pertaining to the details of the data records which are safeguarded in this summary report profile as presented in figures 12 and 13.

Figure 12 Shipping Tonnage and Trip Profiles for the CSSC for CY 1999



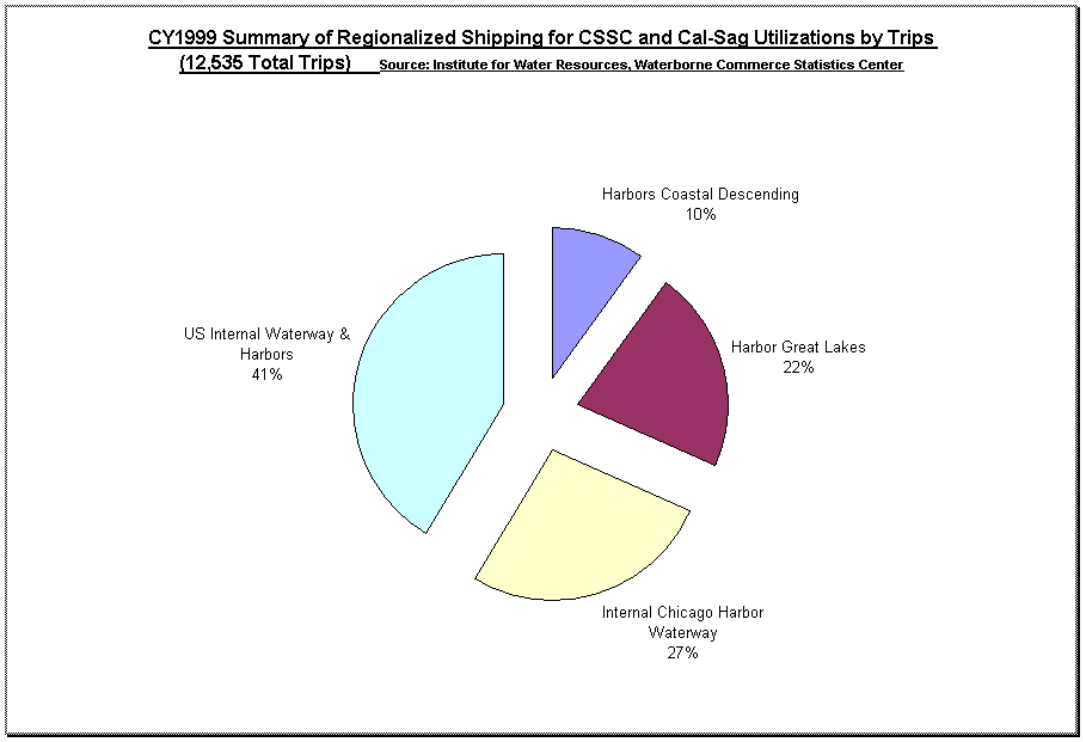
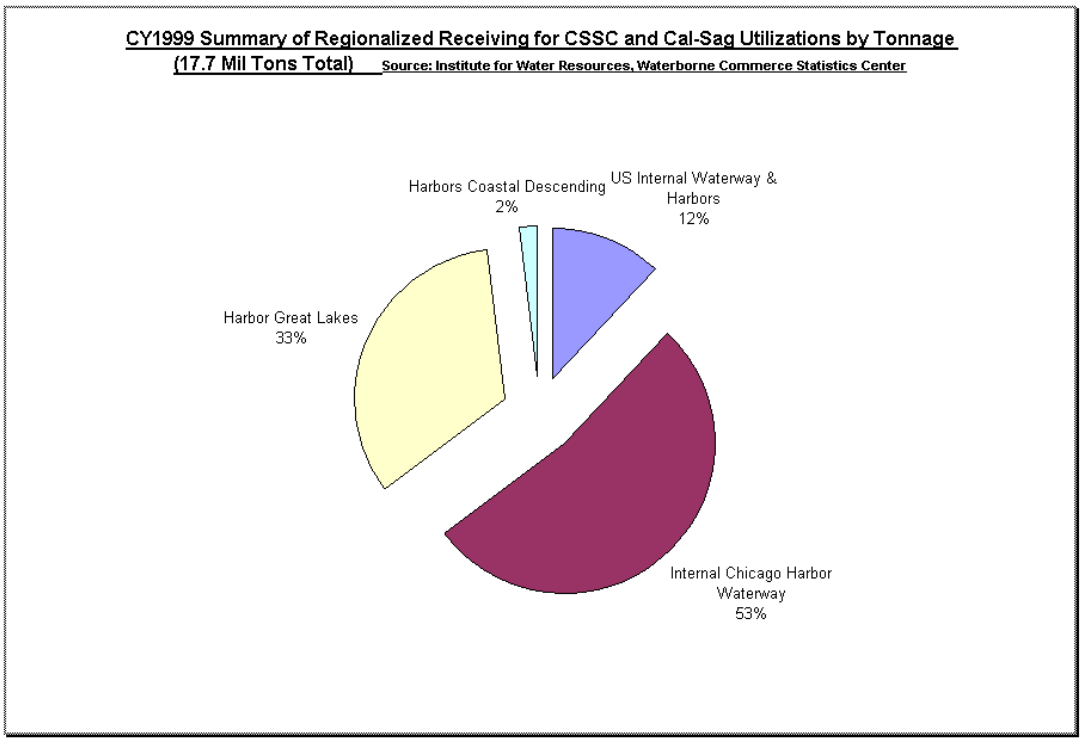
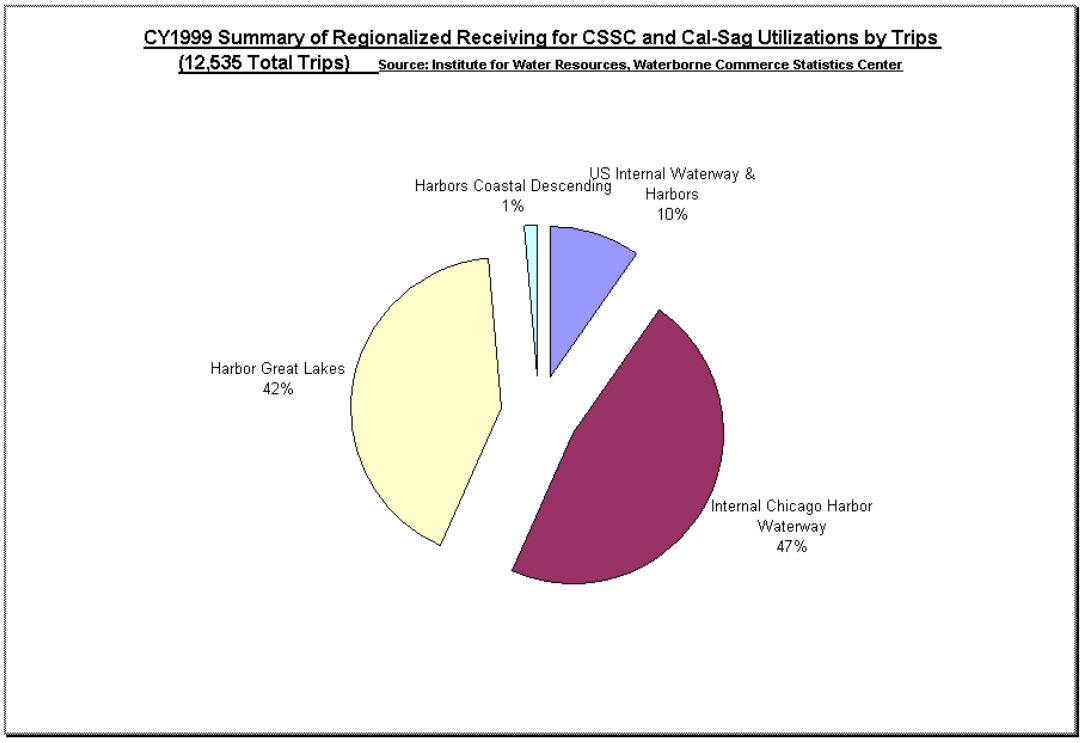


Figure 13 Receiving Tonnage and Trip Profiles for the CSSC for CY 1999





One approach to understanding the figures above is to finish the statement: "Of all the tonnage/trips transiting these two waterways in CY99, xx% was received/shipped by the ……"
Figures 12 and 13 reveal that these two connecting channels[vi] ship roughly 12 percent of their cargo to the Harbors of the Great Lakes and receive roughly 33% of their cargo from the Harbors of the Great Lakes (i.e., Burns Waterway Harbor, Gary IN, Indiana Harbor, Lake Calumet, Chicago Harbor, Ludington Harbor MI, and Lake Michigan IL IN MI and WI open water). If measured on a trip basis, these two connecting channels served the Great Lake Harbors in roughly 22 percent of the trips to the Harbors of the Great Lakes and receive roughly 42% of their cargo from the Harbors of the Great Lakes.

The dominant destinations for shipments using these connecting channels were not through external destinations but destinations within the channels themselves, roughly 53 percent. The dominant shippers of materials for shipments using these connecting channels were US Internal Waterways & Harbors, roughly 45 percent. The top five shippers depending on these connecting channel services were labeled Morris IL, Port of Baton Rouge, Port of Southern Louisiana, Ohio River mile 308, and Upper Miss River mile 274.

In summary, operators internal to the two channels accounts for 1/3 to 1/2 of their movements. Otherwise, the receivers benefiting are dominated by the harbors of the Great Lakes, and the shippers benefiting are dominated by shippers of the continental internal waterways and associated harbors.

SECTION 4. PROBLEM IDENTIFICATION

1. Geography

The Lemont reach of the CSSC, identified in this text as the 12.5 mile navigation reach between the Lockport lock and the confluence with the CSC as illustrated by exhibit I in the addendum exhibits this appendix, is very difficult and dangerous to navigate for numerous reasons. Among the factors contributing to a risk and safety concern is the original narrowness of the rock cut channel of 160 feet wide in this reach. This reach being a rock cut, there are no natural widenings of the canal for 10 miles from roughly mile 293.6 several miles upstream of the Lockport lock (291) to mile 303.4, the confluence with the Calumet Sag Channel. This ten mile reach incorporates a large bend in the waterway between river mile 296 and 299. It is on the upstream end of this bend - which travelling downstream redirects traffic from a West-Southwest direction to a South direction - that the most intense tug and barge mooring, fleeting, docking and servicing activity is located. This intense activity occurs over a five mile stretch from river mile 299 through the Calumet Sag Channel juncture. In a 2.5 mile reach, 299 – 301.5, there are 7 slips which have been constructed for barge and tow marine services. It is in this area where the fleeting and congestion is most severe.

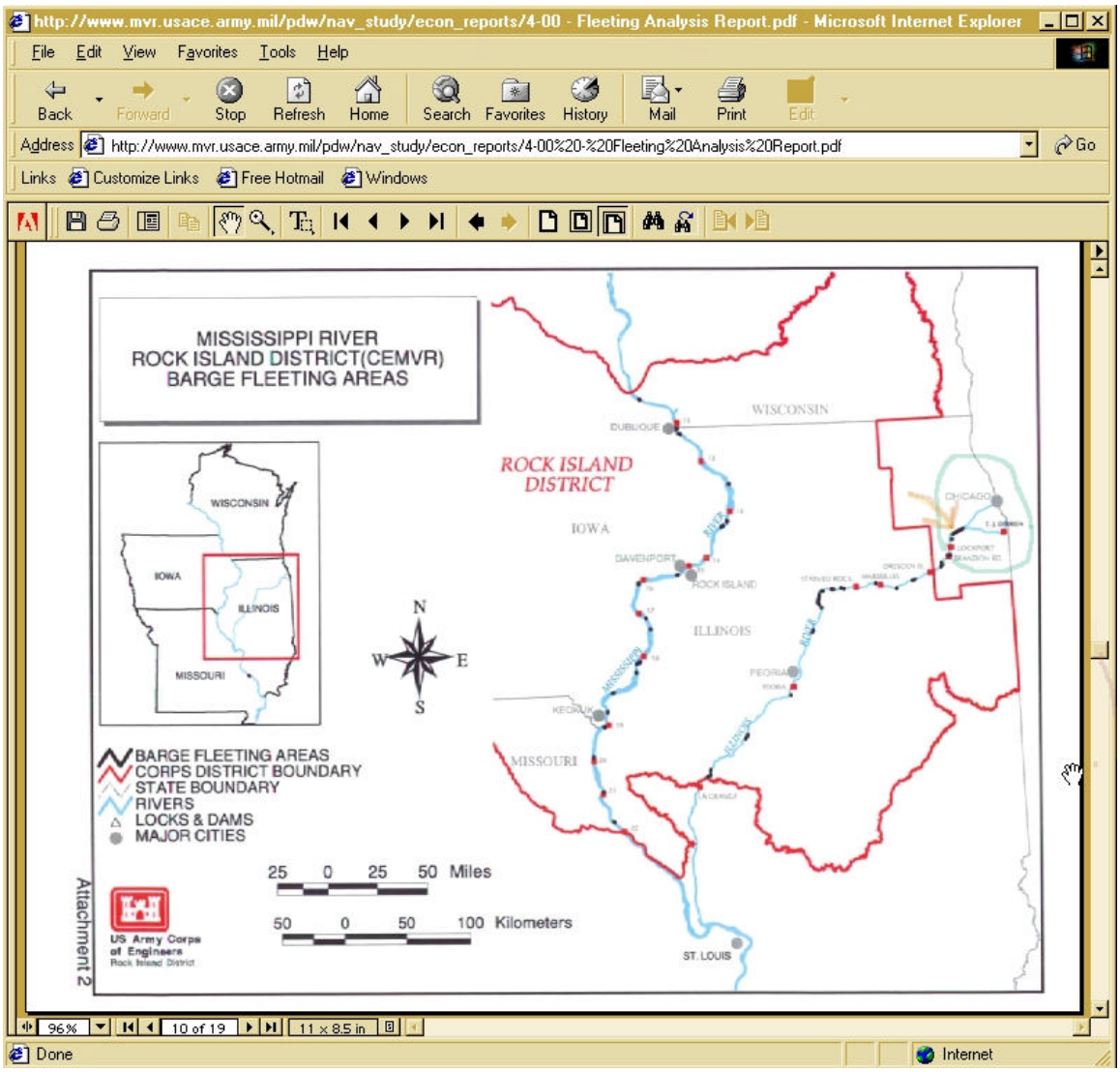
2. Low Bridge

An additional factor contributing to risk and delays in this reach is the low clearance for the Burlington Northern Santa Fe RR Swing Bridge at river mile 300.6. This bridge does not operate as a swing bridge and is effectively fixed with a vertical clearance of 19.1 ft.. Because of this severe vertical clearance, not only are larger line tows prevented from upstream navigation, but harbor tows which will navigate this reach must have telescoping pilot houses to operate. This down pilot house condition temporarily reduces the sight lines and increases the risk for the pilot of the tow and surrounding vessels and structures. Another impact from this vertical constraint is that light barges and stacked covered barges must at times be ballast or have their covers reconfigured in order to clear the bridge. Further, on a number of occasions each year, commercial vessels (i.e., Corps heavy crane barges, heavy equipment barge loads) and passenger vessels (touring and cruise vessels) are stymied from further navigation between the Mississippi and the Great Lakes and vice versa, due to this lowest bridge clearance. The actual bridge structure, which is a center hub rotating swing design, is not operable, and is discussed in detail in the cost estimating portion this appendix.. The low bridge constraint has been addressed by the industry via the telescoping pilot house tows, the termination of the line tow utilization before the bridge, the ballasting of 1-2% of the barges for clearance, and the rerouting of large equipment items along next best watercourse or transit options.

3. Fleeting and Docking Activity

The navigation servicing activity claims much space in the navigation channel of the CSSC. Barges and tows are moored in the channel on one bank or the other, frequently two abreast. If two abreast, the remaining channel width is reduced to 90 feet, limiting any tow to two conventional 35 foot barge widths wide. Some canal lengths have a single barge moored on the left and right banks. Barges on the left and right bank may be two abreast. In these instances the opposite bank is usually clear. The tow captain is required to navigate this 10 mile narrow reach, around a river bend, among moored and fleeting barges, among regular delays for oncoming traffic tows and operator's fleet activities, and among tow boats and recreational boaters navigating the same waters.

Figure 14a Upper Mississippi River Basin Study Fleeting Analysis Illustration Locating Lemont Congestion Area Constraining Inland and Great Lakes Navigation



A fleeting analysis preformed for the Upper Mississippi River – Illinois Waterway System Navigation Study, "Fleeting Analysis" Interim Report, April 2000, included this reach of the Chicago Sanitary and Ship Canal in their inventory of operators and barge capacities. Their inventory captured a capacity[vii] for 376 barges in this reach. This barge inventory was associated with 10 distinct operator locations between river mile 295.0 and 302.5 as defined in exhibit A in the addendum. The illustration in Figure 14a, extracted from the report PDF file available on the Rock Island District internet site (http://www.ursbethesda.com/umr-iwwsns/documents/4-00%20-FleetingAnalysisReport.pdf), shows the location of current interest in the perspective of the regional waterway structure.

An independent barge and tow inventory was completed by the Corps Chicago District from a series of September 1999 aerial photographs. For the critical Lemont reach, the 12.5 mile navigation reach of the CSSC between the Lockport lock and the confluence with the CSC, 316 barges were counted from the aerial including both chemical and bulk

cargo barges. Of the total 159 were counted along the banks, 147 were counted in operator slips, and 10 were in motion in the canal. This aerial inventory of barges is summarized in exhibit A in the addendum. Exhibit A also contains the aerial barge inventory for the upstream reaches of the CSSC, Little Calumet River, and Calumet River: The barges inventoried along these reaches from the photo are 11, 0 , 6, and 26, respectively. The inventory subtotals support the identification of the Lemont reach as an area of intense congestion. Most important, discussions with members of the Illinois River Carriers Association (IRCA), as with the Maritime Administration, also reflect the high concern of the industry with the delays and difficulties associated with this segment of the Illinois Waterway for commercial navigation.

4. Time of Transit

From discussion from significant long time intense business users of this segment of the watrerway is was learned that a straight through passage (e.g., best possible existing conditions) can be expected perhaps 15 percent of the trips and requires from 45 120 minutes to complete. An extremely delayed passage can be expected perhaps in 15 percent of the trips and requires from 4 - 12 hours to complete. It is not uncommon for tows to sit 3, 4, and 5 hours. (The other 70 percent of the trips the passage time would require an in between amount of time to complete.)

5. Risk and Safety

a. Collisions

In discussion with the Illinois River Carriers Association (IRCA) the risk and safety attributes of this reach were surfaced by way of discussion of recent collisions or allisions in the subject reach. The Coast Guard files on reported incidents, reviewed by personnel from the Chicago District at the local marine Safey Office in Burr Ridge IL, contained three reports from the past three years which resulted in damage to structure and / or cargo, and which could be directly attributable to the congestion, narrowness, and space constraints in the Lemont reach.

The most recent incident, from summer 2001, involved a multiple barge tow headed downstream colliding with a double width moored barge in the channel. This incident involved a snaking maneuver where the pilot was required to wiggle his tow in the space of channel which remained subsequent to fleeting and mooring activity along the banks of the rock cut channel.

In September of 2000 a single barge from a larger tow was holed and sunk in channel (See Figure 14) when it collided with rock debris along the side of the channel. The rock was from a crumbling rock wall. Inference from a Coast Guard Public Notice reproduced in addendum exhibit F, suggest that the tight constraints of the canal in this area, and the use of canal width for fleeting, contributes to a shortened life expectancy or a higher maintenance expense for the canal, as tow captains forced to navigate along a side wall of the canal will inadvertently bump the rock wall causing it to split and

crumble. As the rock cut walls fall into the canal, the risk of puncture increases, and the navigable portion of an already constrained navigation system grow worse.

A third incident from September of 1999 involved two moving tows when a double wide tow barge configuration heading downstream struck a tow vessel along side a double wide barge configuration heading upstream.

Vessel and cargo damages estimated in the reports for these three incidents are n/a, $23,000 and $42,000, respectively.

Figure 14b Sunken Barge, Looking DS, Confluence of CSSC and the CSC

Skilled and talented tow pilots are needed to safely transit this difficult waterway reach. Because the tow captain was able to maneuver this barge to the juncture point the waterway was not closed down entirely due do the sinking. Should a tow or barge sink in the narrow 160 foot CSSC channel, or should a barge or dockside related chemical spill occur in this reach, the entire navigation transport business would pause, incurring great navigation and transport delays, and sure secondary and multiplier impacts to shippers and receivers throughout the U.S.

b. Chemicals

Fortunately, the investigations for this study have not yet[viii] surfaced any serious incidents involving chemical spills into the waterway. However, there are several large waterside facilities within this congested segment which do a freight movement business in petroleum and chemicals (e.g., anti freeze, benzene, glycol styrene). As shown in figures 5 and 6, the petroleum and chemical movements combined represent the dominant product moved on the CSSC. For the CSSC in total, the list below provides a feeling for the intensity of this business segment along the waterway:

INTAC Automotive Products, Lemont Plant Wharf.
K. A. Steel Chemicals Wharf.
Powell Duffryn Terminals, Lemont Wharf.
Rowell Chemical Corp., Willow Springs Terminal Wharf.
Valvoline, Willow Springs Wharf.
Shell Oil Co. and Argo Terminal Co. Wharf.
GATX Terminals Corp., Argo Terminal Wharf No. 1,2,3.
Trumbull Asphalt, Summit Plant Wharf.
Lake River Corp., Main Wharf.
Amoco Oil Co., Chicago Terminal Wharf.
Petroleum Fuel and Terminal Co., Chicago Division Wharf.
J. M. Sweeney Co., Cicero Terminal Wharf.
Koppers Industries, Stickney Terminal Wharf.
Olympic Oil Wharf.
Citgo Petroleum Corp., Cicero Compound Plant Wharf.
Mobil Oil Corp., Cicero Avenue Dock.
Ameropan Oil Corp., Bell Oil Terminal Wharf.
Apex Motor Fuel Co. Wharf.

The heavy chemical and petroleum business in these two waterways is also reflected by the large number of tanker barges employed, as presented in addendum exhibit C. In this exhibit, as reflected as the percentage of tanker barges in use as a percent of all non-self propelled barges, the CSSC average is roughly 23 percent for all five years 1994-99. The same five year average percentage for the CSC is roughly 18 percent tanker barges of all non-self propelled barges in the data base. This high level of chemical business existing on the waterways should heighten the concerns for risk and safety as an argument to provide some relief to the difficult navigation challenges facing the users of this waterway segment.

c. Flood Control Water Diversions

The Metropolitan Water Reclamation District (MWRD) of Greater Chicago has some control over the CSSC water levels in order to prevent catastrophic flooding in downtown Chicago. More than 15 times a year on average the Lockport pool is drawn down in anticipation of heavy rains to provide additional flood water storage within the waterway banks. During these draw downs, although the CSSC has, in general, a depth in excess of 20 feet, and usually a depth of 26-28 feet, river navigation is slowed or halted, depending on how near to the open sluice gates or operating Lockport Controlling Works (discussed below) the tow is located. The closer the tow is to the lock, the greater the threat to navigation. At times, the draw down is so great that tows near the lock touch bottom and safety maneuvers must ensue to not loose any barges from the tow. On a less frequent basis, an additional facility to draw down the CSSC, located 2.2 miles upstream of the Lockport lock is operated. This facility known as the MWRD butterfly dam and controlling works, will discharge water directly from the CSSC to the neighboring DesPlaines waterway at the downstream descending side, river mile 293.2. Members of the IRCA have related how powerful and threatening the hydraulic forces created by this

process can be, especially since often the tow captains have not received prior warning of the draw downs.

d. Other Traffic and Other Problems

The use of this waterway by recreational boaters is viewed as a small but potentially growing and serious problem for commercial navigation in the study waterway segment. Recently an incident involving a speed boater racing along the CSSC in the location of the restrictive RR bridge did damage to barge equipment docked along the side of the waterway. Damage was caused by the huge wakes created by the speeding craft in the narrow channel. With talk of increasing the number of small boat harbors along the CSC or CSSC, the captains are concerned that pleasure boaters, should their numbers increase, will only contribute to the current congestion and delay prone navigation challenges. Finally, probably due to the effects of barge fleeting along the waterside and captains not quite squeezing through without canal side bumping, a portion of the stone CSCC wall just downstream of the CSC juncture, (descending right wall) has crumbled and fallen into the canal creating a navigation hazard which has contributed to one barge being sunk as discussed previously. Although the tow captains have learned to avoid this reach, this condition adds another element of danger contributing to risks, and another reason for delays in navigation over this reach.

SECTION 5. OPPORTUNITIES

The Calumet-Sag modification, authorized by the River and Harbor Act of 1946 provides for widening the CSSC to 225 feet from the Sag Junction to Lockport; replacing three highway bridges in this reach and two in Joliet; and replacing the existing emergency dam above Lockport. This authorization has been deferred for further study, although a number of restrictive bridges have been replaced. Reference the first endnote to this Appendix for more information.

Obviously, the need to widen the CSSC channel has been seen as a solution to this navigation traffic bottleneck problem for many decades now. Over time, as the lands surrounding the canal have filled in, and the level of waterside users has increased both in numbers and size, the difficulty in completing this vision has also increased. Still, a number of opportunities have been discussed among the users and those involved in the waterway through administrative and regulating authorities which may be evaluated further.

This economic analysis will now turn to the proposals which may relieve the congestion and reduce the risk in these connecting waterways.

1. Provide Additional Mooring Areas

Providing additional areas for mooring would be a direct response to the growth in congestion along the canal banks which has proven the biggest difficulty to tow captains and to a more time saving delivery of products. This is a sticky issue since many of the tow captains are employed by the operators who fill the canal banks with their moored barges. A few suggestions have been recommended to increase the mooring supply.

a. Three Mile Wall

Many operators believe making available mooring areas along the 3 mile wall, a CSC north bank wall directly upstream of the juncture (the right wall descending), would alleviate much of the congestion in the CSSC canal. The land use for this property is designated “corporate use channel maintenance & access” by the owner: MWRD. The land in the vicinity immediately off the bank is Cook County Park District, Forest Preserve land. This use extends for nearly three miles upstream from the junction. The bank is rock cut and is suitable for tie-off (e.g., dead men, cable and chain). Not the entire three mile length is vacant unused. Nearest the juncture on the CSC Illinois Marine Towing has their Lemont Cal-Sag Mooring operation which extends from mile 303.9 to mile 304.1 and has a capacity for 5 barges. The Illinois Central Railroad Company and the Illinois DOT also own portions of the mooring. For a three mile length, this reach would have an estimated capacity for 75 standard 200 foot length barges allowing for 10 foot spacing between each. Many of the tanker barges are larger size, of 290 by 50 dimensions. Use by the larger tank barges would reduce the overall

capacity but would not impair the overall goal of the additional area - to relieve obstruction in the narrow CSSC caused by moored barges.

b. Widen the CSSC

There remain areas along the banks of the CSSC proximate to the areas of congestion which could be widened by 50 to 60 feet along the left side descending, from the Lemont RR bridge to the Romeo Highway Bridge. Not only would widening allow for moorings outside the current channel, but it would also potentially allow for a passing area, where one tow could pull aside to let another vessel or tow pass without having to delay at the extreme upstream or downstream end of the 10 mile long Lemont narrows. A review of diagrams provided by MWRD on their internet site[ix] indicates the existing use for right of way consideration of channel banks. Reviewing this information resulted in two lengths within the strategic location that are not currently shown as leased, but are shown as vacant. One location is a half mile stretch just downstream of the restrictive RR bridge in Lemont, RM 300 – 300.5 left bank descending. The second location is a 1.2 mile reach at the downstream portion of the bend in the canal, RM 296.2 to 297.3 left bank descending. Widening of one or both of these canal areas to permit passing, or/and to accept moored barges , which would otherwise be in the narrow canal, or/and to permit for a tow turning maneuver, would serve to relieve the congestion in the area. Using a 25 barge per mile accommodation factor the two sites would provide 1.7 miles of mooring potential for 42 at single width and 84 at double width.

c. Quarry Utilization

A third opportunity involves opening a large existing flooded quarry in Lemont for commercial navigation utilization. From approximately RM 301.11 to 301.4 along the left bank descending, ¾ of a mile upstream of the restrictive Lemont RR bridge is an abandoned quarry known as “commoners quarry.” This quarry site is the largest of a group of eight abandoned and flooded quarry sites or pockets between the CSSC and the I&M canal waterway, between RM 300.8 and 302. A number of the smaller quarry sites are under consideration by the Village of Lemont for recreational or/and conservation use. The “commoners” site is situated opposite bank from three slips on the right bank descending known as Lemont industrial slips A, B, and C in the Corps navigation chart records. The owner of the slips is shown as the MWRD, and the operators are some of the larger commercial operators in the area. The quarry site is approximately 2000 ft in length and 800 ft in width, covering approximately 37 acres. Based on square footage the quarry site could store 195 standard size barges allowing for five feet spacing of the barge length and width. Factoring the storage capacity by .7 (reference endnote vi) to estimate the utilization capacity of the quarry yields an estimate of 137 standard size barges for fleeting or servicing purposes. Alternatively, a portion of the quarry site could be used for a turning basis or a passing notch. The location of the site is in the most heavily congested area of the 10 mile Lemont narrows. The land bridge separating the quarry from the CSSC is approximately 175 feet in width.

2. Provide Additional Turning Basin or Passing Cut

This opportunity was included in the previous discussion on additional fleeting area. If there are reasons to refrain from proceeding with fleeting areas, the same three areas mentioned above could be dedicated to improve the navigation environment in the bottleneck area by their use as a maneuvering basin or a passing notch.

3. Remove the Vertical Restriction from the Burlington Northern Santa Fe RR Bridge (Lemont RR Bridge)

The navigation constraints caused by the vertical limitations of the Lemont RR bridge have been discussed in the problem identification section of this appendix.. Should this constraint be relaxed via raising the bridge or returning it to a swing operation, the impact would be to permit all tows requiring no more than 24.4 ft. vertical clearance to navigate clear through the CSC to the Great Lakes. This would be roughly a 5 ft. improvement over the existing vertical limits from this single bridge constraint. They would not be able to use the CSSC into the Chicago Harbor Lock due to many additional vertical constraints along the CSSC beginning at river mile 312 of the CSSC. Additionally, the need to ballast barges which are not continuing up the CSSC beyond river mile 312 would be removed. The cruise ship or promotional vessels (e.g., the "Niagara Prince") wanting to navigate through Lockport lock would be allowed. The large commercial crane barges and large equipment and parts movers (e.g., the Corps Crane Barge "Hercules") would also gain access through the currently vertically constricted portion of the waterway allowing connections between the Great Lakes, the Illinois and Mississippi Rivers, and the Gulf ports, and beyond. An additional benefit would be the safety enhancement of not having to lower the pilot house thereby maintaining maximum field of vision for the tow captain. This drawback in made more tangible since, in this area, distances between structures are so short that navigation radar is useless.

4. Additional Mooring Commentary

a. <u>Propriety Mooring</u>

The governance of waterway bank usage for barge mooring is often not clear. Certainly most of the mooring space in use is proprietary in the sense that leases are granted by the property owner to the user, or the property owner is the user. Still stories are heard of barges being moored to tree trunks and in areas which are either not officially authorized or in areas which cause a navigation safety hazard. The code of honor among the barging interest concerning barge mooring spaces has not been found to be written. A competitive self-governance, which may or may not lead to an efficient overall commodity movement operation, may be the rule in what appears to be a laissez faire environment. An effective restriction of barge moorings in this narrow channel to one wide would eliminate a great deal of congestion, yet the communication back from the industry is that this is not feasible given the need to assemble and dissemble barge tows in this area of high barge service and cargo transfers.

b. Free Mooring

One industry spokesman has suggested that the additional mooring areas along the 3 mile wall be “free fleet,” or open to users on a non-propriety basis. Some information has been obtained that, in precedence, there are “informal” anchorage along the Columbia River for which the Corps has provided several large mooring buoys to prevent them from drifting into the main channel.

c. Coast Guard

Addendum exhibit F, a fairly recent public notice from the Coast Guard, Captain of the Port of Chicago, recaps the chief problems identified in the area. Two clarifications should be noted in regard to this document: the reference in item 1.c. should be to the CSC and not the Calumet River; and clarification on the Corps permitting role for fleeting purposes is needed. The Chicago District permitting section chief has related that the Corps does not regulate fleeting. The Corps regulates structures. If structures are to be placed in the water to tie up, then a Corps permit is required. If structures are placed to tie up above the ordinary high water mark, a Corps permit is not needed. Fleeting and anchorage areas are regulated by the Coast Guard.

SECTION 6. ECONOMIC EVALUATIONS

A spreadsheet evaluation model has been constructed which provides an estimate of the cost savings to the navigation community if trip time is reduced due to any reason. The benchmark for this comparison is a depiction of the navigation cost incurred under the current conditions of the subject study reach: the CSSC between the Lockport lock to the Cal-Sag junction. The approach is a non dynamic estimator which does not include consideration for risk and uncertainty, and is consistent with data and method which may be employed in a reconnaissance study level analysis.

1. Parameters Used in the Evaluation Model

There are three significant components to the evaluation model: a profile of the existing condition navigation traffic; an estimate of the associated cost for the traffic profiled; and the imputation of a travel time frequency schedule - in this case set as a monthly scenario. The first two components are input sets. The input sets used are presented in addendum exhibit G (1/2). The third component, the frequency travel time schedule, also contains the framework for the with project scenarios, and is presented in addendum exhibit G (2/2). The scenarios presented are referenced to navigation records for usage of the CSSC for the year 1999 as previously presented.

2. Notes on the Model Inputs

a. Tug or Tow Trips

The inputs used as presented in addendum exhibit G are the annual vessel trips (i.e., tows or tug) recorded for the CSSC for the year 1999. This input datum can be traced back to information presented in addendum exhibit E. The source as cited is the Navigation Data Center.

b. Barge Count Per Tow

This input is a derived ratio which is also traced back to information presented in addendum exhibit E. The value is the mean number of barges per tow or tug derived by simply dividing the barge count total by the tow and tug count total on the CSSC for the year 1999.

c. Barge Type Amalgam

Three types of barges have been distinguished for these evaluations: the standard size (i.e., 200’ x 35’) dry cargo barge; the standard size tanker barge; and the oversized tanker barge. Data presented in addendum exhibit C, as discussed earlier in this attachment, reflect the mix of dry cargo to tanker on the CSSC to be roughly 75/25 over the 5 years of record. Further inquiries to the District field personnel indicate that of the tanker subset, roughly 65 percent are estimated to be oversize. These input percentages can be seen represented on addendum exhibit G (1/2).

d. Barge Type Daily Costs and Amalgam Costs

For each of the three barge types a daily cost was derived from selected weightings for the many variations of vessels provided in annual Corps guidance (i.e., Economic Guidance Memorandum 00-05, FY 2000 Shallow Draft Vessel Operating Costs) which is accessible through the Corps HQ internet site. As presented in the addendum exhibit G(1/2), the daily cost derived were $101.35, $328.12, and $531.12, respectively. The amalgam cost for a barge, averaged out to $191.03. This guidance also provides daily tow boat cost. The selected weightings for tow boats amounted to a daily value of $2,419.07. This value far out weights the barge count per tow total of $645.26.

e. Average Tow and Barge Configuration Daily Cost

To derive the "average" tow and barge configuration daily cost is simply a matter of adding the cost for the tow and the cost for the barge configuration, which amounts to a total daily cost of $3,064 (2419.1 + 645.3).

3. A Typical Month of Navigation Expense – Baseline Conditions.

Addendum exhibit G (2/2) shows the spreadsheet evaluation model. The 31 roles reflect 31 days in a month. Some error is introduced by not using a true average month duration, however since the month configuration is used to derive the "average transit time" over the entire month this error is not significant. A 31 day month would be very nearly the same as a 28 day month. Each day of this symbolic month is assigned a time of transit. This time of transit is based on comments drawn from a few men in the industry who have experience and personal knowledge of these matters. The sources did not necessarily agree. What is patterned as the second column in addendum exhibit G (2/2) is the baseline trip time frequency schedule as synthesized from their responses. The way to read the exhibit would be to notice that for 3 of 31 days a travel time of 45 minutes is imputed. This reflects field comments to the effect that 15 percent of the time tows can transit this reach in 45 minutes. At the other extreme, for 3 of 31 days a travel time greater than 300 minutes is imputed. This reflects field comments to the effect that 15 percent of the time it takes over 4 hours to transit, and can take up to 12 hours.

Under baseline conditions, the average monthly travel time is shown to compute to 182.2 minutes. Multiplying this average travel time estimate by the number of annual trips yields the total annual transit time in minutes. This figure can then be converted to days as presented in the addendum exhibit G (2/2).

4. A Typical Month of Navigation Expense – Project Conditions.

This evaluation model is intended to capture savings from plans which would reduce congestion or restrictions, and thus decrease the travel time required through the subject reach. The object is to estimate the anticipated time saving as dollar benefits. The addendum exhibit G (2/2), presents dollar benefits in PL2000 for four time saving scenarios: 15, 30, 45, and 60 minutes. The yearly dollar benefits are computed based on subtracting the time saving scenario amounts from the baseline time imputed amounts.

For example: Say, a plan would reduce the transit time by 30 minutes. The baseline transit times are reduced by 30 minutes for each daily estimate of transit time, except that no transit time is allowed to drop below the 45 minute efficiency time. Due to this exception, there is a diminishing marginal return as time saving intervals are increased. The annual value of time saved in the four scenarios presented range from $168,000 to $618,000.

5. Plan Benefit Estimates Based on the Trip Time Savings Evaluation Model

There are many reasons for delays in navigation transit time in the study area. Some reasons for delays are the arrival rate of towboats, the departure rate of towboats, the speed of barge turnover, the limitations of available space, recreational vessels, high winds, fog, diverted flows through the lock (i.e., draw downs), and service-fleeting-docking congestion. The heaviest traffic seasons are two: in the Spring from March to mid-May, and the harvest season from September to Thanksgiving.

Of the opportunities presented in Section 5, the benefit to trip time savings would be attributable to freeing up space and reducing congestion (decongestion). The other sources for delays in transit time would not be affected. Under perfect conditions, if all trips were transited in the minimum 45 minutes, the annual time saving benefits over baseline conditions are estimated by the model to be $1,718,500. For estimating purposes, assume that freeing up space and reducing congestion could, at best, allow for 50% of the perfect condition benefit estimate, or, $860,000 annual time saving benefits. An 89 minute savings, used for an input scenario in the evaluation model, would provide the "maximum" $860,000 benefit from congestion relief. The other 50% of benefits estimated from an ideal condition, will be "left on the table" to account for the multifarious sources of transit delay.

Estimated time savings may be applied to the potential fleeting areas: the 3 mile wall, the canal expansion, and the quarry site conversion. The proposal with the greatest apparent impact would be the quarry site conversion because of its size and its central location. Because the 3 mile wall site is roughly twice the size of the canal expansion site this would probably have the next greatest level of beneficial impact. An estimate of the benefits associated with these sites should consider both their size and their location.

a. <u>Quarry Site Benefits.</u>

Turning to the quarry site, a level of benefits may be premised on consideration of the capacity of the site and the site location. The capacity has been estimated to accommodate 137 barges, as discussed in Section 5. Compared to the barge inventory from the aerial photograph, which enumerated 159 barges on the waterway banks, as presented in the addendum exhibit A, this represents 86% of the barges along the canal banks. Consideration should also be given to the location of the quarry site, which is in the heart of the congestion. Therefore it is estimated that the quarry site would provide 86% of the maximum potential benefit from decongestion, and there should be no diminishment due to location considerations. The annual benefit for the conversion of the quarry site for additional fleeting purposes is estimated to be $741,000.

b. 3 -Mile Wall Benefits.

The single width capacity of the 3 mile wall site has been estimated to accommodate 75 barges, as discussed in Section 5. However since there is accommodation for a 5 barge mooring currently active along this site this estimate will be reduced to 70. The CSC is 220' wide compared to 160' width for the CSSC. It is likely that utilization of the 3 mile wall site along the CSC would be at the two barge width dimension. In recognition of this potential, the 70 single width barge estimate will be increased 50% to a 105 barge capacity estimate for benefit estimation purposes. Compared to the barge inventory from the aerial photograph, which enumerated 159 barges on the waterway banks, as presented in the addendum exhibit A, this represents 66% of the barges along the canal banks. Consideration should also be given to the location of the 3 mile wall site, which is at the extreme upstream end of the congestion. This location is a few miles distance from the heart of the congestion centered around the Lemont RR bridge. Furthermore, this location will induce traffic at the juncture of the CSC and CSSC, where turning tows are common. Therefore, due to distance and interference with juncture traffic, a site location diminishment factor of 50% is to be applied to this site capacity decongestion benefit estimate. The annual benefit for the utilization of the 3 mile wall for site for additional fleeting purposes is estimated to be $284,000.

c. Canal Widening Benefits.

The single width capacity of the canal widening site has been estimated to accommodate 42 barges, as discussed in Section 5. It is likely that utilization of the canal widening site, if widened to 60 feet or more, would be at the two barge width dimension. In recognition of this potential, the 42 single width barge estimate will be increased 75% to a 74 barge capacity estimate for benefit estimation purposes. Compared to the barge inventory from the aerial photograph, which enumerated 159 barges on the waterway banks, as presented in the addendum exhibit A, this represents 46% of the barges along the canal banks. Consideration should also be given to the location of the canal widening site, which is at the downstream portion of the congestion. This location is also a few miles distance from the heart of the congestion centered, around the Lemont RR bridge. However, this location will not induce traffic at the juncture of the CSC and CSSC, where turning tows are common. Therefore, due to distance, a site location diminishment factor of 75% is to be applied to this site capacity decongestion benefit estimate. The annual benefit for the utilization of the canal widening site for additional fleeting purposes is estimated to be $298,000.

These benefit estimates are not comprehensive as they do not account for increases in safety and reduction in collision damage which would ensue. They should be considered as the principal quantifiable component of the potential benefits from these plans.

Benefits from providing for turning basins or passing cuts, would not be as great as the benefits estimated for the decongestion provided by the provision of fleeting areas. To the extent that a fleeting area site could be used as a turning basin or a passing cut, this would diminish the fleeting capacity of the site. And along the 3 mile wall site these function would not be so useful since the juncture area can be used for these purposes. These substitute functions would be most useful at the canal widening site, which is

roughly midpoint between other possible maneuvering areas. This is an additional qualitative benefit for the canal widening site.

6. Benefits Estimates for Re-operation of the Lemont RR Bridge

The benefits from this proposal are difficult to establish. Industry contacts have indicated that they have accommodated to the vertical bridge constraints and are operatively accustom to it. A review of the Coast Guard incident reports reveals that the bridge downstream of Lockport lock at river mile 276 is producing far more incidents then the Lemont RR bridge at river mile 300.6. Quantitatively, if operational, it could be expected to reduce the need for ballasting operations greatly. At the extreme, assuming ballasting takes place solely for the Lemont RR bridge passage, and not upstream bridges on the CSSC, the time savings can be estimated at 3 hours, times 5887 annual tows, times .015 requiring ballast, times $3064/day, divided by 24hrs./day: equals $34,000 average annual savings attributable to ballasting time savings. Saving due to not having to use the telescoping pilot house tows and allowing the line barges to navigate further upstream along the CSSC and through the CSC (if not taller than 24.4') have not been quantified. Additional benefits of allowing passage for commercial cruise ships, equipment barges and other tall vessels have not been quantified. This proposal can be flushed out further in another study phase. One consideration for giving it pause is that the Lemont RR Bridge is functional, and any plan to make it again operational as a swing bridge would entail cost for both operations, which would be labor intensive, as well as disruption cost to the RR timetables. All in all the industry did not appear to think this plan would be their number one priority for the problems identified in this study area.

SECTION 7. ECONOMIC BENEFIT AND COST ESTIMATES

More specifications on the plans considered as well as some details on the plan cost estimates are currently available for two proposals: re-operation of the Lemont RR bridge and providing for pin moorings along the 3 Mile Wall. These cost estimates are incomplete as they do not include lands, easements, relocations and rights of way, but do include a fifty percent contingency, and estimates for engineering and design and construction management. This information will be presented in a separate report section yet to be determined. The cost estimate available for re-operation of the Lemont RR bridge is $3,016,000. The cost estimate for mooring piers along 1 mile of the 3 Mile Wall is $1,208,000. Expanding this estimate out to the 2.8 miles of wall not yet being used the total cost is $3,081,000 (holding engineering and design and construction management estimates constant).

The annualized available cost estimates, at the discount rate of FY01 .06375, over a 50 year project life, are $205,830 for the 3 Mile Wall and $201,436 for the Lemont RR bridge. Available quantified benefit estimates for these two plans are $284,000 and $34,000, respectively. The resultant benefit and cost ratio for these two plans are 1.38 and .17, respectively.

Summary of Average Annual Benefits by Category
Lemont Reach, Chicago Sanitary and Ship Canal

Alternative	First Cost	AAEC	AAEB	Net Benefit	BCR
Quarry site	n.a	n.a	$ 741,000	n.a	n.a
3 mile wall	$ 3,381,000	$ 225,820	$ 284,000	$ 58,180	1.26
Canal widening	n.a.	n.a.	$ 298,000	n.a.	n.a.
Lemont RR bridge	$ 3,016,000	$ 201,436	$ 34,000	$ (167,436)	0.17

SECTION 8. ENDNOTES

[i] IN EXCERPT: **Water Resources Development in Illinois 1995**, USACE, Chicago District pages 51-53:
The Illinois Waterway, the connecting link between the Great Lakes and the Mississippi River navigation systems, is one of the nation's busiest routes for commercial barge transportation. It handled 167,932,012 tons of commerce in 1992.
The 1992 commodity breakdown is as follows: Farm Products 22% Coal 21% Petroleum 14% Other 43%
Included in the waterway are the Chicago, Des Plaines and Illinois rivers, plus several canals, in particular the Calumet-Sag Channel and the navigable portions of the Little Calumet and Calumet rivers.
Illinois history reveals that the Illinois River was already being used as an uncharted path for Indian canoes when the early explorers Father Marquette and Jean Nicolet made use of it for their primitive craft.
As early as 1822, the U.S. Congress recognized the potential of the stream for interstate commerce and passed the first of several improvement acts, which resulted in 1848 in the completion of the Illinois and Michigan Canal linking Lake Michigan to the Illinois River at LaSalle, Ill. Mule drawn barges plied this early canal.
The state of Illinois in 1871 completed two locks and dams on the Illinois River, and the federal government built locks in 1873 at Kampsville and La Grange to provide a seven-foot depth from the mouth of the river at Grafton to LaSalle. These locks were 75 feet wide and 350 feet long.
In 1900, the upper end of the Illinois and Michigan Canal was replaced as far south as Lockport by the Chicago Sanitary and Ship Canal, which, though constructed primarily for sanitary purposes, also provided sufficient depth for navigation. In 1908, voters in the state of Illinois took a further important step by approving a $20 million bond issue to fund the canalization of the Des Plaines and Illinois rivers from Lockport to Utica. However, construction was not begun until 1921.
In 1922, the Metropolitan Sanitary District of Greater Chicago completed construction of the Calumet-Sag Channel to prevent pollution of Lake Michigan by reversing the flow of the Calumet River. The channel connected the heavily industrial area surrounding the Calumet River with the waterway.
In 1930 the federal government, by authority of the Rivers and Harbors Act enacted in that year, assumed responsibility for the still unfinished improvement completed the project and opened the Illinois Waterway to navigation three years later. Since that time it has been maintained and operated by the U.S. Army Corps of Engineers.
Since 1988, the Illinois River has been studied in order to determine what navigation structure improvements, if any, need to be made to usher the waterway into the next century and beyond. The Corps' 1988 Inland Waterway Review identified La Grange, Peoria, Lockport and Marseilles locks as being among the 20 locks in the country with the highest average delays in 1987 and in the greatest need of improvement.
The St. Paul, Rock Island and St. Louis districts have recently undertaken an Upper Mississippi-Illinois Navigation Study performing detailed systemic environmental, engineering and economic studies with the goal of prioritizing capital improvements to the navigation system.
The Illinois Waterway was further improved during the years 1936 to 1938 with the construction of two modem lock and dams, Peoria and La Grange, which replaced four outmoded installations between Utica and Grafton. In 1960 the Thomas J. O'Brien Lock and Controlling Works was completed on the Calumet River. Today, the waterway is completely canalized with a minimum depth of nine feet over its entire stretch of 327 miles, from its junction with the Mississippi at Grafton to Lake Michigan at Chicago Harbor and at Calumet Harbor and River.
The principal commodities moved on the Illinois Water- way are coal, petroleum products, grain, soy beans, sand and gravel, sulphur and other chemicals and iron and steel products. Cargo is carried in open or covered barges made up in tows of from one to 17 barges pushed by towboats. In 1935, the commercial traffic on the waterway amounted to 1,695,000 tons, but by 1975 it had climbed progressively to a record-breaking 47,242,597 tons.
Pleasure craft are heavy users of the waterway, which also provides many recreational opportunities, including parks at the locks themselves, 10 state and several municipal parks, a state forest and 14 conservation areas along the waterway banks. In addition, 39 boat clubs, marinas and service areas for

small boats are maintained by communities or organizations, encouraging residents and visitors to enjoy the tributaries of the waterway.

The waterway section from Lake Michigan to Lockport is about 36 miles long. It is controlled at one end by the Thomas J. O'Brien Lock and Dam located near the Lake Calumet area and at the other end by Lockport Lock and Power House. Passing through the Chicago metropolitan area, the waterway uses the Chicago River, the south branch of that river and the Chicago Sanitary and Ship Canal as well as the Calumet and Little Calumet rivers and the Calumet-sag Channel. The waterway can be entered from Lake Michigan through the Chicago Lock (on the Chicago River) operated by the Chicago District, U.S. Army Corps of Engineers, or through Calumet Harbor and River.

From Lockport south, some 60 miles downstream, the waterway falls 139 feet. In this stretch it uses the Des Plaines and Illinois rivers and consists of a series of four pools that have been created by permanent dams and locks. Locks and dams controlling navigation along this stretch include Brandon Road, Dresden Island, Marseilles and Starved Rock. The lifts at each of the locks are: Lockport, 39.5 feet; Brandon Road 35 feet; Dresden Island, 21.75 feet; Marseilles, 24.75 feet; and Starved Rock, 18.5 feet.

Through the 231 miles from Starved Rock to Grafton, the waterway falls more gently. There are lifts of I I feet at Peoria Lock and IO feet at La Grange Lock. Below La Grange, to Grafton, a distance of 80 miles, the route is maintained for barge traffic by Lock and Dam No. 26 in the Mississippi River at Alton.

Nine-foot depths are provided by two navigable movable dams located at Peoria and La Grange. During periods of low water, these dams are raised to provide sufficient depths. Navigation utilizes the locks to move progressively from one pool to the next. During period of high water, when ample depths are available, the dams are lowered to the bottom and navigation passes freely over the lowered dams without the necessity of lockages.

Seven of the eight locks on the Illinois Waterway are 110 feet in width by 600 feet in length. The Thomas J. O'Brien Lock on the Calumet River is 100 feet in width by 1,000 feet in length.

All eight locks can handle a towboat and eight jumbo barges in one lockage. In the upper sections of the waterway, the six locks are electrically controlled; the lower locks are hydraulically operated.

Fom Grafton, Ill., to Chicago, the Nine-Foot Navigation Project includes the following: (1) seven locks, six dams and a navigation channel nine feet in depth and 300 feet in width from Grafton to Lockport; (2), a channel in the Chicago Sanitary and Ship Canal nine feet deep and 200 feet to 300 feet wide from Lockport to the controlling works, from there 160 feet wide to the junction with the Calumet-Sag Channel and 175 feet to 300 feet wide ftom the Sag Junction to Lake Street in Chicago on the South Branch of the Chicago River; (3) a small-boat harbor at Peoria. This portion of the project is essentially complete with only minor widening remaining to be done.

The Calumet-Sag Channel, originally 60 feet wide and having many restrictive bridges, was a navigation bottleneck for many years. This channel could only accommodate tows of two or three barges and required special towboats with telescoping pilothouses. The Calumet-Sag modification, described as follows, was authorized by the River and Harbor Act of 1946 to allow full-sized tows to operate between the Chicago Sanitary and Ship Canal and Turning Basin No. 5 in the Calumet River. The modification consists of three parts.

Part I is 99 percent complete. The authorization called for construction of a nine-foot-deep, 225-foot-wide channel in the Calumet-Sag Channel to its junction with the Little Calumet River to Lake Calumet; construction of a lock and dam in the Calumet River and removal of the old Blue Island controlling lock; replacement or alteration of 14 railroad bridges and 17 highway bridges crossing the Calumet-Sag Channel and Little Calumet and Calumet rivers; and removal of six small highway bridges also was authorized.

Part II is now deauthorized because it was not economically justified. The project authorization called for construction of the following: a lock and controlling works; a nine- foot-deep channel that is 225 feet wide along the general route of the Grand Calumet River from its junction with the Little Calumet River to the Indiana Harbor Canal and from there is 160 feet wide to a proposed terminal in Gary, Indiana; a nine-foot-deep channel that is 225 feet wide in the Indiana Harbor Canal from the Grand Calumet River to the head of deep-draft navigation. Altering or rebuilding nine railroad and eight highway bridges.

Part III provides for widening the Chicago Sanitary and Ship Canal to 225 feet from the Sag Junction to Lockport; replacing three highway bridges in this reach and two in Joliet; and replacing the existing emergency dam above Lockport. Part III has been deferred for further study.

Legislation authorizing the Calumet-Sag modification required that local interests furnish all necessary rights-of- way and disposal areas for dredged materials, that they assume responsibility for altering or

relocating obstructive utilities, and, in the case of Part III, that they assume responsibility for altering or replacing highway bridges. For Part I of the project, the Metropolitan Water Reclamation District of Greater Chicago agreed to serve as the responsible local interest and as such provided much of its own lands, acquired privately owned land and altered utility lines. Many other state, county, city and private agencies also rendered invaluable assistance.

The work completed on the Calumet-Sag modification includes widening 16.2 miles of channel from the Sag Junction through Blue Island, widening channel walls immediately east of that city and widening the channel at Acme Bend in the Little Calumet River. The Gulf, Mobile and Ohio; Wabash; Baltimore and Ohio Chicago Terminal; Grand Trunk Western; and the Chicago, Rock Island and Pacific railroad bridges across the Calumet-Sag Channel were altered. The Pennsylvania, Chicago and Western Indiana, Illinois Central Gulf and Penn Central railroad bridges across the Little Calumet River also were altered. In addition, a railway bridge was completed over the Little Calumet River for the Illinois Central Railroad. Ten new highway bridges were constructed across the navigation channel at 104, 95th, Harlem, Kedzie, Western, Ridgeland, Francisco and Indiana avenues and at Chatham, Division and 127th streets. Pier conversion was also completed for five bridges at Cicero, Crawford and Ashland avenues and at Southwest Highway and Halsted Street.

Construction of the Thomas J. O'Brien Lock and Controlling Works in the Calumet River was authorized under Part I of the Calumet-Sag modification and completed in 1960. Measuring 110 feet in width by 1,000 feet in length, the lock permits the ready movement of tows consisting of 14 barges and a towboat. No rearrangement is necessary before the tows enter the chamber. Together, the lock and controlling works are designed to prevent the flow of polluted water from the Little Calumet and Grand Calumet rivers into Lake Michigan. The lock and controlling works also control water levels landward of the lock and dam.

[ii] IN BRIEF: http://www.mwrdgc.dst.il.us/water/canal.htm

Experiencing a remarkable recovery from the devastating fire of 1871, Chicago rebuilt rapidly along the shores of the Chicago River. The river was especially important to the development of the city since all wastes from houses, farms, the stockyards and other industries could be dumped into the river and carried out into Lake Michigan.

The lake, however, was also the source of drinking water. During a tremendous storm in 1885, the rainfall washed refuse from the river far out into the lake, past the water intake cribs. Typhoid, cholera and other waterborne diseases from the contaminated drinking water took their toll. The Chicago Sanitary District (now The Metropolitan Water Reclamation District) was created by the Illinois legislature in 1889 in response to a terrible epidemic which killed thousands of residents of this fledgling city.

This new agency devised a plan to construct channels and canals to reverse the flow of the rivers away from Lake Michigan and divert the contaminated water downstream where it could be diluted as it flowed into the Des Plaines and eventually the Mississippi.

On September 3, 1892, a workforce of 8,500 men, most of them newly arrived immigrants, swung into action. Using every type of earth moving equipment available, including wheelbarrows, mule drawn plows, steam shovels, drag scrapers, drills, liberal shots of dynamite and bare hands, they completed the 28 mile Sanitary and Ship Canal in 1900. The North Shore Channel was completed in 1907 and the Cal-Sag Channel in 1922. Altogether the District built 56 miles of canals, all designed to divert water from Lake Michigan into the Des Plaines and Calumet rivers, rather than having the rivers flow into the lake.

Other Great Lake states began to worry that Chicago's diversion of Lake Michigan water would lower the water level of the lake. So the District installed locks at the lakefront intake points to control the amount of diversion.

[iii] IN BRIEF: http://www.nps.gov/ilmi/

The Illinois & Michigan Canal, completed in 1848, connected the Great Lakes to the Mississippi River watershed along a longstanding Indian portage route. The 97-mile canal extended from the Chicago River near Lake Michigan to the Illinois River at Peru, Illinois. It rapidly transformed Chicago from a small settlement to a critical transportation hub between the East and the developing Midwest. The towpath trail along the canal is a State park that runs through a rural and wooded landscape linking a number of towns laid out by the original canal commission.

[iv] INBRIEF: http://www.lemont.il.us/about.htm
Settled in 1836, and incorporated in 1873, the Village of Lemont offers the look and feel of the past combined with a progressive eye to the future. The historic Village, with a population of 13,100 residents, is nestled among the bluffs of the Des Plaines River Valley offering scenic views unique in the Chicagoland area.
As one of the oldest communities in northeastern Illinois, Lemont's history originated with the construction of the Illinois and Michigan Canal which linked the Mississippi River and the Great Lakes. Subsequent quarrying, railroad and canal employment brought many Irish, German, Polish and other European immigrants who chose to settle and remain.

[v] Maritime Administration (847) 298-4535, April 4, 2001 e-mail alpha.ames@marad.dot.gov

The MARAD Great Lakes Region, now located in Des Plaines, Illinois, covers sixteen states, the eight Great Lakes states and states bordering on the Missouri, Upper Mississippi, Illinois Waterway and Ohio River basins. MARAD offers financial aid programs to vessel owners and promotes waterborne commerce for secure National economic development and National Defense

[vi] To facilitate the data analysis the four summary shipping and receiving pie charts presented are based on the identity of shippers and receivers constituting 90 percent of the total year tonnage. The remaining 10 percent of tonnage consist of shippers and receivers constituting roughly 90% of the data records. This remaining 10 percent of tonnage is assumed to be nearly proportional to the proportions represented by the 90% tonnage data presented in the pie charts.

[vii] Capacity figures represents the number of barges that can fit within a given fleeting area. However, according to fleeters, “usable” capacity is generally 2/3 to 3/4 of capacity because of the need to move barges around within the fleeting area. This occurs when barges are shuttled between the terminals and the fleeting areas and when making up the tows for transport to the destination. All barge capacity numbers assume normal river stage. Source: http://www.mvr.usace.army.mil/pdw/nac_study/econ.htm, page 8.

[viii] The Chicago District had the opportunity to examine the paper files on record at the local Coast Guard safety office. These records constituted approximately three years of incidents reported. The larger data base of records for this area was not accessible except through a freedom of information request to be processed by the Coast Guard HQ. This request has been submitted to the local Coast Guard office who in turn forwarded to their HQ. A response is being awaited as of the conclusion of this report preparation.

[ix] MWRD Real Estate Atlas can be found on the WEB at:
http://www.mwrdgc.dst.il.us/Law/real_estate_atlas.htm

Attachment 6
- ADDENDUM EXHIBITS

The Chicago Sanitary and Ship Canal and the Calumet Channel Connecting Channels

U.S. Army Corps of Engineers, Chicago District
LRCPM-PL

July 1, 2002

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Barge & Tow Inventory From Aerial of September 1999

River Mile Beg. @	Barge Count	Non-Barge Description & Count	Craft Placement	Direction or Location	Barge Array Width	Barge Array Length
Chicago Sanitary & Ship Canal Downstream of CalSag Channel Confluence						
291 to 292	6 BB	1 Tug	Moving	Upstream	2	2
292	1 BB	1 Tug	Moving	Upstream	1	1
292.7	1 BB	N/A	Bank	Right Bank	1	1
293	16 BB	N/A	Bank	Right Bank	1	16
293	2 BB	N/A	Bank	Right Bank	2	1
294	14 BB	N/A	Bank	Right Bank	1	14
295	3 BB	N/A	Bank	Right Bank	1	3
295	1 BB	1 Tug	Moving	Upstream	1	1
295.2	1 BB	N/A	Slip	N/A	1	1
295.3	N/A	N/A	N/A	N/A	N/A	N/A
296	N/A	N/A	N/A	N/A	N/A	N/A
298	9 BB	N/A	Bank	Left Bank	1	9
298	16 BB	N/A	Bank	Left Bank	2	8
299	4 BB	N/A	Bank	Left Bank	1	4
299	18 BB	N/A	Bank	Left Bank	2	9
299	6 BB	N/A	Bank	Right Bank	1	6
299.1	36 BB	N/A	Slip	N/A	N/A	N/A
299.4	6 BB	N/A	Slip	N/A	N/A	N/A
299.7	30 BB	N/A	Slip	N/A	N/A	N/A
299.8	30 BB	N/A	Slip	N/A	N/A	N/A
300	14 BB	N/A	Bank	Right Bank	1	14
300.5	12 BB	N/A	Bank	Right Bank	2	6
300.6	N/A	N/A	N/A	N/A	N/A	N/A
301	1 BB	N/A	Bank	Right Bank	1	1
301	8 BB	N/A	Bank	Right Bank	2	4
301.1	29 BB	N/A	Slip	N/A	N/A	N/A
301.4	9 BB	N/A	Slip	N/A	N/A	N/A
301.5	6 BB	N/A	Slip	N/A	N/A	N/A
302	12 BB	N/A	Bank	Left Bank	1	12
302	18 BB	N/A	Bank	Left Bank	2	9
303	5 BB	N/A	Bank	Left Bank	1	5
303	2 BB	N/A	Moving	Upstream	1	2
303	N/A	1 R	Moving	Upstream	N/A	N/A
Sub-Total	316	3	Bank=159; Moving=10; Slip=147			
Chicago Sanitary & Ship Canal						
304	3 BB	N/A	Bank	Left Bank	1	3
304.1	2 BB	N/A	Bank	Left Bank	1	2
305	2 BB	1 Tug	Moving	Downstream	1	2
306	4 BB	1 Tug	Moving	Downstream	1	4
307.9	N/A	N/A	N/A	N/A	N/A	N/A
309.1	N/A	N/A	N/A	N/A	N/A	N/A
309.2	N/A	N/A	N/A	N/A	N/A	N/A
312.2	N/A	N/A	N/A	N/A	N/A	N/A
313.1	N/A	N/A	N/A	N/A	N/A	N/A
313.4	N/A	N/A	N/A	N/A	N/A	N/A
314.1	N/A	N/A	N/A	N/A	N/A	N/A
314.8	N/A	N/A	N/A	N/A	N/A	N/A
Sub-Total	11	2	Bank=5; Moving=6; Slip=0			
Calumet Sag Channel						
304.3	N/A	N/A	N/A	N/A	N/A	N/A
306	N/A	1 R	Moving	Upstream	N/A	N/A
307.2	N/A	N/A	N/A	N/A	N/A	N/A

308.2	N/A	N/A	N/A	N/A	N/A	N/A
310.8	N/A	N/A	N/A	N/A	N/A	N/A
310.9	N/A	N/A	N/A	N/A	N/A	N/A
311.5	N/A	N/A	N/A	N/A	N/A	N/A
312.5	N/A	N/A	N/A	N/A	N/A	N/A
314.1	N/A	N/A	N/A	N/A	N/A	N/A
314.9	N/A	N/A	N/A	N/A	N/A	N/A
315.7	N/A	N/A	N/A	N/A	N/A	N/A
315.9	N/A	N/A	N/A	N/A	N/A	N/A
316.9	N/A	N/A	N/A	N/A	N/A	N/A
317.3	N/A	N/A	N/A	N/A	N/A	N/A
317.5	N/A	N/A	N/A	N/A	N/A	N/A
317.5	N/A	N/A	N/A	N/A	N/A	N/A
317.5	N/A	N/A	N/A	N/A	N/A	N/A
317.5	N/A	N/A	N/A	N/A	N/A	N/A
317.5	N/A	N/A	N/A	N/A	N/A	N/A
317.9	N/A	N/A	N/A	N/A	N/A	N/A
317.9	N/A	N/A	N/A	N/A	N/A	N/A
318.2	N/A	N/A	N/A	N/A	N/A	N/A
318.5	N/A	N/A	N/A	N/A	N/A	N/A
318.9	N/A	N/A	N/A	N/A	N/A	N/A
319.1	N/A	1 R	Moving	Downstream	N/A	N/A
319.7	N/A	1 R	Bank	Right Bank	N/A	N/A
Sub-Total	0	3	Bank=0; Moving=0; Slip=0			
Little Calumet River						
320.1	N/A	N/A	N/A	N/A	N/A	N/A
320.1	N/A	37 R	Slip	Left Bank	N/A	N/A
322.2	N/A	N/A	N/A	N/A	N/A	N/A
322.3	N/A	N/A	N/A	N/A	N/A	N/A
322.6	N/A	N/A	N/A	N/A	N/A	N/A
322.6	N/A	N/A	N/A	Left Bank	N/A	N/A
322.7	N/A	20 R	Slip	Right Bank	N/A	N/A
323.4	N/A	60 R	Slip	Left Bank	N/A	N/A
324.2	N/A	30 R	Slip	Left Bank	N/A	N/A
324.6	N/A	1 R	Moving	Upstream	N/A	N/A
325.3	N/A	N/A	N/A	N/A	N/A	N/A
325.3	N/A	N/A	N/A	N/A	N/A	N/A
325.8	6 BB	1 Tug	Moving	Upstream	2	3
Sub-Total	6	1	Bank=0; Moving=6; Slip=0			
Calumet River						
326.8	N/A	3 R	Moving	Upstream	N/A	N/A
326.9	N/A	N/A	N/A	N/A	N/A	N/A
327.1	N/A	1 Commercial	Bank	Left Bank	1	1
327.1	N/A	2 R	Moving	Downstream	N/A	N/A
327.3	8 BB	N/A	Bank	Right Bank	4	2
327.3	14 BB	N/A	Bank	Right Bank	2	7
327.3	3 BB	N/A	Bank	Right Bank	1	3
327.6	N/A	N/A	N/A	N/A	N/A	N/A
328.1	N/A	N/A	N/A	N/A	N/A	N/A
328.2	N/A	N/A	N/A	N/A	N/A	N/A
330.1	8 BB	N/A	Slip	N/A	N/A	N/A
330.1	N/A	N/A	Slip	N/A	N/A	N/A
330.7	N/A	N/A	N/A	N/A	N/A	N/A
331.5	N/A	N/A	N/A	N/A	N/A	N/A
332.6	N/A	N/A	N/A	N/A	N/A	N/A
Sub-Total	33	1	Bank=26; Moving=0; Slip=8			

Freight Traffic by Waterway

Source: Water Borne Commerce Statistics Center, Navigation Data Center, www.wrsc.usace.army.mil/ndc/wcsc.htm		Internal Traffic - Inland Waterways Only										Within-Port			
			Inbound***			Outbound****			Through****			Intra*****			
		Total (000's)	IN-Up stream*	IN-Down stream**	Inbound Total	Out-- Up stream	Out-Down stream	Outbound Total	Thr-Up stream	Thr-Down stream	Through Total	Intra-Up bound	Intra-Down bound	Intra-Total	
1999	1														1999
Calumet-Sag Channel, IL	2	7449	201	70	271	8	366	374	5142	1663	6805	0	0	0	1999
Chicago Sanitary and Ship Canal	3	17500	5877	151	6028	1316	2551	3867	5281	1567	6848	579	179	758	1999
Illinois Waterway	4	43724	10021	280	10301	1116	22686	23802	4713	1061	5774	2869	977	3846	1999
1998	5														1998
Calumet-Sag Channel, IL	6	8805	659	17	676	38	321	359	5021	2749	7770	0	0	0	1998
Chicago Sanitary and Ship Canal	7	18164	5463	157	5620	1254	2656	3910	5561	2333	7894	480	260	740	1998
Illinois Waterway	8	41774	10606	395	11001	932	19741	20673	4788	1816	6604	2346	1151	3497	1998
1997	9														1997
Calumet-Sag Channel, IL	10	10041	279	4	283	57	354	411	5318	4030	9348	0	0	0	1997
Chicago Sanitary and Ship Canal	11	18900	5370	1937	7307	835	2432	3267	5622	1997	7619	515	191	706	1997
Illinois Waterway	12	42994	10269	2184	12453	1150	20132	21282	4623	1486	6109	2136	1014	3150	1997
1996	13														1996
Calumet-Sag Channel, IL	14	12636	359	28	387	71	377	448	5006	6795	11801	0	0	0	1996
Chicago Sanitary and Ship Canal	15	20493	4879	4329	9208	658	2128	2786	5471	2362	7833	495	171	666	1996
Illinois Waterway	16	46236	9448	4493	13941	922	21594	22516	4569	1918	6487	2278	1014	3292	1996
1995	17														1995
Calumet-Sag Channel, IL	18	12077	319	74	393	75	503	578	4855	6251	11106	0	0	0	1995
Chicago Sanitary and Ship Canal	19	19696	4525	3619	8144	682	2253	2935	5207	2903	8110	370	138	508	1995
Illinois Waterway	20	47428	10232	3914	14146	849	22880	23729	4530	2284	6814	1765	973	2738	1995
1994	21														1994
Calumet-Sag Channel, IL	22	12874	522	31	553	81	467	548	6069	5701	11770	0	0	0	1994
Chicago Sanitary and Ship Canal	23	24588	7259	2126	9385	1078	2820	3898	7446	3255	10701	486	118	604	1994
Illinois Waterway	24	50878	12405	2417	14822	1466	21279	22745	5833	2586	8419	3671	1223	4894	1994
	25														
1994 - 1999 Mean	26														Mean
Calumet-Sag Channel, IL	27	10647	390	37	427	55	398	453	5235	4532	9767	0	0	0	Mean
Chicago Sanitary and Ship Canal	28	19890	5562	2053	7615	971	2473	3444	5765	2403	8168	488	176	664	Mean
Illinois Waterway	29	45506	10497	2281	12777	1073	21385	22458	4843	1859	6701	2511	1059	3570	Mean
	30														

Vessel Trips by Waterway

Source: Water Borne Commerce Statistics Center, Navigation Data Center, www.wrsc.usace.army.mil/ndc/wcsc.htm

		Upbound Vessels							Downbound Vessels						
			Self-Propelled		Non-Self Propelled (Barge)					Self-Propelled		Non-Self Propelled (Barge)			
		Total	Pass & Dry Cargo	Tow or Tug	Dry Cargo	Tanker	Total		Total	Pass & Dry Cargo	Tow or Tug	Dry Cargo	Tanker	Total	
1999	1														1999
Calumet-Sag Channel, IL	2	5314	0	1240	3350	724	4074		6862	1431	1328	3317	786	4103	1999
Chicago Sanitary and Ship Canal	3	14225	1434	3010	7403	2378	9781		12992	1	2887	7697	2407	10104	1999
Illinois Waterway	4	39324	7557	8105	19420	4242	23662		38798	6125	6455	22586	3632	26218	1999
1998	5														1998
Calumet-Sag Channel, IL	6	5678	0	1349	3473	856	4329		1453	1453	1441	3404	989	4393	1998
Chicago Sanitary and Ship Canal	7	14120	1455	3024	7074	2567	9641		12615	2	2956	7163	2494	9657	1998
Illinois Waterway	8	46835	16617	7686	17790	4742	22532		45129	14243	6520	20421	3945	24366	1998
1997	9														1997
Calumet-Sag Channel, IL	10	6934	0	1320	4695	928	5623		8750	1953	1294	4471	1032	5503	1997
Chicago Sanitary and Ship Canal	11	15809	1955	3206	8084	2564	10648		13737	2	3328	7887	2520	10407	1997
Illinois Waterway	12	49016	16886	8302	19105	4723	23828		47483	14933	7466	21086	3998	25084	1997
1996	13														1996
Calumet-Sag Channel, IL	14	8657	0	1431	6031	1194	7225		10698	1942	1381	6155	1220	7375	1996
Chicago Sanitary and Ship Canal	15	16674	1944	3111	8949	2670	11619		15258	2	3137	9315	2803	12118	1996
Illinois Waterway	16	49301	14191	7834	22349	4926	27275		47178	12249	6180	24603	4146	28749	1996
1995	17														1995
Calumet-Sag Channel, IL	18	8341	500	1304	5444	1090	6534		9158	1263	1412	5421	1059	6480	1995
Chicago Sanitary and Ship Canal	19	14762	1266	3104	8197	2195	10392		14116	503	2964	8206	2443	10649	1995
Illinois Waterway	20	43544	9048	8109	21805	4579	26384		40641	7284	6914	22459	3971	26430	1995
1994	21														1994
Calumet-Sag Channel, IL	22	8189	0	1258	5729	1193	6922		9236	1216	1280	5619	1112	6731	1994
Chicago Sanitary and Ship Canal	23	17480	1217	3141	10500	2622	13122		16416	1	3173	10359	2883	13242	1994
Illinois Waterway	24	41116	8432	5920	21659	5096	26755		39479	7216	5918	22034	4302	26336	1994
	25														1994
1994 - 1999 Mean	26														Mean
Calumet-Sag Channel, IL	27	7186	83	1317	4787	998	5785		7693	1543	1356	4731	1033	5764	Mean
Chicago Sanitary and Ship Canal	28	15512	1545	3099	8368	2499	10867		14189	85	3074	8438	2592	11030	Mean
Illinois Waterway	29	44856	12122	7659	20355	4718	25073		43118	10342	6576	22198	3999	26197	Mean
	30														

Lockage Statistics for Lockport and O'Brien Locks 1999-1994

Source: Source: Lock Performance Monitoring System, Navigation Data Center, www.wrsc.usace.army.mil/ndc/lpms.htm

Illinois River Mile	Lock Chamber	Vessels* Total	Bottoms* Total	Tonnage* Ktons	Lockages* Total	Percent* Delay Tows	Average* Delay Tows	Barge* Total	Up Stream Loaded Barges	Down Stream Loaded Barges	Up Stream Empty Barges	Down Stream Empty Barges	Loaded* Barge Total	Empty* Barge Total	Percent Loaded Total	Up Stream Percent Loaded	Down Stream Percent Loaded	Up Stream Tows	Down Stream Tows	Tows* Total	Ratio of Barge per Tug
291.1	Lockport on CSSC Sanitary and Ship Canal																				
	1999	4481	21085	16039	3494	56	2.48	16604	7624	2436	633	5911	10060	6544	60.6%	92.3%	29.2%	1453	1494	2947	5.6
	1998	4382	21102	17103	3316	57	3.17	16720	7660	3012	808	4240	10672	5048	63.8%	90.5%	41.5%	1372	1401	2773	6.0
	1997	4715	20442	15411	3418	57	2.36	15727	7048	2658	872	5149	9706	6021	61.7%	89.0%	34.0%	1365	1395	2760	5.7
	1996	4102	19037	14865	3262	50	2.20	14935	6548	2626	893	4668	9374	5561	62.8%	88.0%	37.7%	1346	1359	2705	5.5
	1995	3234	17543	14987	2661	61	4.41	14309	6116	3324	1004	3865	9440	4869	66.0%	85.9%	46.2%	1146	1206	2352	6.1
	1994	5019	24636	19701	3694	65	2.94	19517	8494	3894	1291	5938	12388	7229	63.1%	86.8%	39.6%	1578	1616	3194	6.1
	Mean	**4322**	**20641**	**16351**	**3308**	**58**	**2.92**	**16319**	**7248**	**3025**	**917**	**4962**	**10273**	**5879**	**63.0%**	**88.7%**	**38.1%**	**1377**	**1412**	**2789**	**5.9**
	Standard Deviation	617	2391	1835	351	5	0.82	1867	857	523	220	860	1140	805	1.8%	2.4%	5.9%	142	137	279	0.3
326.5	Thomas J. O'Brien on Calumet River																				
	1999	28599	36953	7372	8581	18	0.25	8354	3623	1079	555	3097	4702	3652	56.3%	86.7%	25.8%	1212	1319	2531	3.3
	1998	26901	35918	8855	7972	24	0.32	9017	3892	1731	659	2735	5623	3394	62.4%	85.5%	38.8%	1246	1284	2530	3.6
	1997	23044	34674	10470	7785	24	0.28	11830	3892	3026	2229	2683	6718	5112	56.8%	62.4%	51.2%	1548	1600	3148	3.8
	1996	21883	36287	12849	8347	26	0.29	14404	3564	4615	3640	2585	8179	6225	56.8%	49.5%	64.1%	1896	1850	3746	3.8
	1995	23370	36174	11997	8350	23	0.29	12804	3397	4177	3029	2201	7574	5230	59.2%	52.9%	65.5%	1692	1638	3330	3.8
	1994	21515	35562	13292	8441	27	0.31	14047	4128	4232	2959	2728	8360	5687	59.5%	58.2%	60.8%	1908	1868	3776	3.7
	Mean	**24219**	**35961**	**10806**	**8246**	**24**	**0.29**	**11743**	**3716**	**3143**	**2179**	**2705**	**6859**	**4883**	**58.5%**	**65.9%**	**51.0%**	**1584**	**1593**	**3177**	**3.7**
	Standard Deviation	2872	704	2345	303	3	0.02	2547	258	1462	1297	302	1463	1127	2.3%	16.3%	15.9%	306	251	555	0.2

*	Vessels Total	The total number of vessels which have passed through a lock chamber; including tows, passenger boats/ferries, recreational vessels, cargo carrying vessels, U.S. Govt. contractor, commercial fishing boats, other, and light (towboat w/o barges). Barges are counted separately
*	Bottoms Total	The combined total number of vessels and barges which have passed through a lock chamber.
*	Tonnage Ktons	The combined total tonnage from all loaded barges which passed through the lock chamber; reported in Ktons.
*	Lockages Total	The total number of all lockages at a lock chamber. A lockage is the same as a cut. A lockage is the transfer of a vessel(s), or that part of the tow which can be contained in the lock chamber, through a chamber in a single direction.
*	Percent Delay Tows	The percentage of all tows delayed before passing through a lock chamber.
*	Average Delay Tows	The average delay time, expressed in hours, calculated only for tows waiting to pass through a lock chamber.
*	Barge Total	The total number of barges (loaded and empty) which have passed through the lock.
*	Loaded Barge Total	The total nnumber of loaded barges which contained commodities and/or has cargo.
*	Empty Barge Total	The total number of empty barges which have passed through a lock chamber.
*	Tows Total	The total number of tows with their barges passing through a lock chamber.

Total	Upbound Vessels			Downbound Vessels									
	Tug	Non-Self Propelled (Barge) Total		Tug	Non-Self Propelled (Barge) Total		Tug Total	Barge Total	Freight Total		Ratio of short tons per Tug (000's)	Ratio of short tons per Barge (000's)	Ratio of Barge per Tug
1999													
Calumet-Sag Channel, IL	1240	4074		1328	4103		2568	8177	7449		**2.9007**	**0.9110**	**3.1842**
Chicago Sanitary and Ship Cana	3010	9781		2877	10104		5887	19885	17500		**2.9727**	**0.8801**	**3.3778**
Illinois Waterway	8105	23662		6455	26218		14560	49880	43724		**3.0030**	**0.8766**	**3.4258**
1994													
Calumet-Sag Channel, IL	1258	6922		1280	1112		2538	8034	12874		**5.0725**	**1.6024**	**3.1655**
Chicago Sanitary and Ship Cana	3141	13122		3173	2883		6314	16005	24588		**3.8942**	**1.5363**	**2.5348**
Illinois Waterway	5920	26755		5918	4302		11838	31057	50878		**4.2979**	**1.6382**	**2.6235**

U.S. Department of Transportation
United States Coast Guard

Commanding Officer
United States Coast Guard
Marine Safety Office

215 W. 83rd. St. Suite D
Burr Ridge,IL. 60521
Phone: (630)986-2155
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16700
August 22, 2000

CAPTAIN OF THE PORT CHICAGO PUBLIC NOTICE 02/00

Subj: FLEETING ON THE CHICAGO SANITARY AND SHIPPING CANAL, MILE MARKER 299-303

1. The Sanitation and Ship Canal near Lemont from Mile Marker 303 south to Mile Marker 299 has recently been under review. This area is very narrow, only 150 feet in some places, and has several inlets where barges are fleeted along the canal. In addition, it is also common for tows transiting this area to use the opposite channel wall as a guide to safely pass in areas with doublewide moorings. The deteriorated canal wall crumbling into the canal along with the doublewide moored barges restrict the channel. The Coast Guard has conducted a review of this area and met with several key operators. The following guidelines are recommendations that resulted from our discussion and will reduce the risk of incident while transiting this area:

a. Moor oil and hazardous material (red flag) barges as the most inboard barge;

b. Moor barges single-wide across from a slip or across from deteriorated bank wall;

c. Moor barges single-wide from Mile Marker 303.2 to Mile Marker 303.1 (600ft from entrance to Calumet River;

d. Do not leave holes or notches in a fleeting area unless in the process of building or breaking down a particular tow; and,

e. If requested by a tow in transit, a fleet owner MUST provide assist vessel in areas that have barges moored doublewide.

In addition to these requirements, a copy of Captain Clay Fust's letter dated, April 12, 1995, is enclosed identifying the safe fleeting and mooring practices that remain in effect.

2. Discussion with the Army Corps of Engineers (ACOE), Chicago District, has indicated that there are no ACOE permitted fleets in this area. In the event that these guidelines are not adhered to, and safety is compromised, restrictive enforcement action may be necessary.

R. E. SEEBALD
Captain, U. S. Coast Guard
Captain of the Port

Encl: Captain of the Port Chicago Public Notice 3-95

Total Tow Cost Estimate ("Average" Tow and Barge Configuration)	Day	1	$3,064
			Cost/Day
Tow Cost Per Day Estimate	Day	1	2419.07
Barge per Tow (Waterway CSSC 1999)		3.38	645.26
Weighed Barge Cost Per Day Estimate	Day		191.03
Open Hopper or Covered Hopper Barge:	Mix	0.75	101.35
Chemical Tank Barge (Standard Size)	Mix	0.0875	328.12
Chemical Tank Barge (Oversize = 65% of allTanker Barges which are 25% of all Barges))	Mix	0.1625	531.12
FDR		0.06375	
Source: USCOE, Economic Guidance Memorandum 00-05, FY2000 Shallow Draft Vessel Operating Costs.			

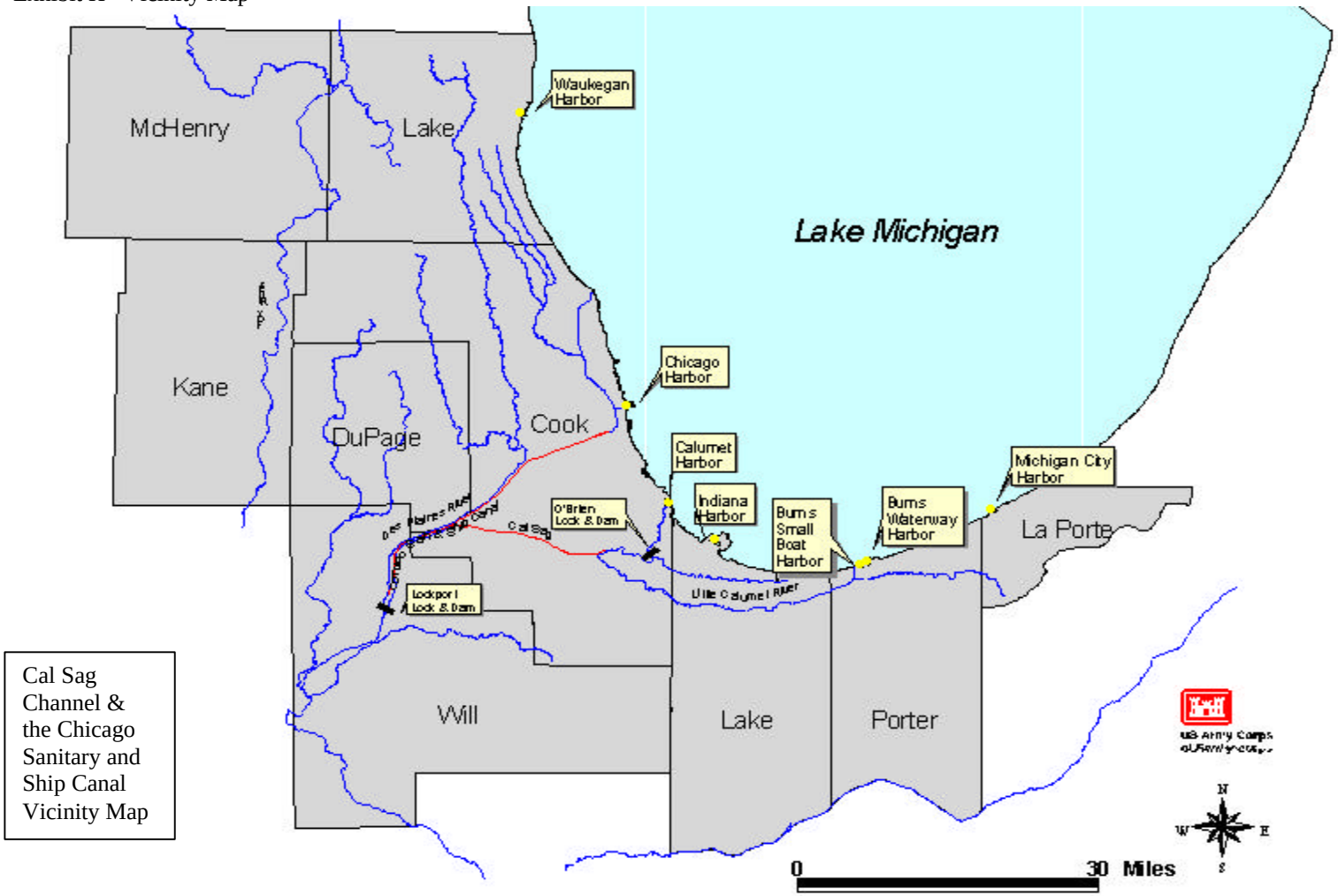
Total Vessel Trips by Waterway		Tow or Tug
1999		
Calumet-Sag Channel, IL		2,568
Chicago Sanitary and Ship Canal		**5,887**
Illinois Waterway		14,560
Source: Lock Performance Monitoring System, Navagiation Data Center, www.wrsc.usace.army.mil/ndc/lpms.htm		

Marine Transit Time Evaluator - Shallow Draft Vessels

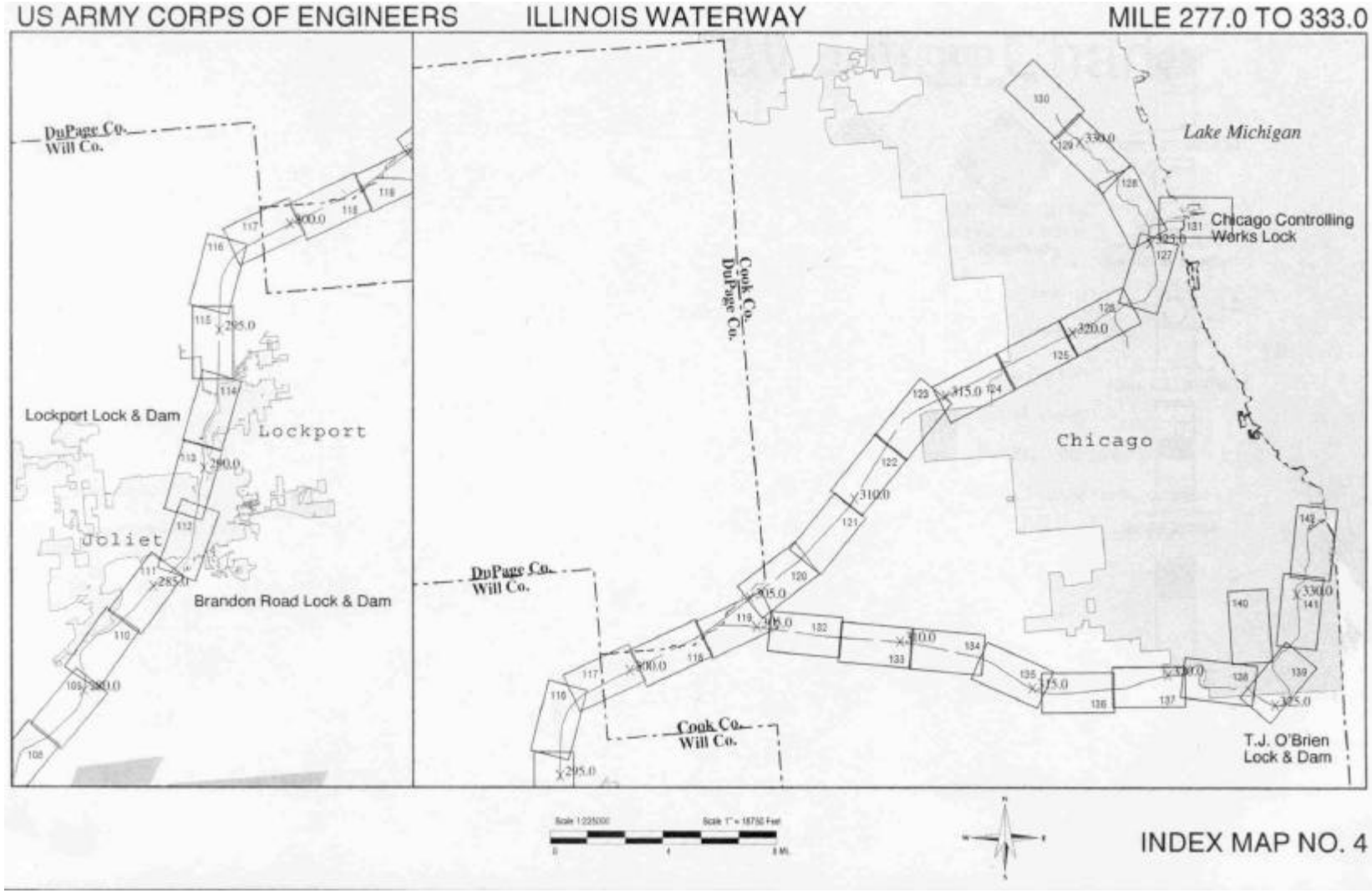
Typical Month of Transit Used to Estimate Annual Transit Delay Savings

			Transit Time Scenarios Minutes			
	Additive (Minutes/Day) =	9.8				
Average Transit Time minutes =		182.2	168.8	156.1	144.2	133.0
	1	45.0	45.0	45.0	45.0	45.0
	2	45.0	45.0	45.0	45.0	45.0
	3	45.0	45.0	45.0	45.0	45.0
	4	54.8	45.0	45.0	45.0	45.0
	5	64.6	49.6	45.0	45.0	45.0
	6	74.4	59.4	45.0	45.0	45.0
	7	84.2	69.2	54.2	45.0	45.0
	8	94.0	79.0	64.0	49.0	45.0
	9	103.8	88.8	73.8	58.8	45.0
	10	113.7	98.7	83.7	68.7	53.7
	11	123.5	108.5	93.5	78.5	63.5
	12	133.3	118.3	103.3	88.3	73.3
	13	143.1	128.1	113.1	98.1	83.1
	14	152.9	137.9	122.9	107.9	92.9
	15	162.7	147.7	132.7	117.7	102.7
	16	172.5	157.5	142.5	127.5	112.5
	17	182.3	167.3	152.3	137.3	122.3
	18	192.1	177.1	162.1	147.1	132.1
	19	201.9	186.9	171.9	156.9	141.9
	20	211.7	196.7	181.7	166.7	151.7
	21	221.5	206.5	191.5	176.5	161.5
	22	231.3	216.3	201.3	186.3	171.3
	23	241.2	226.2	211.2	196.2	181.2
	24	251.0	236.0	221.0	206.0	191.0
	25	260.8	245.8	230.8	215.8	200.8
	26	270.6	255.6	240.6	225.6	210.6
	27	280.4	265.4	250.4	235.4	220.4
	28	290.2	275.2	260.2	245.2	230.2
	29	300.0	285.0	270.0	255.0	240.0
	30	400.0	385.0	370.0	355.0	340.0
	31	500.0	485.0	470.0	455.0	440.0
	Average Transit Time minutes =	**182.2**	**168.8**	**156.1**	**144.2**	**133.0**
	Average Minutes Saved Scenario:	**Baseline**	**15**	**30**	**45**	**60**
	Reduction Percent from Baseline Times		0.073	0.143	0.209	0.270
	Total Annual Transit Time	1,074,300	995,393	920,437	850,200	784,023
	Converted to Days	746.0	691.2	639.2	590.4	544.5
	Days Saved	-	54.8	106.8	155.6	201.6
Estimated Annual Value of Transit Days Saved			**$167,915**	**$327,422**	**$476,887**	**$617,712**
Present Value 20 Year Stream, .06375:			$1,868,683	$3,643,803	$5,307,165	$6,874,364
Present Value 10 Year Stream, .06375:			$1,214,204	$2,367,614	$3,448,407	$4,466,717

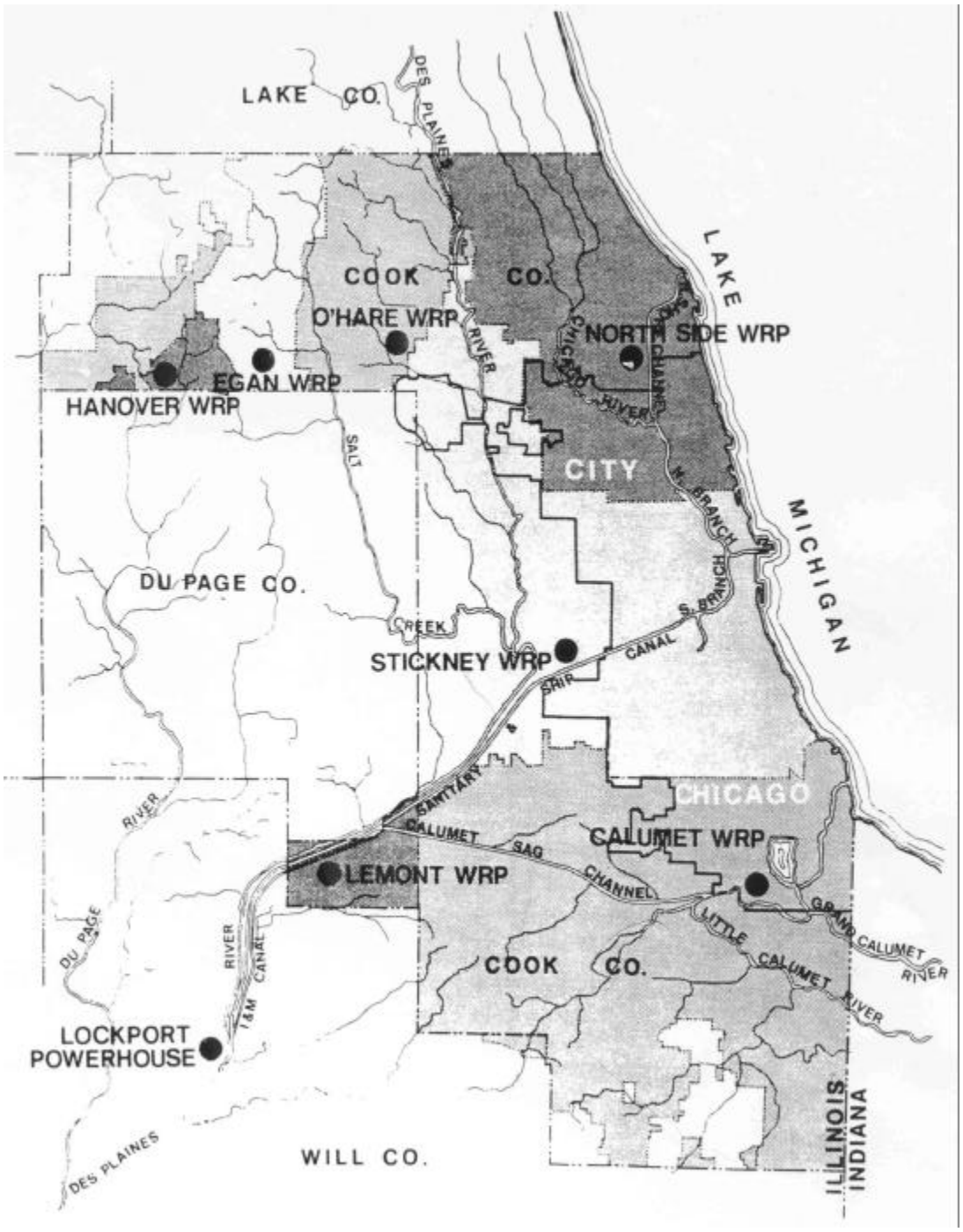
Exhibit H Vicinity Map



Cal Sag Channel & the Chicago Sanitary and Ship Canal Vicinity Map



Economic Appendix, Attachment 6, Addendum Exhibit I Location Map



Economic Appendix, Attachment 6, Addendum Exhibit J MWRDGC Facilities and Service Area

ATTACHMENT 7

GREAT LAKES SHIPPING:
A PRELIMINARY INVESTIGATION of LAND-SIDE ENVIRONMENTAL EFFECTS

Great Lakes Shipping: A Preliminary Investigation of Land-Side Environmental Effects

Mark L. Burton
Marshall University

December, 2001

Introduction

Different transportation modes often operate in distinct geographic areas and produce mode-specific environmental impacts. Thus, individual transportation decisions regarding mode and routings collectively impact different communities in a variety of ways. This is particularly true in the case of Great Lakes shipping. Geographically, Great Lake routings often vary from land-side alternatives by hundreds or even thousands of miles. Moreover, Great Lake vessels are large in size compared to locomotives and trucks, so that both shipment characteristics (such as trip frequency) and environmental impacts of individual movements are very different under alternative transportation scenarios.

Recognizing these potentially disparate impacts, the US Army Corps of Engineers (Corps), has elected to investigate the differential environmental effects that may be expected under different levels of navigation support on the Great Lakes over the coming decades. If, through other research, the Corps determines that this level of support will change materially, then it is likely to engage in a substantive and thorough environmental investigation. However, the current effort represents a reconnaissance study only and, as such, is valuable as a demonstration rather than a definitive quantification.

An Overview of Potential Land-Side Effects

In 1999, 182 million tons of US freight moved on the Great Lakes. This volume was up from 167 million tons in 1990.[1] In the absence of any Great Lakes shipping capacity, it is likely that some portion of this traffic would disappear. However, it is equally likely that some portion of currently observed traffic would divert to land-side alternatives, involving the increased use of rail and/or truck transport. The majority of the damages associated with emissions, congestion, noise, etc. are attributable to human exposure to these negative outcomes. Because Great Lakes navigation often reduces this

[1] *Waterborne Commerce of the United States: Part 3 – Waterways and Harbors Great Lakes*, US Army Corps of Engineers, Institute for Water Resources, Alexandria, VA.

human exposure, any diversion of Great Lake traffic to other modes would likely increase transportation-related external costs. Specifically, these diversions would result in increased railroad and truck traffic that would, in turn, increase human exposure to emitted pollutants, resulting in increased human mortality and morbidity. The increased traffic would also be likely to measurably increase traffic delays to other motorists, requiring these motorists to incur costs which they currently avoid and/or necessitating additional investments in highway infrastructure.[2] It is important to recognize that these costs are external costs – costs borne by parties who are not involved in either buying or selling the transportation services that produce them. Thus, they are not typically captured in the assessment of National Economic Development (NED) project benefits.[3]

Methodology

Because both temporal and financial resources are currently very limited it was necessary to try to assess the land-side external impacts of Great Lakes navigation based on the results of previous analyses. Specifically, the current work seeks to:

- Use air quality results from the Soo Locks study to estimate emissions-related values for the whole of currently observed Great Lakes traffic;

- Employ existing estimates of per-ton emissions damages to estimate the potential value of placing existing land-side container traffic onto the Great Lakes system; and

- Use traffic/congestion delay results developed by the Tennessee Valley Authority and researchers from the University of Tennessee to estimate additional external cost reductions that might be attributable to moving existing rail and truck container traffic to the Great Lakes system.

Each task is discussed in detail below.

Existing Great Lakes Traffic. As noted, in 1999 there were 182 million tons of US traffic on the Great Lakes. Additionally, there were about 40 million tons of Canadian traffic during the same time period. Had Great Lake shipping been unavailable, some (possibly significant) portion of this traffic might have disappeared. However, the remainder would have moved by a variety of all-land alternatives. Identifying the specific quantities involved is beyond the scope of the current investigation. Instead, the emission values developed as a part of the Soo Locks study have been applied to the total

[2] There is, in fact, a long list of potential negative outcomes associated with diversions of Great Lakes traffic. Human exposure to airborne pollutants and increased traffic congestion costs are only a subset of the overall effects.

[3] Some may argue that increased railroad and truck congestion will also increase shipping costs for existing land-side shippers. While this may be true, any such cost increases suffered by transportation users should be captured in the normal course of a NED investigation.

volume of existing Great Lakes traffic. *Readers must understand that this approach necessarily overstates the magnitude of estimated benefits*.

The Soo Locks benefit values result from estimated differentials in human exposure to particulate matter (PM10) and the resulting differences in the probability of morbidity and mortality. While there are certainly other emissions-related damages, PM10 exposure is estimated to result in approximately 75 percent of total costs.[4] Table 1 indicates the commodity-specific values employed within the current work.

The application of the Soo Locks pollution abatement values to the whole of Great Lakes traffic implies a number of important assumptions. First, the application implicitly assumes that the characteristics of all Great Lake shipments are relatively similar to the movements used in the Soo Locks study. It also assumes that the land-side alternative routings pass through metropolitan areas to a similar degree and that those metropolitan areas have demographic and geographic characteristics similar to the areas affected within the Soo study. To the extent that these assumptions are not valid, the resulting estimates may be biased.

Table 1.
Soo Locks Emission Parameters

Commodity	*Per Ton Emissions Benefit*
Coal	$4.90
Petroleum Products	$2.79
Chemicals	$14.53
Crude Materials	$2.97
Sand and Gravel	$2.71
Food and Farm Products	$11.38
Weighted Average All Commodities	**$2.79**

Emission Savings from Vessel-borne Containers. Given the extraordinary time sensitivity of container movements, consideration of vessel diversions may seem curious. Certainly, given current traffic volumes, there is no reason to imagine that such diversions would ever occur regardless of the line-haul vessel costs. However, both

[4] For a full discussion of the Soo Locks study see, Mark L. Burton and Michal A. Newsome, "Assessing Transportation-Related External Costs: Valuing Decreases in PM-10 Emissions Due to Mode Switching," US Army Corps of Engineers, Huntington District, July 2001.

highway and rail infrastructure is at or near capacity in many locations and the costs of expanding that capacity are likely to be significant. At the same time, annual container movements over US ports are projected to grow by four million units over the next 10 years.[5] In light of these factors assessing the impacts of moving truck and rail container movements to vessel is not unreasonable.

Given current resource constraints, it was necessary to apply a number of simplifying assumptions in order to develop some plausible estimate of the emissions savings attributable to the diversion of either truck or rail-truck container traffic to a vessel-truck routing. First, it was assumed that shipment distances would be similar regardless of which mode or modal combination is used. This assumption almost certainly biases the results in favor of the marine alternative. Next, representative values were developed for fuel consumption per ton-mile of transportation. Motor carriers were assumed to provide 100 ton-miles of service per gallon of fuel consumed. For rail carriage the corresponding value is likely to be as much as 300 ton-miles per gallon.[6] However, even if rail is used for the primary line-haul movement, a truck dray is necessary at one or both ends of the movement. Hence, the 300 ton-mile per gallon value was reduced to 250 within the current application. Finally, line haul vessel movements typically generate ton-mile per gallon values of 650. Once again, however, the overall container movement will require a truck move at one or both ends of the shipment. Moreover, truck-vessel routings are likely to require relatively long truck movements. Therefore, the current analysis assumes an overall fuel consumption rate of 450 ton-miles per gallon.

The current methodology used to calculate the damages from human exposure to emitted pollutants does not immediately yield a straightforward method of converting fuel consumption into monetary damages. Therefore it was necessary to return to the methods of earlier studies – specifically, the valuations used in the Missouri River basin and in the initial Ohio River basin study.[7] Based on these studies the overall air quality value of reduced fuel consumption was valued at $2.00 per ton.

Congestion Delays. Again, under current conditions, it is difficult to imagine a scenario that would divert highway container traffic to a vessel-truck routing. However, given the projected growth in container traffic, along with increased highway congestion,

[5] See, "Avoiding Clogged Arteries," *Traffic World*, July 9, 2000, p. 99.

[6] Railroads routinely obtain 500-600 ton-miles of transportation per gallon of fuel expended in the unit train movement of dry-bulk materials. However, the characteristics and handling of intermodal trains are much more similar to those of passenger trains – light weights, quick acceleration, and relatively short train lengths.

[7] See "Available Navigation, Fuel Consumption and Pollution, Abatement: The Missouri River Basin," U.S. Army Corps of Engineers, Omaha, Nebraska. Also see "Valuing the Air Quality Impacts of Modal Choice: More Evidence from the Ohio River Basin," U.S. Army Corps of Engineers, Huntington District.

examining the degree to which current highway container traffic consumes overall road capacity is likely to be instructive.

All-truck container movements have a variety of impacts on the communities through which they pass. Emissions and air quality issues have been treated above. Truck movements also contribute to highway congestion, congestion delays and the probability of accidents that result in both personal injuries and property damage. Thus, any infrastructure project that materially reduces the volume of container movements by highway holds the potential to measurably improve the quality of life in a variety of communities. At the outset, however, two important caveats should be noted. First, because there are typically drays at the origin and / or destination locations of all container movements, it is unlikely that a modal switch to a truck-vessel alternative would significantly impact highway traffic in originating or terminating cities. Second, to the extent that off-road traffic diversions might help to diminish congestion-related problems in line-haul communities, the same gains could be accomplished regardless of whether the diversion is to vessel or rail.

The variety of highway container flows between the east-coast and mid-west converge and diverge at numerous locations. Any comprehensive analysis of the effects of vessel container diversions would, therefore, necessarily route all traffic in order to identify the incremental impacts of container diversions. Such an effort is well beyond the scope of the current analysis. Instead, the current effort focuses on a single example – Toledo, Ohio. Two principal interstate highways serve Toledo, I-75 and I-80. The latter of these is an integral link in many east-west container movements. Table 2 summarizes estimated Interstate highway truck traffic in the Toledo area for 1997.[8] The Area is pictured graphically in Figure 1.

Table 2
1997 Toledo Area Interstate Truck Traffic

Route	*Route Miles*	*Estimated Daily Truck Miles*
I-75	44.7	335,440
I-475	20.4	200,187
I-80	25.7	98,612
I-480	14.6	69,724
Total	**105.4**	**703,963**

[8] For current purposes, the Toledo area was defined as Wood and Lucas Counties in the State of Ohio. Data on average daily traffic (ADT) counts were drawn from the federal Highway Performance Monitoring System (HPMS) data set. The analysis also assumes a 15 percent level of heavy vehicle usage.

Figure 1
Toledo Area Highways

Container flows estimated by the Tennessee Valley Authority, combined with the results of highway routing software, suggest that approximately 460,000 containers pass through the Toledo area each year in route to or from other locations. Assuming that the majority of these containers stay on I-80, this implies approximately 35,000 truck miles per day that are incremental to the container traffic. This represents approximately five percent of all area interstate truck traffic.[9]

In order to estimate the magnitude of the congestion-related savings that might be realized from a diversion of pass-through Toledo container traffic, the current analysis adapts results developed by the Tennessee Valley Authority and the University of Tennessee in a study of Chattanooga truck diversions.[10] Again, this approach necessitates very strong assumptions. However, the results do, at least, hint at the possible value of relieving the Toledo area of some portion of currently observed truck traffic.

Estimation Results

Estimation results of the air quality savings attributable to current Great Lakes navigation are provided in Table 3. Similar air quality results that might be attributable to the diversion of both rail and truck container traffic to a vessel-truck routing are provided in Table 4. Finally, the estimated benefits of reduced traffic congestion in the

[9] Even though the traffic in question is concentrated on I-80, network effects make it necessary to consider all area traffic, including both trucks and passenger vehicles.

[10] See, "Impact of Increased Truck Traffic Due to Chickamauga Lock Closure, Tennessee Valley Authority, Knoxville, Tennessee, 1999.

Toledo area that might be expected from a diversion of container traffic to a Great Lakes routing are reported in Table 5. All figures represent annual values and are reported in 1998 dollars.

Table 3
Air Quality Savings Attributable to Current Great Lakes Shipping

Commodity	*1998 Tons*	*Per-Ton Savings*	*Total Savings*
Coal	41,450,657	$4.90	$203,108,221
Petroleum	7,343,896	$2.10	$15,422,181
Crude	599,887	$2.10	$1,259,762
Stone	45,073,836	$2.70	$121,699,358
Grains	16,467,511	$11.40	$187,729,622
Chemicals	1,863,906	$14.50	$27,026,635
Ores & Minerals	10,814,324	$2.97	$32,118,543
Iron Ore & Steel	87,003,163	$2.97	$258,399,395
Others	11,414,098	$2.80	$31,959,475
Total	**222,031,278**		**$878,723,192**

Table 4
Air Quality Savings from the Diversion of Container Traffic to a Great Lakes Routing

	East-Bound	West-Bound	Total
Total Number of Target Railed Containers (1999)	390,200	517,800	908,000
Fuel Savings from Diversion of Railed Containers (gallons)	11,128,000	14,650,000	25,778,000
Dollar Value of Reduced Emissions from Diversion of Railed Containers	$32,271,200	$42,485,000	$74,756,200
Total Number of Target Trucked Containers (1999)	349,166	463,016	812,182
Fuel Savings from Diversion of Trucked Containers (gallons)	39,962,000	44,848,000	84,810,000
Dollar Value of Reduced Emissions from Diversion of Trucked Containers	$115,889,800	$130,059,200	$245,949,000

Table 5
Toledo Area Congestion Reduction Benefits

	Estimated Benefit
Congestion Delay Reduction	$8,188,080
Incident Delay Reduction	$948,300
Reduced Number of Crashes	$2,158,200
TOTAL	$11,294,580

ATTACHMENT 8

St. CLAIR ICE-BOOM ALTERNATIVE ANALYSIS

1. INTRODUCTION

The St. Clair River Ice Boom Alternative proposes to evaluate potential improvements to the St. Clair and Detroit Rivers within the Great Lakes system. Navigation on the middle lakes of the Great Lakes can occur all year depending on winter conditions. Ice formation and breakup on the lakes and in the rivers can cause delays to navigation interests and flooding problems for riparian properties. The St. Clair and Detroit rivers are problematic areas with their many-channeled delta, and the jamming of large ice floes from Lakes Huron and St. Clair. The problems could be reduced by the proper placement of ice-retaining booms across the mouths of the rivers (see **Figure 1**). Ice booms have been found to be quite effective in controlling the movement of ice in the St. Mary's River, the Niagara River, and in the St. Lawrence Seaway.

Previous studies conducted on the installation of ice booms at the heads of the St. Clair and Detroit Rivers provide details on the location of the booms and their costs. Problems previously identified with ice jams in the rivers include: delays to navigation due to vessels stuck in the ice in the navigation channel; scouring of the river bottom; and flooding and other damage of shore property.

The brief outline presented here relies heavily on information obtained from a report generated in March of 1995, Analysis of Great Lakes Icebreaking Requirements, Final Report, prepared by the U.S. Department of Transportation for the U.S. Coast Guard. This report determines Federal and user requirements, reviews icebreaker capabilities/operating costs and historical ice conditions, and presents a benefit-cost ratio for the overall icebreaking program. In the course of achieving this end, the referenced report developed a cost model for the steel industry looking at alternatives such as stock piling and alternate modes of transportation. The frequent references to the "ice season" on the great lakes involve the months December through March. Ice boom costs were adjusted from the 1974 Navigation Season Extension report.

FIGURE 1
St. Clair River and Detroit River

2. BACKGROUND

Previous studies focus on two facets of ice management in the St. Clair-Detroit River region, the control of ice for flood management and/or the reduction of ice for increased navigability.

a. Flood Control. The U.S. Army Corps of Engineers has general statutory responsibility for flood control but does not have suitable equipment for ice management tasks so, the Coast Guard provides icebreaking support for flood control. The Corps relies on the Coast Guard to provide facilities to break ice to prevent or relieve flooding. Breaking ice for flood control is a difficult and often hazardous undertaking due to narrow, shallow, and sometimes winding channels. Additionally, the relieving of an ice obstruction risks property damage from the released water and ice washing against property along the river banks.

Figure 2 shows the U.S. Coast Guard Ninth District (USCG -D9) divided into area segments and **Figure 3** shows the USCG -D9 average annual operating hours expended on icebreaking for flood control over the years 1980-1994 by area. Area 2 includes the Detroit and St. Clair Rivers and is the focus of this analysis with an annual average of 289.5 ice breaking hours. Thus, Area 2 comprises about 14 percent of the total 2113 annual hours of icebreaking spent in all USCG Ninth District areas.

FIGURE 2
Ninth District Icebreaking Operation Areas

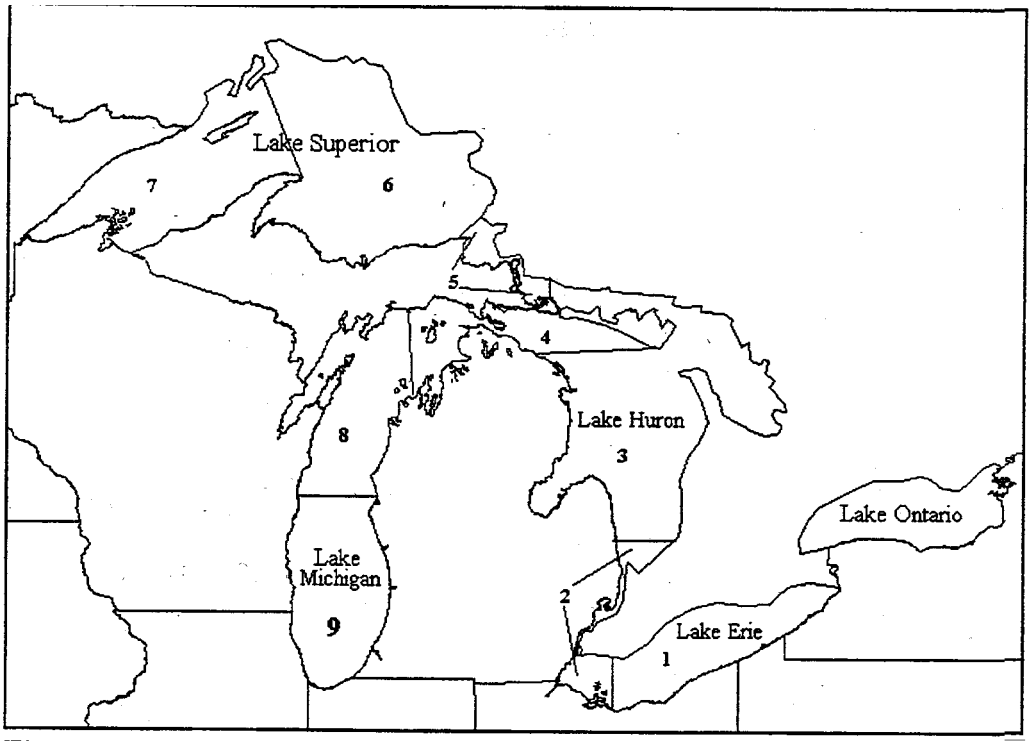
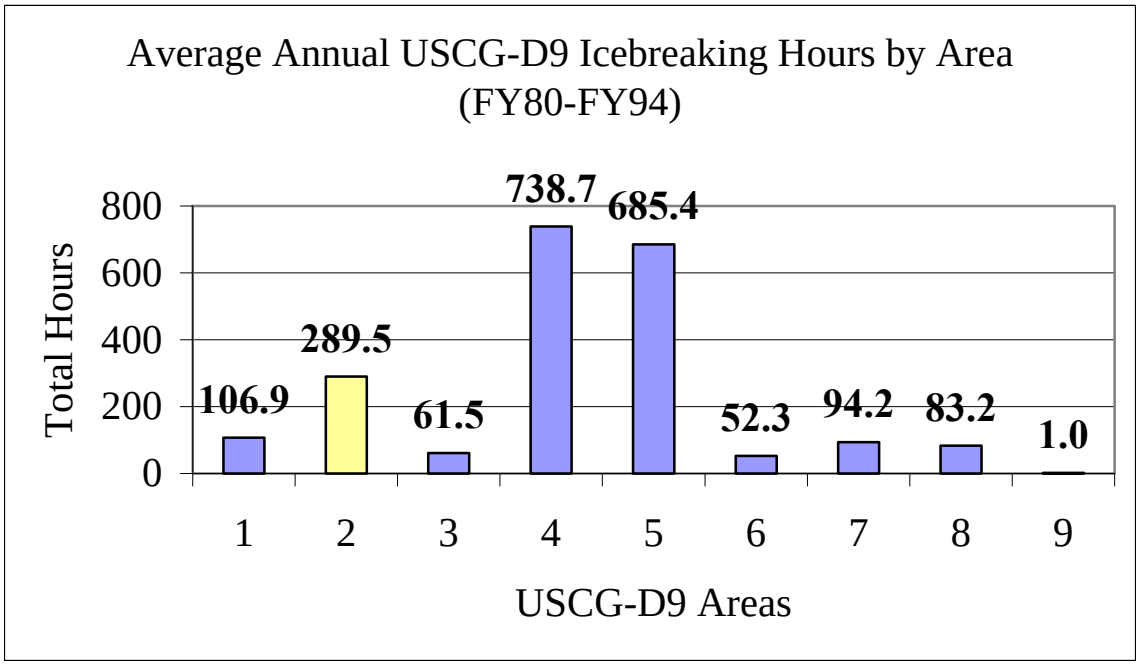


FIGURE 3



"The Corps has a winter ice management program for the St. Marys, St. Clair, and Detroit Rivers. The document for this program outlines the winter monitoring and emergency operations plans which provide guidance for alerts and actions to be undertaken to prevent or reduce flooding in case of adverse ice conditions. The course of actions may include requesting that the U.S. Coast Guard provide icebreaking services to critical ice retardation/blockage areas to relieve the flood hazard as well as requesting that the U.S. Coast Guard initiate coordination procedures with the Canadian Coast Guard for curtailing up and down bound vessel transits through formations above critical ice areas to prevent release of additional ice. In addition to requests by the Corps, the U.S. Coast Guard may also provide icebreaking services directly in response to requests by Federal, State, or Local Government agencies, or private interests at their own initiative.

The Corps also utilizes the technical services of the Cold Region Research Engineering Laboratory (CREL) in Hanover, NH.

Comments provided to the 1994 analysis indicated that while theory and practice include a wide array of techniques for exerting control over ice accumulations and jams in advance of their development there is a much smaller and generally far less effective arsenal of techniques to deal with ice accumulations and jams and resultant flooding once they have developed. Depth limitations dictate which icebreaking vessels can be used at various locations. In the connecting channels, moderate ice accumulations can be addressed by "Bay-class" vessels, but the most severe ice conditions and resultant flooding require the size and power of Mackinaw."[1]

b. Increased Navigability. Shipments through the St. Clair-Detroit rivers continue through the ice season, benefiting from its removal. Total and ice season tonnage are depicted in **Table 1** for the years 1989 - 1998. The average annual tonnage through the St. Clair-Detroit River system for the referenced 10-year period is 228,589,000 short tons. The 1995 study determined that over 5 percent of the total annual shipments occur during the ice season; averaging 11,727,000 short tons.

TABLE 1

Annual and Average Tonnage for the St. Clair and Detroit Rivers in Short Tons (Thousands) – WCUSGL (1998)

	St. Clair River, MI	Channels in Lake St. Clair, MI	Detroit River, MI	Port of Detroit, MI	TOTAL
1989	78,458	69,851	75,662	20,701	244,672
1990	75,438	64,034	69,635	17,735	226,842
1991	66,003	54,232	57,894	14,321	192,450
1992	68,613	58,131	63,134	16,303	206,181
1993	69,062	56,982	62,662	17,422	206,128
1994	75,531	63,963	72,027	18,718	230,239
1995	78,813	68,555	73,502	18,661	239,531
1996	78,546	67,111	75,023	18,604	239,284
1997	79,777	68,211	75,939	18,135	242,062
1998	84,238	71,970	82,842	19,454	258,504
10 Year Avg.	75,448	64,304	70,832	18,005	228,589
Average Ice Season Tonnage					**11,727**

c. Vessels. There are three classes of vessels used for ice breaking on the Great Lakes and they are presented in **Table 2**. The WTGB-102 Bristol Bay and the WAGB Mackinaw are used in the St. Clair-Detroit River area. Vessel costs were determined in the 1995 study and were adjusted to 2002 dollars using the CWCCIS, CWBS-Composite Index (Weighted Average).

TABLE 2

3 Vessel Classes Used in Ice Breaking on the Great Lakes

Designation	Vessel Type	# Available	Beam	Length	Draft	Yrs built
WAGB	Icebreaker	1	74'5"	290'	19'	1944
WTGB	Harbor Tugs, Medium	5	37'6"	140'	12'	1978-1980
WLB	Seagoing Tenders	3	37'	180'	13'	1944

Vessels Available for use in District 2

Designation	Vessel Name	Home Port	Beam	Length	Draft	Year built
WTGB-102	Bristol Bay	Detroit, MI	37'6"	140'	12'	1979
WLB-392	Bramble*	Port Huron, MI	37'	180'	13'	1944
WAGB	Mackinaw**	Cheboygan, MI	74'5"	290'	19'	1944

*Not used for ice breaking in 1994

** The Mackinaw is being replaced with a similar vessel

3. COSTS

This analysis compares the cost of the current ice breaking system utilizing ice-breaking vessels to the cost of the proposed alternative utilizing ice booms at the headwaters of the St. Clair and Detroit rivers (see Figure 1).

a. Current System Costs. The current means of ice breaking in the St. Clair-Detroit River system utilizing ice breaking vessels results in the use of nearly 290 man hours per season, about 14 percent of the total man hours in the entire district (as shown in Figure 3 above). **Table 3** portrays the vessels and the corresponding costs per vessel utilized in ice breaking in the entire USCG Ninth District.

TABLE 3

Current Costs

Ninth District Budgeted Domestic Icebreaking Costs, 1994$ - 2002$

	WTGB's	Mackinaw	Junipers (a)	2002$ (b)
Ninth District fleet size	5	1	2	
Cost per Vessel	$1,048,856	$4,616,023	$3,333,000	
Total Cost per vessel class	$5,244,280	$4,616,023	$6,666,000	
% Ice Breaking	100% (3)			
	50% (2)	100%	33%	
Total vessel class cost	$4,195,424	$4,616,023	$2,222,000	
District 1994 Total Icebreaking Cost		$8,811,447		
Attributable to district 2 (c)		$1,207,419		**$1,425,906**

(a) Junipers were not included in the total due to a lack of information on the Junipers ice breaking capabilities in 1994.

(b) CWCCIS, CWBS-Composite Index (Weighted Average) used to adjust to 2002 dollars

(c) Area 2 involves 14% of the total hours spent in icebreaking - 14% of total costs attributed

The average annual cost of ice breaking in the entire USCG Ninth District is $8,811,447 with 14 percent of that or $1,425,900 attributable to the St. Clair-Detroit River (area 2).

b. Proposed Ice Boom Costs. The cost of ice booms in Lake Huron at the headwaters of the St. Clair River and Lake St. Clair at the headwaters of the Detroit River are presented separately and combined in **Table 4.** The Average Annual Cost approaches $800,000 and includes a 25 percent contingency.

TABLE 4

LAKE HURON and LAKE ST. CLAIR ICE BOOM COSTS

Lake Huron Ice Boom									
Description	Year	Quantity	Units of Measure	Unit Cost	1973 Amount	Economic Construction Cost in Corresponding Year Values [a]	Present Worth Factor [b]	2002 Present Worth	
Boom sections and connecting chains, etc.	2005	4450	Linear Ft	$60	$267,000	$1,021,030	0.8308	$848,242	
10 YEAR LIFE	2015					$1,408,570	0.4478	$630,760	
	2025					$1,948,872	0.2414	$470,406	
	2035					$2,696,414	0.1301	$350,817	
	2045					$3,730,695	0.0701	$261,630	**$2,561,855**
Anchors	2005	16	each	$15,000	$240,000	$917,780	0.8308	$762,465	
50 YEAR LIFE									**$762,465**
Light-pier	2005		Lump Sum		$430,000	$1,644,355	0.8308	$1,366,082	
50 YEAR LIFE									**$1,366,082**
Ice Buoys (large)	2005	2	each	$12,500	$25,000	$95,602	0.8308	$79,423	
25 YEAR LIFE	2030					$214,641	0.1772	$38,037	**$117,460**
Lake Huron Total									**$4,807,863**

Lake St. Clair Ice Boom									
Description	Year	Quantity	Units of Measure	Unit Cost	1973 Amount	Economic Construction Cost in Corresponding Year Values [a]	Present Worth Factor [b]	2002 Present Worth [c]	
Boom sections and connecting chains, etc.	2005	6000	Linear ft	$60	$360,000	$1,376,669	0.8308	$1,143,697	
10 YEAR LIFE	2015				$360,000	$1,899,195	0.4478	$850,463	
	2025				$360,000	$2,627,693	0.2414	$634,256	
	2035				$360,000	$3,635,614	0.1301	$473,012	
	2045				$360,000	$5,030,151	0.0701	$352,760	**$3,454,187**
Anchors	2005	23	each	$15,000	$345,000	$1,319,308	0.8308	$1,096,043	
50 YEAR LIFE									**$1,096,043**
Ice Buoys (large)	2005	2	each	$12,500	$25,000	$95,602	0.8308	$79,423	
25 YEAR LIFE	2030				$25,000	$214,641	0.1772	$38,037	**$117,460**
Lake St. Clair Total									**$4,667,690**
Subtotal									$9,475,553
Contingency		25%							$2,368,888

TOTAL	**$11,844,441**
Average Annual Cost	**$791,000**

[a] Calculated utilizing CWCCIS, Civil Works Construction Cost Index, Composite.
[b] Present value adjustment factors utilize the current Corps interest rate of 6 3/8%.

The ice booms also require a total annual operation and maintenance cost of $383,000 as delineated in **Table 5**.

TABLE 5

Ice Boom O&M Costs

O&M	1973	2002*		1973	2002*
Lake Huron Ice Boom			**Lake St. Clair Ice Boom**		
Annual Placement and Removal of Boom 12 @$2,000 ea.	$24,000	$84,000	Annual Placement and Removal of Boom 15 @$2,000 ea.	$30,000	$104,000
Annual Maintenance and Repair of Boom 12 @ $2,000	$24,000	$84,000	Annual Maintenance and Repair of Boom 15 @ $2,000	$30,000	$104,000
Lightpier Annual Maintenance	$1,000	$3,000	Ice Buoy Annual Maintenance 2 @ $300	$600	$2,000
Ice Buoy Annual Maintenance 2 @ $300	$600	$2,000			
TOTAL		**$173,000**	**TOTAL**		**$210,000**

Combined Annual O&M	**$383,000**

[*] Calculated utilizing CWCCIS, Civil Works Construction Cost Index, Composite.

The annual cost of implementation of the Ice Booms is summarized below in **Table 6.** The total combined annual cost for the ice booms in 2002 dollars is $1,174,000.

TABLE 6

Ice Boom Cost Summary

Average Annual Cost	$791,000
Annual O&M	$383,000
Annual Cost of Ice Booms	**$1,174,000**

c. Cost Comparison. A cost summary of the annual cost of ice-breaking vessels and the annual cost of the proposed ice booms is shown in **Table 7**. The ice booms offer an annual cost savings of $251,900, the difference between the vessels annual cost ($1,425,900) and the ice-boom annual cost of ($1,174,000).

A caveat to the direct financial comparison is the assumption that ice booms would eliminate the need for ice breaking vessels. Additionally, a comparison of the alternative costs should include an estimate of the potential costs of any damage associated with ice breaking by vessels. Thus, the annual cost of ice booms is probably understated, by not accounting for any additional need for the use of ice breaking vessels in extreme weather situations and the annual cost of the use of ice breakers is understated by not including a value for the hazardous nature of ice removal. Quantification of these costs is not possible, given the time and resources for this reconnaissance level effort.

TABLE 7

Direct Cost Comparison	
Current Annual Cost of Ice Removal Attributable to Area 2 (TABLE 3)	**$1,425,906**
Proposed Booms Annual Cost	
Average Annual Cost	$791,000
Annual O&M	$383,000
Annual Cost of Ice Booms (TABLE 6)	**$1,174,000**
Annual Cost Difference	**$251,906**

d. Environmental Costs. Environmental impacts should be assessed for each of the alternatives. Several studies have been completed on the effects of ice breaking offering a wide range of opinions varying from “no effects” to “extremely detrimental” environmental consequences. The severity of the consequences depends on a myriad of circumstances such as weather conditions, vessel size and speed, and proximity to spawning areas to name just a few. The difficulty of evaluating the accuracy of these various reports and their applicability to ice breakers and/or ice booms is left for the environmentalists at the next level of study. Environmental impacts have the potential to alter the economic results. Several studies are noted in the references to this report which may prove useful in future evaluations.

4. BENEFITS

The benefits utilized in the 1995 report to calculate a benefit-cost ratio for ice breaking over the entire ninth district included only those attributable to shipping which directly benefited from ice breaking activities. Shipping benefits for area 2, the St. Clair-Detroit River system, are presented in **Table 8** and are based on a ten-year average for ice season tonnage. The dollar value of the benefits was calculated by determining the cost savings achieved with vessel transport compared to three alternatives: increased stockpiling, rail shipment, and Escanaba pre-positioning. The average season benefits in 2002 dollars are $99,357,000.

TABLE 4-1

Shipping Benefits, St. Clair-Detroit River System		
	1998	**2002***
10-yr Average Tonnage	228,589,300	
Average Ice Season Tonnage	11,726,631	
Average Ice Season Benefits	$91,532,537	**$99,357,123**

***** Calculated utilizing CWCCIS, Civil Works Construction Cost Index, Composite

The benefits to vessel movement are not likely to vary when changing from the current situation of utilizing ice-breaking vessels to utilizing ice booms. However, there are benefits which may accrue with the use of ice booms that do not occur with the current icebreaker system. The other benefits achieved through ice booms are listed below in **Table 9**. Quantification of these other associated benefits would involve a need for data that is, at best, difficult to obtain at this level of study.

TABLE 9

Other Benefits		
Benefit	**Reason for benefit**	**Possible Method for Quantification**
Increased Property Protection	Ice booms offer some additional property protection by decreasing the need to relieve ice obstructions which risks property damage caused by the released water and ice washing against property along the riverbanks. Ice booms may offer some advanced flood protection.	Review historical property damages due to ice breaking. Review historical flood damages due to ice build-up or release.
Decrease in Hazardous Work	Breaking ice for flood control is usually a difficult and often a hazardous undertaking	Review Coast Guard records for accidents and their associated costs and any additional compensation required in the performance of ice breaking activities
Increased Control	While theory and practice include a wide array of techniques for exerting control over ice accumulations and jams in advance of their development there is a much smaller and generally far less effective arsenal of techniques to deal with ice accumulations and jams and resultant flooding once they have developed	Review historical emergency costs which may have been prevented.
Increased Vessel Availability for Other Areas	Depth limitations dictate which icebreaking vessels can be used at various locations. In the connecting channels, moderate ice accumulations can be addressed by the WTGB and WLB vessels, but the most severe ice conditions and resultant flooding require the size and power of Mackinaw (WAGB).	Ice booms would decrease or eliminate the need for ice breaking vessels in the area, allowing the limited number of vessels to be utilized elsewhere.

5. BENEFIT-COST SUMMARY

The benefits to shipping, along with the current cost of ice breaking and the expected cost of ice boom construction, are shown in **Table 10**. Also included in the table is the annual cost savings that would be achieved if the ice booms eliminated the need for icebreakers. As was indicated above, this assumption is too strong, but it is further assumed that the costs for the continued need for ice breaking vessels would be offset by the decreased necessity to perform this hazardous duty and the benefits not yet quantified as enumerated in Table 9.

TABLE 10

Benefits and Costs of Ice Removal	
Current Annual Cost of Ice Removal Attributable to St. Clair-Detroit River	**$1,425,906**
Average Annual Cost	$791,000
Annual O&M	$383,000
Annual Cost of Ice Booms	**$1,174,000**
Annual Cost Savings	**$251,906**
Average Annual Ice Season Benefits in 2002 dollars*	**$99,321,805**

With either alternative, the benefits to shipping far outweigh the cost of icebreaking activities. This comparison indicates that there would be a cost savings of over $250,000 annually.

The direct Federal savings through decreased annual expenditures by the Coast Guard has not been directly quantified since there has been no estimate as to the decreased need for icebreakers. If the need for icebreakers were eliminated, the benefit to the government would be equal to the difference in cost between the two alternatives of $250,000.

6. CONCLUSION

The accuracy of the cost of ice boom construction is questionable since these costs were merely adjusted to current dollars from a report completed in 1974 and technological advances could significantly affect the results. Whether updated costs would increase or decrease the bottom line is uncertain. Technological advances may decrease the cost of construction by advancing our ability to produce the same product cheaper or may increase it by design improvements that increase efficiency along with costs. In addition, environmental considerations could potentially have a significant impact on the cost.

The benefits accrued to shipping are calculated from a much more recent, thorough report. Further study is required to determine the difference in the benefits between the

current use of icebreakers and the possible use of ice booms. In order to make a reasonable comparison between these alternatives, it is also necessary to estimate the continued need, if any, for icebreakers after the installation of the ice booms.

This review of the available information indicates that placing ice booms in the St. Clair-Detroit River system has the potential for federal savings and further study is warranted.

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1) Draft Final Report, Analysis of Great Lakes Icebreaking Requirements, February 10, 1995, U.S. Department of Transportation, with suggested revisions.

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3) Great Lakes and St. Lawrence Seaway, Navigation Season Extension, Demonstration Program, System Study to Extend Navigation Season on St. Clair-Detroit Rivers System, MAIN REPORT, VOLUME 1 OF 3, Detroit District, Corps of Engineers, Contract No. DACW 35073-C0208, Acres American Incorporated, Buffalo, New York, August 1974.

4) Final Survey Study for Great Lakes and St. Lawrence Seaway, Navigation Season Extension, Volume II, Appendices A – B, August 1979, U.S. Army Engineer District, Detroit, Corps of Engineers, Detroit, Michigan.

5) Listing of Previous Studies on Environmental Impacts:
   a) Poe, T.P., Edsall, T.A., Hiltunen, J.K., Effects of Ship-Induced Waves in an Ice Environment of the St. Marys River Ecosystem. U.S. Fish & Wildlife Service, Ann Arbor, Michigan. Administrative Report No. 80-6. (January 1980).
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   c) Wuebben, J.L., Effect of Vessel Size on Shoreline and Shore Structure Damage Along the Great Lakes Connecting Channels. U.S. Army Corps of Engineers, Special Report 83-11. (May 1983).
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   g) Gatto, L.W., Ice Conditions in the St. Marys River, Michigan and Selected Harbors from Mid-February to Ice-Off. CRREL. (November 1991).
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   i) Zabilansky, L.J., Frankenstein, G.E., Tuthill, A.M., Observation and Measurement of Ice Movement and Sediment Transport on the St. Marys River During Early Opening of Navigation, 15-31 March, 1992. U.S. Army Corps of Engineers, 1992.

ATTACHMENT 9

GREAT LAKE HARBOR PHYSICAL DIMENSIONS

Great Lakes Harbors. The study area consists of thirty-three U.S. harbors located on the Great Lakes system (see **Table** below). These harbors were selected on the basis of the volume commodity traffic handled or on specific requests from local interests. No Canadian ports are described below, recommendations for improvement of Canadian ports being beyond the scope of this study.

TABLE
Great Lakes Navigation System, Harbors Selected for Study

No.	Harbor	No.	Harbor
1.	Alpena Harbor, MI	18.	Lorain Harbor, OH
2.	Ashtabula Harbor, OH	19.	Marinette/Menominee, WI/MI
3.	Buffalo Harbor, NY	20.	Milwaukee, WI
4.	Burns Waterway Harbor, IN	21.	Monroe Harbor, MI
5.	Calcite Harbor, MI	22.	Presque Isle/Marquette, MI
6.	Calumet Harbor/Lake Calumet, IL/IN	23.	Rouge River, MI
7.	Chicago Harbor, IL	24.	Saginaw, MI
8.	Cleveland, OH	25.	Sandusky Harbor, OH
9.	Conneaut, OH	26.	Saugatuck, MI
10.	Detroit, MI	27.	Sheboygan, WI
11.	Drummond Island, MI	28.	Silver Bay, MN
12.	Duluth/Superior Harbor, MN/WI	29.	St Clair River, MI
13.	Escanaba Harbor, MI	30.	Stoneport, MI
14.	Fairport, OH	31.	Taconite, MN
15.	Gary, IN	32.	Toledo Harbor, OH
16.	Green Bay, WI	33.	Two Harbors, MN
17.	Indiana Harbor, IN		

The remainder of this attachment describes the physical dimensions and maintenance costs for each harbor. Local interest comments are provided where available.

1.) Alpena Harbor, Michigan.

a.) Physical Dimensions. Alpena Harbor, Michigan is located at the mouth of Thunder Bay River on the northwest shore of Thunder Bay, Lake Huron, 100 miles southeast of Cheboygan Harbor, Michigan.

SEGMENT 01 – BAY CHANNEL - The bay channel has a depth of 25’ with a width of 200’ from deep water in Thunder Bay to a point 300’ lakeward of the Alpena Light.

SEGMENT 02 – ENTRANCE CHANNEL - The entrance channel is 24 feet deep narrowing to 100’ in width to a point 700’ upstream from the light.

SEGMENT 03 – RIVER CHANNEL - The river channel has a depth of 23’ and a width of 100’ to the Second Avenue Bridge.

SEGMENT 04 – UPPER LIMIT - The upper limit of the Federal project is 18.5’ deep with a width of 75’ and a length of 1,600’.

SEGMENT 05 – TURNING BASIN - The turning basin would be located at the mouth of the river with a depth of 19’ and a trapezoidal shape. It would have a maximum width of 700’ including the channel width and a maximum length of 900’ along the channel line with a breakwater 550’ in length paralleling the lakeward side of the new turning basin.

b.) Maintenance Costs. For FY 1999, continuing engineering and design for the repair of the existing rubblemound breakwater had a total cost of $75,865. Total cost of the existing project to the end of FY 1999 was $1,557,021 of which $337,394 was for new work and $1,199,627 was for maintenance.

2.) Ashtabula Harbor, Ohio.

a.) Physical Dimensions. Ashtabula Harbor, Ohio is located on Lake Erie approximately 119 miles southwest of Buffalo, New York and 59 miles northeast of Cleveland, Ohio.

SEGMENT 01 - ENTRANCE CHANNEL - The entrance channel has a project depth of 29’ with a width of 600’ and a length of 200’.

SEGMENT 02, 03, 04 AND 05 - OUTER HARBOR - The outer harbor has a project depth of 27’ with the width varying from 600’ to 4917’ and a length of 3590’.

SEGMENT 06 AND 07 -ASHTABULA RIVER CHANNEL - The Ashtabula River channel has a project depth of 27’ with the width varying from 160’ at 645’ south of the outer harbor to 118’ at 3015’ south of the outer harbor and a length of 3015’. The river channel has one non-federal dock on the western and eastern sides with the distance between these facilities ranging from 300’ at the north end to 280’ at the southern end.

SEGMENT 08 AND 09 - CONRAIL DOCKS - These non-federal dock facilities are located on the eastern and western sides of the Ashtabula River channel and have an existing water depth ranging from 24’ at the northern end to 12’ at the southern end. The vessel berthing width is 66’ and length is 2478’.

SEGMENT 10 - CONRAIL MINNESOTA SLIP - This non-federal slip is comprised of two dock facilities, the Ashtabula and Buffalo Dock Co. and the Union Dock Co. The slip is approximately 770,868 square feet with the water depth varying from 22’ at the southern end to 27' at the northern end. The width of the slip is 250’ in the northern section and 160’ in the southern section with a length of 3225’.

SEGMENT 11 - PINNEY DOCK AND TRANSPORT CO. #1 AND #2 - This non-federal facility has an existing water depth of 28’ with a width of 244’ and a length of

1979'. The existing facility is adequate for single vessel berthing of 105' beam vessels, but would require widening to 260' for 130' vessel beams.

SEGMENT 12 - PINNEY DOCK AND TRANSPORT CO. #3 AND #4 - This non-federal facility has an existing depth of 27' with a width of 218' and a length of 2,042'.

b.) Maintenance Costs. As of FY98, the federal cost of the completed project was $12,240,147; the non-federal cost was $5,743,000. Total expenses for FY98 were $348,806.

3.) Buffalo Harbor New York.

a.) Physical Dimensions. Buffalo Harbor, New York is located at the eastern end of Lake Erie, at the head of Niagara River, 176 miles east of Cleveland, Ohio.

SEGMENT 01 – LAKE APPROACH CHANNEL TO THE SOUTH ENTRANCE - The lake approach channel to the south entrance has an authorized project width of 1000', length of 2,000', and depth of 30'.

SEGMENT 02 – SOUTH ENTRANCE - The south entrance has an authorized project width varying between 1,200 and 400', a length of 1,950', and depth of 29'.

SEGMENT 03 – INNER HARBOR, SOUTH SECTION - The inner harbor, south section has an authorized project width varying between 1,100 and 1,600', a length of 3,900', and depth of 28'.

SEGMENT 04 – INNER HARBOR, MOORING AREA - The inner harbor, mooring area has an authorized project of 900', a length of 4,200', and depth of 23'.

SEGMENT 05 – INNER HARBOR, MIDDLE SECTION - The inner harbor, middle section has an authorized project width varying between 500 and 1,600', a length of 11,150', and depth of 27'.

SEGMENT 06 – NORTH ENTRANCE CHANNEL - The north entrance channel has an authorized project width of 800', a length of 3,000', and depth of 25'.

SEGMENT 07 – INNER HARBOR, NORTH SECTION - The inner harbor, north section has an authorized project width varying between 1,370 and 1,200', a length of 4,800', and depth of 23'.

SEGMENT 08 – BUFFALO RIVER ENTRANCE CHANNEL - The Buffalo River entrance channel has widths varying down to 40', project depths of 22' in soft material and 23' in hard material, and a length of 3,950'.

SEGMENT 09 – BLACK ROCK CANAL ENTRANCE CHANNEL - The Black Rock Canal Entrance Channel has widths varying from less than 40' to 800' at the Buffalo River Entrance, project depths varying from 20 to 21', and a length of 4,700'.

b.) Maintenance Costs. Total costs for the FY98 were $1,448,168 exclusive of expenditure on preparation of a decision document to address the use of section 312 environmental-dredging authority which was $28,373. Total costs for the project to the end of FY98 were $18,837,601 for new work and an estimated $9,188,000 in non-federal costs.

4.) Burns Harbor, Indiana.

Specific Information / Requests:

William D. Friedman, Executive Director, Indiana Port Commission has indicated that a deeper draft in Burns Harbor would lead to substantial cost savings for shippers and consignees in terms of both time and direct financial savings.

Al Ames, Region Director, U.S. Department of Transportation, Maritime Administration, Great Lakes Region, has indicated that the traffic here "…continues to be strong and growing in importance." and has recommended that this area be included in the Great Lakes Navigation Study.

a.) Physical Dimensions. Burns Harbor, Indiana is located on the southern shore of Lake Michigan approximately 9 miles east of Gary, Indiana and 14 miles southeast of Michigan City, Indiana.

SEGMENT 01 - ENTRANCE CHANNEL - The Entrance Channel has a project depth of 29' with a width of 385' and a length of 1885'.

SEGMENT 02 - OUTER HARBOR BASIN - The Outer Harbor Basin has a project depth of 28' with a width varying from 1582' at the eastern end to 1000' at the western end and a length of 3650'. The existing dimension of the outer harbor allows the current fleet to use it as a turning basin.

SEGMENT 03 - EAST HARBOR ARM - The East Harbor Arm channel is federal and all docks and berthing areas are non-federal. The eastern side is an active Bethlehem Steel dock. The channel is maintained at a water depth of 27' with the width being 620' between the federal limits and 820' overall between dock facilities.

Non-Federal Facilities. The non-federal docking facility on the eastern side has a dock length of 3925', a width of 100' and a water depth of 27'. A 105' vessel beam would extend into the federal channel by 5', but with an overall width of 820' there is adequate room for other vessels to maneuver around a docked vessel with 130' beam.

The non-federal docking facility on the western side has a dock length of 1725', a width of 100' and a water depth of 27'. Vessels can operate safely due to the overall channel width of 820'.

SEGMENT 04 - WEST HARBOR ARM - The West Harbor Arm consists of a federal navigation channel and a non-federal facility on both the eastern and western sides. The western side is inactive. All other facilities are owned by the Ports Commission and leased to operators.

Federal Facilities. The federal facilities extend from the outer harbor basin 3900' to the south to the end of the harbor arm. The west harbor arm has a project depth of 27' and a federal channel width of 620'.

Non-Federal Facilities. The non-federal docking facility on the eastern side has a dock length of 2213', a width of 100 feet and a water depth of 27'. The western side is inactive

The non-federal dock facility on the western side has a length of 2450', a width of 100' and a water depth of 27'. Vessels can operate safely due to the overall channel width of 820'.

b.) Maintenance Costs. Total cost to the end of FY98 was $25,055,340, $13,599,900 was for new work and $11,455,440 was for maintenance.

5.) Calcite Harbor, Michigan.

Specific Information / Requests:

In 2000, John N. Lauer, Chairman, President, and CEO of Oglebay Norton stated, "We are pleased to have concluded this transaction under mutually favorable terms. This transaction provides Oglebay Norton with a complementary business and creates significant synergies with our existing limestone facility in Port Inland and with our Marine Services and Transportation business. It also strengthens our position in construction aggregates, building materials, industrial and environmental markets in the Great Lakes region. We expect the acquired business to be accretive to earnings this year."

A December 2000 publication of Mineral Industry Surveys, by the U.S. Department of the Interior, U.S. Geological Survey, ranked Michigan Limestone Operations 8th in a list of the top 10 leading quarries in the U.S. in terms of total output of crushed stone for the year 1999. The company has 2 active quarries producing both Limestone and Dolomite. It is expected that this area will continue to produce well into the future.

a.) Physical Dimensions. Calcite Harbor is located just southeast of Rogers City, Michigan on the upper northeast side of the Lower Peninsula of Michigan on Lake Huron 3.3 miles west of Adams Point.

Depth through the center channel into the harbor is privately maintained at 26' with direct access to rail. The harbor is protected on the north and northwest by a point and breakwater and to the southeast by Quarry Point. The harbor offers no shelter from north to east winds except for small craft, which can enter the tug basin on an emergency only basis.

b.) Maintenance Costs. Calcite Harbor is private, no operations or maintenance costs are available.

6.) Calumet Harbor and River, Illinois/Indiana.

a.) Physical Dimensions. Calumet Harbor is located at the mouth of the Calumet River on the southwestern shore of Lake Michigan. The harbor is located approximately 14 miles northwest of Gary, Indiana and 12 1/2 miles south of Chicago Harbor. The harbor is in the south portion of the city of Chicago, IL and comprises an outer harbor protected by breakwaters and the Calumet River.

SEGMENT 01 - ENTRANCE CHANNEL AND OUTER HARBOR - The entrance channel and outer harbor is maintained at 1500 feet wide with a 12,000-foot breakwater along the north side and extends from the Illinois-Indiana border approximately 20,000 feet into Lake Michigan at an existing depth in excess of 27 feet.

SEGMENT 02 - CALUMET RIVER CHANNEL - The Calumet River federal channel continues from the Indiana-Illinois border up river approximately 8 miles to Lake Calumet. The river has a width of between 180 and 400 feet and contains numerous bends and obstructions.

SEGMENT 03 - NORTH SLIP AND APPROACH CHANNEL - This non-federal facility has a slip 2800 feet long, 190 feet wide at 27-foot depth with an approach channel 1300 feet in length. It is rail connected (EJ&E) and has potential as a container facility.

SEGMENT 04 - SOUTH SLIP - This non-federal facility is a slip 1400 feet long varying from 100 feet to 300 feet in width at 27-foot depth. The city of Chicago is working on a land swap deal with the federal government such that the South Slip will soon be half federal and half non-federal.

SEGMENT 05 - SLIP #1 - This non-federal facility is a slip 1080 feet long with an average width of 340 feet at 27-foot depth.

b.) Maintenance Costs. The harbor and river have experienced high maintenance costs for the last five years due to dredging, however, structural maintenance has been fairly low.

7.) Chicago Harbor, Illinois.

a. Physical Dimensions. Chicago Harbor and Chicago River are located in northeast Illinois, on the southwest shore of Lake Michigan, in Cook County, within the corporate limits of the city of Chicago.

SEGMENT 01 – HARBOR ENTRANCE CHANNEL - The Harbor Entrance Channel has a length of 6,400' extending from the north and south breakwaters east into Lake Michigan with a width of 800' and a depth of 29'.

SEGMENT 02 – INNER ENTRANCE - The Inner Entrance is inside the north and south breakwaters with a length of 2,950, a width varying between 500 and 1080', and a depth of 26'.
SEGMENT 03 – NAVY PIER/CITY OF CHICAGO OVERSEAS TERMINAL - This segment has a length of 2,950', a width of 380', and a depth varying between 25 and 29'.

SEGMENT 04 – LOCK - The Lock has an over sill depth of 23', a length of 600' and a width of 80'.

SEGMENT 05 – RIVER ENTRANCE CHANNEL - The River Entrance Channel has a project length of 1700', width of 500', and depth of 21' and offers access to the Chicago Police Marine Unit and Columbia Yacht Club.

SEGMENT 06 – LAKE SHORE DRIVE TO MICHIGAN AVENUE - This segment has a length of 2,580', a width of 200', a depth of 21' and contains 2 Bascule bridges. The Columbus Drive Bascule Bridge has a horizontal clearance of 176' and a vertical clearance of 21'. The Michigan Avenue Bascule Bridge has a horizontal clearance of 195' and a vertical clearance of 17'.

SEGMENT 07 – MICHIGAN AVENUE TO ORLEANS ST - This segment has a length of 3,900', a width of 175', a depth of 21' and contains 7 Bascule Bridges at Wabash Street, State Street, Dearborn Street, Clark Street, LaSalle Street, Wells Street, and Orleans Street. The minimum horizontal clearance of the seven Bascule Bridges is 193' at the Wabash St. Bascule Bridge; the minimum vertical clearance of 17' is at LaSalle St., Wells St., and Orleans St.

SEGMENT 08 – ORLEANS ST TO CHICAGO AVE - This segment extends to the southwest for a length of 700' turning to the North-northwest for a length of 4,100' with a depth of 19' and a width narrowing to 80'. It contains 4 Bascule bridges at Kinzie Street, Grand Avenue, Ohio Street, and Chicago Avenue with a minimum horizontal clearance of 105' and a minimum vertical clearance of 14', both at the Kinzie Street Bascule Bridge.

SEGMENT 09 – EAST OF GOOSE ISLAND - This segment has a length of 3,125', a width of 80', a depth varying from 13 to 17', and contains 2 Bascule bridges at Ogden

Street and Division. The minimum horizontal and vertical clearances occur at the Ogden Street Bascule Bridge with a horizontal clearance of 56' and a vertical of 15'.

SEGMENT 10 – WEST OF GOOSE ISLAND - This segment has a length of 5,200', a width of 170', and a depth of 15'. It contains 3 Bascule Bridges at: North Halsted Street, Ogden Avenue, and Division Street with a minimum horizontal clearance of 100' at Division Street and a minimum vertical clearance of 17' at both the North Halsted and Division Street Bridges.

b.) Maintenance Costs. Total cost for maintenance, labor, and lock at Chicago Harbor for FY98 was $4,512,080. Total cost for Chicago River for FY98 was $298,532. Total costs of the Chicago Harbor project to the end of fiscal year 1998 were $46,327,329 of which $4,788,827 was for new work, $40,051,902 for maintenance, $1,326,600 for rehabilitation, and $160,000 for Harbor and Dams funds. Total cost of the Chicago River project to the end of fiscal year 1998 were $17,289,395, of which $1,500,565 was for new work and $15,788,830 was for maintenance.

8.) Cleveland Harbor/Cuyahoga River, Ohio.

Specific Information / Requests:

The Cleveland-Cuyahoga County Port Authority indicated interest in the Great Lakes Navigation Study and in cooperation with our Canadian counterparts. They have completed a study regarding a ferry service to the southern shore of Lake Erie in Ontario, with a specific example cited as to the benefits of such a service. The development of the proposed ferry would not require further deepening or changes in current locks.

Paul DeMarco, Area Manager for LTV Steel and Richard W. Harkins, Vice President – Operations, Lake Carriers' Association, have indicated strong support for the repair and maintenance of the Cuyahoga River based on the number of businesses and employees relying on this waterway. John Jamian, Chairman, American Great Lakes Ports Association indicated an interest in reviewing methods of controlling erosion in the area to reduce future maintenance costs.

a.) Physical Dimensions. Cleveland Harbor, Ohio is located on Lake Erie approximately 176 miles southwest of Buffalo, New York and 76 miles east of Toledo Harbor, Ohio.

SEGMENT 01 - LAKE APPROACH CHANNEL - The Lake Approach Channel has a project depth of 29' with the width varying from 600' to 750' and a length of 1162'.

SEGMENT 02 - WEST BASIN - The West Basin has a project depth of 28' with the width varying from 1150' to 1570' and a length of 4800'.

SEGMENT 03 - ENTRANCE CHANNEL - The Entrance Channel from the lake approach channel to the pier range has a project depth of 28’ with a width varying from 750’ to 225’ and a length of 1162’.

SEGMENT 04 - EAST BASIN WESTERN SECTION - The East Basin Western Section has a project depth of 28’ with the width varying from 1300' to 1540’ and a length of 1478’.

SEGMENT 05 - EAST BASIN EASTERN SECTION - The East Basin Eastern Section has a project depth of 27’ with the width varying from 1540’ to 1250’ and a length of 3800’.

SEGMENT 06 - EAST BASIN AIRPORT RANGE - The East Basin Airport Range has a project depth of 27’ with a width of 500’ and a length of 16,420’.

SEGMENT 07 - PIER RANGE - The Pier Range which connects the outer harbor to the Old River and Cuyahoga River has a project depth of 27’ with a width of 225’ and a length of 1584’.

SEGMENT 08 - OLD RIVER - The Old River has a project depth of 27’ with a width of 120’ and a length of 5800’.

SEGMENT 09 - CONRAIL ORE DOCK #11 - The Conrail ore dock is a non-federal facility and has an overall length of 1685’, of which 1250’ has a water depth of 28’ and a width of 75’.

SEGMENT 10 - PORT OF CLEVELAND DOCK #20 - This non-federal dock facility located in the pier range has a length of 1000’, a width of 50’, and a water depth of 27’.

SEGMENT 11 - PORT OF CLEVELAND DOCK 24 WEST - This non-federal dock facility has a length of 630’ with a width of 133’ and the water depth varying from 18' at the southerly end to 27' at the northerly entrance.

SEGMENT 12 - PORT OF CLEVELAND DOCKS 24 EAST & 26 WEST - This non-federal dock facility has a length of 665', a width of 215’, and a water depth varying from 15’ at the southerly end to 27’ at the northerly entrance.

SEGMENT 13 - PORT OF CLEVELAND DOCKS 26 EAST & 28 WEST - This non-federal dock facility has a length of 715’, a width of 225’, and a water depth varying from 15’ at the southerly end to 27’ at the northerly entrance.

SEGMENT 14 - PORT OF CLEVELAND DOCKS 28, 30 AND 32 - These three non-federal dock facilities have a combined overall length of 1600' with a width of 75’ and a water depth varying from 25 to 28’.

SEGMENT 15 - PORT OF CLEVELAND DOCKS 32 EAST AND 34 - This non-federal dock facility has a length of 707' with a width of 230' and a water depth varying from 14' at the southerly end to 27' at the northerly end.

SEGMENT 16 - PORT OF CLEVELAND DOCK 34 EAST & MUNICIPAL PIER - This non-federal dock facility has a length of 707' with a width of 170' and a water depth varying from 10' at the southerly end to 23' at the northerly end.

SEGMENT 17 - ONTARIO STONE CORPORATION - This non-federal dock facility located at the southwestern edge of the pier range has a length of 522', a width of 50', and a water depth of 27'.

b.) Maintenance Costs. Estimated total Federal cost of the existing project in Cleveland Harbor is $33,852,100, $29,315,100 for completed work, $4,537,000 for new work. Operations and other costs totaled $9,061,717 for FY98.

9.) Conneaut, Ohio.

a.) Physical Dimensions. Conneaut Harbor, Ohio is located on Lake Erie approximately 73 miles northeast of Cleveland and 28 miles southwest of Erie, Pennsylvania.

SEGMENT 01 - LAKE APPROACH CHANNEL - The Lake Approach Channel has a project depth of 30' with the width varying from 850' to 450' and a length of 500'.

SEGMENT 02 - OUTER HARBOR - The Outer Harbor has a project depth of 27' with the width varying from 450' at the lake approach channel to 2850' at the southern end and a length of 3530'.

SEGMENT 03 - ENTRANCE CHANNEL - The Entrance Channel has a project depth of 27' with the width varying from 257' at the northern end to 167' at the southern end and a length of 2250'.

SEGMENT 04 - U.S. STEEL CORPORATION DOCK #1 - This non-federal dock facility has a length of 2639', a width of 55', and a water depth of 24'.

SEGMENT 05 - PITTSBURGH AND CONNEAUT DOCK CO.- DOCKS #2 & #3 - This non-Federal dock facility has a length of 1230', a width of 167', and a water depth varying from 17' at the southern end to 26' at the northern end.

SEGMENT 06 - PITTSBURGH AND CONNEAUT DOCK CO., DOCK #6 - This non-federal dock faci1ity has a docking 1ength of 1560', an overall length of 2507', a width of 55', and a water depth of 27'.

b.) Maintenance Costs. Actual costs for new work for the complete portion of the project were $7,541,369. Operations and other expenses during FY98 were $40,150.

10.) Detroit River Michigan.

Specific Information / Requests:

John Jamian, Detroit/Wayne County Port Authority, and Chairman, American Great Lakes Ports Association, has indicated his support for the entire Great Lakes Navigation Study and specifically stated, "Lake Erie and the Detroit River Livingston Channel also demonstrate the need to increase channel depth."

The Detroit Harbor is currently a home base for the cruise ship Arcadia and has a funded passenger terminal to be built in the near future. The planned passenger terminal is expected to be located at the foot of Clark Street in Southwest Detroit, adjacent to Detroit Marine Terminal. There is currently a vacant ten-story warehouse on the parcel. They expect to begin the environmental work on the property around August 2001 with demolition of the warehouse proceeding in January of 2002. Development on the passenger terminal would begin sometime around April of 2002, and be complete toward the end of 2002 or near the spring of 2003. The terminal is being funded through a $6 million federal TEA-21 grant, then matched 20 percent, or $1.5 equally by the City of Detroit and State of Michigan. The State of Michigan is funding the demolition through a $3 million CMI grant. The current Port Authority is aggressively seeking improvement and growth in the Harbor. Thus, with continued expansion and improvement in Harbor facilities, growth in use of the harbor is expected to exceed area growth.

a.) Physical Dimensions. The Detroit River, Michigan is located along a 31-mile stretch on the United States side of the Detroit River channel, which connects Lake St. Clair with Lake Erie.

SEGMENT 01 - NICHOLSON DOCK (GREAT LAKES AVE.I) - This non-federal dock is located along the downstream side of the slip. The slip is 2400' in length with a water depth of 27' and a width of 450'.

SEGMENT 02 - GREAT LAKES STEEL DOCKS - This non-federal facility has 2600' of dockage parallel to the river at depths in excess of 27' and a slip at the mouth of the Rouge River 1320' long and averaging 200' in width at 27' water depth.
SEGMENT 03 - CONTAINER MARINE TERMINAL - This non-federal facility is located at the foot of Orleans Street, 2.8 miles upstream of the Ambassador Bridge. The facility has 1200' of dock parallel to the river at an existing depth of 27'.

SEGMENT 04 - NICHOLSON SUMMIT STREET AND DETROIT PUBLIC LIGHTING COMMISSION DOCKS - These non-federal facilities are parallel to the river with a total 1500' of dockage with a depth of 27'.

SEGMENT 05 - DETROIT MARINE TERMINAL DOCK - This non-federal facility is 2325' long with a depth of 27' running parallel to the river.

b.) Maintenance Costs. Total cost for the existing project to the end of FY98 was $241,171,505 of which $76,877,357 was for new work, $121,823,563 for maintenance, and $42,470,585 for diked disposal.

11.) Drummond Island, Michigan.

a.) Physical Dimensions. Port Drummond is located on Drummond Island, MI across De Tour Passage, the entrance to St. Mary's River, from De Tour Village on the easternmost end of the Upper Peninsula.

The navigation channel depth is 23'.

b.) Maintenance Costs. Port Drummond is private, no operations or maintenance costs are available.

12.) Duluth-Superior Harbor, Minnesota-Wisconsin.

Specific Information / Requests:

Davis Helberg, Executive Director, Duluth Seaway Port Authority has indicated support for the Great Lakes Navigational Study as a whole and for soliciting a cooperative effort with the Canadian government. "We need a comprehensive, binational study independently examining each of the three dimensions based on three "E" words: Economics, Engineering and Environment."

The Harbor is currently experiencing a growth in cruise ship interest with 2 stops by the Arcadia scheduled for 2001, and at least 2 stops by Cape May Light, and 4 stops by Cape Cod Light scheduled for 2002.

a.) Physical Dimensions. Duluth-Superior Harbor, MN-WI is located at the extreme western end of Lake Superior between the cities of Duluth, Minnesota on the north and Superior, Wisconsin on the south.

SEGMENT 01 - SUPERIOR ENTRY CHANNEL - The Superior Entry Channel has a project depth varying from 33' at the lake entrance to 27' at the Superior Harbor Basin entry, the width varies from 415 to 1100', and has a length of 3500'.

SEGMENT 02 - ALLOUEZ BAY CHANNEL - The Allouez Bay Channel has a project depth of 27' with a width of 400' and a length of 2218'.

SEGMENT 03 - SUPERIOR HARBOR BASIN - The Superior Harbor Basin has a project depth of 27' with a length of 8026' and the width varying from 600 to 1500'.

SEGMENT 04 – SUPERIOR ANCHORAGE AREA - This area is on the north side of the Superior Harbor basin with a length of 3,600', a width of 950 – 1300' and a project depth of 27'.

SEGMENT 05 — SUPERIOR FRONT CHANNEL - The Superior Front Channel has a project depth of 27' with a width of 600' and a length of 14,098'.

SEGMENT 06 - EAST GATE BASIN - The East Gate Basin has a project depth of 27' with a length of 5500' and the width varying from 600 to 3700'.

SEGMENT 07 - DULUTH SHIP CANAL - The Duluth Ship Canal has a project depth varying from 32' at the lake entrance to 28' at the Duluth Harbor Basin entry, with a width of 250', and a length of 1700'.

SEGMENT 08 - DULUTH HARBOR BASIN - The Duluth Harbor Basin has a project depth of 28' with a length of 9400' and a width varying of 2200'.

SEGMENT 09 — DULUTH ANCHORAGE AREA - The Duluth Anchorage Area has a project depth of 27 - 28' with a length of 4000' and a width of 1300'.

SEGMENT 10 - WEST GATE BASIN - The West Gate Basin has a project depth of 27' with a length of 4000' and a width varying from 400'to 850'. There is a horizontal opening of 175' on the Burlington Northern railroad bridges, one located in each the north and south channel eastern sections. There is a vertical clearance of 123' under the John Blatnik Bridge.

SEGMENT 11 - 21ST AVE. W. CHANNEL (OUTER END) - The 21st Ave. W. Channel, outer end, is located at the northeast end of the North Channel and northwest end of the West Gate Basin and has a project length of 2000', width of 200', and depth of 27'.

SEGMENT 12 - HOWARDS BAY - Howard's Bay is located at the east end of the South Channel and southern end of the West Gate Basin and has a project depth of 27', a length of 6,000' and a width that varies from 100' to 300'.

SEGMENT 12a - NORTH CHANNEL EASTERN SECTION - The North Channel Eastern Section has a project depth of 27', a length of 10,085', and a width of 400'. At the Burlington Northern Railroad Bridge there is a horizontal clearance is 175'.

SEGMENT 12b - NORTH CHANNEL WESTERN SECTION - The North Channel Western Section has a project depth of 27', a length of 3590' and a width of 400'.

SEGMENT 13 — CROSS CHANNEL - The Cross Channel connects the center of the North and South Channels and has a project depth of 27', length of 2000' and width of 1300'.

SEGMENT 14a – SOUTH CHANNEL - EASTERN SECTION - The Southern Channel

Eastern Section has a project depth of 27', a length of 4013' and the width varying from 400' to 800'. There is a horizontal clearance at the Burlington Northern Railroad Bridge of 175'.

SEGMENT 14b - SOUTH CHANNEL - WESTERN SECTION - The Southern Channel Western Section has a project depth of 27', a length of 4488' and a width of 400'.

SEGMENT 15 - UPPER CHANNEL - The Upper Channel extends north to south from the western end of the North and South Channels to the Minnesota Channel and has a project depth of 23', a length of 6,100' and a width of 500'. The Grassy Point Burlington Northern Railroad Bridge has two horizontal openings of 175'. There are two other bridges located in this channel: the new Arrowhead highway bridge with a horizontal clearance of 400'and a vertical clearance of 120', and the bascule Grassy Point Arrowhead highway bridge with a horizontal clearance of 211'.

SEGMENT 16a - MINNESOTA CHANNEL (OUTER END) - The Minnesota Channel, Outer End, extends from the Upper Channel on the east to the Minnesota Channel, Inner End on the west and has a project depth of 23', length of 5,750', and a width of 600'.

SEGMENT 16b - MINNESOTA CHANNEL (INNER END) - The Minnesota Channel, Inner End extends from the Minnesota Channel, Outer End around the west side of Clough Island and has a project length of 14,500', width of 200', and depth of 20'.

SEGMENT 17 - BURLINGTON NORTHERN TACONITE FACILITY - This non-federal dock facility has a water depth of 27', a docking length of 1250' and a berthing width of 150'.

SEGMENT 18 - BURLINGTON NORTHERN ORE DOCKS #1, #2, & #4 - This non-federal dock facility has a water depth of 28' at doc #1 west and 27' at the other docks. The lengths of docks #1, #2, and #4 are 2458', 2313' and 2063', respectively.

Dock #1 west has a vessel berthing width of 163'.

Dock #1 east and #2 west have a width of 194'.

Dock #2 east and #4 west are separated by a double row of wood piling and each berthing area is 194' wide.

Dock #4 east has a vessel berthing width of 150'.

SEGMENT 19 - BURLINGTON NORTHERN ORE DOCK - This non-federal dock facility has a length of 2083', a width of 163' on both the west and east sides and a water depth that varies from 23' at the southern end to 27' at the northern end.

SEGMENT 20 - M & O ELEVATORS, INC. (ELEVATOR M & 0) - This non-federal slip has a length of 1104', a width of 313' and a water depth varying from 18' at the southern end to 27' at the northern end.

SEGMENT 21 -GREAT LAKES STORAGE & CONTRACTING CO. - This non-federal facility has a dock length of 1038', a berthing width of 200' and a water depth varying from 12' at the southern end to 27' at the northern end.

SEGMENT 22 - CARGILL, INC. DOCK "D", CLURE PUBLIC TERMINAL & SEAWAY PORT AUTHORITY - These non-federal dock facilities consist of a slip with Cargill on the north side and Clure Public Terminal on the south side. The Seaway Port Authority dock is located directly adjacent to Duluth Harbor Basin Southern Section.

The Cargill and Clure slip have a length of 1,615', a width of 344' and a water depth varying from 27' at the western end to 30' at the eastern end.

The Seaway Port Authority has three docks with lengths of 2000', 600' and 1200', a width that varies from 94' to 138' and a water depth of varying from 26' to 30'. At the dock area where the width is 94', the length is 600'. The other two docks have vessel berthing widths of 130' or greater.

SEGMENT 23 - CARGILL, INC. DOCK "C" & UYMAN-MICUAELS CO. - This non-federal dock facility has a docking length of 1263', a width of 169' and a water depth of 27'.

SEGMENT 24 – CAPITOL ELEVATOR CO. & HALLETT DOCK CO. #3 - This non-federal slip has a length of 1732' a width that varies from 119' at the western end to 219' at the eastern end and a water depth that varies from 25' at the western end to 27' at the eastern end.

SEGMENT 25 - CARGILL, INC. DOCK "B1" & HALLETT DOCK CO. #3 - This non-federal slip has a length of 2070' a width that varies from 125' at the western end to 163' at the eastern end and a water depth that varies from 18' at the western end to 27' at the eastern end.

SEGMENT 26 - CARGILL, INC. DOCK "B2" & SUPERWOOD CORPORATION - This non-federal dock facility has a length of 1726', a width varying from 135' at the western end to 175' at the eastern end and a water depth varying from 21' at the western end to 27' at the eastern end.

SEGMENT 27 - GENERAL MILL, INC. & SUPERWOOD CORPORATION - This non-federal dock facility has a length of 2063', a docking width of 166' for General Mills and a water depth that varies from 24' at the western end to 27' at the eastern end. The Superwood Corp. dock is comprised of a 354' long dock at the eastern end and the remainder of the dock with woodpiles to the west.

SEGMENT 28 - HALLETT DOCK CO #5, D.M.&I ORE DOCKS #5 & #6 & LIMESTONE DOCK - These non-federal dock facilities have a water depth and docking length of 27' and 1750' at Hallett Dock #5, 28' and 2388' at D.M. & I Dock #5, 27' and 2263' at D.M. & I. Dock #6 and 27' and 1844' at D.M. & I Limestone Dock. Hallett Dock #5 and D.M. & I Dock #5 have a width between them of 350'.

D.M. & I Dock 5 east and 6 west have a vessel berthing width of 175' and 160', respectively.

D.M. & I Dock 6 east and Limestone Dock have a width between them, which varies from 163' at the northern end to 226' at the southern end.

SEGMENT 29 - THE C. REISS COAL CO. INLAND DOCK - This non-federal dock facility has a docking length of 2344', a vessel berthing width of 175' and the water depth varying from 21' at the northern end to 27' at the southern end.

SEGMENT 30 - DULUTH DOCK AND TRANSPORT CO. - This non-federal dock facility has a docking length of 1700', a vessel berthing width of 175' and the water depth varying from 18' at the northern end to 27' at the southern end.

SEGMENT 31 - HALLETT DOCK CO. #6 - This non-federal dock facility has a length of 2463', a width of 200' and the water depth varies from 23' at the northern end to 27' at the southern end.

SEGMENT 32 - GLOBE ELEVATORS - This non-federal dock facility has a 1ength of 1425', a vessel berthing width of 153' and a water depth of 27'.

SEGMENT 33 - FARMERS UNION GRAIN TERMINAL ASSOC. DOCK #1 - This non-federal dock facility has a docking length of 1750', a width of 229' and the water depth varies from 14' at the southern end to 27' at the northern end.

SEGMENT 34 - FARMERS UNION GRAIN TERMINAL ASSOC. DOCK #2 - This non-federal dock facility has a docking length of 10251, a width of 138' and the water depth varies from 18' at the southern end to 271 at the northern end.

SEGMENT 35 - ORBA/REISS TRANSSHIPMENT DOCK - This non-federal dock facility has a length of 1425', a width of 119' and a water depth of 30'.

b.) Maintenance Costs. Total cost of the existing project to the end of FY98 was $103,265,911, of which $17,226,343 was for new work, $72,927,909 for maintenance, $1,556,249 for diked disposal, and $11,555,410 for rehabilitation.

13.) Escanaba Harbor, Michigan.

Specific Information / Requests:

Escanaba houses 11 of the 18 principal employers in Delta County, Michigan. Of these, at least 4 rely heavily on use of the harbor.

a.) Physical Dimensions. Escanaba Harbor is situated on the west shore of Little Bay de Noc on northern Lake Michigan in Delta County 6 miles NE of Ford River and 7 miles NW of Peninsula Point. The harbor is 100 miles north of Milwaukee Wisconsin and approximately 110 miles west of the Straits of Mackinaw. Escanaba Harbor is a natural harbor 4½ miles up Little Bay de Noc, which opens to the south into Green Bay on Lake Michigan. The harbor is 3½ miles wide at Escanaba with a natural channel adjacent to the west shore, 1½ mile wide with depths of 28 to 40' within 0.4 mile of shore.

The area under consideration extends from the Escanaba River on the north to sand point and the Escanaba Yacht Club on the south.

SEGMENT 01 - ESCANABA COAL & DOCK CO. - This dock is 2.1 miles NW of Escanaba Light with a 1,050' face with depths varying from 21 to 27' alongside. The facility contains open storage for 125,000 tons of coal and tank storage for 330,000 barrels. The Escanaba Coal & Dock Co. is concurrently operated by itself, Upper Peninsula Power Co. and Standard Oil Division of Amoco Oil Co.

SEGMENT 02 – CHICAGO AND NORTH WESTERN TRANSPORTATION CO., ORE DOCK #6 - The dock is 1.7 miles NW of Escanaba Light, 1,979' north and south faces with depths varying between 28 and 35' on the north and 28 to 31' on the south side. The facility contains open storage for 2 million tons of material and has one traveling ship loader with an average rate of 4,000 tons per hour.

SEGMENT 03 – C. REISS COAL CO. DOCK #2 - The C. Reiss Coal Co. is located 1 mile WNW of Escanaba Light having a length of 1900', a width varying between 325 and 750' and depths varying from 21 to 24'. The facility contains open storage for 170,000 tons of coal.

SEGMENT 04 – ESCANABA TERMINAL DOCK - This dock is 1 mile N of the mouth of Escanaba River. This offshore wharf has 278' of berthing space with dolphins and a depth of 28' alongside. It has tank storage for 640,000 barrels for the receipt of petroleum products it is owned by the U.S. Government and operated by Continental Services Co., Inc.

SEGMENT 05 – CITY DOCK - The City Dock is located 1500' west of Sand Point with depths ranging from 17 to 20'.

SEGMENT 06 – ESCANABA YACHT CLUB - The Escanaba Yacht club is located at

the cove at Sand Point with depths varying from 1 to 15'. It is an irregularly shaped cove with an approximate width of 475' and length of 1500'.

b.) Maintenance Costs. Escanaba Harbor is private. In 2000, the City of Escanaba and the Michigan State Waterways Commission constructed new Harbor Service Buildings with restrooms, showers, laundry accommodations and office space. At a cost of $2.2 million, the project also included construction of 400' of broadside docking for vessels 60' and larger, parking and landscaping.

14.) Fairport Harbor, Ohio.

a.) Physical Dimensions. Fairport Harbor, Ohio is located on the south shore of Lake Erie at the mouth of Grand River, 33 miles east of Cleveland, OH.

SEGMENT 01 – WEST BREAKWATER EXTENSION - The west breakwater extension is approximately 600' in length with a depth of 22' and a width of 600' at the beginning of the east breakwater.

SEGMENT 02 – ENTRANCE CHANNEL - The entrance channel behind the west and east breakwaters extends for approximately 2200' with a depth of 23' and a width of 800' narrowing to 200' at the mouth of the Grand River.

SEGMENT 03 – MORTON SALT COMPANY, FAIRPORT MINE - This segment of the Grand River extends from the mouth of the Grand River at the west and east pier lights, 3900' in land with a depth of 21' and a width of 200' narrowing to 130'. This segment includes federal ramps, Ronyak & Sidley, Inc., Painesville Grand River Dock Co., and Morton Salt Co., Fairport Mine on the west and Union San & Supply Corp., The Northeastern Road Improvement Co., and U.S. Industrial Chemical Co. on the east.

SEGMENT 04 – REPUBLIC STEEL/OSBORNE CONCRETE & STONE - This segment extends from segment 03 for 2000' in land with a width of 130' widening to a width of 200' and has a depth of 19' through the channel. Located along this segment are Republic Steel Corp., Grand River Lime Plant and Osborne Concrete & Stone Co. which has a trapezoidal harbor maintained at a depth of 15' with a length of 600' on the inner edge and 900' on the river edge.

SEGMENT 05 – RIVER STREET - This segment extends from segment 04 in land an addition 2600' on the Grand River to the Grand River Yacht Club on the west and the Fairport Harbor Yacht Club on the east. It has a varying depth of 15 to 10' and is maintained for a length of 1900', the maintained width narrows from 200' to 100', while the actual river width increases from 200' to just over 400'. Also included in this segment are: Winfield's Leeside Marina, Rutherford's Landing, Kishman Fish Co., Douglas & Mcleod, Inc., Merriman Holbrook, Inc., and a second Rutherford's Landing all on the west side.

SEGMENT 06 – BALTIMORE & OHIO R.R. - This final segment runs from segment 05 in land on Grand River an additional 3,800'. The natural depth in this segment is not maintained and varies from 1 to 11'. 800' in from segment 05 is a swing bridge for the Baltimore & Ohio Railroad with a horizontal clearance of 56' and a vertical clearance of 18'. The remainder of the east side of this segment is used by the Grand Harbor Yacht Sales & Service. This segment stops a fixed Baltimore & Ohio Railroad bridge with a horizontal clearance of 72' and a vertical clearance of 20'.

b.) Maintenance Costs. Total Federal cost for the completed portion of the project is $2,591,000 with non-Federal costs of $101,000. During FY98, operations costs totaled $526,684.

15.) Gary, Indiana

a.) Physical Dimensions. Gary Harbor, Indiana is a private, entirely artificial harbor located at the southern end of Lake Michigan approximately 22 miles southwest of Michigan City, Indiana and 26 miles southeast of Chicago. The entire harbor was developed and is owned by the United States Steel Corporation.

SEGMENT 01 - OUTER HARBOR - The Outer Harbor has a water depth and width that vary from 30' and 300' at the non-federal facility channel to 33' and 1100' at the lake entrance and a length of 2400'.

SEGMENT 02 - UNITED STATES STEEL CORPORATION - This non-federal dock facility has a water depth that varies from 28' at the southern end to 30' at the outer harbor entrance, a width of 246' and a length of 4,350' on the east dock and 5,280' on the west dock.

SEGMENT 03 - TURNING BASIN - The Turning Basin is located at the southern end of the non-federal dock-facility and has a water depth that varies from 18' to 27' and is approximately 750' in diameter.

b.) Maintenance Costs. Gary Harbor is private, no operations or maintenance costs are available.

16.) Greenbay, Wisconsin.

Specific Information / Requests:

Al Ames, Region Director, U.S. Department of Transportation, Maritime Administration, Great Lakes Region, has indicated that Green Bay has an "…impressive growth potential if they only had deeper harbors." and has recommended that this harbor be included in the Great Lakes Navigation Study.

John Jamian, the Detroit/Wayne County Port Authority, and Chairman of the American Great Lakes Ports Association has summarized the statements made by Dean R. Haen,

Port Manager, Brown County, and has stated, "One example of inadequate channel depths is the Port of Green Bay, Wisconsin. Many ocean-going ships do not call upon the Port of Green Bay because of its limited, 22' channel draft." And, "Many lake vessels are required to off-load a portion of their cargo at another port before calling on Green Bay. This draft limitation hinders the full utilization of the port and negatively impacts the local economy." Mr. Haen has also indicated, "The St. Lawrence Seaway Development Corporation and American Great Lakes Port Association are supportive of our request and they will be including our request as part of an overall Great Lakes infrastructure improvement request."

Ellen Fisher, Chief, Harbors and Waterways, Wisconsin Department of Transportation has offered her support for deepening of the harbor, "This port is an important component of Wisconsin's multimodal transportation system and the improved efficiency gained by such an improvement is a goal we share."

Trent Renfro, Area Distribution Manager, Lafarge Corporation has indicated, "…the economic benefit to Lafarge of dredging the Green Bay harbor and channel to seaway depths ranges from $40,000 - $50,000 annually – in terms of efficiencies gained by larger individual cargoes."

Bruce Riutta, Vice President, Fox River Dock Company, Inc. has indicated that a "…deeper draft will reduce shipping costs which will increase the tonnage we will handle both domestic and foreign." And, "The deeper draft will give us access to the world market for many products which now move elsewhere." Mr. Riutta has characterized the benefits as, "I would believe that the domestic vessel rates would drop by $0.50 to $0.70 per ton and the foreign vessel rates would drop by $2.00 to $4.00 per ton. This would result in an increase in our annual tonnage of 200,000 to 300,000 tons of product."

Tim Weeden, Regional Manager, Midwest Public Affairs, Fort James Corporation indicates an inability to utilize the capacity of boats delivering coal for use in their power plant. Also, he has stated, "We would realize significant benefits associated with fewer boats carrying larger loads…" which would reduce congestion and the associated costs. "Cost reductions in these areas will further strengthen our business activities in the Green Bay area."

Wesley H. Garner, President, Great Lakes Calcium Corporation has indicated, "The economic benefit to Great Lakes Calcium will total approximately $375,000 per year."

Fred Nast, CEO, Western Lime Corporation has indicated a significant savings would be achieved by the reduction in raw materials costs. In 1999 terms, "…our finished product cost would have decreased $194,246.46, or $.58 per ton of product." and, "…with an average selling price of under $50.00 per ton, a $.58 per ton savings is very attractive."

a.) Physical Dimensions. Green Bay Harbor, Wisconsin is located at the mouth of Fox River at the head of Green Bay, about 180 miles from Milwaukee,

WI via Sturgeon Bay Canal, and about 49 miles southwest of Marinette/Menominee Harbor, MI/WI.

SEGMENT 01 – OPEN HARBOR - From mile 02 to mile 09 from Grassy Island into open harbor, depths are maintained at 26', and width narrows from 500' to 300'.

SEGMENT 02 – ENTRANCE - From Grassy Island at mile 01 to the mouth of the Fox River depth is maintained at 24' with a width of 300'.

SEGMENT 03 – MOUTH TO TURNING BASIN - From the mouth of the Fox River to the turning basin, just over a mile long, depth is maintained at 24' with an irregular width averaging 300' to the turning basin. This segment includes: American Can Co., Charmin Paper Co., Texaco Inc., Philips Petroleum Co., Sinclair Refining Co., Green Bay Yacht Club, and McDonald Lumber Co. on the east shore and, Universal Atlas Cement Co., Green Bay Soap Co., American Oil Co., Mobil Oil Co. Inc., Cities Service Oil Co., F. Hurlbut Co., Clark Oil & Refining, Gustafson Oil Co., Wisconsin Public Service Corp., and Northwestern Hanna on the west shore.

SEGMENT 04 – TURNING BASIN TO FORT HOWARD PAPER CO. - This 2 mile long segment is maintained at a depth of 24' with an irregular width averaging 325'. This segment services: Fort Howard Paper Co., Leight Tr. & Storage Co., Huron Cement, Shell Oil Co. Inc., and C. Reis Coal Co. all on the west shore.

SEGMENT 05 – C. & N. W. RAILWAY TURNING BASIN - 2,200' in length from mile 03 inland with a project depth of 20'.

SEGMENT 06 – ST. HWY. 57 & 32 - This segment is just over 3 miles long with a project depth of 18' and a width of 150'.

SEGMENT 07 – UPSTREAM LIMIT TURNING BASIN - The turning basin has a depth of 21' and a width of 600' servicing Nicolet Paper Corp., and Northwestern Hanna.

b.) Maintenance Costs. Total cost of the existing project to the end of FY98 was $57,131,901, of which $9,946,395 was for new work, $39,281,195 for maintenance, and $7,904,311 for diked disposal.

17.) Indiana Harbor, Indiana

Specific Information / Requests:

Al Ames, Region Director, U.S. Department of Transportation, Maritime Administration, Great Lakes Region, has indicated that the traffic here "…continues to be strong and growing in importance." and has recommended that this area be included in the Great Lakes Navigation Study.

a.) Physical Dimensions and Shipping Season. Indiana Harbor, Indiana is an artificial harbor at East Chicago, Indiana, on the southwest shore of Lake Michigan in Lake County, 19 miles southeast of Chicago Harbor and 31 miles west of Michigan City, Indiana.

SEGMENT 01- ENTRANCE CHANNEL - The federal entrance channel extends from the North Breakwater, north approximately 8000' into Lake Michigan at depths of 28' and 29'. The channel width is 800 feet except at the north breakwater where it narrows to 550'.

SEGMENT 02 - OUTER HARBOR - The federal outer harbor is an irregular area south of the north breakwater, approximately 1700' by 2000' with a 28' depth.

SEGMENT 03 - INDIANA CANAL ENTRANCE CHANNEL - The federal channel from the outer harbor to the Railroad Bridge is included in the study area. This channel is 250' in width and approximately 3500' in length with a depth of 27'.

SEGMENT 04 - EAST SLIP - This non-federal facility is a slip 2400' in length and 200' in width at 27' depth and includes the approach east of the federal channel.

b.) Maintenance Costs. Total costs of the existing project to the end of FY98 were $18,465,889 of which $4,909,648 was for new work and $13,556,241 was for maintenance.

18.) Lorain Harbor, Ohio.

a.) Physical Dimensions. Lorain Harbor, Ohio is located 25 miles west of Cleveland, OH on the south shore of Lake Erie at the mouth of the Black River.

SEGMENT 01 — ENTRANCE CHANNEL - The Entrance Channel has a depth of 28', a width that varies from 800' at the lake entrance to 525' at the outer harbor and a length of 2,375'.

SEGMENT 02 - OUTER HARBOR - The Outer Harbor has a project depth of 27', a width that varies from 525' at the entrance channel to 2,361 at the widest point to 220' at the Black River entrance and a length of 4000'.

SEGMENTS 03, 04 AND 05 - BLACK RIVER CHANNEL - The Black River Channel has a project depth of 27' a width that varies from 220' at the outer harbor to 690' at the Black River Turning Basin, and a length of approximately 15,840'. Due to sharp river bends, a narrow river channel, and vertical clearance obstructions, vessels greater than 730' are restricted from navigating the channel.

SEGMENT 06 - MUNICIPAL PIER - This non-federal facility has a water depth of 27', a width of 250', and a length of 516'.

SEGMENT 07 - TOLEDO, LORAIN, AND FAIRPORT CO. SLIP - This non-federal dock facility has a water depth of 27', a width that varies from 140' at the southern end to 417' at the northern end and a length of 1100'.

b.) Maintenance Costs. Total operations and other expenses for FY98 were $1,356,728. Federal cost for new work on the existing project total $20,475,000 as of the end of FY98.

19.) Marinette/Menominee, Wisconsin/Michigan.

Specific Information / Requests:

Paulette S. Enders, Community Development Director, Office of Community Development, City of Marinette has indicated that dredging to a depth of 26' "…would have a significant positive impact on commercial navigation in Marinette, Wisconsin; Northeast Wisconsin; and the Upper Peninsula of Michigan."

The Marinette Fuel and Dock Co. shipped 259,902 tons in 1999 and 283,208 tons in 2000 consisting of 196,634 tons of pig iron, 50,375 tons of road salt, 15,933 tons of coal, 16,500 tons of limestone, and 3,766 tons of pulp. All commodities were up in 2000 from 1999 figures except pulp.

Marinette Marine Corp. launched 8 vessels in 1999 with a total value of $118.5 million and 3 in 2000 with a total value of $84,165,914.

Any project to deepen this harbor would certainly benefit these firms and those on the Menomonee, Michigan side as well.

a.) Physical Dimensions. The harbor is located on Lake Michigan at the mouth of Menominee River on the western shore of Green Bay, 16 miles northwest of the mouth of Sturgeon Bay, 49 miles northeast of Green Bay Harbor, and about 155 miles from Milwaukee via Sturgeon Bay Canal. The Menominee River forms the boundary between the commercial harbors at Marinette, WI and Menominee, MI.

SEGMENT 01 – OUTER ENTRANCE - This segment is 2500' in length with a project depth of 26', currently dredged to 23', with a 600' width.

SEGMENT 02 – INNER ENTRANCE - 2100' in length from the breakwalls to the Michela Coal & Dock Co. on the Wisconsin side and Ann Arbor R.R. and Marathon Corp., Div of Amer. Can Co. on the Michigan side at the mouth of the Menominee River. This segment is 300' to 500' wide with a project depth of 24', currently dredged to 21'.

SEGMENT 03 – ENTRANCE TO MUNICIPAL WHARF - This segment is 6500' in length from the mouth of the Menominee River to the Municipal Wharf with a 300' width narrowing to 200' and a project depth of 24', currently dredged to 21'. The turning basin included in this segment has a project and actual depth of 21'. This segment

includes: Carpenter Cook Co., Dormer Co., Limestone Products Co., and Northwestern-Hanna Fuel Co. on the Michigan side of the Menominee River, and Marinette Fuel & Dock Co., a public dock, the turning basin, Ansul Chemical Co., and a portion of the Municipal Wharf.

SEGMENT 04 – MUNICIPAL WHARF/MARINETTE MARINE - With a length of 1100', a width of 150' and a depth of 19', this segment contains the majority of the Municipal Wharf from segment 03 and Marinette Marine Corp. on the Wisconsin side.

SEGMENT 05 – UPSTREAM PROJECT LIMIT - The length of this segment is 1400', with a width of 90' and a depth of 12', this segment contains Kargard Boat & Engine Co., a Boat House, and the Yacht Club all on the Wisconsin side.

b.) Maintenance Costs. Total cost of the existing project to the end of FY98 was $5,475,969, of which $570,238 was for new work, $2,960,219 for maintenance, $593,660 for diked disposal, and $1,351,852 for rehabilitation.

20.) Milwaukee, Wisconsin.

Specific Information / Requests:

The Detroit District of the U.S. Army Corps of Engineers has been directed to assist in a pending project on the shore side of segment 03. The Corps will assist in creating an inner harbor of refuge and, along with proposed work by the Wisconsin Department of Administration, a Lakeshore State Park will be developed.

a.) Physical Dimensions. Milwaukee Harbor is located on the west shore of Lake Michigan approximately 85 miles north of Chicago, Illinois, and approximately 83 miles west of Grand Haven, Michigan. It is a harbor of refuge covering 3 ½ miles of shoreline with the main entrance in the center and breakers on the north and south.

SEGMENT 01 – OUTER ENTRANCE CHANNEL - The Outer Entrance Channel has a length of 1,800' with a width varying from 800' in Lake Michigan, narrowing to 300' between the north and south breakers then expanding to 600' inside the breakwalls. Project depth in this segment is 30'.

SEGMENT 02 – BEHIND SOUTH BREAKWATER - The area behind the South Breakwater has a project length varying between 4,960 and 5,920', a width of 2,240', and a depth of 28'.

SEGMENT 03 – BEHIND NORTH BREAKWATER - The area behind the North Breakwater has a project length of 4,400', a width varying between 1,160 and 1,560' and a depth of 21'.

SEGMENT 04 – INNER ENTRANCE CHANNEL - The Inner Entrance Channel has a project length of 2,000', a width varying between 180 and 440', and a depth of 28'.

SEGMENT 05 – MILWAUKEE/KINNICKINNIC CONNECTION - This area between the Milwaukee and Kinnickinnic Rivers has a project length of 5,000', a width varying between 240 and 560', and a depth of 27'.

SEGMENT 06 – KINNICKINNIC - The Kinnickinnic River portion of the project area has a length of 2,200', a width varying between 180 and 80', and a depth of 27'.

SEGMENT 07 – MILWAUKEE - This segment to the north of the entrance has a length of 4,100' with 2 branches; north on Milwaukee River for 680' and around Lakeshore Sand and Stone to the south for 920' then west for 680'. The width of this segment varies from as much as 240' to 70' with a project depth of 21'.

b.) Maintenance Costs. Total harbor expenses for FY98 were $1,354,333. Total project expenses to date were $6,934,804 federal and $478,000 non-federal at the end of FY98.

21.) Monroe Harbor, Michigan.

a.) Physical Dimensions. Monroe Harbor, Michigan is located at the mouth of the River Raisin on Lake Erie, approximately 36 miles south of Detroit, Michigan and 14 miles north of Toledo, Ohio.

SEGMENT 01 – OUTER CHANNEL - The outer channel, which includes the area from the mouth of the River Raisin to the intersection with the Toledo Channel in Lake Erie, is approximately 9 miles in length, with a width of 300' and a project depth of 21'.

SEGMENT 02 - RIVER RAISIN REACH - This reach, from 3000' upstream to the mouth of the River Raisin, is 200' wide and has a current depth of 21'.

SEGMENT 03 - TURNING BASIN - The trapezoidal Turning Basin, 1200' by an average of 1400', has a depth of 18', 3' less than the outer channel depth.

SEGMENT 04 – INNER SEGMENT - This innermost segment of the federal project area spans a length of 3,800' with a width of 100' and a depth of 9'.

b.) Maintenance Costs. Total cost of the existing project to end of FY98 was $60,228,885, of which $987,340 was for new work, $20,551,963 for maintenance, and $38,689,582 for diked disposal.

22.) Presque Isle/Marquette Michigan.

a.) Physical Dimensions. Presque Isle Harbor is located on the south shore of Lake Superior within the city limits of the city of Marquette, Michigan.

The harbor is 158 miles west of Sault Ste. Marie, Michigan and 255 miles east of Duluth, Minnesota. The bay that forms the harbor is an indentation of about one-half mile into the west coast line of Lake Superior and extends about one and one-half miles in a north-south direction along the coast. Presque Isle Point protects the harbor on the north. The harbor opens directly into Lake Superior to the east.

SEGMENT 01 - INNER AND OUTER HARBOR - This federal harbor is 1000’ wide at the dock area with a maximum width of 3000 feet and length of 2800 feet with water depths of 28 feet or greater.

SEGMENT 02 - L.S. & I.R.R. DOCK #2 - This non-federal facility has a loading dock that extends 1400' from the shoreline with two slips on either side, each 1200' long and 200' wide with a depth of 27'.

b.) Maintenance Costs. Maintenance surveys and environmental studies were completed in 1998 at a cost of $19,534. Total cost of the existing project to the end of FY98 was $3,182,595, of which $1,252,192 was for new work, $1,837,403 for maintenance, $16,500 for diked disposal, and $76,500 for rehabilitation.

23.) Rouge River, Michigan.

a.) Physical Dimensions. The Rouge River rises in Oakland and Washtenaw Counties and is 30 miles long flowing southeasterly through Wayne County and joining Detroit River at the westerly limit of the city of Detroit, Michigan.

SEGMENT 01 – OLD CHANNEL - The Old Channel is 1-½ miles in length from the Detroit River to the point where the Short Cut Canal reaches the Rouge River. Depths in this segment range from 25’ at the mouth of the Rouge to 17’ at various points along the reach. The width of the Old Channel varies throughout its length from 240’ at the mouth of the river to 150’ where it meets the Short Cut Canal and narrowing to 100’ at points. The project depth of the first ¾ mile is 17’; the remainder is 21’, but is not currently maintained.

SEGMENT 02 – SHORT CUT CANAL - The Short Cut Canal is ½ mile long, extending from the Detroit River to the Rouge River with a project depth varying from 25’ at the Detroit River to 21’ at the Rouge. The width of this segment narrows from 400’ at the Detroit River to less than 200’ at the Rouge. Depths are currently about 21’ throughout the segment.

SEGMENT 03 – ROUGE RIVER - This segment extends 2-¼ miles inland to Dix Avenue, having project depths that vary between 21 and 25’ and an average width of 200’.

SEGMENT 04 – TURNING BASIN - The Turning Basin has an irregular shape, with a project depth of 21’, a width of approximately 600’, and length up to 1,088’.

SEGMENT 05 – UPPER LIMIT - This ¼ mile long segment extends from the turning basin and is not maintained. It has depths that vary between 6 and 18' and widths between 150 and 200'.

b.) Maintenance Costs. Maintenance surveys and environmental studies were completed in 1998 at a cost of $147,340 and dredged material was removed at a cost of $310,973. Total cost of the existing project to the end of FY98 was $38,162,329,of which $675,251 was for new work, $22,579,760 for maintenance, and $14,907,318 was for diked disposal.

24.) Saginaw, Michigan.

a.) Physical Dimensions. Saginaw River is formed by the union of Tittabawassee and Shiawassee Rivers, 22 miles long, and flows northerly into the extreme inner end of Saginaw Bay, Lake Huron. The Bay is 26 miles wide at its entrance between Point aux Barques to the southeast and Au Sable Point to the northwest, extending about 52 miles to its head.

SEGMENT 01 – ENTRANCE CHANNEL - The entrance channel has a project depth varying from 27' at 14 miles out from the mouth of Saginaw River to 26' and a width of 350'.

SEGMENT 02 – U.S.C.G. / C. OF E. - For 2 miles inland from the mouth of Saginaw River the project depth is 25' with a width of 200'. This segment includes a U.S.C.G. Station, a C. of E. Field Office, Baker's Yacht Service, and other commercial interests on the south and north sides.

SEGMENT 03 – ESSEXVILLE TURNING BASIN / DOW CHEMICAL - The turning basin begins and ends with a width of 200' reaching a maximum width of 675' in the center. The south side is 425' in length with a 20' project depth; the remainder has a project depth of 25'. The north shore houses the Dow Chemical Co. Dock with a project length of 950' and a depth of 25', depths at the dock itself range from 22 to 25 ½'. This segment includes other commercial enterprises on both sides of the river.

SEGMENT 04 – DETROIT & MACKINAC R.R. TO 3RD STREET - This 2-mile segment of Saginaw River has a width of 200' and a project depth of 25'. It contains several commercial entities on both the north and south sides of the river.

SEGMENT 05 – LAFAYETTE AVE. - This 3½-mile segment has a width of 200' and a project depth of 22'. The south side of the river has several commercial facilities.

SEGMENT 06 – AIRPORT TURNING BASIN - This turning basin is 1300' long on the north and 200' long on the south side of the river, width varies from 200' and the outset to a maximum of 650' with a project depth of 22'. Clements municipal Airport is just south of the area.

SEGMENT 07 – CHEBOYGANING CREEK - This 2-mile segment extends to the county line between Bay County and Saginaw County with a project depth of 22' and a width of 200'.

SEGMENT 08 – CROW ISLAND - The segment extends 4 miles into Saginaw County with a project depth of 22' and a width of 200'.

SEGMENT 09 – CARROLLTON BAR AND TURNING BASIN - This 2 mile segment has a project depth of 20' and a width of 200' ending with the Carrollton Turning Basin with Huron Portland Cement Co., and Saginaw Dock & Terminal CO. on the north and U.S. Revetment on the south side of the basin. Maximum width of the turning basin is 550'with a project depth of 20'.

SEGMENT 10 - 6TH STREET TURNING BASIN - This turning basin has a length of 600' on the north and 200' on the south shore, a maximum width of 650' in the center narrowing to 200' on either end with a project depth of 20'.

SEGMENT 11 – CHESAPEAKE & OHIO R.R./ HOLLAND AVE. - This 2 mile long segment contains several commercial enterprises, primarily on the south side of the river. The project depth is 16.5' except at the turning basin at P.C. R.R. with a depth of 15'.

SEGMENT 12 – GREEN POINT - This 3-mile segment extends to the Tittabawasee and Shiawasse Rivers and has a project depth of 16.5', but is not currently maintained.

b.) Maintenance Costs. Total maintenance costs for the FY98 were $2,848,967. Total cost of the existing project to the end of FY98 was $94,684,376, of which $14,930,727 was for new work, $58,801,761 for maintenance, and $20,951,888 for diked disposal.

25.) Sandusky Harbor, Ohio.

a.) Physical Dimensions. Sandusky Harbor, Ohio is located on the south shore of Lake Erie in the southeastern portion of Sandusky Bay, 50 miles west of Cleveland, Ohio.

SEGMENT 01 – MOSELEY CHANNEL - Moseley Channel is the entrance channel to Sandusky Bay running just north of Cedar Point, south of Bay Point. The project dimensions are 2.15 nautical miles in length, 400' in width with a depth of 26'. As of 1993, project depths were not maintained, center depth was 24'.

SEGMENT 02 – UPPER STRAIGHT CHANNEL - The Upper Straight Channel runs 1.04 nautical miles from the Moseley Channel to the intersection of the Lower Straight Channel and the Upper Bay Channel with a width of 400' and a project depth of 25'. As of 1993, project depths were not maintained, center depth varied between 23 and 24'.

SEGMENT 03 – LOWER STRAIGHT CHANNEL - The Lower Straight Channel connects the Upper Straight Channel to the Dock Channel along the shore of Sandusky, Ohio. Project length is 0.77 nautical miles with a width of 400' and a depth of 21'. As of 1993, project depths were not maintained with a center depth varying between 17 and 19.7'.

SEGMENT 04 – DOCK CHANNEL - The Dock Channel runs along the coast of Sandusky, Ohio between the Lower Straight Channel and the Turning Basin with a project length of 1.1 nautical miles, a width of 300' and a depth of 22'. As of 1993, project depths were not maintained, with a center depth varying between 18.9 and 20'. Facilities located along the Dock Channel include: Battery Park Marine, Sandusky Yacht Club, a State Dock, Shoreline Fisheries, Erie Bay Graphics, Neuman Boat Line, Inc., Sandusky Chamber of Commerce and the City Dock, Displaco-Midwest, Inc., Cardinal Services, Inc., Deepwater Mariner, Erie Sand and Gravel, and Royal Yacht Services and Storage. These facilities have rail access through B & O R.R. and Conrail.

SEGMENT 05 – UPPER BAY CHANNEL - The Upper Bay Channel extends from the Upper Straight Channel to the north side of the Lower Bay Channel for a distance of 1.64 nautical miles, a width of 1.64 nautical miles and a project depth of 25'. As of 1993, project depths were not maintained, center depth was 23'.

SEGMENT 06 – LOWER BAY CHANNEL - The Lower Bay Channel extends from the Upper Bay Channel to the Turning Basin connecting to the Dock Channel. Project dimensions are a length of .24 nautical miles, a width of 350', and a depth of 24'. As of 1993, project depths were not maintained, with center depth varying between 20.5 and 22.8'. This channel has access to Silos No 3 and The Lower Lake Dock Co. (Norfolk Southern Ry.)

SEGMENT 07 – TURNING BASIN - The Turning Basin connects with the Dock Channel on the east and the Lower Bay Channel on the north. Project length is 0.5 nautical miles with a width varying between 300 and 1,725' and a depth of 24'. As of 1993, project depths were not maintained, with center depth at 21.5'. The basin has access to The Lower Lake Dock Co. (Norfolk Southern Ry.)

b.) Maintenance Costs. Total cost of maintenance and other activities during 1998 was $788,163. Actual cost for new work for the completed project was $6,250,121 federal and $675,000 non-federal.

26.) Saugatuck, Michigan.

Specific Information / Requests:

Felicia V. Fairchild, Executive Director, Saugatuck/Douglas Area Convention and Visitors Bureau and Gordon Gallagher, City Manager, Saugatuck have indicated that the cruise ship, Le Levant, will increase its visits from 8 in 2001 to 16 in 2002 and that the cruise ship, Cape May Light, will visit 14 times in 2002. Due to this increase in

passenger traffic, they are requesting that the harbor be classified as a deep draft harbor to provide safe passage for these vessels. During the 2001 season, Le Levant attempted to hug the northwest side of the turning basin due to a natural depth limitation and hit a private dock. Further deepening could avoid damages to vessels and property.

a.) Physical Dimensions. Saugatuck Harbor, Michigan is located on the east shore of Lake Michigan, 90 miles northeast of Chicago, Illinois and 22 miles north of South Haven, Michigan.

SEGMENT 01 - LAKE MICHIGAN EXTENSTION - Leading to the north and south breakwaters at the mouth of the Kalamazoo River, this segment extends 800' in to Lake Michigan. With an initial width of 750', it narrows to 120' at the breakwaters having a project depth of 16'.

SEGMENT 02 – BREAKWATER AREA - The north and south breakwaters extend 700' into Lake Michigan and an additional 1,800' into the Kalamazoo River. Project depth is 16' with a width of 120'.

SEGMENT 03 – KALAMAZOO RIVER - The remainder of the project area extends to 2 miles upstream in the Kalamazoo River to Saugatuck, Michigan. Project depth is 14' with a width varying from 160 to 90'.

SEGMENT 04 – TURNING BASIN - Saugatuck has a natural turning basin at the end of the federal project limit in Kalamazoo Lake. According to the U.S. Army Corps of Engineers, Detroit District project map dated September 30, 1986, the depth in this area is 17'. Considering the recent problems of the cruise ship Le Levant, the depth must now be significantly less.

b.) Maintenance Costs. Total cost for the existing project to the end of FY98 was $4,826,764, of which $364,527 was for new work and $4,462,237 for maintenance.

27.) Sheboygan, Wisconsin

Specific Information / Requests:

Jacqueline Jarvis, Director, Department of City Development, Sheboygan, Wisconsin has requested a channel-deepening project in the navigation channel. Ms. Jarvis has indicated that the previous channel depth of 20' now only averages 16' due to sediment buildup. The City of Sheboygan is planning to make a major investment in the harbor to attract cruise ships and larger vessels.

Denny Moyer of the Sheboygan Chamber of Commerce has indicated that some areas of the harbor are as shallow as 7'.

The most recent study performed by the Corps in regard to Sheboygan Harbor was a Dredged Material Management Plan Preliminary Assessment for Sheboygan Harbor, Wisconsin in 1996. This study relied on an economic analysis performed in 1986 and a traffic data comparison between 1990 and 1994. The 1996 study concluded that, "A detailed analysis is required to determine the Harbor's optimum depth for current and future utilization."

According to an EPA Federal Register Notice dated June 10, 1986, Sheboygan Harbor basin and turning basin have been recognized as containing PCB's generally lower than 5 mg/kg but do exceed 50 mg/kg in spots within the U.S. Army Corps of Engineers official navigation dredging channel. As of September 1985, the channel had not been dredged since 1973. A March 1980 report of the U.S. Army Corps of Engineers estimated that about 163,000 cubic yards of contaminated soil containing 3.5 tons of PCB's would have to be dredged from the mouth of the river and the harbor to protect human health and the environment. The harbor is listed as an NPL (National Priorities List) Superfund site by the U.S. EPA.

a.) Physical Dimensions. Sheboygan Harbor, Wisconsin is located on the west shore of Lake Michigan approximately 26 miles south of Manitowoc and 55 miles north of Milwaukee, Wisconsin.

SEGMENT 01 – OUTER ENTRANCE - The outer entrance has a length of 700' coming up to the protected area. It is 450' wide with a project depth of 25'.

SEGMENT 02 – ENTRANCE CHANNEL - The entrance channel has a trapezoidal shape with a length 4,840' on the south side and 1,000' on the north. Project depth starts at 25 decreasing to 21' through southern 500' of width and 20' through the northern 400' of width.

SEGMENT 03 – SHEBOYGAN RIVER #1 - This segment is 1700' in length with an irregular width varying from 200' at is start to as much as 360' before declining to 165' at its end with a project depth of 21'. The facilities located along this segment include: the Yacht Club and City Park, the U.S.C.G., and Hildebrand Lumber and Supply Co. on the north, and: C. Reiss Coal Co. and a tank farm serviced by C. & N.W. Ry. on south.

SEGMENT 04 – SHEBOYGAN RIVER #2 - This segment is 1,800' in length with a width varying from 165-125' and a project depth of 21'. The Naval Armory and Wisconsin Power and Light Co. are on the north side.

SEGMENT 05 – SHEBOYGAN RIVER #3 - This segment is 1,300' in length with a width of 100' and a project depth 15'.

b.) Maintenance Costs. Total cost for new work of the existing project was $648,271, exclusive of amounts spent on previous projects. Operations and other expenses for FY98 totaled $194,224.

28.) Silver Bay, Minnesota.

a) Physical Dimensions. Silver Bay Harbor, Minnesota is a non-federal harbor and is located on Lake Superior approximately 51 miles northeast of Duluth, Minnesota and 5 miles southwest of Taconite Harbor, Minnesota.

SEGMENT 01 - RESERVE MINING COMPANY - This non-federal facility has a water depth that varies from 27' at the dock to 100' at the harbor entrance, the width varies from 500' at Beaver Island Entrance to 1080' in the harbor and a length 3970'.

b.) Maintenance Costs. No operations or maintenance costs are available for this non-federal harbor.

29.) St. Clair, Michigan.

a.) Physical Dimensions. The Detroit Edison Company Power Plant and coal receiving dock is the major commercial dock facility on the St. Clair River, which connects Lake Huron on the north to Lake St. Clair. The dock is located on the west, United States, side of the river, 4 miles downstream from the city of St. Clair, Michigan and 18 miles downstream from the foot of Lake Huron.

SEGMENT 01 - EDISON DOCK - This non-federal facility is 1000' in length parallel to the channel approximately 330' back of the west channel line at the north end and 250' at the south. The slip between the St. Clair River channel and the dock face is 27' deep.

b.) Maintenance Costs. Total cost of the existing project to end of FY98 was $45,821,739, of which $19,213,246 was for new work and $26,608,493 was for maintenance. Total expenses for the FY98 were $812,947.

30.) Stoneport Harbor, Michigan.

Specific Information / Requests:

In 2000, John M. Piecuch, Lafarge Corp., wrote "The Presque Isle acquisition should be accretive to earnings in 2001. As we integrate this acquisition, we expect to take advantage of considerable synergies, through the coordination of shipping logistics on the Great Lakes, our ability to offer a larger line of complementary aggregate products, and our ability to achieve operating efficiencies." Lafarge Corp. has existing water-based aggregate production facilities on Manitoulin Island, Ontario and Marblehead, Ohio and is expected to maintain strength well into the future.

A December 2000 publication of Mineral Industry Surveys, by the U.S. Department of the Interior, U.S. Geological Survey, ranked Lafarge Corp. 5th in a list of the top 10 leading companies in terms of total output of crushed stone in the U.S. for the year 1999. The company has 28 active quarries. The markets serviced by the Presque Isle facility are projected to grow at a rate of 3 to 5 percent annually. With an estimated 550 million

tons of reserves, the quarry is capable of maintaining use for more than 50 years at current production levels.

a.) Physical Dimensions. Stoneport Harbor, Michigan is a non-federal harbor located on Lake Huron approximately 20 miles north of Alpena, 4 miles south southeast of Presque Isle Harbor, and 7 miles north northwest of Rockport Harbor servicing one of the largest stone quarries in the U.S.

b.) Maintenance Costs. Operations and maintenance costs for this private harbor are unreported.

31.) Taconite Harbor, Minnesota.

a.) Physical Dimensions. Taconite Harbor, MN is a non-federal harbor and is located on Lake Superior approximately 76 miles northeast of Duluth, MN and 25 miles northeast of Silver Bay, MN.

SEGMENT 01 – ERIE MINING CO. - This non-federal facility has a water depth that varies from 27' at the dock to 65' in the harbor, with the width varying from 400' at the eastern and western entrances to 1500' in the harbor and a length of 2560'.

b.) Maintenance Costs. Operations and maintenance costs for this private harbor are unreported.

32.) Toledo Harbor, Ohio.

a.) Physical Dimensions. Toledo Harbor, Ohio is located on Lake Erie approximately 76 miles west of Cleveland, Ohio, and 61 miles south of Detroit, Michigan.

SEGMENT 01 - ENTRANCE CHANNEL - The Entrance Channel has a water depth of 28' with the width varying from 500' at the northern end to 967' at the Maumee Mooring Basin, located at the mouth of the Maumee River, and a length of 97,118'.

SEGMENT 02, 03 & 04 - MAUMEE RIVER CHANNEL - The Maumee River Channel has a water depth of 27', a width varying from 200' to 850' and a length of 32,748'.

SEGMENT 05 - C & 0 RAILROAD COAL DOCK - This non-federal dock facility has a water depth varying from 25' at the southern end to 27' at the northern end, a length of 2163' and a width of 250'.

SEGMENT 06 - C & 0 RAILROAD COAL DOCK - The C&O Railroad Coal Dock is a non-federal facility with a depth varying from 25' at the southern end to 28' at the northern end, a length of 2313' and a width of 300'.

SEGMENT 07 — TOLEDO OVERSEAS TERMINAL CO. - This non-federal facility is

located at the very northerly end of the Maumee River Channel and has a length of 4000', a vessel berthing width varying from 350' at the southern end to 700' at northern end, with a depth varying from 20' to 27'.

b.) Maintenance Costs. Total cost of the completed existing project was $15,567,147. Total expenses for FY98 were $3,328,312.

33.) Two Harbors, Minnesota.

a.) Physical Dimensions. Two Harbors, Minnesota is located on Lake Superior on the north side of Agate Bay, approximately 26 miles northeast of Duluth, Minnesota and 25 miles southwest of Silver Bay, Minnesota.

ITEM 01 - HARBOR TURNING BASIN - The existing federal limits in the harbor vary because of the configuration. The water depth within the federal limits varies from 28' in the northern section to 30' in the southern section.

ITEM 02 - DULUTH, MISSABE & IRON RANGE RY. CO. ORE DOCK #1, #2 & #6 - This non-federal dock facility has a water depth that varies from 24' at the western end to 30' at the eastern end at docks #1 and #2 and the water depth varies from 12' at the western end to 35' at the eastern end at dock #6. The lengths of docks #1, #2 and #6 are 1458', 1528' and 1152', respectively.

Dock #1 north has a vessel berthing width of 138' and a docking length of 1180'.

Dock #1 south and #2 north have a width of 194'.

Dock #2 south and #6 north have a width of 757'.

Dock #6 south has a vessel berthing width of 514' at the narrowest point.

b.) Maintenance Costs. Total cost of the existing project to the end of FY98 was $9,417,600, of which $4,170,710 was for new work and $5,246,890 for maintenance. Condition surveys were performed in 1998 at a cost of $1,755.