SLS-72-1

FOURTH COAST - SEAWAY SYSTEMS REQUIREMENTS ANALYSIS

THE ROLE OF AN INTEGRATED MARINE TRAFFIC INFORMATION AND CONTROL SYSTEM

VOLUME 1 SUMMARY REPORT

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16. Abstract

This report summarizes the need for an Integrated Marine Traffic Information and Control System (IMTIC) in the St. Lawrence Seaway. The analytic emphasis is on the Welland Canal to Gulf of St. Lawrence portion of the Seaway system. The Upper Great Lakes portion is considered only when interdicting impacts could affect Welland-St. Lawrence subsystem capabilities. An important conclusion is that the total Seaway system and its component elements require immediate and detailed analytical attention if future cargo demands are to be met.

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INTEGRATED
MARINE
TRAFFIC
INFORMATION
AND
CONTROL SYSTEM

- A proposed SLSA-SLSDC Solution to an Immediate Traffic Management Problem
- An Integrated Requirements Analysis and Concept Feasibility Study

Introduction

The purpose of this report is to summarize the need for an Integrated Marine Traffic Information and Control System (IMTIC) which the Canadian and U.S. Seaway entities propose to install. As a study spinoff, it also documents that the total Seaway system and its component elements require immediate and more detailed analyses if the future cargo demands are to be met. A subsequent volume presents the analytical base from which these results were derived.

The analytic emphasis of both reports is primarily oriented toward the Welland to St. Lawrence Gulf portion of the Seaway system. Attention is given to the Upper Lakes whenever interdicting impacts could affect Welland-St. Lawrence Subsystem capabilities.

Summary Recommendations

The principal recommendations of this study are:

- that the St. Lawrence Seaway Development Corporation proceed with the implementation of IMTIC Step 1 jointly with the St. Lawrence Seaway Authority
- that DOT invite other U.S. and Canadian marine oriented entities to form an interagency task force to coordinate and initiate vessel/cargo control and information programs on the Great Lakes - St. Lawrence River
- that DOT conduct an in-depth Fourth Coast systems and requirements analysis for traffic control and cargo information systems using this study as a base

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Preliminary Findings

The original intent of the St. Lawrence Seaway Authority's Integrated Marine Traffic Information and Control (IMTIC) program was to include only the Seaway entities. After the formation of the Canadian Maritime Transportation Administration (CMTA) the scope of the program was broadened to consolidate all common data used by the various Canadian maritime activities into one common multi-computer-landline network. The U.S. agencies corresponding to those within CMTA are: U.S. Coast Guard, Maritime Administration, Corps of Engineers, the St. Lawrence Seaway Development Corporation, and the National Oceanographic and Atmospheric Administration.

The initial scope of the Transportation Systems Center Study was to consider only the St. Lawrence sub-system portion of the Seaway. Subsequently, the study was expanded to provide an integrated analysis of the total Seaway system and of those critical elements of the system administered by MARAD, Corps of Engineers and U.S.C.G., as well as SLSDC; but, only in detail sufficient to indicate trends. The "trends" data appear to indicate that all of the U.S. Federal agencies involved in developing the Great Lakes Seaway potential should expand and further coordinate their water research and development programs immediately if the Seaway system is going to "service" the growing cargo demands and meet operational safety requirements.

4th Coast - Seaway System Requirements Analysis - Spinoff Deductions From IMTIC

Feasibility Study

Capacities (Cargo demand)

- Welland-St. Lawrence River Locks (15) element will not meet post 1990 demand
- Ports and Harbors elements cannot meet current peak general cargo loads; and will not meet post 1975 demand
- Traffic Control element cannot meet current peak loads; and will not meet post 1975 demand
- Pilotage (ocean vessels) element cannot meet current peak loads
- Inclement Weather Control element cannot meet present demand
- Fleet element, both lake and ocean cannot meet post 1980 cargo demand

Profits And Losses

- Insurance rates may increase if safety margins continue to decrease during peak loads (Cargo ton-miles $\cong$ safety)
- Improved transit time best dollar saver for lake vessels
- Improved port-turn-around time best dollar saver for ocean vessels
- Master scheduling of elements should save dollars for all

Demand Analysis

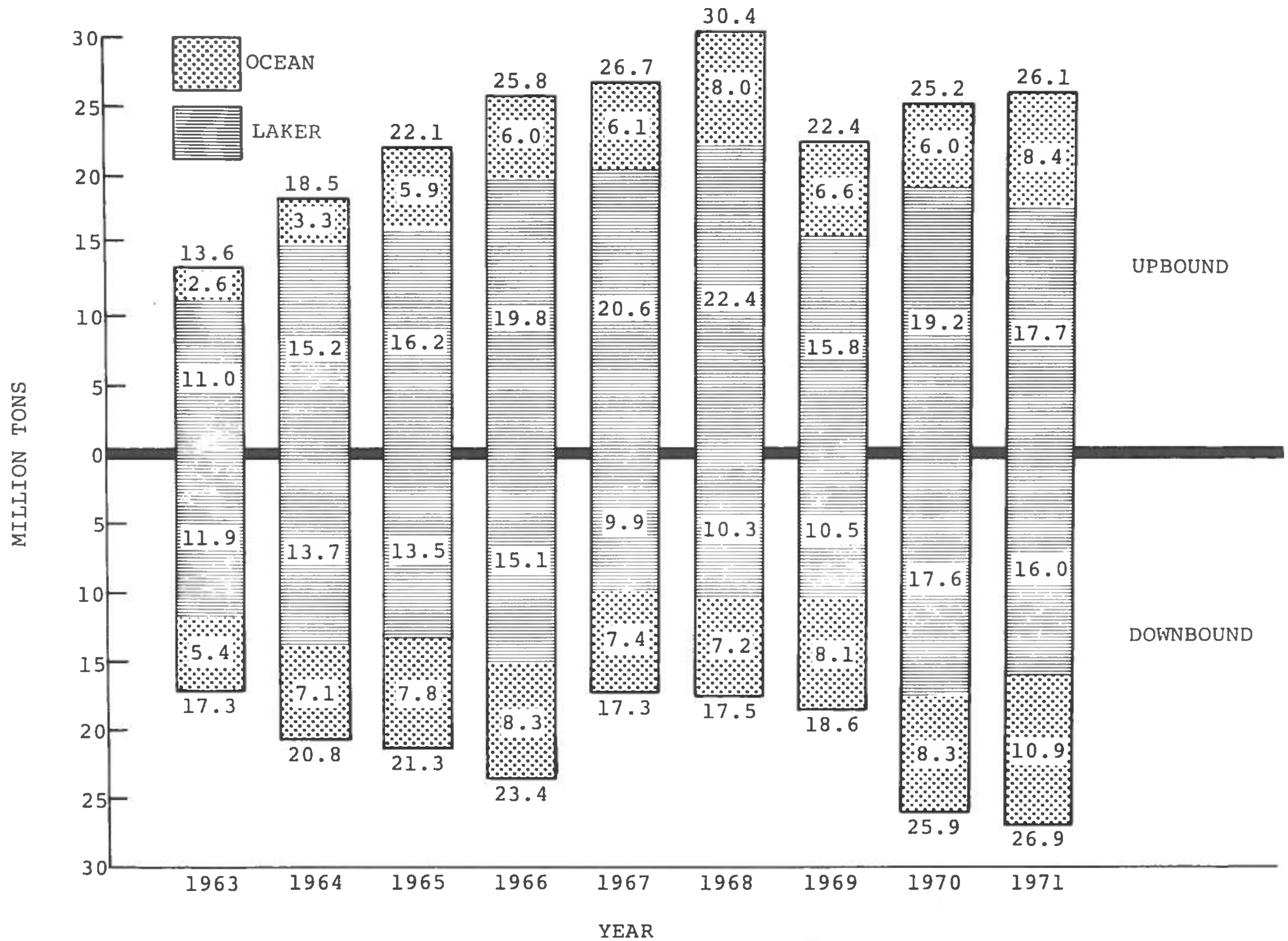
Gross Historical Ocean and Laker Cargo Tonnage Trends

The laker and ocean cargo tons carried by each through the Lake Ontario-Montreal section have been increasing at approximately one million tons per year. The upbound iron ore-laker traffic over-compensates for the downbound wheat traffic; and 1967-1969 years were particularly poor in grain sales. Ocean carried exports have generally exceeded imports by two to three million cargo tons each year except 1968.

The table shown below summarizes the percentage of the total cargo carried by ocean and lakers. Significantly the trend is towards a higher overseas demand.

Percent of Total Cargo Carried Through Montreal-Lake Ontario Section:

YEAR	OCEAN	LAKER
1963	25.7	74.3
1964	26.4	73.6
1965	31.1	68.9
1966	29.1	70.9
1967	30.7	69.3 (Seaway strike)
1968	31.8	68.2 (Mariners strike)
1969	37.8	62.2 (strike effect)
1970	27.9	72.1
1971	36.4	63.6 (strike effect)



MONTREAL-LAKE ONTARIO SECTION OCEAN AND LAKER TRAFFIC

Principal Commodity Flow Analysis

The recent report by Robert Reebie and Associates, Inc. and Corps of Engineers data indicate the following:

- The Mesabi Range provides 53 percent of the U.S. iron ore requirements, other U.S. sources 15 percent, Canada-Labrador Region 15 percent and North Coast Region of South America 14 percent. In the next decade the shift will be to imported sources; heavily in the post 1985 period. Welland and St. Lawrence subsystems will be affected.
- Coal usage is expected to be the same even though some Ontario utilities are planning conversion to oil and gas. Limestone traffic is not expected to change.
- Ontario is expected to become a Quebec petrol supplier as the Alberta oil fields grow and offset the oversea's imports. St. Lawrence will be affected.
- 6 percent of U.S. Hinterland wheat now flows through Seaway. With Russian and New England wheat needs established, the percent share of the wheat and transportation market should grow. Canada Wheat Board decision to ship wheat via Lakeshead instead of Vancouver increases predicted 1972 cargo tonnage. Post 1972 effect undetermined.
- Recent favorable intermodal rate studies for western lumber transhipped via Duluth to Lower Lake ports should influence Welland Canal, Lake Ontario and upstate New York ports.
- Automotive parts manufacturers discovered significantly lower U.S. to Europe shipping costs this year via the Seaway. Overall exports have been increasing at 9 percent per annum volume.
- Welland and St. Lawrence sub-systems should stabilize near 50:50 up/down mix.

1969 Principal Commodity Flow Analysis - Percent of Total Cargo Tonnage

Commodity	Welland	St. Lawrence River	Predicted Change	
			Welland	St. Lawrence
Mineral				
Iron Ore	25	28	UP	UP
Coal	20	-	N/C	N/C
Limestone	3	-	N/C	N/C
Petroleum	3	8	N/C	UP
Agriculture				
Wheat	10	12	UP	UP
Corn	7	9	N/C	N/C
Soy Bean	4	4	N/C	N/C
Lumber	-	-	UP	-
Iron & Steel				
Mfg	7	10	UP	UP
Scrap	2.3	3.2	N/C	N/C
Sub-total	81	74		
Flow				
UP	36.2	54.7	UP	DOWN
DOWN	63.8	45.3	DOWN	UP

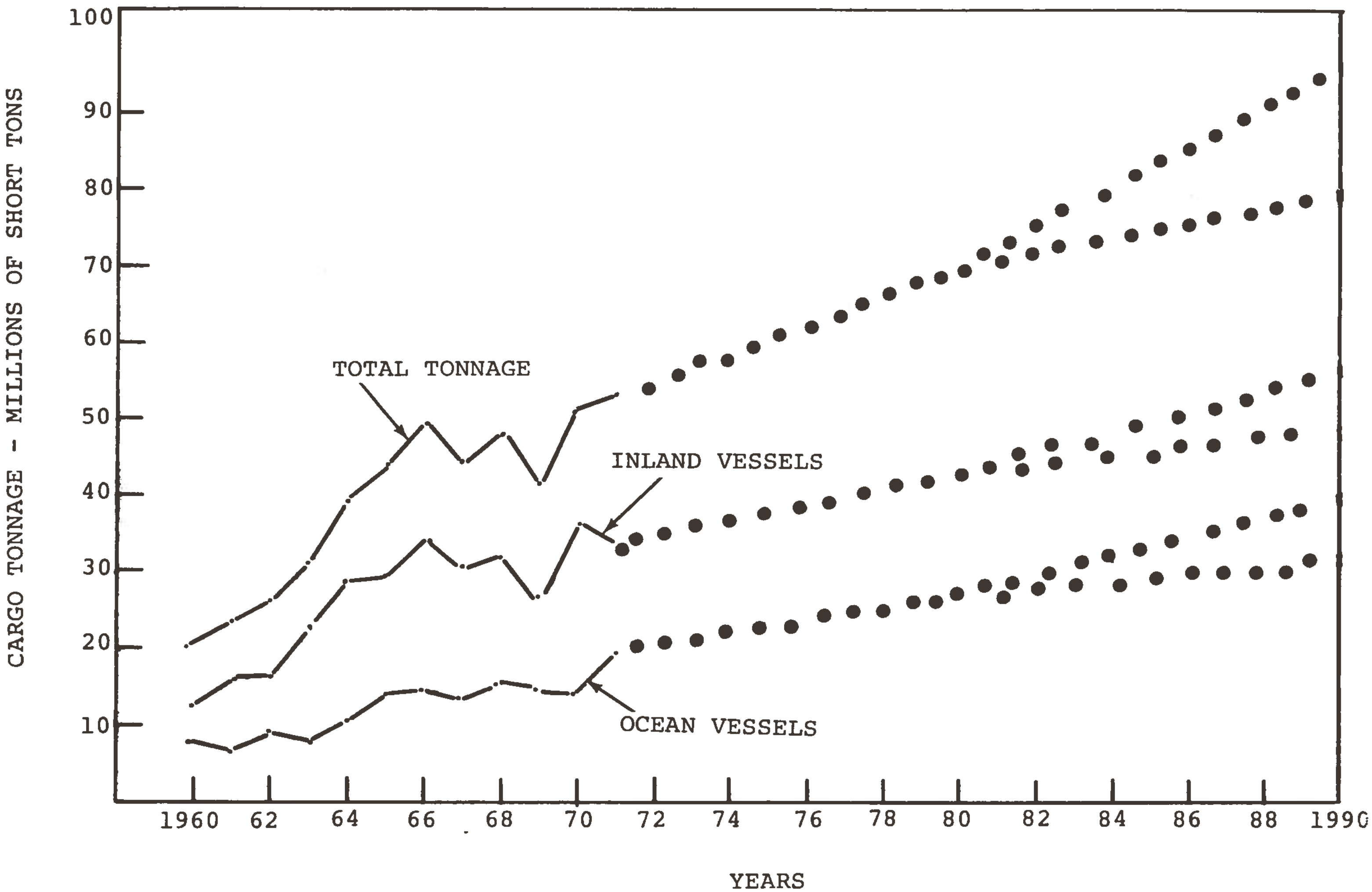
Demand Summary

- CONSERVATIVE cargo tonnage growth projections indicate market is there IF system elements can deliver. System elements are: waterways, ports, fleet, pilotage, weather, safety, traffic control, management information.

30 YEAR GROWTH PATTERNS - MILLIONS OF TONS

	1961-70		1971-80		1981-90	
	Growth Tons	Annual %	Growth Tons	Annual %	Growth Tons	Annual %
Overseas	6.9	9.3	12.7	8.9	13	3.0
Lakers	20.7	12.9	6.6	1.8	13	4.8
Composite	27.6	11.7	19.3	3.8	26	3.7

- The Seaway's share of the U.S. overseas (excluding Canada) transportation market is now 3.5 percent of total U.S. waterborne overseas tonnage. Any appreciable change in this share is not included in forecast.
- The potential impact of the following are not included in this forecast:
  - Season extension
  - Domestic International Sales Corporation (DISC) Program and other pending legislation
  - Market development and advertising activities by Great Lakes interests
  - Strikes

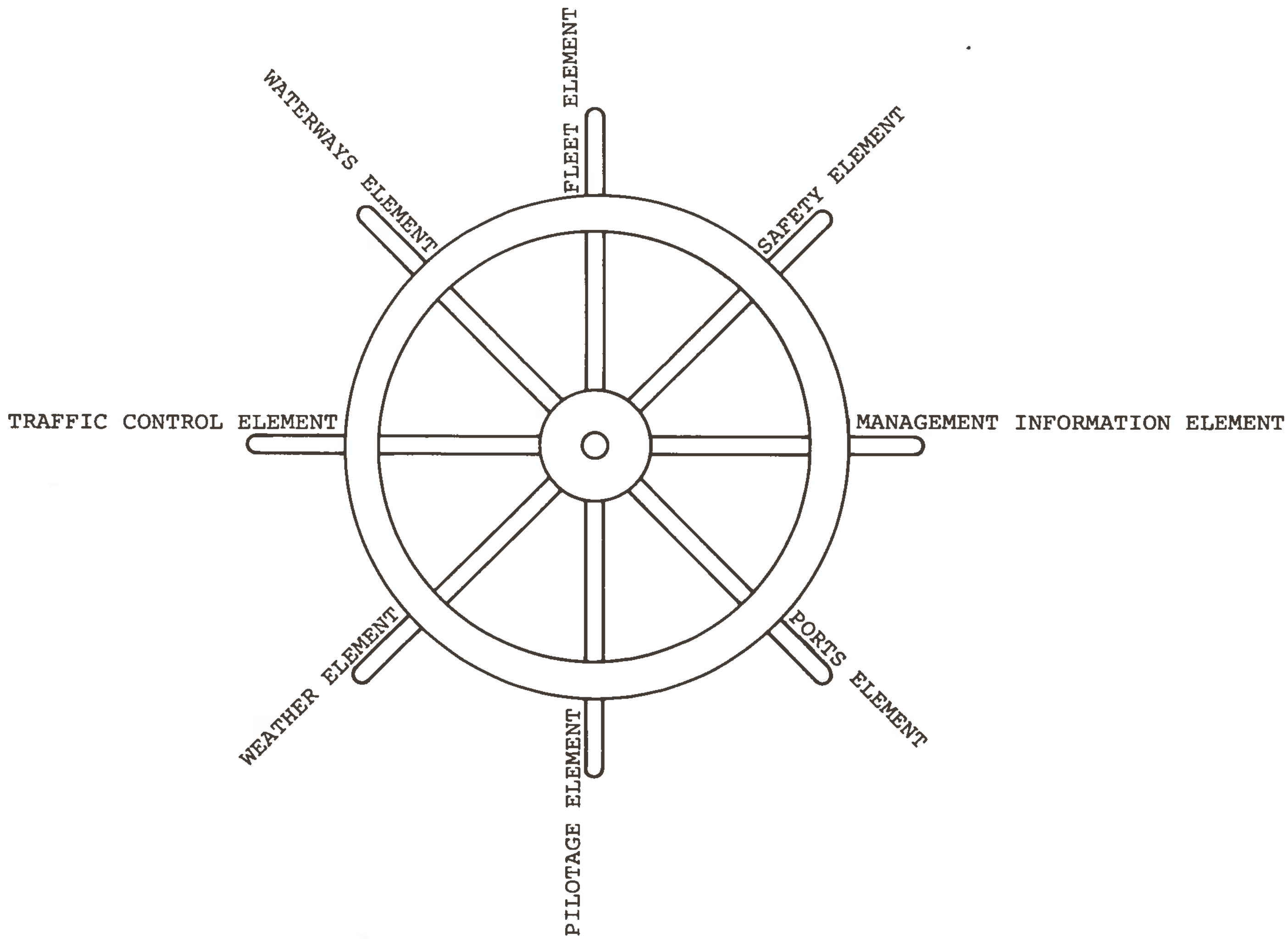


MONTREAL - LAKE ONTARIO SECTION ANNUAL CARGO TONNAGES

Systems Elements

and how they service the Cargo Demand

<u>Waterways</u> including rivers, locks, canals, lakes and channels
<u>Ports</u> and port facilities
<u>Fleets</u> both ocean and lake vessels, plus traffic patterns and capacities
<u>Pilotage</u> and availability of pilots
<u>Weather</u> and effects on Seaway operations
<u>Safety</u> impacts on current and future utilization
<u>Traffic Control</u> for optimum direction and patterning of vessels
<u>Management Information</u> for scheduling vessels, cargoes, ports, and facilities



FOURTH COAST - ST. LAWRENCE SEAWAY SYSTEM

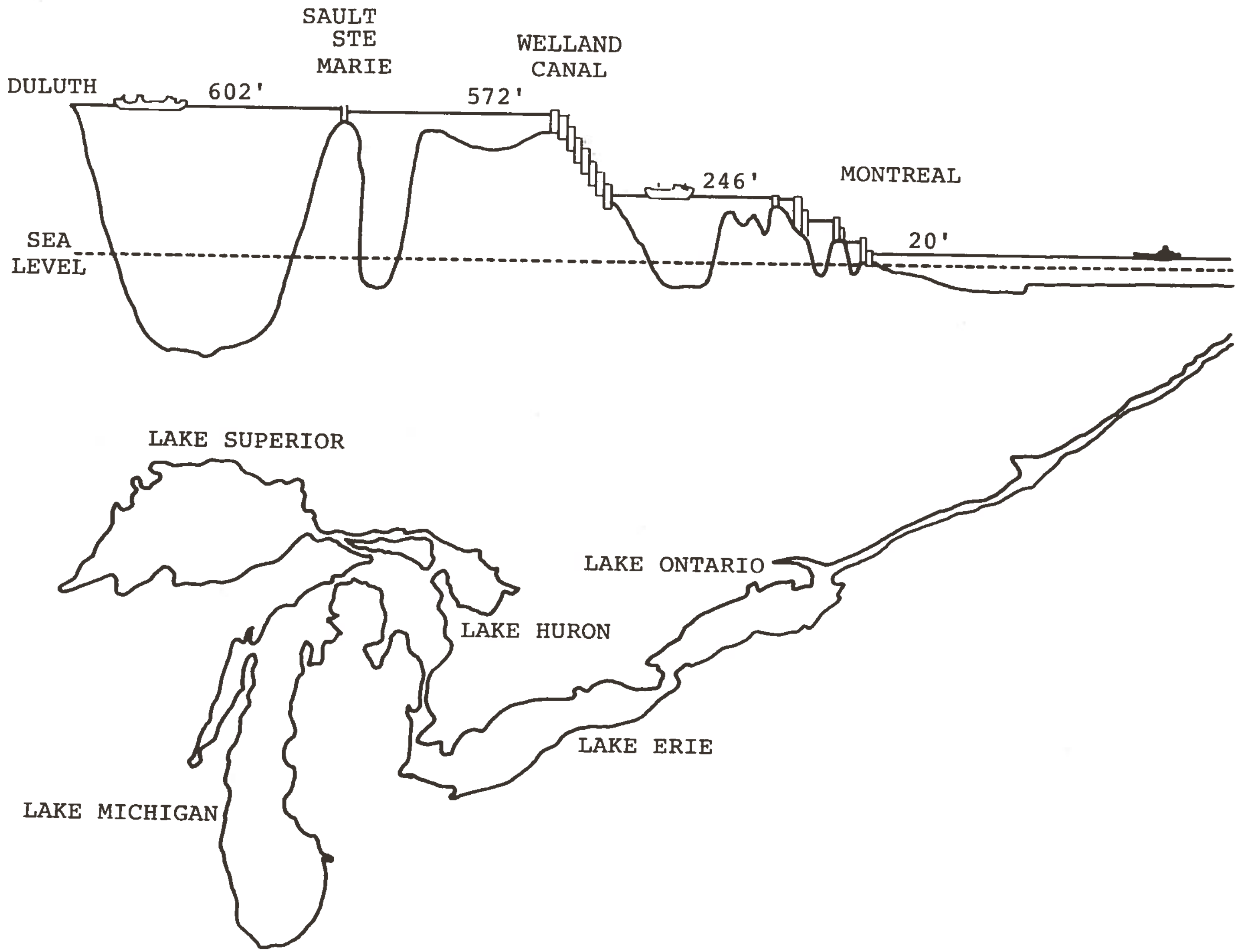
Waterways Elements

The Seaway -- from the entrance at the Gulf of St. Lawrence to the head waters in Lake Superior is over 2300 miles in length. The 189 mile St. Lawrence River section between Montreal and Lake Ontario contains seven locks that lift a ship 226 feet. The 27 mile Welland section between Lake Ontario and Lake Erie contains eight locks that lift a ship 326 feet. A single lock elevation change can be anywhere from six inches (Iroquois) to 45 feet (Snell and Eisenhower). Only the flight locks (4, 5, 6) at Welland are twinned. (Flight locks share one gate). The official 1972 shipping season was designated to be 1 April to 15 December, 259 days.

The St. Clair - Detroit River waterway is a two channel, no locks network connecting Lakes Erie and Huron ... it has an 8 foot drop. The open channel Mackinac Straits connects Lake Michigan to Lake Huron, which are at the same level. Lake Superior is connected to Lake Huron by the St. Mary's River channel and the Sault Ste Marie locks. (21 to 23 foot lift).

The Seaway system is constrained to 35 foot draft ships from Quebec to Montreal, to 16 foot draft 75.5 foot beam, 730 foot length ships in the Welland-St. Lawrence sections; and to slightly less than 27 foot draft, 105 foot beam, 1000 foot length ships in all the other regions. The U.S. and Canadian governments have initiated economic and engineering studies for system expansion for the Welland-St. Lawrence regions; there are no firm implementation plans as of now.

IMTIC is divided into a two step program. The first step is planned to be implemented in the St. Lawrence River - Lake Ontario - Welland sub-systems. The second step would include the remaining sub-systems i.e., Upper Lakes and interconnecting reaches.



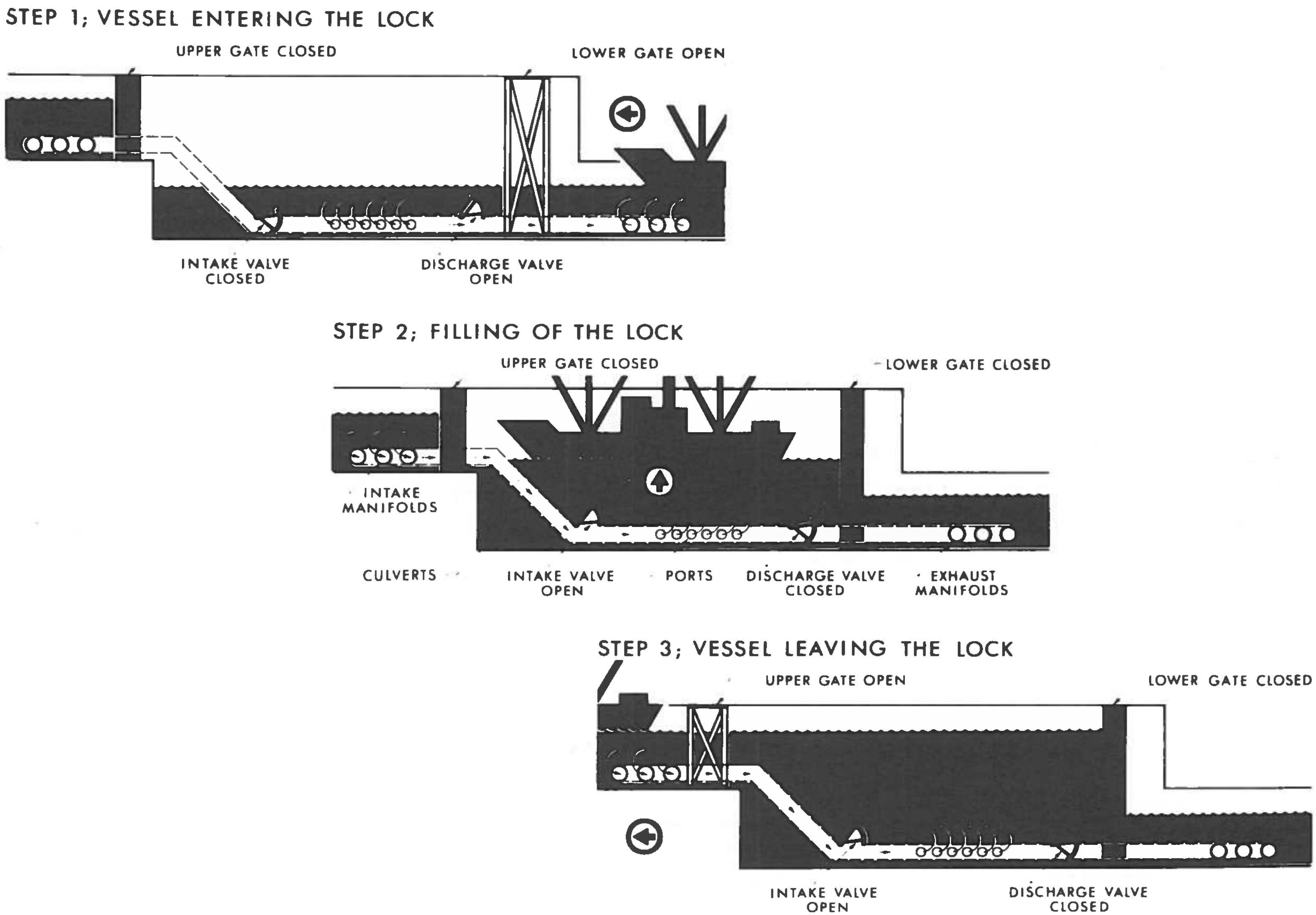
ST. LAWRENCE SEAWAY 2342 MILES DULUTH TO ATLANTIC

Typical Lock Configuration

All of the Welland - St. Lawrence sub-system locks are minimum configured as 860 foot length (pintle to pintle) 80 foot width, 30 foot depth locks. They are gravity flow filled. They are monolithic concrete structures equipped with bull gear driven miter type gates. Initially they were the same basic design used at the Panama Canal with one exception. Panama uses shore based railed vehicles (mules) to tow the ships through the locks while in the Seaway the ships provide their own propulsion.

The upstream side of each gate and the lower side of the downstream gate are protected by elevatable lever arms that contain heavy steel cables (ship arrestors). The lower side of the upstream gate is protected by a sill cantilevered from the lock bottom. Experience has shown that accidents are most likely to happen at these points as well as at the end of the lock walls ... the walls extend 800 - 3800 feet in either direction from the lock gates.

Capital investment in the Welland-St. Lawrence sub-system is over one billion dollars to date.



Typical Method of Locking a Ship in the St. Lawrence Seaway System

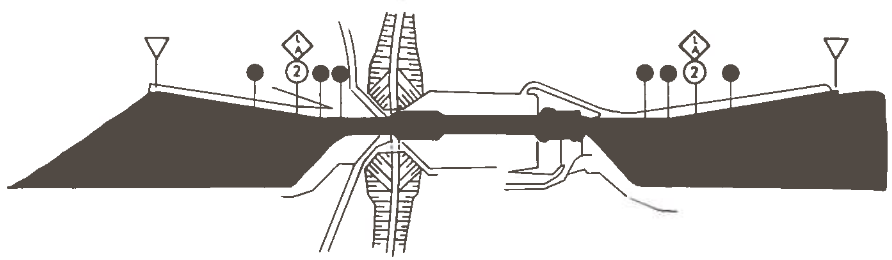
Lock Capability

Every lock in the St. Lawrence - Welland sub-systems now has 24 hour zoom-pan tilt TV that extends visual operational coverage approximately 3,000 feet beyond the locks. Most locks are instrumented with some combination of ultrasonic, microwave, or sonar sensors that automatically report and record vessel progress through the locks. It is planned to similarly instrument the Welland Locks. This information will be a raw data input to the IMTIC computers.

Lock service time is equivalent to the elapsed time that the stern of a down bound ship passes the upstream Limit of Approach light #2, locks through, and its stern passes the down stream Limit of Approach light #2. This time will vary as a function of ship size, 730' ships average 45-65 minutes. The constraining lock in the St. Lawrence sub-system is the Beauharnois Lock at this time. One way throughputs are averaging 45 minutes at Beauharnois. Nominal throughput capability is 23 ships per day and it can achieve a 28-30 ship maximum for short periods of time. Maximum capacity periods averaged 15 percent of the shipping season last year. Ships have been getting larger and the average lock service time has increased. Lock supersaturation and the resulting queues always occur in the spring and fall of the year, and frequently at other times.

Problem Area #1 How does one reduce queueing? (IMTIC could help)

SNELL LOCK (LOCK 5)



EISENHOWER LOCK (LOCK 6)

ULTRASONIC SENSOR } PLANNED 1971
END OF WALL
MITRE GATE
LIMIT OF APPROACH

PREPARED BY S.L.S.A. RESEARCH DIVISION DECEMBER 1970

ST. LAWRENCE SEAWAY SYSTEM MONTREAL-LAKE ONTARIO SECTION
Wiley-Dondero Canal (U.S.A.) (Automatic Data Collection Equipment)

Main Ports Element

There are 56 St. Lawrence - Great Lakes Main Ports, 28 of which are American. Most of them are tailored to provide fast-turn-around service (6-8 hours) to Lakers. During 1971 general and bulk cargo ships were provided much slower port turn around in some areas (3-6 days). Though general cargo is only 12-15 percent of the total cargo tonnage, it represents 24-30 percent of the total cargo in value and revenues. CANADA - St. Lawrence Seaway Authority (SLSA) as part of its IMTIC program will be providing scheduling data to all of its Lake Erie to St. Lawrence Gulf ports and harbors activities by April 1973. By April 1974, this will include estimated and actual arrival and departure dates, cargo manifest data, pilot boat, Customs and Harbor Master scheduling, etc. SLSA will also provide real-time message switching between and within all ports and port activities.

Problem Area #2 A similar approach is desirable in the U.S. Great Lakes area (IMTIC 2). Leadership on the U.S. side to accomplish this objective must be asserted.

1 SEPT-ILES
2 PORT CARTIER
3 BAIE COMEAU
4 MATANE
5 RIMOUSKI
6 RIVIERE-DU-LOUP
7 PORT ALFRED
8 CHICOUTIMI
9 QUEBEC
10 TROIS RIVIERES
11 SOREL
12 CONTRECOEUR
13 MONTREAL
14 CORNWALL
15 MASSENA
16 PRESCOTT
17 OGDENSBURG
18 KINGSTON
19 OSWEGO
20 ROCHESTER
21 BUFFALO
22 OSHAWA
23 *TORONTO
OAKVILLE
PORT CREDIT
LAKEVIEW
24 HAMILTON
25 ERIE
26 ASHTABULA
27 CLEVELAND
28 LORAIN
29 *WELLAND SECTION
ST.CATHARINES
PORT COLBORNE
WELLAND DOCKS
30 SANDUSKY
31 TOLEDO
32 MUNROE
33 WINDSOR
34 DETROIT
35 PORT HURON
36 SARNIA
37 GODERICH
38 OWEN SOUND
39 COLLINGWOOD
40 MIDLAND
41 ALPENA
42 BAY CITY
43 GARY
44 CHICAGO
45 WAUKEGAN
46 KENOSHA
47 MILWAUKEE
48 MUSKEGON
49 GREEN BAY
50 ESCANABA
51 SAULT STE. MARIE
52 MARQUETTE
53 ASHLAND
54 SUPERIOR
55 DULUTH
56 THUNDER BAY

ST. LAWRENCE-GREAT LAKES-Main Ports

Fleet Element - Lakers

The 1971 Traffic Pattern: The users of the Seaway system include tugs and barges, pleasure and military craft, and lakes and ocean cargo carriers. Only the ocean and lakes vessel traffic is analyzed since the other users do not seriously contribute to the Welland and St. Lawrence sub-system congestion.

According to the Great Lakes Carriers Association, during 1971 there were 417 Canadian-U.S. flag vessels of 1,000 ton capacity or more operating on the Great Lakes and St. Lawrence River. (There are a few foreign registered lakers, principally Bahamian, but most do not use the Seaway). 255 are U.S. and 162 Canadian registry; 38 of the latter are maximum cargo capacity vessels specifically tailored to the lock configuration (730 foot, 75 foot 6 inch beam, 26 foot draft). There are a few larger size craft that are captive within the lakes; these are designed constrained by the 1,200 foot locks at Sault Ste. Marie.

The basic traffic pattern of the U.S.-Canadian laker fleet is best illustrated by the table. Significantly the 730 foot vessels account for a large segment of the traffic.

Less than 2 percent of the St. Lawrence sub-system laker transits were made by U.S. bottoms. The U.S. Steel (ore carriers) and Moravia Lines (petroleum carriers) accounted for most of this traffic. Less than 8 percent of the Welland Canal Section sub-system laker transits were made by the U.S. bottoms; these were mostly coal and petroleum bulk carriers. What is significant is that less than 16 percent of the U.S. lake fleet entered Lake Ontario last year and the balance of the U.S. fleet has been mostly involved in U.S. domestic carriage of coal, ore, limestone and petroleum.

Problem Area #3	*It is possible that the Maritime Administration may expand the subsidy for the U.S. lake fleet. This could markedly change the Seaway transits' of the U.S. ships in the next fifteen years since increased grain and iron ore shipments are forecast; and since most of the inter U.S.-Canadian cargo is now transported by Canada. However close attention must be given to the U.S. steel industry to ensure current recovery patterns continue against the stiff Sino-Japanese competition.*

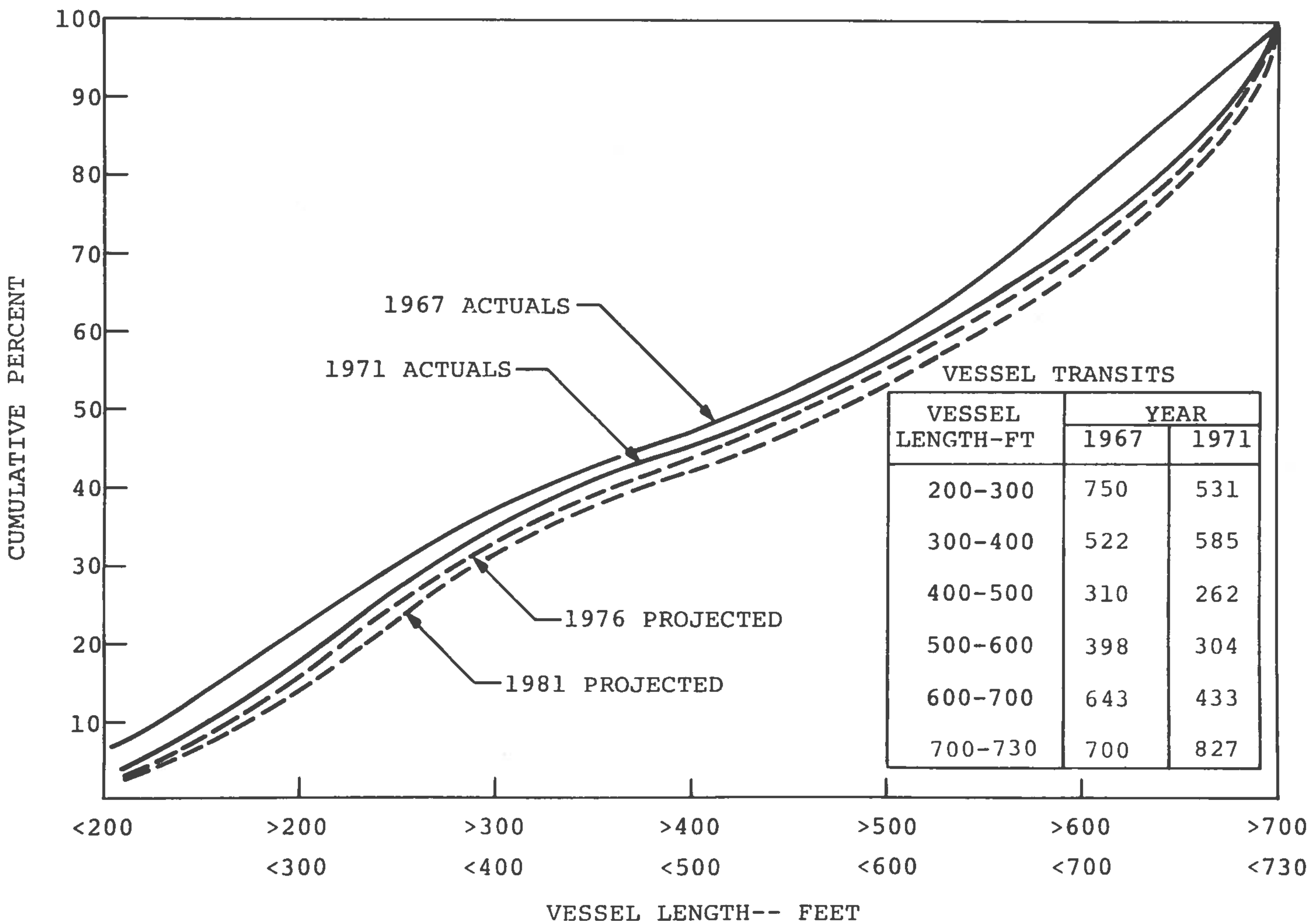
1971 Traffic Pattern - Lakers Over 1,000 Tons

REGISTRY	FLEET SIZE	VESSELS	ST. LAWRENCE	WELLAND	ST. CLAIRE	ST. MARY'S
U.S.	255	0	-	-	DATA UNAVAILABLE	DATA UNAVAILABLE
		8	50	57		
		32	-	286		
		40	50	343		
CANADA	162	7	170	-		
		132	2992	3410		
		17	-	769		
		156	3162	4179		
TOTAL	417	196	3212	4522		
BAHAMIAN	2	2		109		
	419	198	3212	4631		
730 Foot Vessels	40	34	791	1064		
		4	-	509		
		38	791	1573		

Vessel Sizing - Lakers

The optimum upper limit for Lakers is 730 foot length, 26 foot draft, 75 foot 6 inch beams, 25,500 cargo ton capacity. 40 have been launched since 1959, and three more will be launched by April 1974. (Only two are U.S., the Edward L. Ryerson and the Middletown and they do not operate in the Welland - St. Lawrence subsystem). During the 1961-1971 period, the laker fleet increased its per transit length overall (LOA) midpoint by 20 feet and cargo carriage capacity by 2000 tons. Though this 100 ton per LOA foot annual rate exceeded the cargo demand during the 1967-1969 period, the LOA growth rate is expected to continue. The drop in transits of the smaller class vessels also indicates fleet utilization efficiency in terms of payload/transit is improving. Starting in 1963 renewal insurance rates for the older, smaller vessels became so prohibitive that for every four years since at least 200 of these ships have been removed from the fleet. According to a 1969 report by EBS Inc. 65 percent of the fleet is over 20 years of age and 55 percent over 30 years of age. For ships 30 years of age or more insurance rates become prohibitive.

Problem Area #4 Present U.S. construction rate will not meet fleet retirement rate nor projected cargo demand



VESSEL TRANSITS

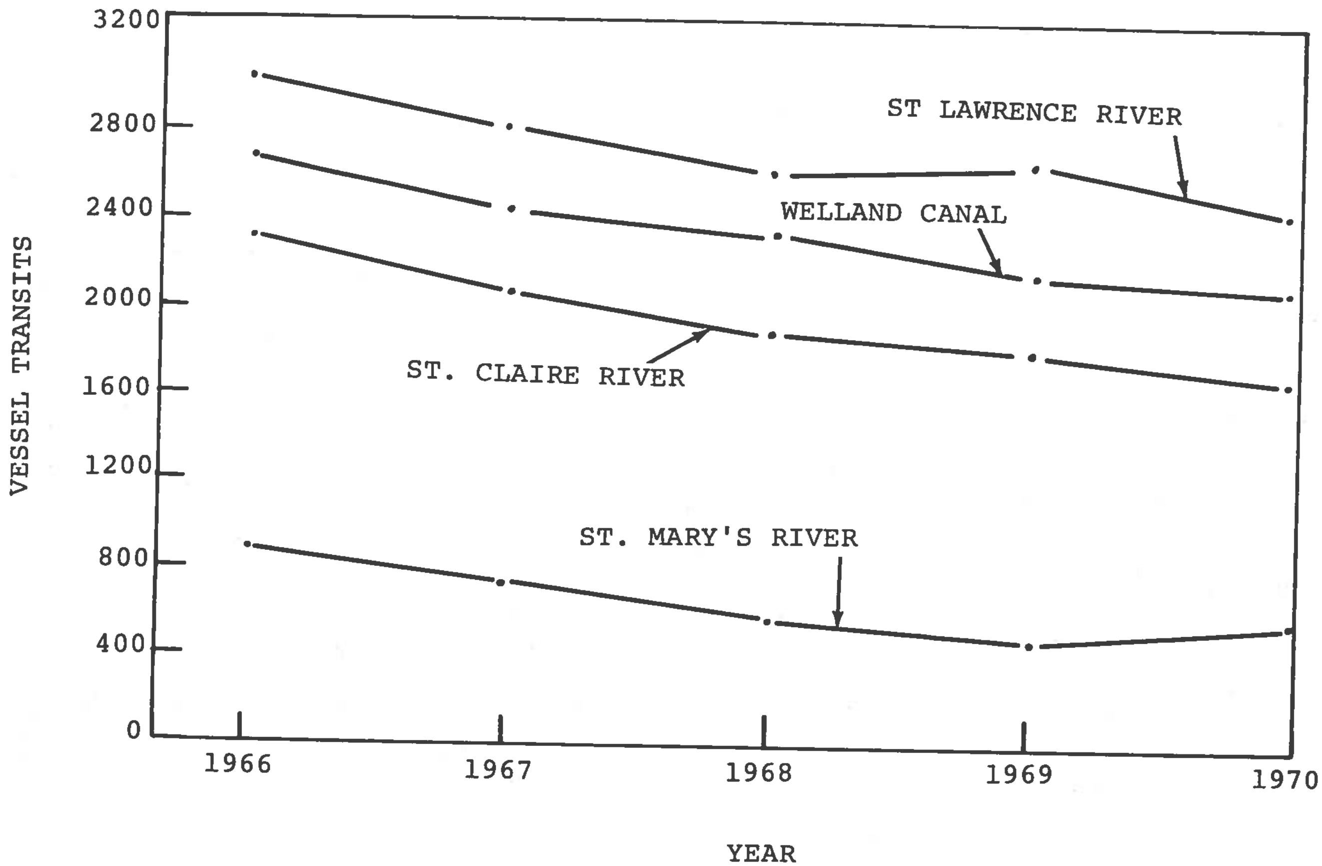
VESSEL LENGTH-FT	YEAR 1967	YEAR 1971
200-300	750	531
300-400	522	585
400-500	310	262
500-600	398	304
600-700	643	433
700-730	700	827

DISTRIBUTION OF INLAND VESSEL TRANSITS AS A FUNCTION OF VESSEL LENGTH

Fleet Element - Ocean Traffic Pattern

According to the preliminary results of the 1970 Great Lakes Pilotage Study of those ocean vessels entering the system at Montreal,* 86-93 percent transit the Welland and 68-70 percent transit into Lake Huron. One-third do not go beyond Lake Huron ports, and one-third each go to Lake Superior and Lake Michigan ports respectively.

(*35 foot draft vessels have entered the Seaway system up to Montreal for the last five years)



GREAT LAKES - ST. LAWRENCE UTILIZATION PATTERN
VESSELS USING REGISTERED PILOTS
PARTIAL TRANSITS INCLUDED

Fleet Element - Ocean Vessel Sizing

The optimum design for salties is 709 foot length, 75.5 foot beams, 26 foot draft, 20,800 cargo tons capacity. The length overall (LOA) midpoint of the ocean fleet appears to be changing more rapidly than the Laker fleet. Since 1967, it has increased at a rate of 12 feet per year; however LOA utilization is not as effective; each foot increased the cargo tons per transit rate by 50 tons. This is undoubtedly due to the differences in cargo density.

Problem Area #5 If LOA growth trend does not continue the fleet will have to increase to meet cargo demand. Are the ships available?

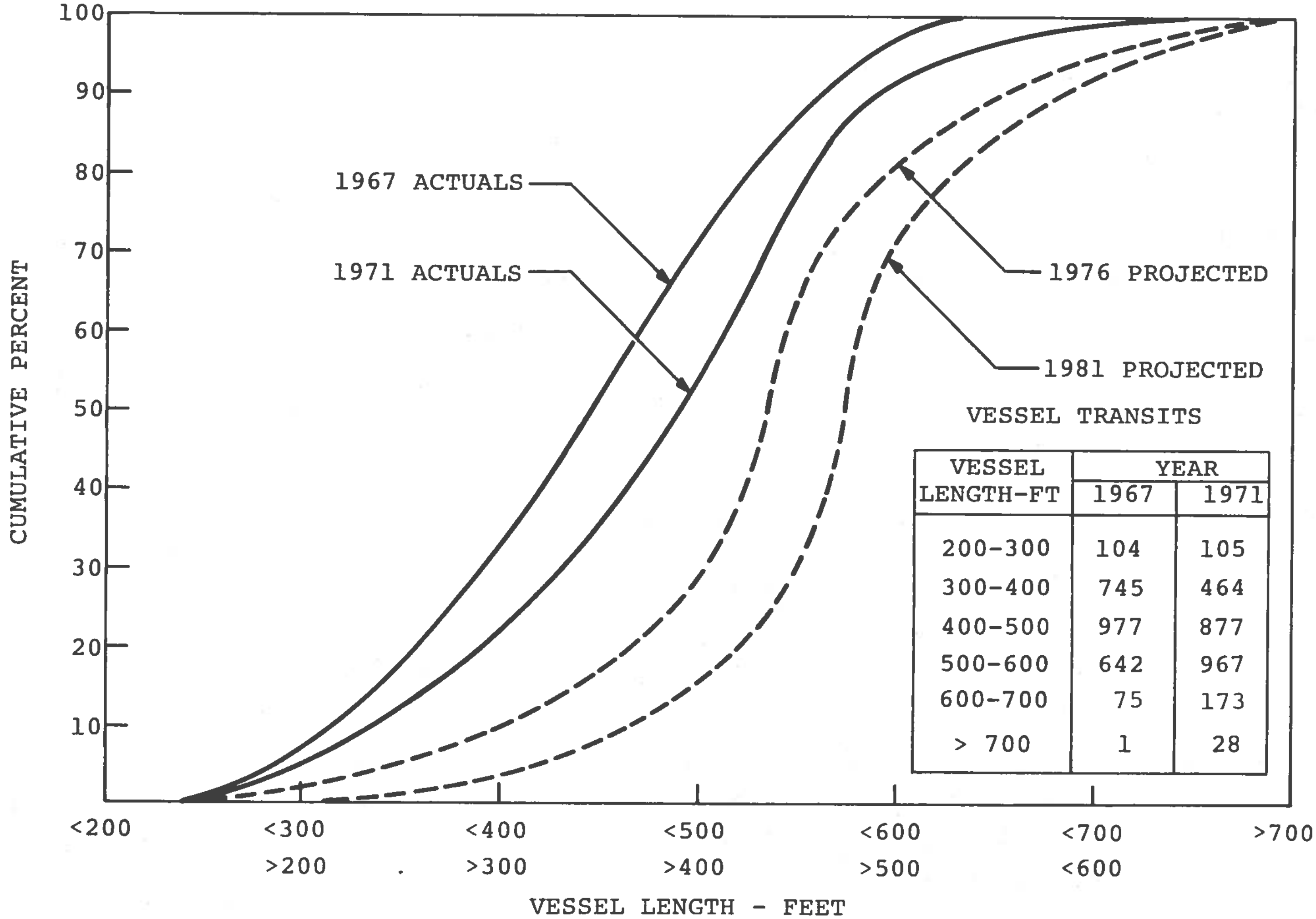
Problem Area #6 If the LOA growth does continue, can the ocean fleet mix meet the 1980-1990 LOA GROWTH DEMAND?

The table shown below tends to indicate that the fleet can meet the LOA demand but this requires an in-depth analysis. As more super ships enter ocean fleet, more 600 to 700 foot vessels could be freed for Great Lakes service. However, the table also indicates another potential problem

OCEAN ENTRIES BASED ON PRE CLEARANCE REQUESTS

YEAR	TOTAL	REPEATS	1st TIME ENTERED	2nd TIME ENTERED	3rd	Skip 2nd YEAR
1969	632	433	199	68 (1970)	40(1971)	29 (1971)
1970	614	439	175	78 (1971)		
1971	757	456	301			

Problem Area #7 Are the indicated trends a function of vessel operating costs such as quality, size, pilotage, safety, and profits? What functions are over-riding?



VESSEL TRANSITS

VESSEL LENGTH-FT	YEAR 1967	YEAR 1971
200-300	104	105
300-400	745	464
400-500	977	877
500-600	642	967
600-700	75	173
> 700	1	28

DISTRIBUTION OF OCEAN VESSEL TRANSITS AS A FUNCTION OF VESSEL LENGTH

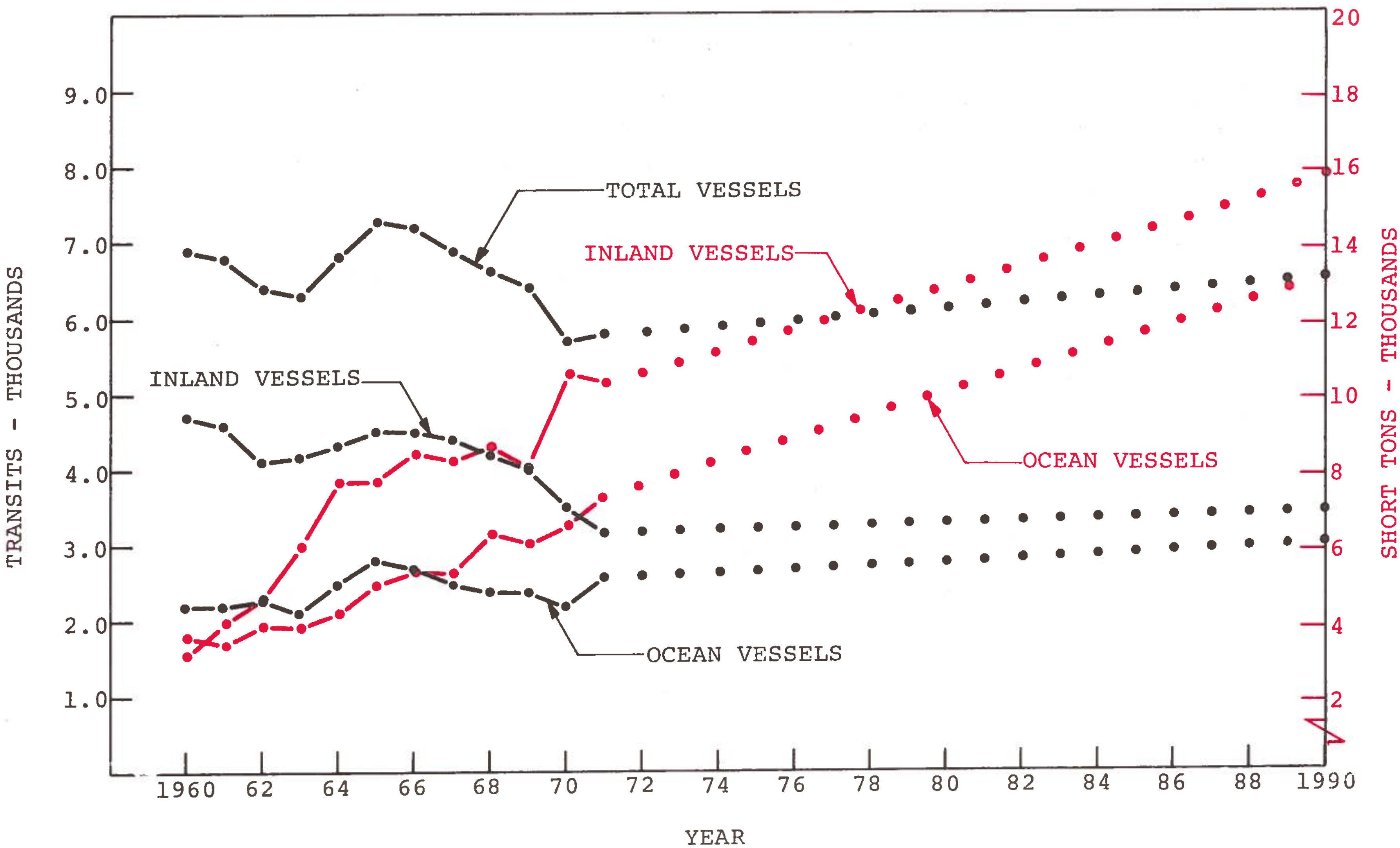
Projected Transits

Transits currently are about 66 percent lakers, 33 percent ocean, no appreciable ratio change is forecast

Ocean: The annual rate of ocean transits has been relatively constant as the cargo carriage capacity has increased. A gradual increase is projected through 1990 on the assumption that cargo carriage capacities though continuing to grow will not increase in size rapidly enough to meet the demand. (1 million cargo tons per year).

Lakers: The annual rate of laker transits has decreased rapidly with the advent of the 730's (25 percent of fleet), and the sharp drop in demand due to strikes in 1969-1971. The transits' forecast assumes that the market demand will only grow at a .6 to 1.0 million cargo tons per year.

Problem Area #8	*These projections do not include any change in the Seaway's share of the Hinterland overseas transportation market nor any significant change in Laker commodity carriage demands. Most probably adjustment peaks like the 1965 peak would occur. This could soon saturate the system*
Problem Area #9	*It takes 7 to 10 years (see cross over points between tonnage/transit and transits chart) for system elements to compensate for major changes in other system elements. If this trend continues, the system may soon be saturated too.*



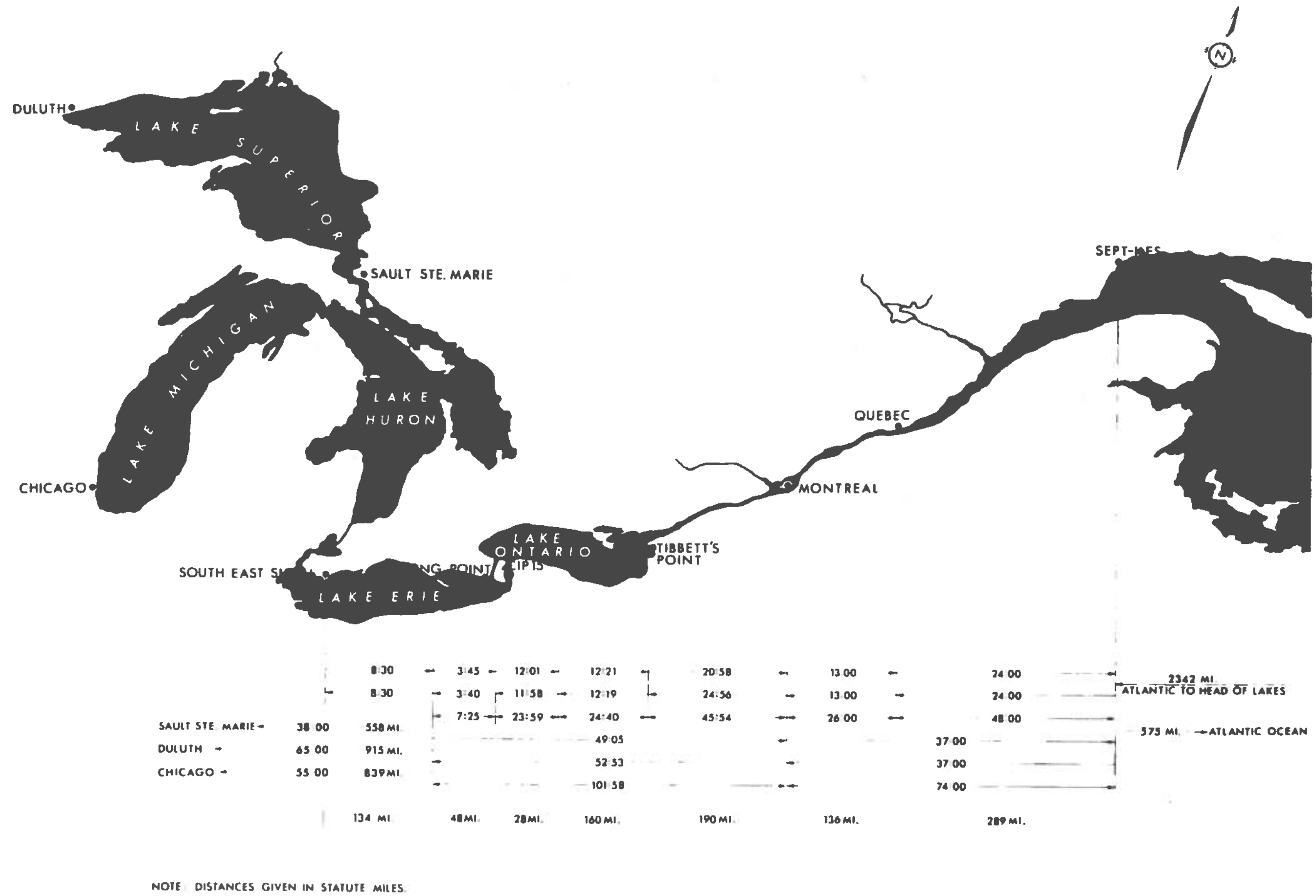
MONTREAL - LAKE ONTARIO Average Cargo - Tonnage/Transit

Average Vessel Transit Times

The actual 1969 average vessel transit times (Lakers and Salties) between ports are shown. These average times are increasing as the LOA's increase. Upbound arrow heads are to the left; down bound to the right. Double arrows are round trip times.

The average 730 foot laker made twenty-six round trips during 1971 (240 days). It picked up wheat in Lake Superior ports which it off loaded between Montreal and Quebec; from there it went to Sept Iles for backhauling Labrador iron ore to Hamilton, Ontario or Erie, Pennsylvania. Nine days were used to transit the system, one day to load-unload at four ports.

The average ocean liner makes four round trips between Europe and the Lakes (67 percent of ocean cargo goes to Europe). It visits three Lakes ports each trip. One each on Lakes Ontario and Erie and thence to the Huron-Superior-Michigan Lakes area. The "average" general cargo vessel was in the system from 24 to 30 days of which 8 to 10 days were spent in transit time. 709 foot salties like the Endwi-Andwi-Rolwi class, specially designed for Chicago to Antwerp operations, can make the Seaway round trip in a minimum of 15 days (Sept Iles to Chicago and return).

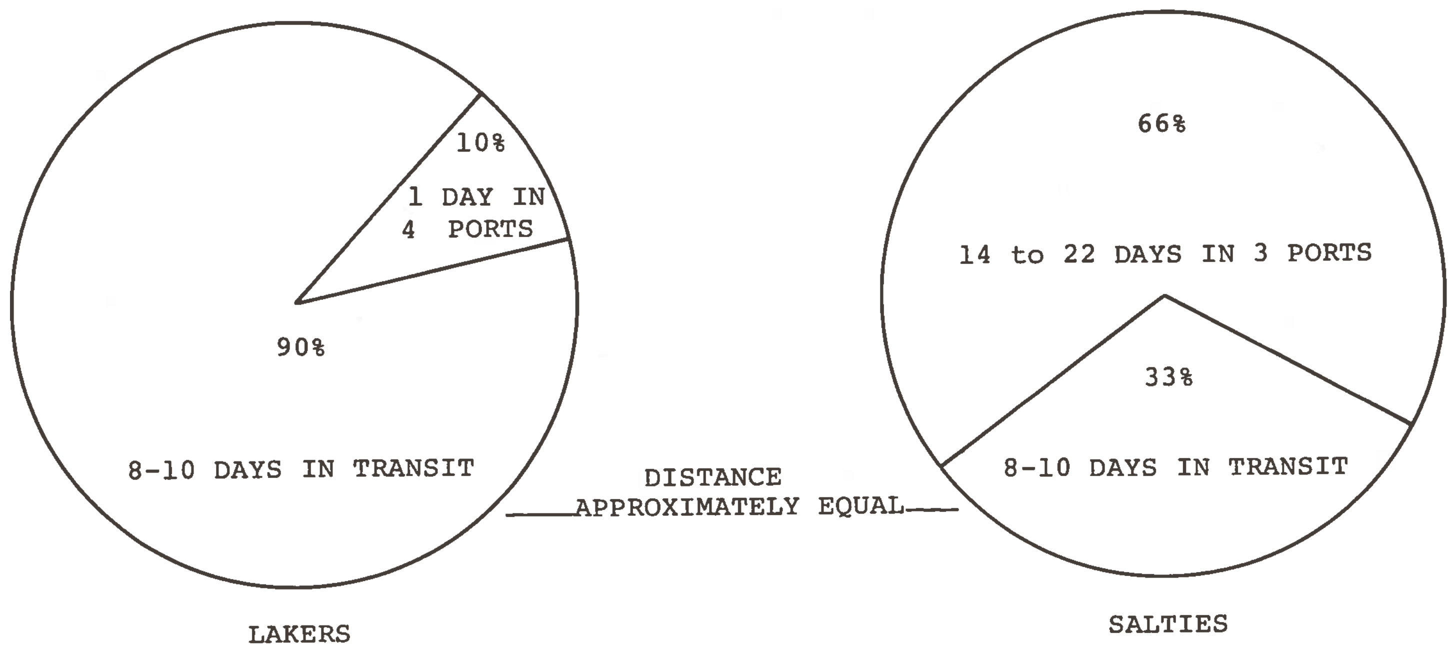


ST. LAWRENCE-GREAT LAKES AVERAGE VESSEL TRANSIT TIMES
-Long Point to Montreal Actual 1969 Figures.
-Other Times Approximate Figures.

Zeroing in on the "Time" Problem

A 12 percent savings in transit time equals one day/round trip for lakers and salties. A 12 percent savings in port operations per round trip for lakers is three hours, for ocean vessels it could mean two to three days. Greater port operations time savings may be available to the general cargo ocean class.

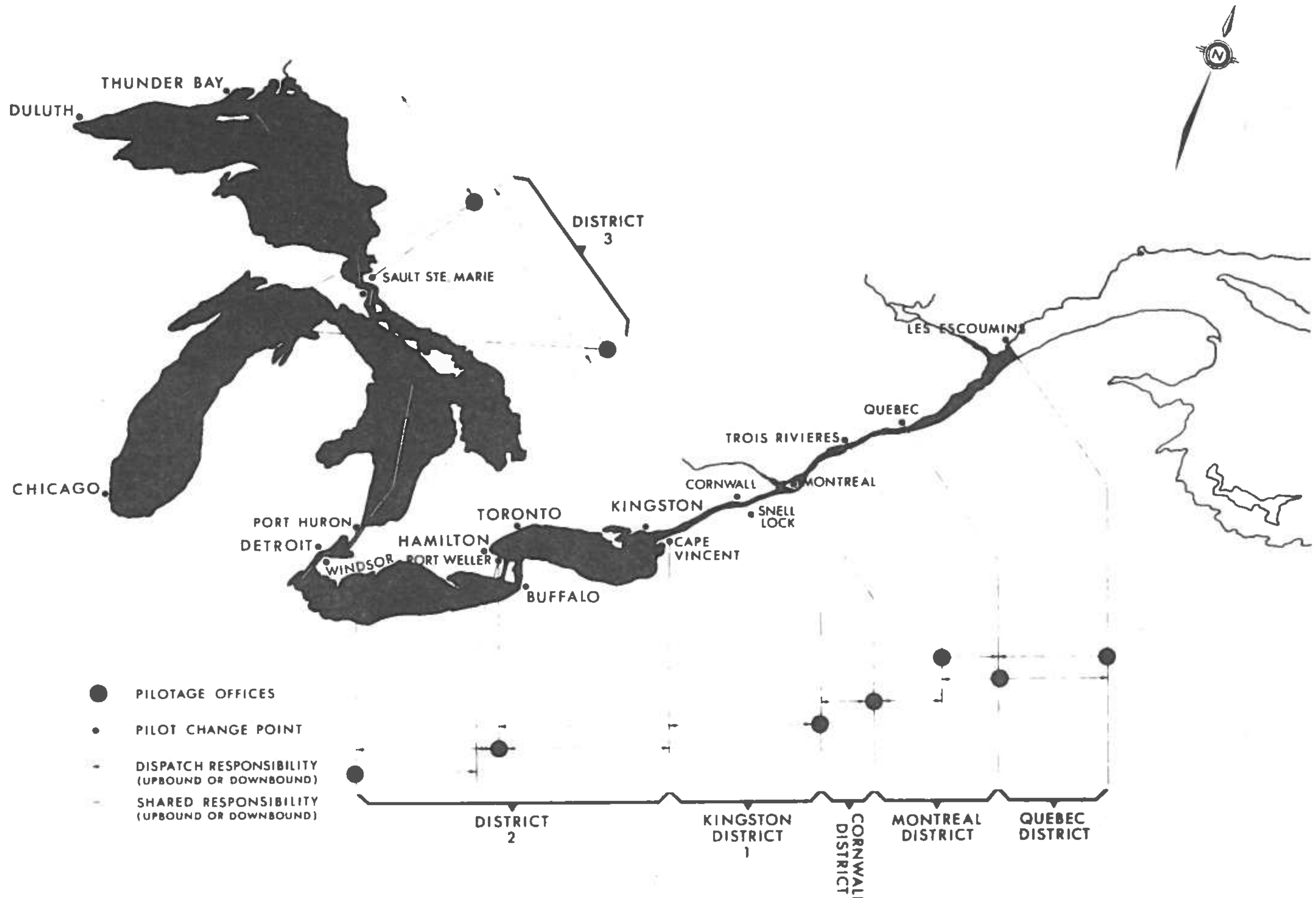
Problem Area #10	*Trade off studies are required to determine if rapid loader capabilities should be ship-borne or port furnished. Also IMTIC could help solve scheduling problems the ports experiencing. MARAD's proposed ports computerized cargo control system should be integrated with IMTIC to maximize effectiveness (Reference MARAD's RFP-2-36238 of March 13, 1972)*



WHERE "TIME" IS SPENT

Pilotage Element

Pilotage is primarily an overseas and coastal ocean vessel problem since most laker deck officers have pilot certificates. There are four pilotage districts, each of which is responsible for its own work assignments and schedule. Pilots are entrepreneurs everywhere except in the Welland Canal ... there they are government employees. Individual workloads and trip assignments are generally predicted on a minimum of three 12-hour trips per week and annual gross personal earnings capacities of approximately $27,000. Towards the end of the season these factors can complicate the timely availability of a pilot. Average vessel round trip pilotage fees are $9,000 for 210 hours of service (9 days).



ST. LAWRENCE-GREAT LAKES-Pilotage Responsibility

Pilotage Delays

The pilot pool size is predicted on the previous years total and average daily transit rate. Peak loadings occur every year in the spring and fall and because of weather, lack of terminal facilities and inefficient scheduling. These peak loadings exceed service capacity. Often pilots are held on the vessel until relieved since vessels which do release pilots often experience difficulties in obtaining pilots when ready to move on.

Problem Area #11 *During 1971 literally thousands of lost time hours each month (after August) occurred at Port Huron, Welland, Cape Vincent and Montreal due to the unavailability of pilots. Even though emergency procedures were used during October, November, and December there were still at times up to 40 vessels awaiting pilots at various pick up points. IMTIC should help solve this problem by improved pilot/vessel scheduling.*

Pilotage Data

DISTRICT	LOCATION	NOMINAL TRANSIT TIME (hours)	PILOTS CANADIAN	PILOTS U.S.	PILOTS TOTAL	TRIP CAPACITY PER WEEK NOV MIN.	NOV MAX.	DEC MIN.	DEC MAX.
Cornwall	MONTREAL-SNELL	12	38	0	38	95	114	48	57
NO. 1	SNELL TO CAPE VINCENT	10	18	13	31	93	124	SAME	
	LAKE ONTARIO	12	7	7	14	42	56	SAME	
NO. 2	C.I.P. 15 TO LOCK 7 (WELLAND SECTION)	12	30	0	30	91	105	SAME	
	LOCK 7 TO PORT HURON (LAKE ERIE)	13	12	33	45	135	180	SAME	
NO. 3	ALL LAKES ABOVE HURON	8	25	33	58	NOMINAL →			

1965 Thru 1971 Accident Record

	St. Lawrence				
	U.S.*	CANADA	S/T	WELLAND	TOTAL
Equipment					
Ship					
Steering Gear	34	17	51	4	55
Engines	186	65	251	2	253
Anchors	8	-	8	-	8
Other	-	1	1	-	1
Lock	-	1	1	2	3
Sub-Total	228	84	312	8	320
Ship Hits					
Locks					
Walls	161	20	181	55	236
Gates	-	9	9	22	31
Arrestors	-	4	4	18	22
Sills/Bullnose	5	1	6	2	8
Bridges	-	2	2	9	11
Piers	-	-	-	1	1
Banks	-	-	-	25	25
Bouys	2	-	2	-	2
Sub-Total	168	36	204	132	336
Lock					
Filling	-	16	16	26	42
Fendering	14	7	21	-	21
Sub-Total	14	23	37	26	63
Ships					
Grounded	79	28	107	6	113
Damaged	104*	-	104	-	104
Weather	-	1	1	2	3
Human Error					
Ship Hits	-	81	81	51	132
Lock Equip	-	3	3	9	12
Collisions	22	15	37	6	43
Other	-	4	4	4	8
Personal Injury	11	-	11	-	11
Sub-Total	33	103	136	70	206
Grand Total	626*	275	901	244	1145

SLSDC and SLSA have completed the initial task of compiling and tabulating the accident data for the 1965 thru 1971 period. There are problems of termino-logy and definitions, but still there is sufficient evidence for the identification of trends after ad-justments are made in the Human Error Category

75% of the Canadian accidents involved 413 Salties

41% of the accidents involved hits

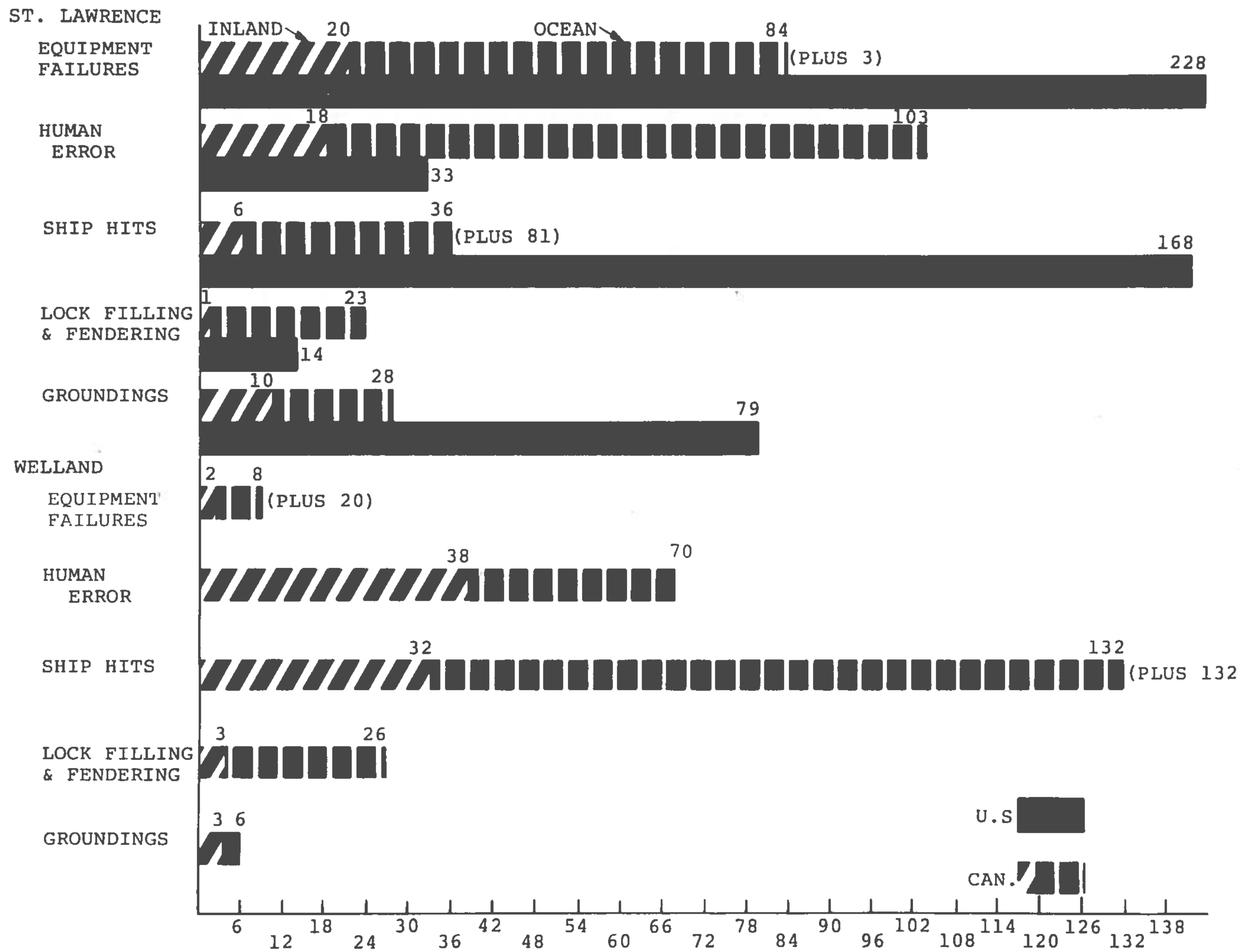
27% of the accidents involved equipment failures

19% of the accidents involved groundings/collision

Problem Area #12: In the past, the Seaway entities, due to funding limitations, have not been able to mount a professional systems safety analytic program comparable to that found in other transportation modes. This summary indicates that a detailed failure mode analysis is urgently needed in order to define corrective requirements for ship and lock equipments and personnel training.

*NOTE: THE U.S. COLUMN HAS MULTIPLE ENTRIES PER ACCIDENT. THE CANADIAN'S DOES NOT.

1965 THRU 1971 ACCIDENT RECORD



CUMULATIVE ACCIDENT RECORD 1965 THRU 1971

System Safety Analysis

Accidents are costing the Seaway and Shipping industries at least $1,500,000 per year now.

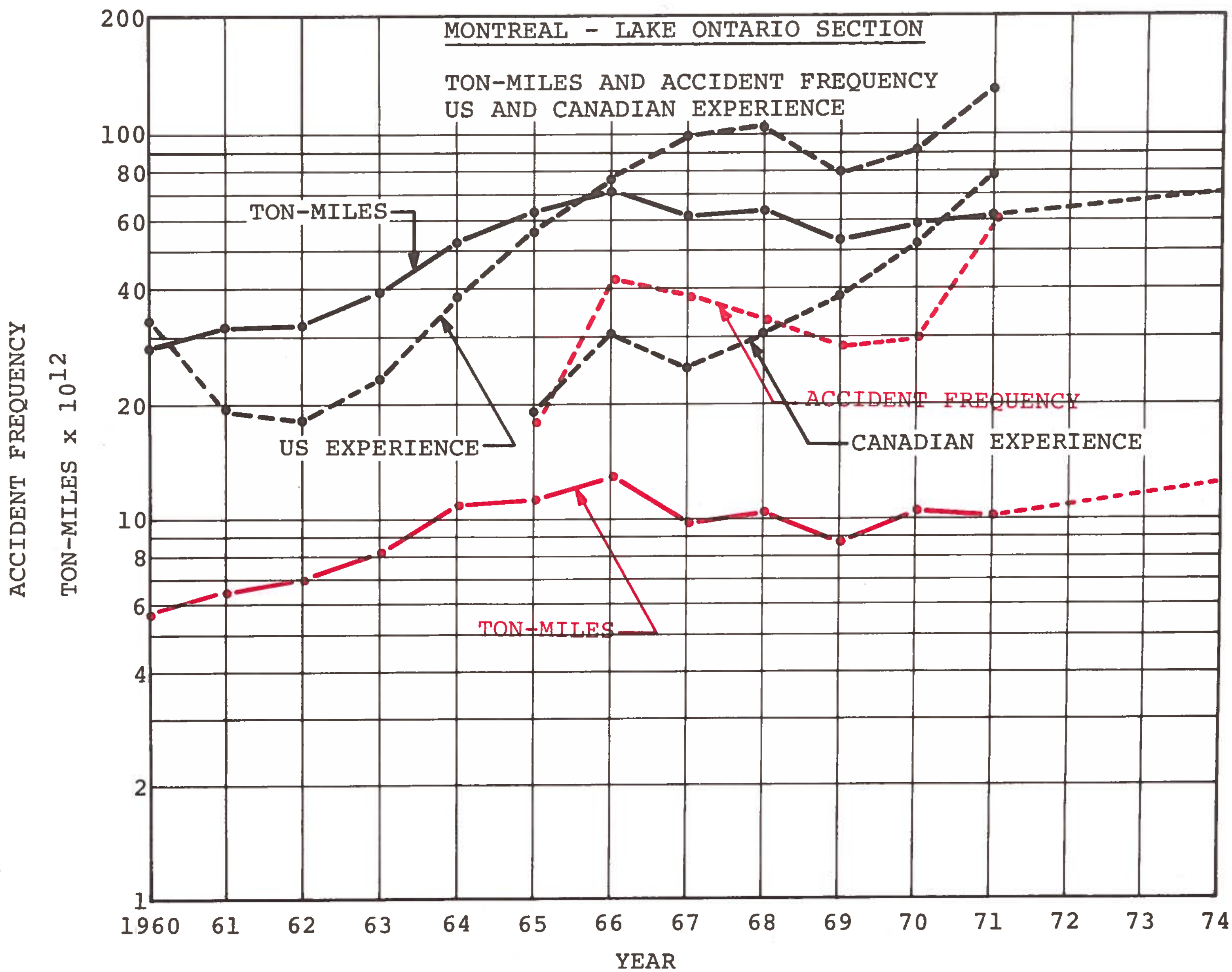
Thru 1965 the U.S. Sector accident record was approximately proportional to each ton mile carried in the St. Lawrence sub-system. Then a number of inter-related events occurred. The lower Snell lock wall was extended; along with a dike installed the previous year, this changed the river flow character. Simultaneously, a bell alarm system was installed to alert the lock master each time the wall was hard hit. Along with these two events, ships got larger, and new pilots and captains were added to the fleet operation. This caused the U.S. accident rate to jump in 1966 and 1967. In 1967, the Canadians installed new vessel traffic control procedures and their accident profile dropped. In 1968 (mid-year), the Americans followed suit and they also revised the bell alarm system (higher impacts were required to sound the alarm). And, as the pilots grew accustomed to the river flow characteristics and wall approaches, the American accident profile returned to parallel the Canadians.

Since 1967, another trend has developed. There appears to be a direct correlation between the accident rate and the ship LOA growth rate....53 Canadian accidents vs 50 foot LOA growth. (This may also account for the Ocean phenomena shown on the previous page). In 1967, the Welland sub-system's new semi-automated second generation traffic control network went into operation with obvious results. Yet, when the Ocean fleet increased 23% in the 1971 (and 301 first timer's entered), Welland could not meet the demand.

Another conclusion based on 1971 data is: As the transit rate increased from 23 to 28 vessels per day, and as this peak continued for approximately five to seven days, accidents happened. April, November and December were the worst months and accidents occurred on foul weather days most often.

Problem Area #13: The prediction is for larger and more (in total and first timers) ocean vessels to use the Seaway System. The accident record will become astronomical if corrective action isn't taken immediately. IMTIC could partially help.

Problem Area #14: The typical ocean accident profile in 1971 seemed to involve turbine driven first timers operating between sundown and midnight, using multi-lingual crews and ocean oriented mechanical and electronic equipment. Their man-machine response times just were not rapid enough, especially in high-denisty traffic conditions. IMTIC and other concurrent technological solutions are needed.



WELLAND SECTION Ton-Miles and Accident Frequency (Red)

Weather and Other Elements - Lost Time Summaries

Seaway operational instructions require the traffic to be slowed down whenever the visibility is less than 3,000 feet and to anchor at 900 feet. Steam fogs caused by water vapors on icy days are the principal cause of low visibility. Though radar reflective navigation aids are on hand, most ocean vessels are not equipped with river radar of high resolution capability and therefore cannot efficiently operate even at 3000 feet visibility. Buried radio frequency transmitting cable concepts which give locational information within three feet have also been employed successfully in canals but frequently the cabling is cut by the passing screws of over-draft-limit ships. Infrared and wind fog-dissipating machines have also proven unsuccessful.

Another major problem are the winds on the high sail (freeboard) areas of ocean vessels and in-ballast lakers. Generally loaded lakers can operate in winds up to 23-25 knots while ocean vessels cannot operate beyond 10-15 knot winds in the Welland section where Westerlies winds blow from abeam. In the St. Lawrence River, 12-18 knot winds are the upper limits (Southwesterlies and northeasterlies-weather helm)

Problem Area #15: Approximately $3.5 to 5.0 million in lost (non-productive) vessel hours were experienced each year during the last four years. Low cost technology solutions are required.

Problem Area #16: The lost time data base will not be available from SLSA until this summer

SEAWAY CLOSED TO NAVIGATION

ST. LAWRENCE SUBSYSTEM

YEAR / ITEM	1968			1969			1970			1971		
	CAN.	U.S.	S/T	CAN.	U.S.	S/T	CAN.	U.S.	S/T	CAN.	U.S.	S/T
VESSEL	70	44	114	41	130	171	75	34	109		42	
WEATHER	**244**	**113**	**357**	**494**	**213**	**707**	**736**	**183**	**919**		**360**	
STRUCTURES	81	32	119	53	20	73	51	38	89		48	
PILOTAGE	6			9	17	26	8	--	8		7	
TOTAL	401	189	590	597	130	727	870	288	1158		457	

WELLAND SUBSYSTEM

YEAR / ITEM	1968	1969	1970	1971	
		ALL - CANADA			
VESSEL	93	61	78		
WEATHER	224	180	180		
STRUCTURES	94	91	165		
PILOTAGE	**1862**	**918**	**407**		
TOTAL	2273	1250	830		

VESSEL LOST TIME HOURS - ST. LAWRENCE SUBSYSTEM

YEAR / ITEM	1968				1969				1970				1971				
	CAN.	U.S.	S/T	NO. of VESSELS	CAN.	U.S.	S/T	NO. VES.	CAN.	U.S.	S/T	NO. VES.	CAN.	U.S.	S/T	NO. VES.	
VESSEL WEATHER STRUCTURES PILOTAGE	DATA NOT REDUCED				DATA NOT REDUCED				DATA NOT REDUCED				928 **11733** 724 6			305 **1171** 491 18	
TOTAL	12026												13391			1985	

VESSEL LOST TIME HOURS - WELLAND SUBSYSTEM

YEAR / ITEM	1968	1969	1970	1971
VESSEL WEATHER STRUCTURES PILOTAGE	DATA TO BE REDUCED	DATA TO BE REDUCED	DATA TO BE REDUCED	451 1247* 1154** **22942**
TOTAL				25794

WELLAND DETAILS - 1971

	UPBOUND			DOWNBOUND		
	VESSEL	AVG	TIME	VESSEL	AVG	TIME
		HR.	MIN.		HR.	MIN.
WIND	11	10	15	15	16	19
FOG	15	14	58	49	13	21
MECH.	4	24	19	4	8	20
OTHER	28	32	33	15	7	28
PILOT.	**529**	**24**	**43**	**239**	**41**	**17**

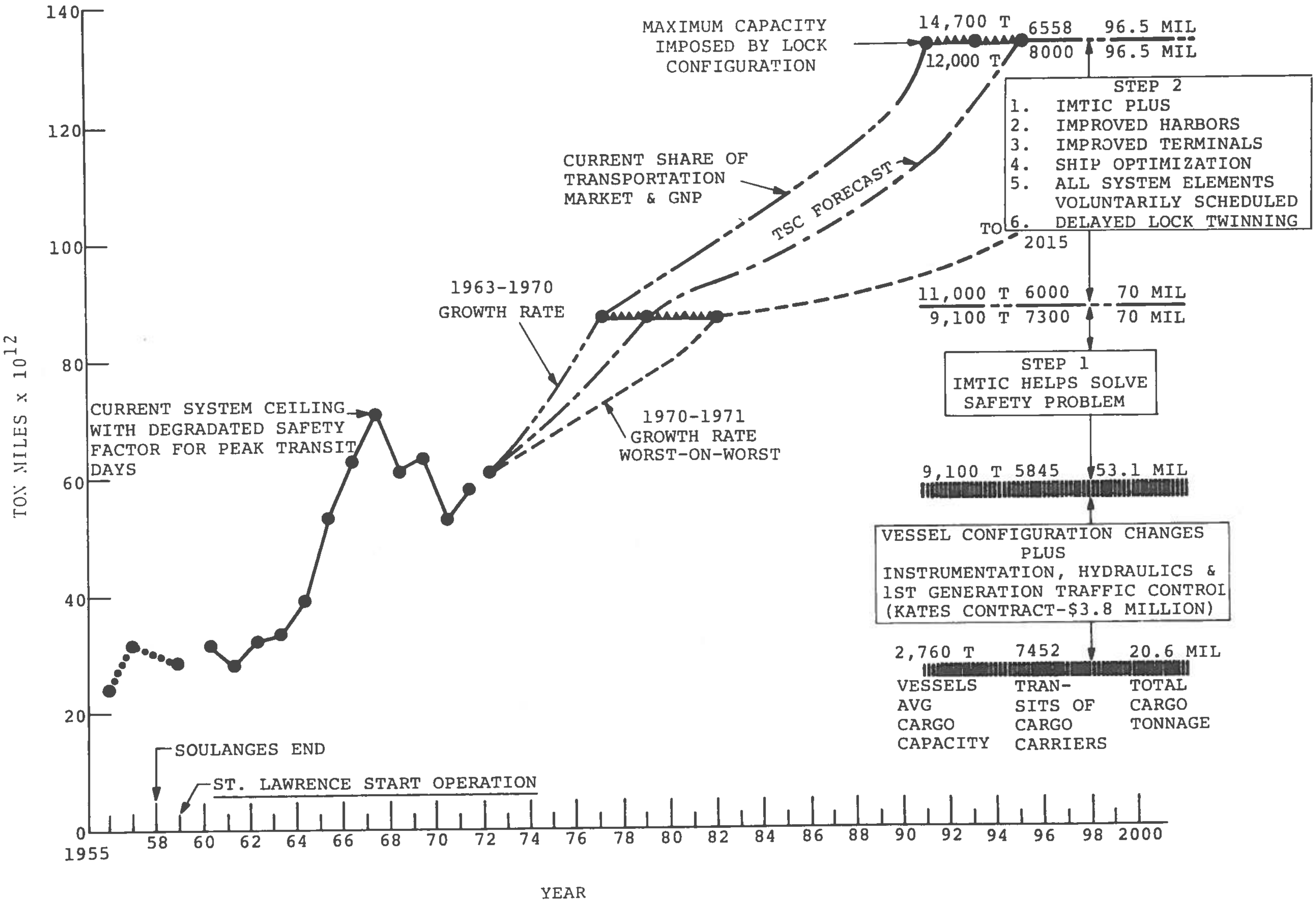
*WIND 368; FOG 879
**MECH 131; OTHER 1023

System Service Capability-Montreal-Lake Ontario Section

It is a fundamental policy of the Seaway Entities that the canal and locks element shall strive for a 100 percent confidence factor in a 100 percent reliable service. The shipping season dates are selected based on this premise as are all system facilities and equipment improvement programs.

The ton-miles chart summarizes all of the demand and systems requirements data discussed so far. It illustrates the following items.

- The St. Lawrence sub-system service capability has doubled since the Soulanges Canal-St. Lawrence Seaway change over
- The St. Lawrence River sub-system service capability has plateaued since 1966, and is most probably saturated at 70×10^{12} ton-miles threshold
- System elements must commence development programs now if post 1974 market demands are to be met
- The 1971 accident rate will most probably double at the 70×10^{12} ton-miles level and increase by a factor of 4 at 90×10^{12} ton-miles if the 1971 system elements remain unchanged.



BALANCING SYSTEM VS MARKET DEMANDS - Actual and Projected for St. Lawrence Section

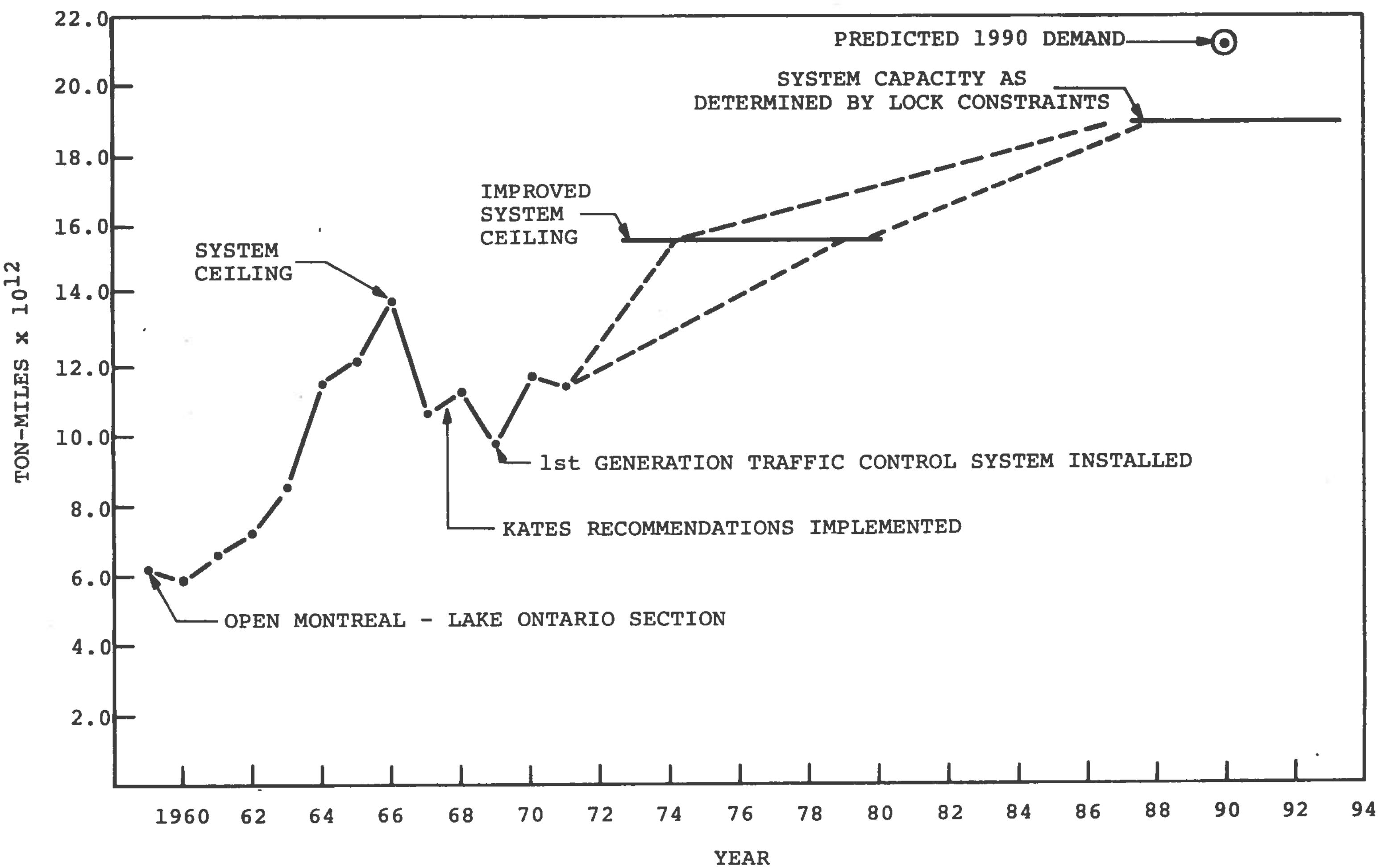
Welland Section

System Service Capability

The ton-mile chart illustrates the demand and service requirements for the Welland Section.

The following conclusions are suggested:

- System service capability has more than doubled since the opening of the Montreal-Lake Ontario section.
- Since 1966, system service capability has plateaued at a level of 11×10^{12} ton-miles. System ceiling is probably 14×10^{12} ton-miles.
- The full impact of the installation and improvements made in the traffic control system at St. Catharines (1967, 1971) will probably not be felt until the 1974-1978 period; the impact of the Kates recommendations in the 1972-1976 period. It is estimated that these improvements will add 15 percent to the system ceiling.
- Projections for 1990 indicate a level of demand of 21.2×10^{12} ton-miles; system capacity cannot meet this demand under current lock configuration and first generation system improvements. In order to achieve <u>at least</u> the capacity determined by the lock constraints, the 1974-1978 system ceiling will have to be raised to this level by second generation improvements in the system elements.



WELLAND SECTION - System Service Capability

IMTIC - The Traffic Control and Management Information Elements

- WHAT WE HAVE
- WHAT WE NEED
- HOW IT IS TO BE IMPLEMENTED
- WHAT IT WILL SAVE
- TODAY'S STATUS

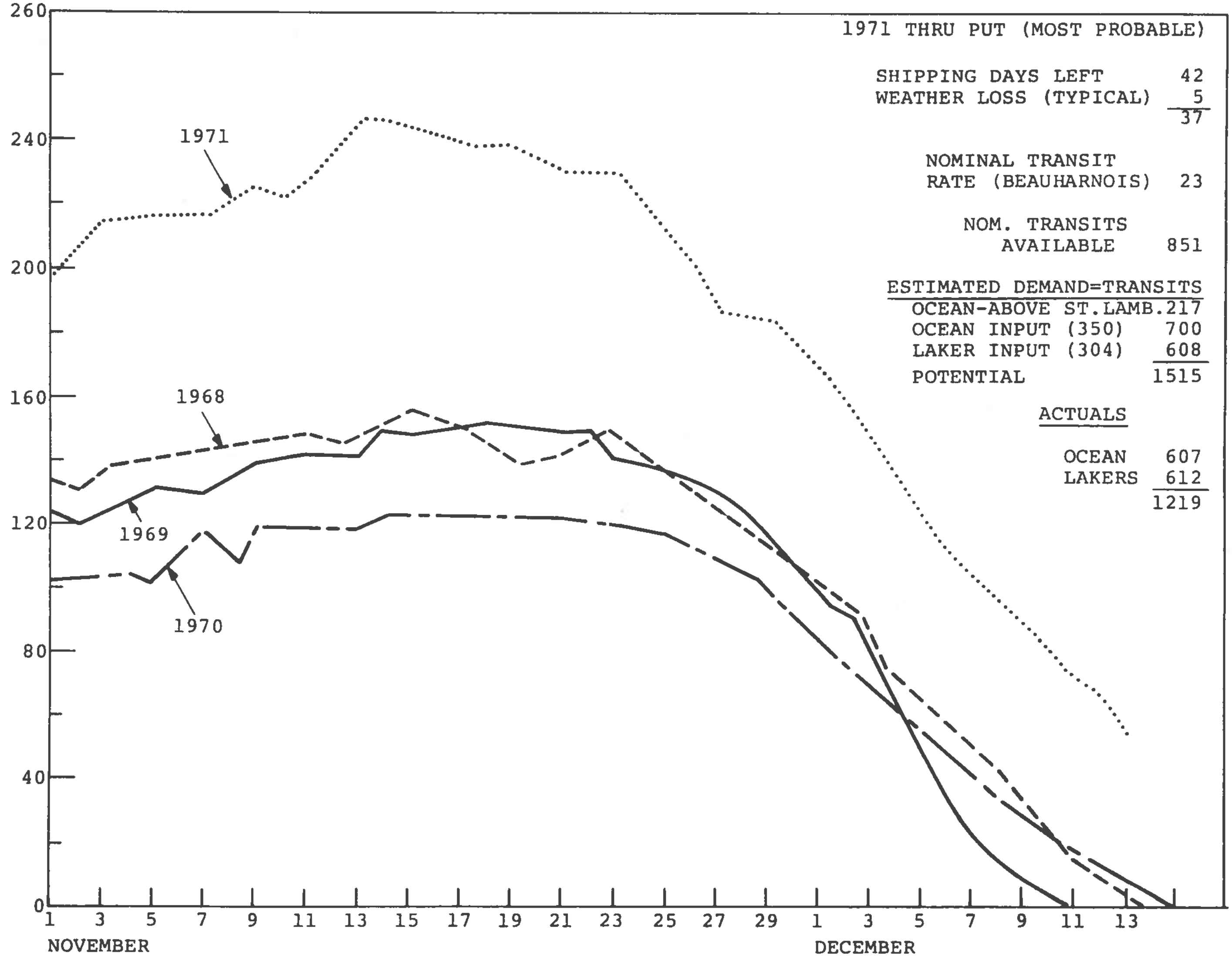
Scope Of The 1971 Year End Problem

There is an historical laker pattern of 304 round trips during November and December. There were 198 ocean vessels in the Seaway above St. Lambert and more than 350 more were requesting entry. (Of these 350 ships, 206 actually entered). Allowing five days lost time due to weather and a nominal throughput capability of 23 vessels per day at the Beauharnois Lock, and facing a December 12, 1971 season closing, a crisis in lack of capacity was obviously imminent. (This crisis was evidenced by an 851 transits capability versus 1515 potential demands). The graph illustrates the magnitude of the problem.

Emergency traffic control measures were announced on November 5 for implementation on November 12. This included the assignment of a sequential first-in-first-out "X" Priority system and the implementation of a joint U.S.-Canadian centralized traffic operational control center at Cornwall, Ontario. 87 vessels entered the Seaway under the "X" rating system. The major problem facing management was the decision making process: There were insufficient accurate vessel location and forecasted traffic pattern data. Such information as there was had to be manually gathered, posted, and tabulated by a 16 man operations staff. The shippers and shipping industry were up in arms, yet the Seaway was not administratively responsible nor <u>prepared</u> to assume such a task of coordinating <u>total</u> marine operations. Most of the data were obtained via telephone calls; and initially there was a great deal of inaccurate and misleading cargo, port availability and ship location information.

Despite this massive manual effort at least 150 ocean vessels elected <u>NOT</u> to enter the Seaway system. They off-loaded their cargoes in Quebec and the Maritime Provinces; cargo on Great Lakes docks had to be rerouted. These 150 ships represented a loss in traffic of at least 3.0 million cargo tons.

This is what IMTIC is all about ... the use of computers to effectively master schedule (voluntarily) all maritime activities using or which are involved in the operation of the Seaway.

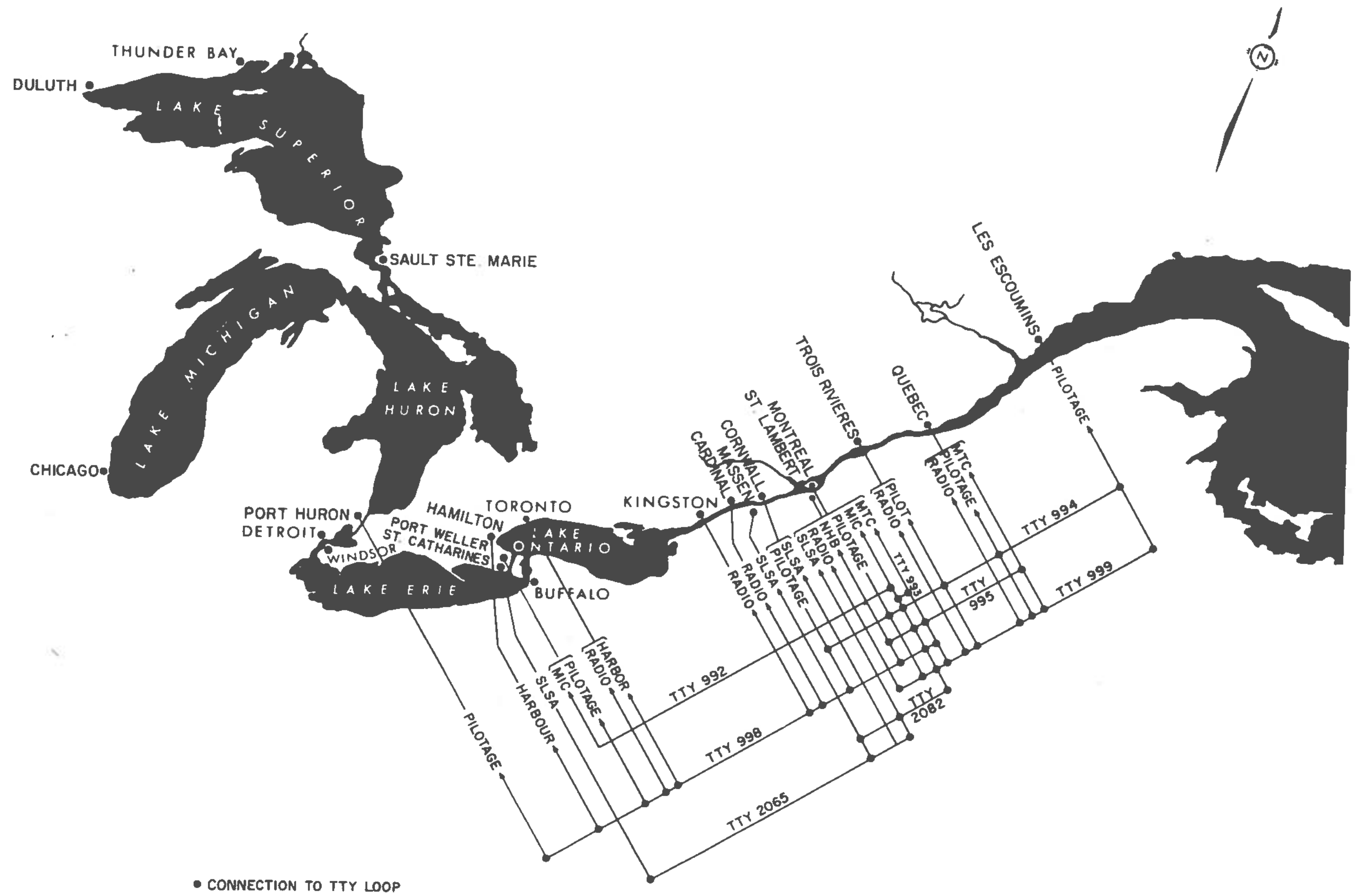


OCEAN VESSELS ABOVE ST. LAMBERT

What We Have

Communications Capability

Currently there are nine TTY station-to-station landlines serving seven Canadian and two U.S. entities. Though interrelated, through a limited message switching capability, they are not entirely interconnected. (It is proposed that IMTIC Step I Phase I have an automated message switching capability).

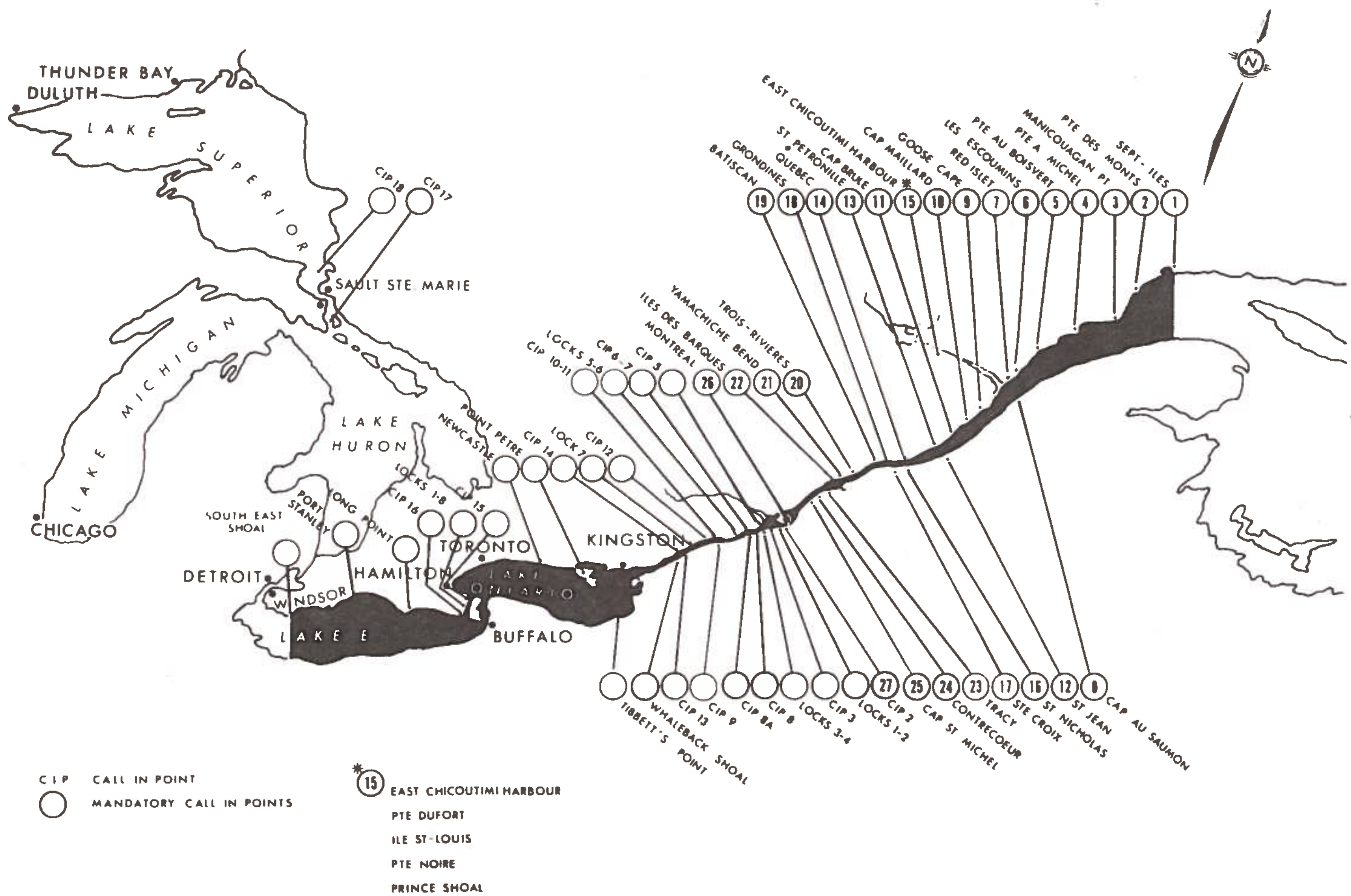


ST. LAWRENCE-GREAT LAKES-Data Communications Teletype Network

What We Have

Vessel Reporting Points

Approximately every fourteen miles between Sept Iles and Port Colborne and twenty-five miles between Port Colborne and Southeast Shoal a vessel must report (call in) to Traffic Control. Reporting includes estimated time of arrival (ETA) at the next call in point and speed.

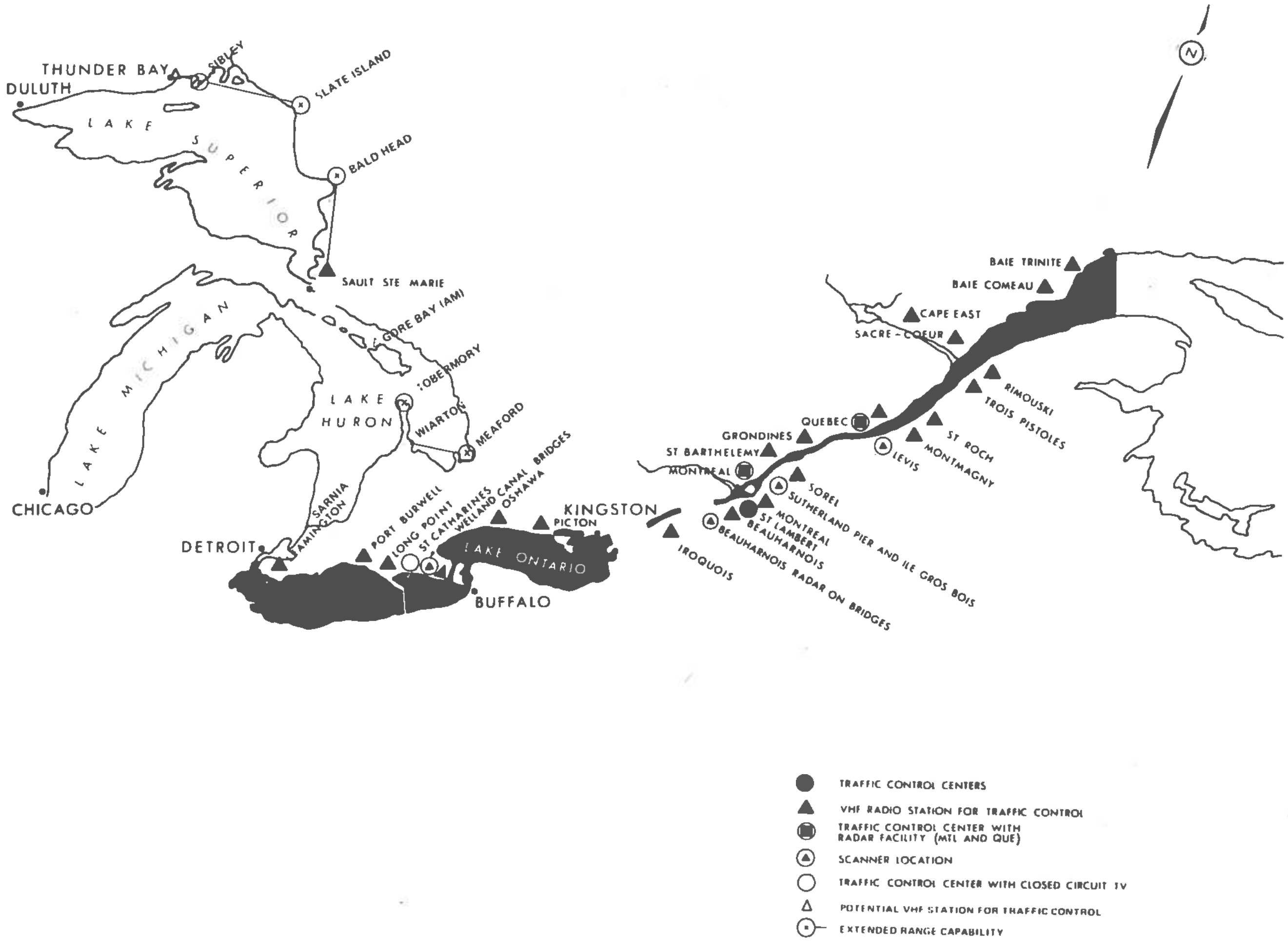


ST. LAWRENCE-GREAT LAKES-Traffic Control Vessel Reporting Points

What We Have

Radio-Radar Network

The effective radiating pattern (ERP) of the Seaway Radio network is 30 miles and 50 miles respectively for the Sept Iles to Port Colborne to Southeast Shoal areas. This limitation inhibits cross talk between reporting areas and provides an overlapping pattern for adjacent areas. The operational FM frequencies being used by the Seaway entities are channels 11, 12 and 14 in Lake Ontario, American and Canadian sectors respectively ... and constant standby on FM channels 6 and 16. Channel 22 "security" band is used by the Coast Guard and SLSDC. In addition, ship to ship FM channels 5 and 13 are used in the canals and lakes respectively. At a recent U.S.-Canada communications conference channels 9 and 17 and 71-74 (splits) were set aside for operational needs. Canada has an existing capability in the Upper Lakes areas and is quite anxious to proceed into Sarnia-Windsor (Port Huron) reach. This radio-radar network represents a basic capability in being necessary for the implementation of IMTIC Step 1. No further capital investment will be required for communications for Step 1. Additional communication capital investment will be required for Step 2.



ST. LAWRENCE-GREAT LAKES - Traffic Control VHF Radio & Radar Sections

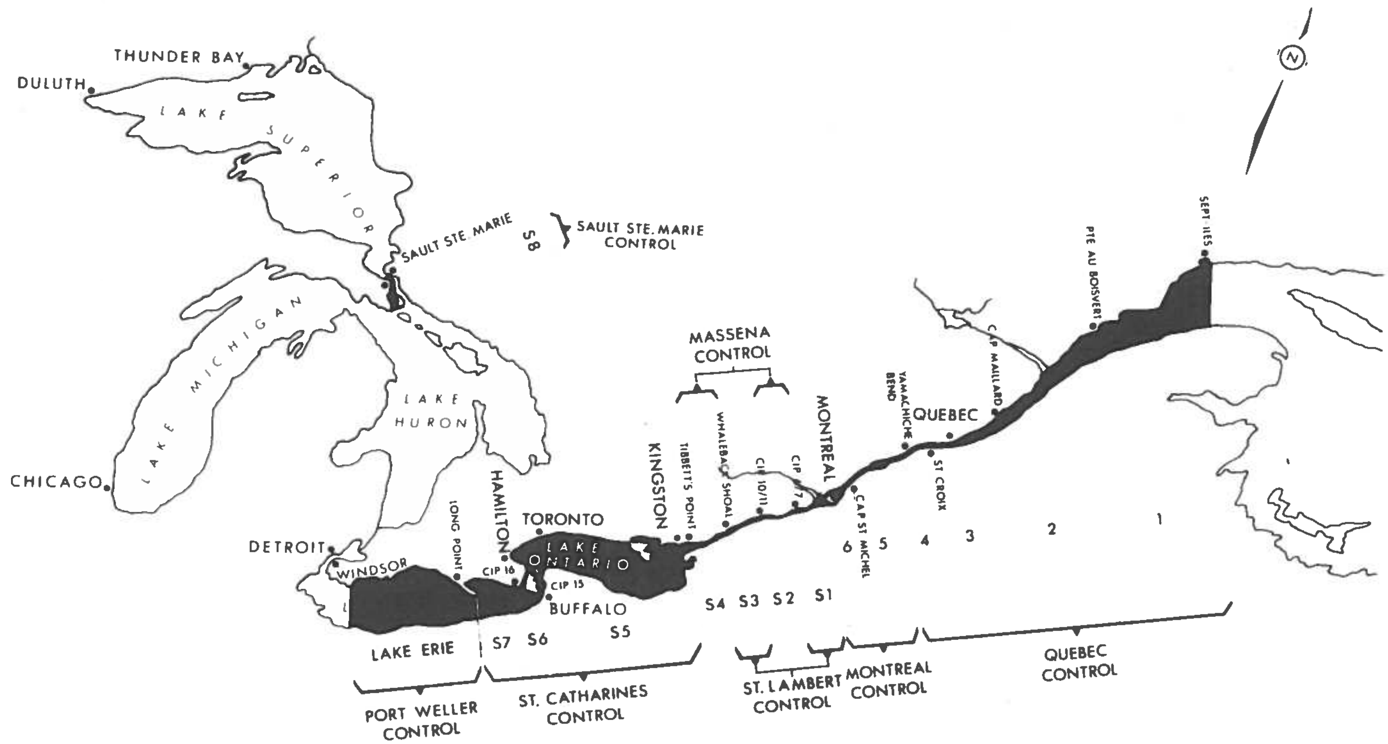
What We Have

Control Sectors

Currently there are seven control sectors, five of which are all Canadian operations. St. Lambert-Massena, is a joint U.S.-Canadian venture in which subsectors 2 and 4 are assigned to the U.S. Sault Ste. Marie operations are independent since four of the five locks primarily used are American.

Though the traffic is "regulated" to the extent that Seaway operational rules are enforced (Canada has a punitive "fines" law) traffic control is only advisory on the ship's master beyond the immediate vicinity of the locks. Within this "understanding" framework, one may say that the St. Lambert and St. Catharines - Lake Ontario are passive (near real time) and positive (real time) traffic control systems. With the exception of the Lock 8 to Lock 7 reach Welland is always under visual positive control. In all other areas, if a vessel is 30 minutes late in reporting, then a search is initiated.

Problem Area #17 Canada suggests that sector control be implemented on the Detroit-St. Claire Rivers.



ST. LAWRENCE-GREAT LAKES - Present Traffic Control Sectors(1970)

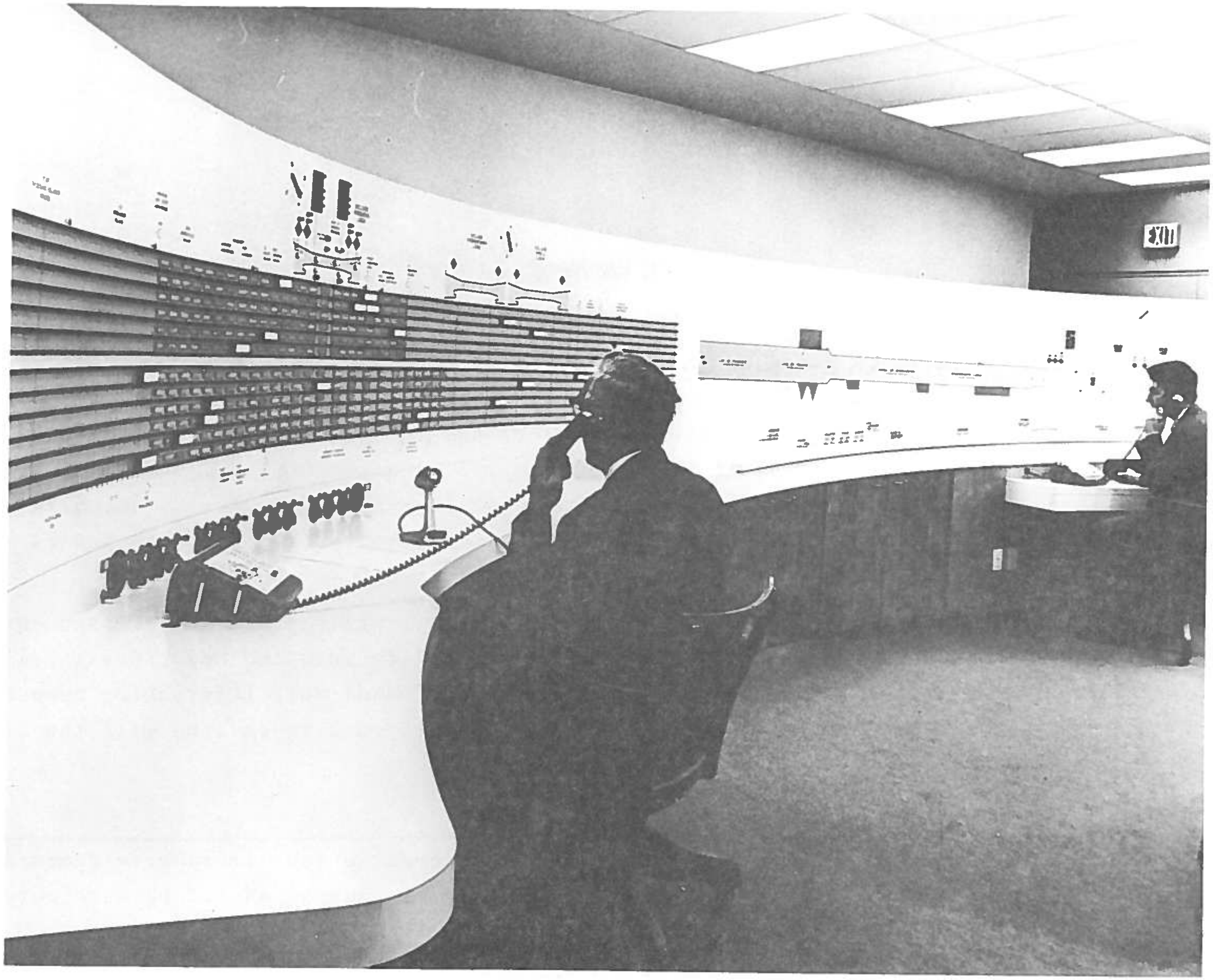
What We Have

Operator-Tools Situation

Only St. Catharines-Port Weller Lakes control have computer-plot board, (alpha-numeric CRT). All other areas are mechanically gear driven or manually operated plot boards. In 1962, the Seaway switched from AM to FM transmission. Centralized traffic control (plot-board display) was initiated at Beauharnois Locks for the Canadian sector (less Iroquois Locks) of the St. Lawrence subsystem in 1966 (right hand side of photograph). The control center was moved to St. Lambert and the U.S. Sector and the Iroquois Locks were added in the winter of 1969-1970 (left hand side of photograph). New operational control procedures were implemented in 1967 by Canada; in 1968 by U.S.

Each traffic controller has at least forty ships at one time under surveillance. He must be knowledgeable about not less than four to five-hundred parameters in his control (i.e. winds, currents, turns and bends, vessel and personnel characteristics, obstacles such as bridges, floating debris, etc.). He is constantly harassed by communications chatter on five FM and two AM channels. Ignoring the psychological impact, if he is above average, alert and intelligent with a 16-bit brain for a computer he is still physiologically limited to handling no more than 1,000 bits per minute ... he just cannot be responsive to the potential 30,000 bit situation.

It is proposed in IMTIC Step 1, Phase II that the Welland-St. Lambert centers have computer-driven fully graphic Cathode Ray Tube traffic display plot board assistance.



St. Lambert Traffic Control Center

What We Need

Vessel Control and Information

As previously mentioned it is proposed that message switching and traffic display be accomplished in Step 1, Phases I and II. However this only solves part of the problem. Somewhere the total cargo demand- traffic movement picture has to be integrated. It is proposed that this will be accomplished in Phases II and III by a computerized near-real time master planning and scheduling control center located at Cornwall, Ontario. Eventually this would be a real-time system (Phase IV) when the technology solution of Automated Vessel Location and Identification System (AVLIS) is achieved.

Step 1 will go a long ways toward solving the spring-winter traffic problem discussed earlier. Step 2 will extend the Step 1 traffic control capability into the Upper Great Lakes area. More importantly Step 2 will also provide the cargo-vessel-port information necessary for improved goods and commodities movement. But not until Step 2 is on-line will the ocean traffic/U.S.A. cargo demand problem really be solved.

Problem Area #18	*Phase IV and the National Oceanographic and Atmospheric Administration's Lake Ontario Ship locator program should be integrated to maximize effectiveness to IMTIC.*

TIME PHASED IMTIC EVOLUTION

	TITLE	EQUIPMENT	CAPABILITY	FUNCTION OPTIONS Canadian	FUNCTION OPTIONS U.S.	INVESTMENT Canadian	INVESTMENT U.S.
Phase 1 1972-73	Message Switching Information Distribution and Off-Line Lock Data Collection - Eastern Region	2 Computers Software α/n CRT 2 Printers	-Data Storage -Limited Data Retrieval -Lock data (auto) -Manual Data Inputs	Link E.R., W.R. M.I.C. α/n Display at ERCC, WRCC.	Upgrade ADC link to E.R. at St. L. or nothing α/n Display or nothing	$120,000	
Phase 2 1972-74	Automated Lock Data Collection and Distribution -Eastern Region Partial Automated Traffic Control	-3rd Computer Graphic CRT Software -Upgrade Phase 1 Computers -200 line printer at Cornwall	-Automate, update -Wxx (man) -NAV (man) -Lock auto -DR vessel location -Report Prep. (auto) -Prelim. Vessel Performance Analysis	-Central Control at Cornwall -Graphic Display at remaining locations -Link Pilots, Harbors, Radios	Link to Cornwall α/n or Graphic Display	$1,080,000	
Phase 3 1973-75	Semi-automated Traffic Control Automated Lock Data Collection and Distribution Western Region	-Traffic Algorithm Software	-Improved D.R. vessel location -Near real time integrated traffic control data -Improved automated report preparation	-Optimized Seaway - wide traffic paterns	Graphic Display	$300,000	
Phase 4 1972-76	Fully Automated Traffic Control (IMTIC)	AVLIS proposed equipment, e.g. -Loran -Pulsed, phase triangulation	-Real time vessel location and identification	Real Time Traffic Control (AVLIS)		$3,000,000	

How it is to be Implemented

Hardware & Software

Today's system is essentially a patchwork of unconnected pilot computer models located at St. Catharines and St. Lambert with some message switching capability at the terminals. It is proposed initially that building block computers (purchased) and leased alpha numeric CRT's and line printers be installed at St. Catharines and St. Lambert; the final planning software would be implemented in Phase III. Terminal users would come on line at their own pace. System life cycle is projected on a 15 year depreciation schedule.

PHASING GEOGRAPHICALLY - IMTIC

	St. Catharines	Cornwall	Massena	St. Lambert	MIC	Others
Present	2α/n CRT's PDP81 TTY	TTY	TTY	TTY PDP8S(ADC)	TTY TTY	TTY TTY
Phase 1, IMTIC 1972-73	1 Computer 5α/n CRT's Line Printer	TTY α/n CRT	TTY or α/n CRT	1 Computer 5α/n CRT's PDP8S (ADC) off line Line Printer	TTY	TTY
Phase 2, IMTIC 1972-74	Expand Computer 4 Graphic CRT's 2α/n CRT's Initial Planning -MIS software	TTY CRT -α/n or graphic Add Computer Initial P.M.S.	α/n or graphic CRT Initial P.M.S.	Expand Computer ADC on line 4 Graphic CRT's 2α/n CRT's Initial P.M.S.	TTY CRT?	TTY CRT?
Phase 3, IMTIC 1973-75	Planning Soft- ware - MIS Software	Planning Soft- ware MIS Software	Planning Soft- ware MIS Software	Planning Soft- ware MIS Software		

How it is to be Implemented

Costs

The Step I implementation cost are as illustrated. In summary the U.S. will be expected to cost share the St. Lawrence sub-system and a portion of the Cornwall central control station on a 73-27 percent (Canada-U.S.) formula basis (up to $250,000 non recurring and $30,000 recurring costs for Phases I through III). For this expenditure the U.S. would receive a complete set of engineering and operational data plus participation in the system research development and operation life cycle activities. The St. Lawrence Seaway Authority has already expanded approximately $10 million of research and development on this program.

The Phase IV implementation costs could vary by an order of magnitude from $300,000 to $3,000,000 dependent on the subsystem selected. Current Loran- ship board transponder concepts under study could approach the lower implementation cost estimate since the Loran stations are already operational in the Great Lakes area.

ESTIMATED IMTIC HARDWARE, SOFTWARE (CAPITAL & RECURRING COSTS/PHASE)

	TOTAL INVESTMENT COST*		RECURRING COSTS (CANADIAN)		NON-RECURRING COSTS (CANADIAN)		RECURRING COSTS (U. S.)		NON-RECURRING COSTS (U. S.)	
	Equipment	Cost	Item	Cost	Item	Cost	Item	Cost	Item	Cost
Phase 1 1972-1973	2 Computers Software & Peripherals	$100,000 $ 20,000	-Communi-cations -10 α/n CRT -Computer Mainte nance	$18,000/yr $18,000/yr $12,000/yr	none	none	2 α/n CRT Printer Comm.	$ 2400/yr $ 2400/yr $ 600/yr	none	none
	Total	$120,000		$48,000/yr				$ 5400/yr		
Phase 2 1972-74	Computer Expansion existing computers 2 graphic CRTs @ $80K plus Software	 $860,000 $220,000	-Communi-cations -Mainte-nance	$28,800/yr $88,000/yr	7 Graphic CRTs	$280,000	Communi-cations Mainte-nance % of com-puter mainte-nance	$ 1200/yr $ 6000/yr $15000/yr	1 graphic CRT & 200-line Printer	$60,000 (est)
	Total	$1,080,000		** $116,800/yr				$22200/yr		
Phase 3 1973-75	Traffic Algorithm Software	$300,000	Probable 2 pro-grammers	$30,000/yr	none	none	none probable	none	none probable	none
Phase 4 1972-76	AVLIS	*** $3,000,000	Dependent on AVLIS method selected							
TOTAL		$4,500,000				$280,000				$60,000

* Subject to U.S. Canadian cost sharing agreements.
** Supercedes Phase 1 recurring costs.
*** Based on Transponder System.

What it Will Save

Benefits

The benefits from IMTIC Steps 1 and 2 are principally improved safety in operations and increased service to the user. Approximately 25 percent of the total savings from IMTIC will be achieved in Step 1, most of them in the St. Lawrence - Lake Ontario - Lake Erie area; the remainder in the Upper Great Lakes in Step 2. Ocean vessels will benefit more from IMTIC than will Lakers. Savings in port turn around time and in port operations are based on the assumptions of improvements in facilities and resources as well as the optimized scheduling of vessels, ports, and cargoes. IMTIC can supply the information; how the information is used determines the extent of the benefits.

POTENTIAL SAVINGS

Millions of Dollars Annually

CATEGORY	IMTIC Step 1 (1972-1980)			IMTIC Step 2 (Post 1980)			
	Laker	Ocean	Total	Laker	Ocean	Total	Total
Port Turn Around	0	$14.0	$14.0	0	$42.0	$42.0	$56.0
In Port Operations	0	$ 1.1	$ 1.1	0	$ 3.2	$ 3.2	$ 4.3
Vessel Transit Time	$0.7	$ 0.6	$ 1.3	*	*	*	$ 1.3
Pilotage*	-	$ 1.0	$ 1.0	**	**	**	$ 1.0
Safety*		$ 0.5	$ 0.5				$ 0.5
TOTALS	$0.7	$17.2	$17.9	0	$45.2	$45.2	$63.1
Reduction in Inventory (One Time Savings)		$ 0.7	$ 0.7		$ 2.2	$ 2.2	$ 2.9

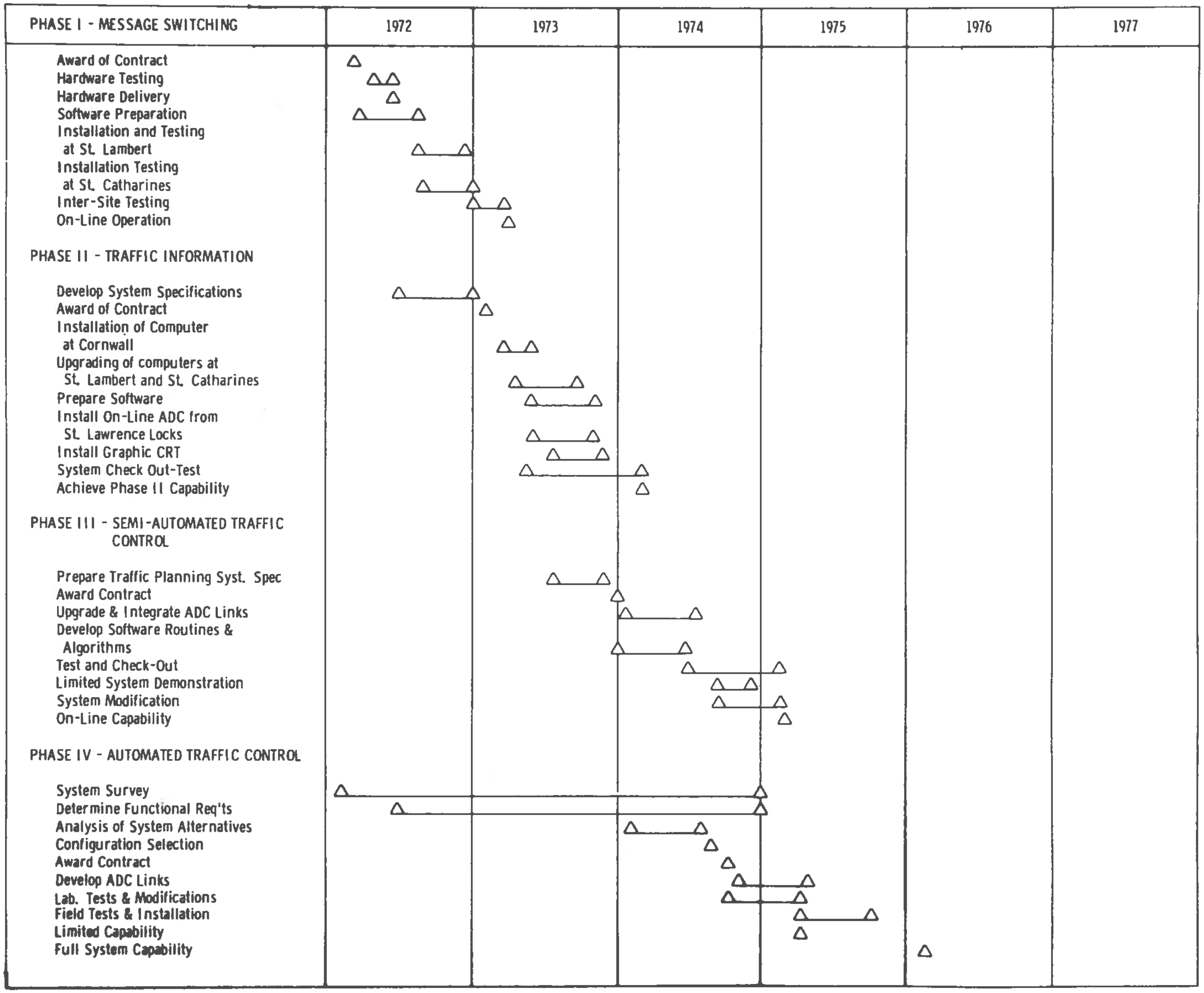
* Further evaluation required

** Lost time data for Lake Erie and Upper Lakes (Districts 2 and 3) are unavailable

Today's Status

- A signed U.S. Canadian memorandum of Understanding for IMTIC, Step 1 agreeing to:
  - conceptual design for Step 1, Phases I and II
  - evolutionary development of IMTIC
  - approximate equipment requirements and estimated investment and recurring costs
  - SLSDC obligation to fund Phases I and II provided approval is granted to proceed with Phase II
  - Phase III and Phase IV short and long range goals
  - Preliminary Phase III and Phase IV cost data could increase by a factor of two
- Preliminary discussions with the U.S. Army Corps of Engineers and the Maritime Administration have indicated a desire to proceed with a joint development effort. It has been proposed that an ad hoc policy committee and working subcommittees be implemented immediately for the purpose of performing a complete Great Lakes integrated systems analysis and defining a unified U.S.-Canadian implementation plan.

IMTIC SCHEDULE



STUDY RECOMMENDATIONS

Study Recommendations

- IMTIC Step 1 be implemented as a joint venture between St. Lawrence Seaway Development Corporation and the St. Lawrence Seaway Authority. System is technically feasible; U.S. involvement justifiable on the basis of cost and benefits.
    - DOT fund investment cost ($250K) for phases 1 through 3
    - SLSDC fund recurring costs for all phases ($50K program)
    - DOT fund phase 4 jointly with other concerned entities
- Using the analysis and results of IMTIC Step 1 study as background, DOT initiate an immediate systems and requirements analysis of traffic control and vessel/cargo information systems for the St. Lawrence River - Great Lakes Area

  DOT should invite other U.S. and Canadian maritime entities to establish an interagency task force which would serve as a coordinating and integrating body for all vessel/cargo control and information system programs in the Great Lakes - St Lawrence River area.

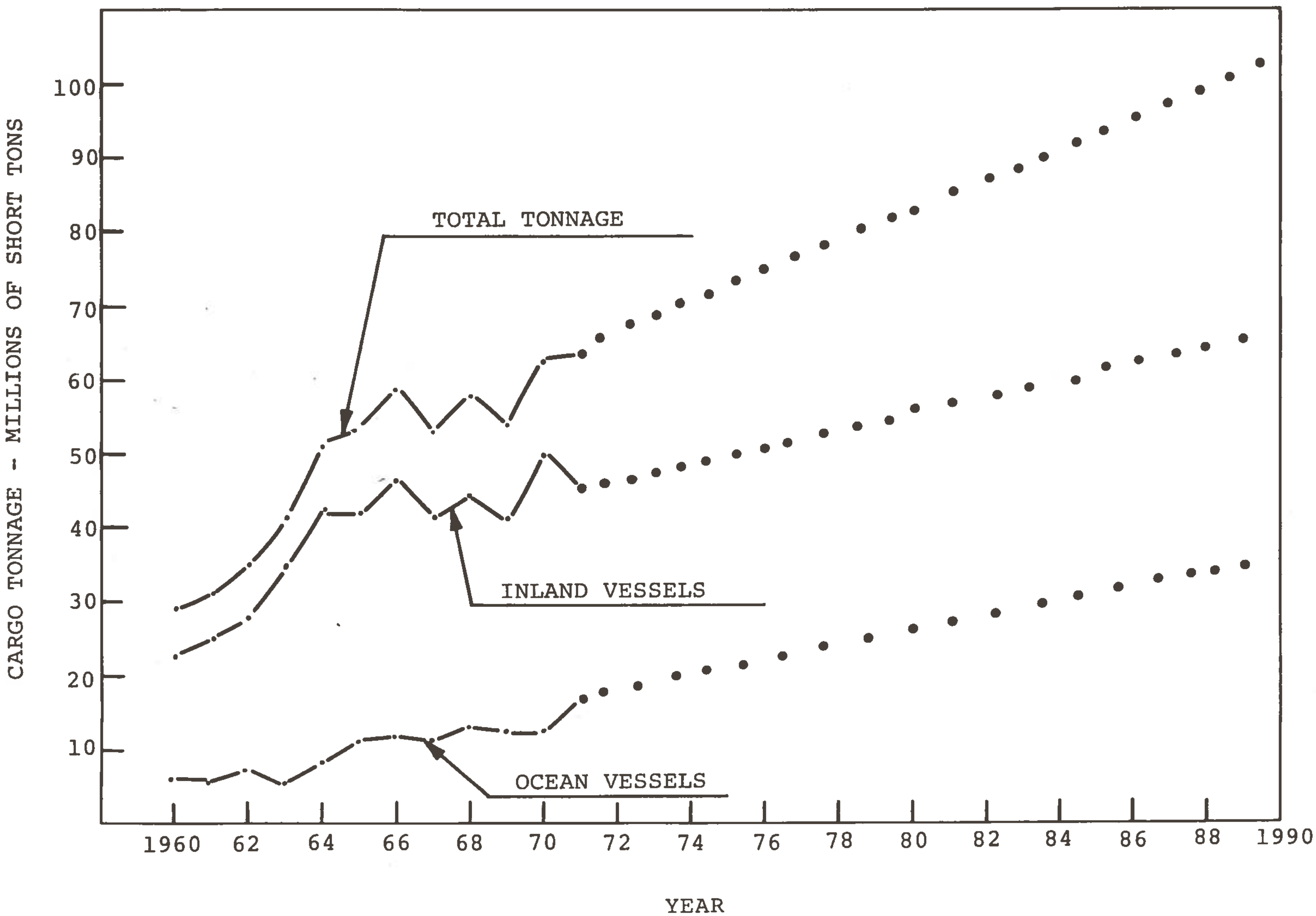
  Task Force to be constituted with membership from the following U.S. agencies and their Canadian counterparts.
    - U.S. Army, Corps of Engineers
    - U.S. Coast Guard
    - St. Lawrence Seaway Development Corporation
    - Maritime Administration
    - National Oceanographic and Atmospheric Administration
    - Federal Communications Commission
- Task Force to serve as an investigating and coordination body. Work assignments to be given to task force study groups to perform studies and investigations of identified problems. A major assignment: Preparation of a unified technical development plan for a U.S./Canadian traffic control and vessel/cargo information system for the Fourth Coast.

Study Recommendations

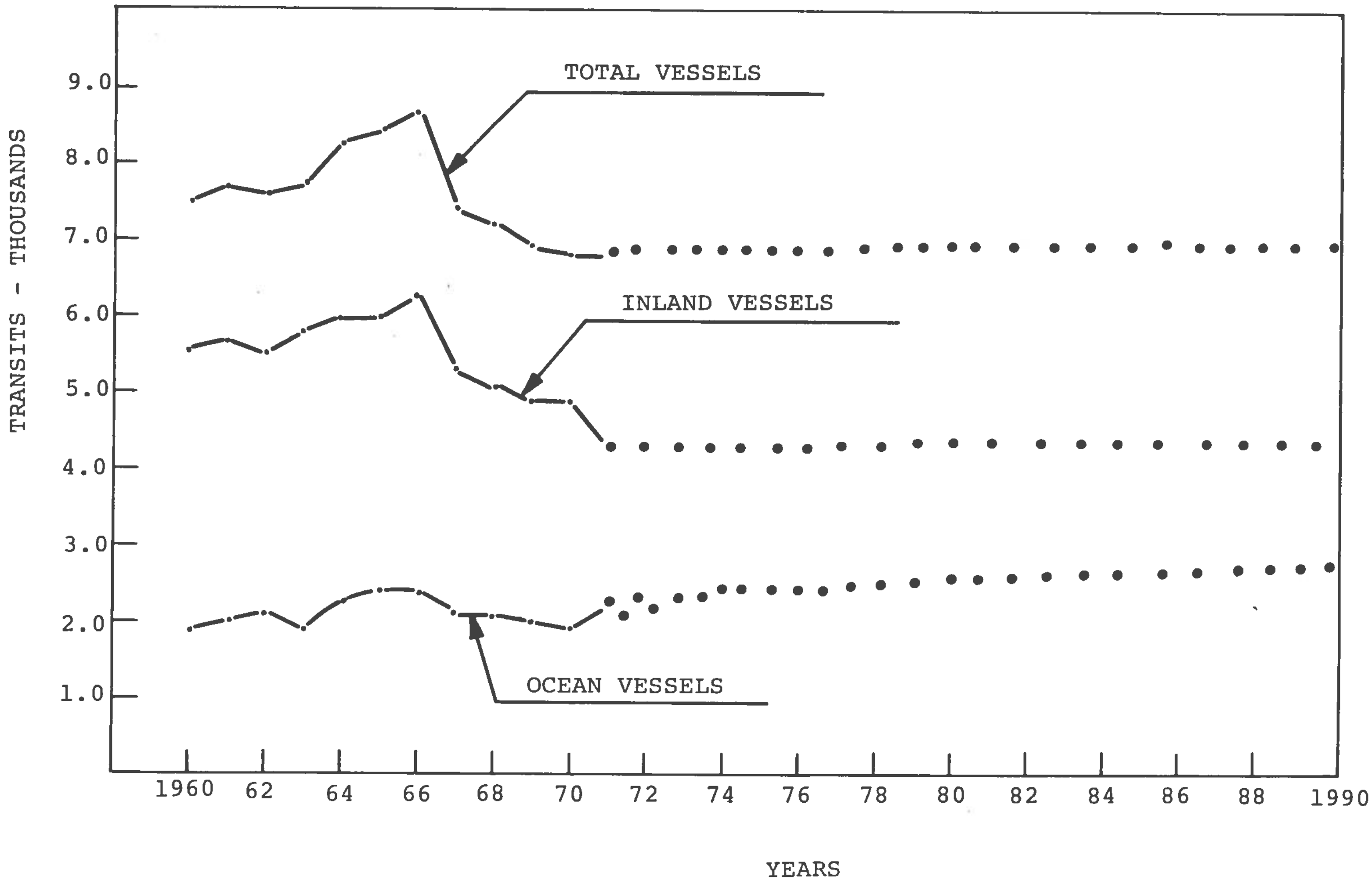
- St. Lawrence Seaway Development Corporation proceed to implement IMTIC Step 1 jointly with the St. Lawrence Seaway Authority
- DOT conduct Fourth Coast System and requirements analysis for traffic control and cargo information systems using IMTIC Step 1 study as base
- DOT invite other U.S. and Canadian maritime-oriented entities to form an interagency Task Force to coordinate vessel/cargo control programs on Great Lakes - St. Lawrence River
- Interagency Task Force to determine problem areas, assign study task to participating members.

REFERENCE DATA

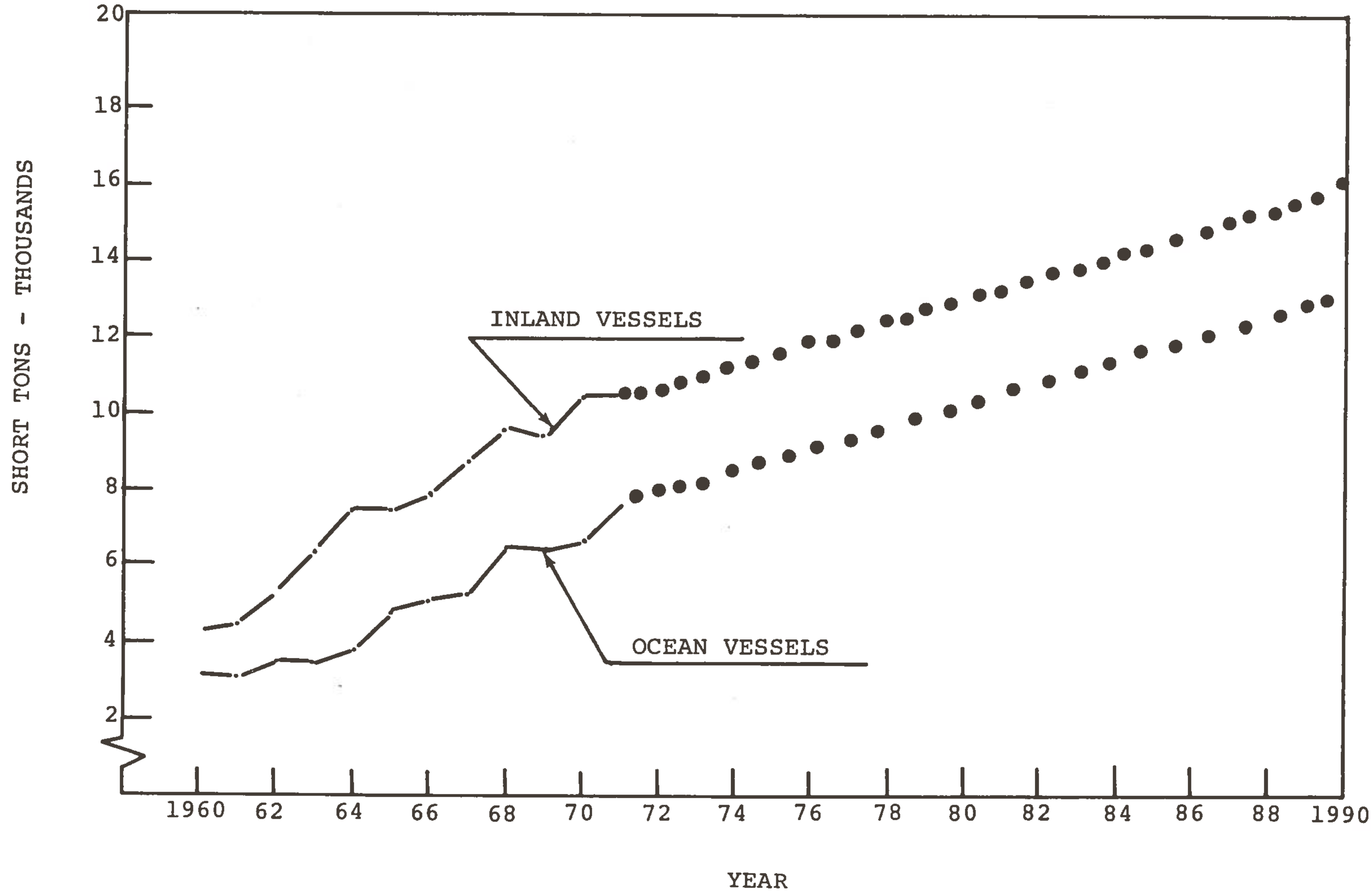
WELLAND SECTION - Ocean and Laker Traffic



WELLAND SECTION - Annual Cargo Tonnages



WELLAND SECTION - Number of Transits Per Year



WELLAND SECTION
Average Cargo - Tonnage/Transit