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This revised plan of study has been prepared to comply with the Stage I planning requirements for a feasibility level study. The material draws heavily upon secondary sources of published information from Federal, State and local agencies. Forecasts of future traffic, estimates of existing lock capacity and related analytical documents were used in the preparation of the Revised Plan of Study. The material in this study reflects estimates of study variables as of June 1979.

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ST. LAWRENCE SEAWAY - ADDITIONAL LOCKS STUDY

PLAN OF STUDY

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FOREWORD

This Revised Plan of Study has been prepared to comply with the Stage I planning requirements for a feasibility level study. Although the Draft Plan of Study was tentatively approved in September 1978, it is felt to be important that this revision of the draft be prepared and distributed for information. Due to the long period of time between Stage I and II documentaiton, this document will provide the reader with the "up to the date picture" of the study, its objectives and its schedule. The revisions in this document were brought about from incorporation of comments received, both from agencies and the public. Appndix K has been added to show these comments and responses. Section 3 and Appendix C have undergone major changes with the following paragraphs addressing these areas in the report.

The material in the Revised Plan of Study draws heavily upon secondary sources of published information available from Federal, State, and local agencies. General statistics and historical records of commercial navigation activity within the GL/SLS region have been used to describe the Base Case (existing conditions) and to delineate the most probable future within the study area.

Forecasts of future traffic, estimates of existing lock capacity and related analytical documents were used in the preparation of the Revised Plan of Study. Changes and revisions to these basic planning tools may have occurred since the date of the draft POS (June 1978) or the revised POS. Forecasts may not agree with other planning reports issued after this date. Material in the revised POS reflect estimates of study variables as of June 1979.

SECTION 1

THE STUDY AND REPORT

ST. LAWRENCE SEAWAY - ADDITIONAL LOCKS STUDY

SECTION 1

THE STUDY AND REPORT

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SECTION 1

THE STUDY AND REPORT

The Great Lakes-St. Lawrence Seaway (GL/SLS) represents the world's largest navigable body of fresh water. Designated as the fourth U.S. seacoast, this system serves as a major trade route of the mid-continent of North America. Ships of the world carry their cargoes to and from the industrial and agricultural heartland of both the U.S. and Canada. This international trade over the years has provided impetus for the development and expansion of ports along the system's 8,300 miles of shoreline. Through these ports more and more cargoes each year pour into the commerce of mid-America and world ports via a fleet of increasingly longer, larger ships.

Although a great deal of the GL/SLS system is open-water navigation, the connecting channels and St. Lawrence River above Montreal involve transit through constricting channels and locks. These constraints, especially the locks, place a limitation on the number and size of vessels which can effectively use the system, thus limiting the capacity of the system and its components.

Since the opening of the St. Lawrence Seaway to deep-draft navigation in 1959, the amount of traffic in size of vessels and total tonnage transiting the Seaway has steadily increased. If this trend continues until the traffic approaches the capacity of the Seaway, delays to shipping will be encountered. This in turn manifests itself as increases in transportation rates and subsequently as increased costs to the nation. This report, the Plan of Study, describes the results of the first stage of a comprehensive study to investigate the present and future problems and needs of the St. Lawrence Seaway as they relate particularly to commercial navigation. The main emphasis during the Plan of Study stage has been to identify these problems and needs, measures for solving them, appraise the adequacy of existing information and data, specify subsequent steps necessary to overcome any deficiencies, and establish a systematic program for conducting the study.

PURPOSE, SCOPE, AND AUTHORITY

On 15 June 1966, at the request of Senator Philip A. Hart of Michigan, the Committee on Public Works of the United States Senate adopted the following resolution authorizing a study of the existing U.S. development on the St. Lawrence River.

> "RESOLVED BY THE COMMITTEE ON PUBLIC WORKS OF THE UNITED STATES SENATE, That the Board of Engineers for Rivers and Harbors created under Section 3 of the River and Harbor Act approved June 13, 1902 be, and is hereby requested to review the report of the Chief of Engineers on the St. Lawrence River-Lake Ontario to the Canadian Border, published as House Document Numbered 1591, Sixty-fifth Congress, and other pertinent reports, with a view to determining whether the existing project for the development of the St. Lawrence Seaway in United States territory, authorized by the Act of May 13, 1954,

(Public Law 358, 83rd Congress), should be modified in any way at the present time, with particular reference to determining the adequacy of the existing locks in the Long Sault Canal, and the advisability of their enlargement or augmentation by the construction of additional or duplicate locks, in view of the needs of the present and anticipated heavy volume of commerce utilizing the waterway."

The study was assigned by the Office, Chief of Engineers, to the North Central Division. In turn, it was assigned to the District Engineer, Buffalo District. This study has been entitled the St. Lawrence Seaway-Additional Locks Study.

The purpose of the St. Lawrence Seaway-Additional Locks Study is to determine the adequacy of the existing locks and channels in the U.S. section of the Seaway in light of present and future needs, and the advisability of their rehabilitation, enlargement, or augmentation. Because of geographic location and traffic patterns, any improvements to the U.S. locks and channels must be accompanied by like improvements to the Canadian components of the St. Lawrence Seaway and the Welland Canal. Therefore, this study will investigate the needs of present and future commerce of the Great Lakes-St. Lawrence Seaway system, and formulate plans of improvement for the U.S. section of the St. Lawrence Seaway assuming compatible improvements to the Canadian sections and Welland Canal. These plans will be formulated to meet these needs utilizing national economic development, environmental quality, social well-being, and regional development as parameters to evaluate various plans. This study and the Great Lakes Connecting Channels and Harbors Study, which will investigate the needs of the upper Great Lakes, connecting channels, and harbors, will be closely coordinated with synchronization of study schedules and funding, exchange of data and plan formulation results, and iterative formulation of total system improvements. Both of the final study reports will thus present the same optimized system while addressing its respective subsystem in detail.

The study will be conducted under two-step authorization procedures. The final report will reflect that degree of investigation necessary to establish the feasibility, desirability, and U.S. interest in further development of the Seaway. If development is found to meet the above criteria, it will be recommended to Congress that detailed investigations necessary to meet the criteria for authorization of construction be authorized. It will be during this latter stage that a joint study with Canada will be necessary to finalize plans and provide the necessary detail for construction.

STUDY APPROACH

This study will be conducted according to guidelines set forth by Principles and Standards for Planning Water and Related Land Resources as established by the Water Resources Council in 1973. These Principles and Standards (PS) require a framework for the systematic preparation and evaluation of alternative ways of addressing problems, needs, concerns, and opportunities under equal objectives of National Economic Development (NED) and Environmental Quality (EQ). NED is achieved by increasing the value of the nation's output of goods and services and improving economic efficiency. EQ on the other hand is achieved by the management, conservation, preservation, creation, restoration, or improvement of the quality of certain natural and cultural resources and ecological systems. Principles and Standards also require the measurement and assessment of impacts of a proposed action and their display or account in terms of contributions to National Economic Development (NED), Environmental Quality (EQ), Regional Development (RD), and Social Well-Being (SWB). The conditions and criteria which must be applied when evaluating plans are also set forth by P&S and other laws governing water resources development. This study will utilize the multiobjective planning framework established by the Office of the Chief of Engineers, U.S. Army Corps of Engineers and published in the Federal Register, Vol. 40, No. 217, dated 10 November 1975. This framework, in the form of Corps regulations, sets forth guidance for conducting feasibility studies for water and related land resources consistent with the previously stated requirements of P&S.

A representation of this framework or planning process is provided in Figure 1-1. This process involves three separate stages of plan development: Development of a Plan of Study, development of intermediate plans; and development of detailed plans utilizing the four functional planning tasks of problems identification, formulation of alternatives, impact assessment, and evaluation. More specific attention is given to the planning process throughout Section 6 - Study Management.

The study will use existing economic, environmental, and engineering data when available. When data gaps are identified and a need for the data exists, detailed studies and investigations will be conducted throughout the feasibility study. Corps of Engineers personnel will be utilized to manage the study and to furnish necessary expertise, when available, to carry out the study. Where expertise is unavailable from within Buffalo District, it will be sought from SLSDC, other agencies and/or architect/engineer contractors. Close coordination will be maintained throughout the study with concerned and affected agencies, incorporating their views, comments, and concerns. Development of early and continued public involvement is integral to the successful accomplishment of this study. Workshops and public meetings will serve as the main forum for input of public concerns, their perceptions of problems and needs of the area, and their preferences and priorities.

The National Environment Policy Act (NEPA) of 1969 requires Federal agencies to assess and document the effect of proposed actions on the environment in an Environmental Impact Statement (EIS). In compliance with this requirement, an EIS will be prepared in conjunction with the study report and furnished and integrated into the document for agency and public scrutiny and comment.

STUDY PARTICIPANTS AND COORDINATION

The Corps of Engineers has been assigned the responsibility of conducting this study. Accordingly, the Corps assumes full responsibility for the accomplishment of the various study components, overall plan formulation and evaluation, conclusions, and recommendations.

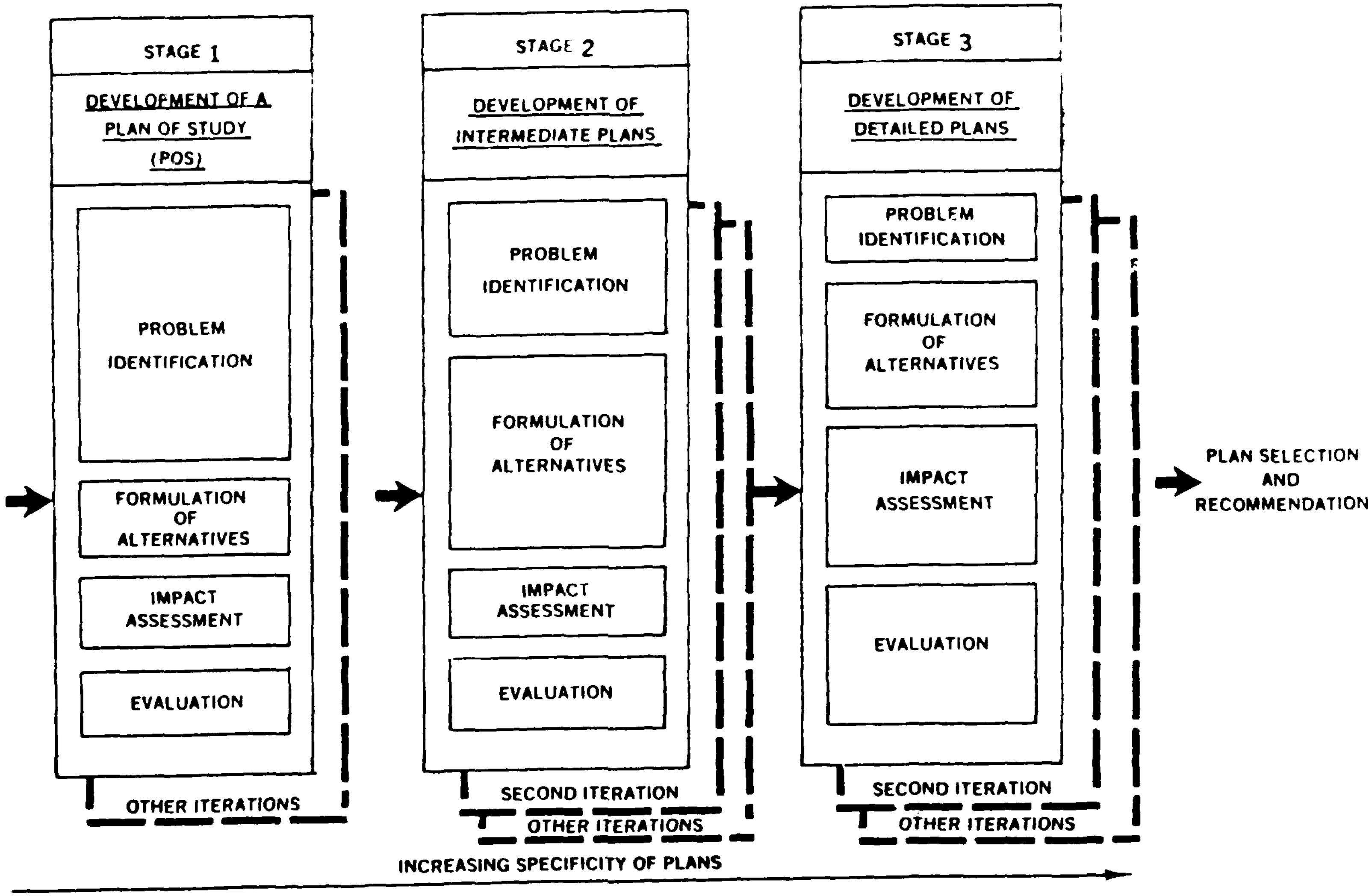

Figure 1-1 - Plan Development Stages

Although the responsibility for conduct of the study lies with the Corps, it is recognized that data and information from this study as well as studies of other agencies must be coordinated. Thus, this study is being coordinated with interested agencies, organizations, and the general public.

The following is a listing of the agencies and organizations which have been coordinated with during the Plan of Study stage.

Agencies

International

International Joint Commission
Great Lakes Fishery Commission

Federal

- Members of Congress
- Department of Agriculture
  - Soil Conservation Service
- Department of the Army
  - Office, Chief of Engineers
    - North Central Division
      - Chicago District
      - Detroit District
      - St. Paul District
    - North Atlantic Division
      - New York District
- Department of Commerce
  - Economic Development Administration
  - Maritime Administration
  - National Oceanic and Atmospheric Administration
    - Office of Coastal Zone Management
    - Office of Sea Grant
    - National Ocean Survey, CLERL
    - National Marine Fisheries Service
- Department of Health, Education, and Welfare
  - Public Health Service
- Department of Housing and Urban Development
- Department of Interior
  - Bureau of Indian Affairs
  - Bureau of Mines
  - Bureau of Outdoor Recreation
  - Fish and Wildlife Service
  - Geological Survey
  - National Park Service
- Department of State
- Department of Transportation
  - St. Lawrence Seaway Development Corporation
  - U.S. Coast Guard
- Water Resources Council
- Environmental Protection Agency

FERC
Council on Environmental Quality
Advisory Council on Historic Preservation
DOE
St. Regis Mohawk Tribe

State of Illinois

Department of Transportation
State Clearinghouse

State of Indiana

State Planning Services Agency
Department of Natural Resources

State of Michigan

State Clearinghouse
Department of Natural Resources
Michigan Sea Grant Program

State of Minnesota

State Clearinghouse
Department of Natural Resources

State of New York

Members of the State Legislature
State Clearinghouse
Department of Transportation
Office of Parks and Recreation
Department of Commerce
Department of Environmental Conservation
St. Lawrence - Eastern Ontario Commission
Power Authority of the State of New York
New York Sea Grant Program

State of Ohio

State Clearinghouse
Department of Natural Resources

State of Pennsylvania

State Clearinghouse
Department of Natural Resources

State of Wisconsin

State Clearinghouse
Department of Natural Resources

Regional

Great Lakes Basin Commission
Great Lakes Commission
Upper Great Lakes Regional Commission
Black River - St. Lawrence Regional Planning Board
St. Lawrence - Franklin Water Resources Planning Board

County

Jefferson County
  Cooperative Extension Service
St. Lawrence County
  Environmental Management Council
  Cooperative Extension Service

Local

Towns and Villages along the St. Lawrence River
Great Lakes Port Authorities
Property Owners
Interested Public
Universities and Colleges
Libraries

Organizations

Civic

Chamber of Commerce of the USA
Jefferson County Chamber of Commerce
Massena Chamber of Commerce
St. Lawrence County Chamber of Commerce
League of Women Voters

Industry

American Association of Port Authorities
American Bureau of Shipping
American Pilots Association
Association of American Railroads
Council of Lake Erie Ports
Dominion Marine Association
Federation of St. Lawrence River Pilots
Great Lakes - Seaway Users Association
Great Lakes Task Force
Great Lakes Waterways Development Association

Industrial Users Group
International Association of Great Lakes Ports
International Longshoremen's Association
International Shipmaster's Association
Lake Carriers' Association
Lake Erie Marine Trades Association
Lake Freight Association
Lake Pilots Association
Marine Engineers Beneficial Assn.
Masters, Mates, and Pilots
New York State Waterways Assn. Inc.
Seafarers International Union
Shipping Federation of Canada, The
St. Lawrence Seaway Pilots Association
Upper Great Lakes Pilots, Inc.
U.S. Great Lakes Shipping Association
Water Transport Association
Western Great Lakes Port Association

Environmental

American Fisheries Society
New York State Conservation Council
American Assn. for Conservation Information
American Committee for International Wildlife Protection, Inc.
American Conservation Assn., Inc.
American Rivers Conservation Council
American Scenic and Historic Preservation Society
Canada-U.S. Environmental Council
Conservation Foundation
Ducks Unlimited, Inc.
Federation of Conservation Clubs
Friends of the Earth
Great Lakes Tomorrow
Intl. Assn. of Fish and Wildlife Agencies
Izaak Walton League of America
Laboratory of Ornithology - Cornell University
Lake Erie Cleanup Committee, Inc.
National Audubon Society
National Campers and Hikers Assoc., Inc.
National Water Resources Assn.
National Watershed Congress
National Waterways Conference, Inc.
National Wildlife Federation
Natural Resources Council of America
Natural Conservancy
New York State Assn. of Conservation Commissions
Northeast Assoc. of Fish and Wildlife Resource Agencies
Outboard Boating Club of America
St. Lawrence Valley Conference Council
Sierra Club
Sport Fishing Institute

United States Tourist Council
Wetlands for Wildlife, Inc.
Wildlife Society

There will be two levels of coordination. The first is low level, information only type, which will consist of information letters and newsletters informing the agency or organization of the status and results of the study. Basically, these include those agencies or organizations which did not respond to a letter informing them of the initiation of the study and requesting a response if they wished to actively participate in the study. The second level of coordination will be maintained with those agencies and organizations who responded to the initial coordination letter and those who may not have responded, but it is felt have an expertise or capability which would be an asset to the study at a later date. This second level of coordination will be a much more active one, with some agencies or organizations participating in the study by performing work items or study components, by furnishing their data and information, or in the form of advise and assistance. Opportunities for further input through review of reports and participation at workshops and public meetings is discussed more fully in Section 6-Study Management and Appendix E - Public Involvement, along with coordination with and involvement of the general public.

STUDY RESULTS

The study will be divided into three distinct stages of development as shown in Figure 1-1. The results of each stage will be documented and presented in a report format at the end of each stage. These reports will be furnished to other agencies and publics for review and comment along with serving as internal management documents.

The first report, presented herewith is the Plan of Study (POS) which reflects the results of Stage 1 in the study process. The POS sets forth the justification for the study, documents the findings of the tasks undertaken to date, and establishes a program for managing the study. The POS is also the basis for review and approval of completed and future study efforts by higher authority. In addition, this POS in particular also serves as the vehicle for recommending to higher authority that the two-stage authorization process be pursued.

Results of Stage 2 and Stage 3 will be presented in the Preliminary Feasibility Report (PFR) and the Final Feasibility Report (FFR), respectively. These reports will present the development of plans, and the assessment and evaluation of their impacts. The specificity of the reports increases as the study progresses towards completion. An Environmental Impact Statement will also be prepared and integrated into the FFR.

SECTION 2

RESOURCES AND ECONOMY OF THE STUDY AREA

ST. LAWRENCE SEAWAY - ADDITIONAL LOCKS STUDY

SECTION 2

RESOURCES AND ECONOMY OF THE STUDY AREA

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SECTION 2

RESOURCES AND ECONOMY OF THE STUDY AREA

An accurate and comprehensive environmental, social, and economic resource data base is essential to effective planning for development of water resources. Paramount to this data base development is the early identification of existing conditions. This data base is then refined throughout the study giving a rational basis for assessment and evaluation of likely consequences of alternative plans and for finally selecting a plan of action for recommendation. It will also furnish a basis for evaluating the need for enhancement, mitigation, or replacement measures.

At this stage of the study, the needed resource data base is one that is sufficient to provide a useful profile of existing physiographic, biological, aesthetic, cultural, social, and economic elements, that constitute the area's natural and human environment. The intent is to determine, as early as possible, those resources which should be preserved, enhanced, protected, or approached with care. Another purpose of this initial activity is to identify data gaps and deficiencies, and to determine if a monitoring program of selected resource components needs to be initiated to establish baseline conditions. The study efforts required to fill these gaps will be conducted during subsequent study stages.

This section is devoted to briefly identifying this resource data base. More detailed discussion is found in Appendices A and B. The level of comprehensiveness and detail is dependent upon that which is already known about the study area and/or has been described and identified by previous studies and reports.

NATURAL ENVIRONMENT

General.

The Great Lakes-St. Lawrence Seaway System consists of Lakes Superior, Michigan, Huron, Erie, and Ontario, their connecting channels and the St. Lawrence River above Montreal, Quebec, (Figure 2-1). The System spans more than 2,300 miles and has a water surface, U. S. and Canada combined, of over 95,000 square miles. The international boundary between the United States and Canada passes through all of the Great Lakes and their connecting channels except Lake Michigan which is wholly within U. S. territory. Any effects from modifications and/or alterations on the United States side of the System may therefore have possible effects to the Canadian portion.

The project area (Figure 2-2) under consideration is the section of the St. Lawrence River which forms the international border between U. S. and Canada, spanning from Tibbetts Point near Cape Vincent, NY, to the eastern tip of Cornwall Island near Cornwall, Ontario. Included in this reach of the river is the Thousand Island region and Lake St. Lawrence. The former is an important recreation and wildlife habitat area, and the latter is the man-made impoundment behind the Moses-Saunders Power Dam and the Long Sault Dam.

This section of the river is under joint navigation control of the St. Lawrence Seaway Development Corporation, a corporate agency of the United States, and the St. Lawrence Seaway Authority of Canada.

The remainder of this section is a summary of the natural environment of the study area. The natural environment of the St. Lawrence River project area is discussed in greater detail in Appendix A, of this report.

Topography.

The Great Lakes-St. Lawrence Seaway System spans two major physiographic provinces. Lake Superior, the St. Lawrence River, and part of the north shore of Lake Huron lie in the Laurentian Uplands Province, characterized by low-lying swamps, poorly drained areas, and occasional ranges of hills. Lake Michigan and most of Lakes Huron, Erie, and Ontario lie in the Interior Lowlands Province. This province is best identified with the Niagara Escarpment, a more or less continuous ridge extending from the Door Peninsula of Lake Michigan, through the Bruce Peninsula and Manitoulin Island of Lake Huron, to the Niagara Region of New York and Ontario.

In general, the topographical features of the System were created by Pleistocene glaciation. Continental ice sheets, repeatedly advanced and declined, scouring glacial valleys. As the glaciers receded, large deposits of debris and vast sections of eroded bedrock were irregularly exposed. The present topography reflects this irregularity, having rolling hills and ridges, depressions with lakes and marshes, and both flat and sloping plains. Elevations within the System range from over 1,900 feet above sea-level at Mt. Curwood in the Huron Mountains to 152 feet above sea-level at Cornwall, Ontario. The major stream areas have a flat profile.

Along the project area, there are no very striking relief features such as mountains, great cliffs, volcanic formations, or sharp-cut valleys. St. Lawrence River follows a prelaid valley. This valley is actually a series of depressions, each one lower than the next, and not necessarily in a straight line. The Thousand Island section is a broadened valley with internal hilly patches. These hills became islands when the river occupied the valley.

This region has been in a gradual uplifting state since the glaciers receded. The tectonic forces of uplift were most recently apparent by the violent earthquake of 1944. Massena, NY, and Cornwall, Ontario, were collectively at the epicenter of the quake which registered a seven on the Richter scale. The damage of these communities was assessed at one million dollars each.1/

Geology and Soils.

Prior to the Ice Age, the Great Lakes were nonexistent. The region was comprised of well drained valleys and divides of several large rivers. When the continental ice cap spread southward from Canada, it scoured these

1/ A geological Study of the Massena-Cornwall Earthquake, and its Bearing on the Proposed St. Lawrence Project. 1945

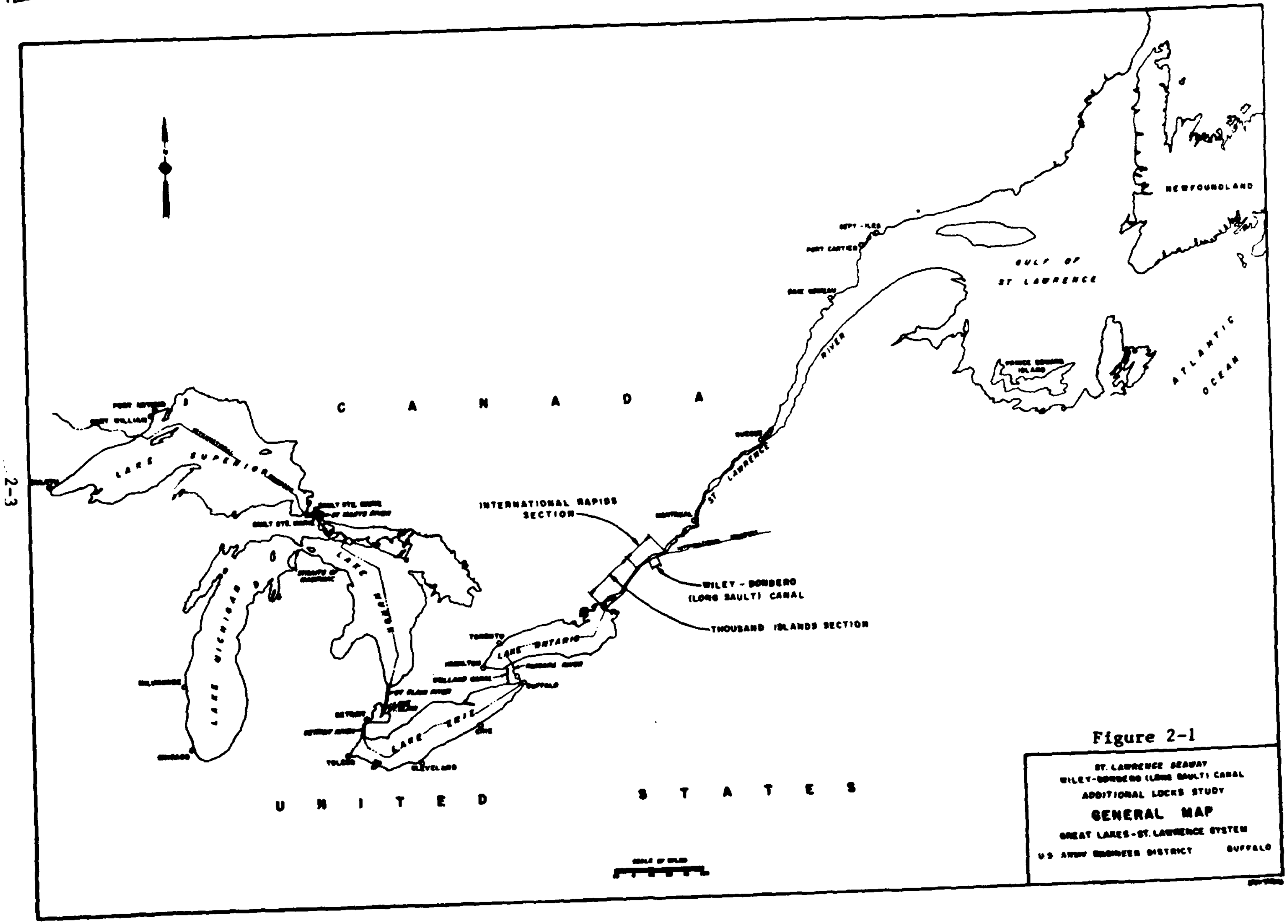
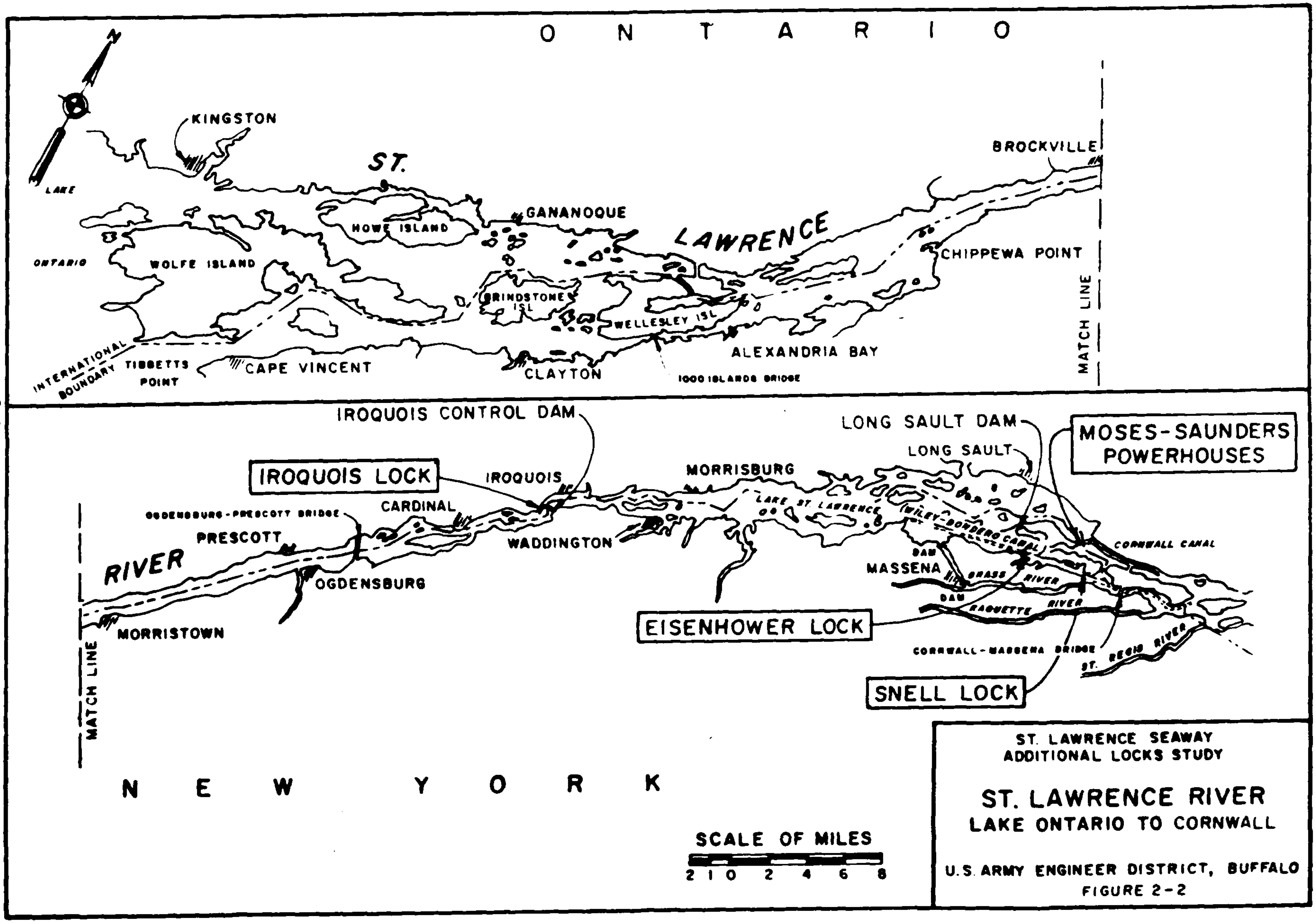


Figure 2-1

ST. LAWRENCE SEAWAY
WILEY-DONDERO (LONG SAULT) CANAL
ADDITIONAL LOCKS STUDY
GENERAL MAP
GREAT LAKES-ST. LAWRENCE SYSTEM
U.S. ARMY ENGINEER DISTRICT BUFFALO



ST. LAWRENCE SEAWAY
ADDITIONAL LOCKS STUDY

ST. LAWRENCE RIVER
LAKE ONTARIO TO CORNWALL

U.S. ARMY ENGINEER DISTRICT, BUFFALO
FIGURE 2-2

preglacial valleys, eroding the bedrock and entraining the debris in the ice mass. As the final ice sheet retreated to the north, vast irregular deposits of overburden (up to 1,100 feet thick in some areas) were laid down and sections of bedrock were exposed. Preglacial valleys were deepened in some areas and filled in in others, ultimately forming the Great Lakes-St. Lawrence River Basin.[2/]

As the ice receded, there was ponding of the melt waters between the ice and the glacial deposits. The levels and patterns of the melt-water lakes changed during development as new lower outlets were uncovered.

The bedrock of the Great Lakes-St. Lawrence River Basin consists of a succession of sedimentary formations overlying a Precambrian rock base. The major bedrock features include the exposure of the Precambrian base along most of Lake Superior on the west and at points along the St. Lawrence River to the east; the Ordovician and Silurian stratas which approach the surface on the west shore of Lake Michigan and around most of Lake Ontario; the shallow Devonian platform at the southern tip of Lake Michigan and along Lake Erie and the southeastern portion of Lake Huron; and, finally, the deep sedimentary basin of Mississippian formation centered under most of the State of Michigan.

Overburdened or unconsolidated sediments blanket the bedrock surface of the Great Lakes-St. Lawrence River Basin.

The composition of the overburden ranges from large boulders to fine silts and clays. Lacustrine deposits represent the former boundaries of early glacial lakes and also presently border the Great Lakes.

The soils of the Great Lakes-St. Lawrence River Basin reflect the changing of the levels of the early glacial lakes. As new lower outlets were uncovered, sediments were deposited at each lake level, resulting in extensive flat areas with fine textured lake deposits.

Within the project area the bedrock formations lie close to the surface. The overburden is of a slightly different nature, as marine clays often form the surface layer. As the ice receded from this region, marine waters backed up from the sea into the St. Lawrence lowlands. These waters laid down muds in the depressions between the glacial ridges.

The soils of the project area are extremely diverse and are strongly influenced by glaciation. Many of these soils have a typical silt loam surface, a silty clay or silty-clayey loam subsoil, and underlying material of varved silt and clay. Drainage patterns vary according to soil types. Water movement in the clay soils is generally impeded, while the sands and fine sandy loams are usually rapidly permeable.

[2/] Referred to as Basin within this text.

Climate.

The Great Lakes-St. Lawrence River Basin is considered to be in the temperate zone climate, but there are some unique features in the region: there is little month to month variation in precipitation amounts; there is a marked temperature contrast across the 750 miles of latitude; and the Great Lakes strongly influence the continental air masses within the Basin.

The Basin has relatively temperate summer and winter temperatures, with an average annual range from 39°F on Lake Superior to 48.7°F on Lake Erie. Minimum monthly temperatures occur in January/February, and maximum monthly temperatures occur in July.

Mean annual precipitation for the entire Basin is about 31 inches. Average annual rainfall varies from 26 inches in northeastern Minnesota, to as much as 46 inches at the eastern end of Lake Ontario.

Hydrology.

The Great Lakes-St. Lawrence Seaway System has a total drainage basin of 298,800 square miles, including 95,000 square miles of surface water. Because of the natural storage ability of the Great Lakes, the System's discharge into the St. Lawrence River is relatively stable (roughly 240,000 cubic feet per second).

Approximately one-third of the average annual precipitation, nearly 12 inches, becomes runoff and reaches the System. The remaining two-thirds of the precipitation is distributed among surface evaporation, transpiration, soil moisture needs, and to recharging ground water aquifers.

Nearly half of the land portion of the Great Lakes-St. Lawrence River Basin is underlain with aquifers. Most recharging of these aquifers occurs during the spring snowmelt period, with only minimal recharging occurring during the summer because of the high evapo-transpiration needs.

The Basin's low topographic relief and the abundances of lakes, marshes, and peat bogs reflect the poor development of regional drainage systems.

The above general conditions also reflect the hydrological characteristics of the project area. As mentioned, the flow rate of the St. Lawrence River is relatively uniform, averaging 240,000 cfs.

Water Levels and Flows.

The water levels of the Great Lakes are dynamic, constantly changing. However, due to the natural regulation afforded by the large surface area of the lakes and the restrictive nature of the connecting channels, these changes are gradual.

Three types of water level fluctuations occur: long-term, seasonal, and short-term. Long-term changes, extreme high level to extreme low level and vice-versa, are noncyclical, occurring over long periods of time (usually greater than ten years). The long-term variations reflect changes to the total water supply, mainly precipitation. Seasonal changes take the form of high levels in the spring and low levels in the fall. During the winter months, precipitation is stored in the form of snow and ice. As the weather becomes warmer in the spring, this stored water is released as runoff. In the summer and into the fall, this runoff is decreased and evaporation increases, resulting in lower water levels. Short-term fluctuations are caused by external forces, such as wind, acting upon the lake surface. These variations are usually local. They do not affect the volume of water in the lake, and they do not affect the lake surface uniformly. An extreme example of this type of change occurred during a storm on Lake Erie on 3 November 1955. During the storm, a 13.2 feet difference in water level elevation was recorded between Buffalo, NY and Toledo, OH.[3/]

Man has attempted limited regulation of Lake Superior and Lake Ontario by building control structures in the St. Marys River and the St. Lawrence River, respectively. The regulation is carried out under prescribed rules set forth in the Order of Approval for each lake. The Orders are established by the International Joint Commission (IJC). The control structure in the St. Marys River was completed in 1921. The Order of Approval provides that the operations maintain the level of Lake Superior as nearly as possible between elevation 600.5 feet and 602.0 feet (International Great Lakes Datum, 1955). The mean lake level since construction of the control works has been 600.5, the lower limit as provided by the Order.

In 1952 the Governments of Canada and the United States sought approval from the IJC to construct hydro-electric power facilities in the International Rapids Section of the St. Lawrence River between Massena, NY and Cornwall, Ont. The IJC approved the proposed works, subject to the conditions in the Order of Approval. The order included directives stating that the monthly mean elevation of Lake Ontario be regulated within a range of 242.8 feet (navigation season) to 246.8 feet (all seasons), as nearly as may be; that navigation and riparian interests downstream are to be provided no less protection than would have occurred without the project; and that the lake level be regulated to benefit shoreline property owners on Lake Ontario by reducing the extremes of stage which had been experienced. During periods when water supplies to the lake are in excess of the supplies of the past (1860-1954), the control works are to be operated to provide all possible relief to riparian owners upstream and downstream. When the supplies are less than those of the past, operations are to provide all possible relief to power and navigation interests.[4/]

3/ Hunt, Ira A. Jr. 1959. Winds, sind set-up and seiches on Lake Erie. Lake Survey District, Corps of Engineers, Detroit, MI 59pp.

4/ International Joint Commission. 1976. Further Regulation of the Great Lakes. 96pp.

The regulation of Lake Ontario began in July 1958. The current plan, Regulation Plan 1958-D, has been in effect since October of 1963. A detailed analysis of how this plan operates along with an analysis of the effectiveness of regulation during the recent period of high water on the Great Lakes (1972-74) is contained in the report by the St. Lawrence-Eastern Ontario Commission, "Lake Ontario and the St. Lawrence River: Analysis of and Recommendations concerning High Water Levels."[5/]

On 7 October 1964, the Governments of Canada and the United States requested the IJC to study the factors affecting water level changes on the Great Lakes and to determine if further regulation was practical. The IJC established the International Great Lakes Levels Board in December of 1964 to carry out the study. The Board's final report was submitted to the IJC in December of 1973. While the report did not recommend any specific changes to the current regulation of Lake Ontario, it did find that the physical dimensions of the St. Lawrence River were not adequate to accommodate the record supplies received by Lake Ontario during 1972-73 and still satisfy the criteria of the IJC Order of Approval. The Board concluded that further study to improve the regulation of Lake Ontario was necessary.[6/]

Water Quality.

The development within the Great Lakes-St. Lawrence River Basin has exacted a high price in the deteriorating quality of its water resources. The streams and lakes have been heavily damaged by discharges of wastes, by polluted runoff from urban, agricultural, and mine development, and by accelerated siltation, erosion and sedimentation.

Federal, State, and local efforts to remedy existing water pollution problems and to prevent further deterioration of water quality vary within lake and river basins because of varying situations and availabilities of required resources and technologies. The governmental program for the control of water pollution in the country was completely revised by the Federal Water Pollution Control Act Amendments of 1972 (Public Law 92-500). The two major goals set by the above legislation are:

- To achieve water that is clean enough for swimming and other recreational uses, and clean enough for the protection of fish, shellfish, and wildlife, wherever possible, by July 1983; and

5/ St. Lawrence-Eastern Ontario Commission. 1975. Lake Ontario and the St. Lawrence River: Analysis of and Recommendations Concerning High Water Levels, SLEOC, Watertown, NY. 200+pp.

6/ International Great Lakes Levels Board. 1973. Regulation of Great Lakes Water Levels: Report to the International Joint Commission. 294pp. + appendices.

- To have no discharges of pollution into the nations waterways by 1985.

The St. Lawrence River carries a Class "A" rating; suitable water supply for drinking or food processing. The highest classification of the tributaries of the river is Class "C", or water suitable for fishing. Reasons for this lower rating include among others: disposal of human and industrial wastes (treated or untreated), nonpoint source pollution such as runoff from rural and urban lands and highways, and erosion runoff from agriculture and construction locations.

Groundwater resources are of varying quality in the project area. Much of the St. Lawrence River shoreline is developed in the form of summer cottages. Where the septic systems encounter the water tables, groundwater pollution and leaching of waste products does occur. The groundwater resources in carbonate bedrock may have excessive hardness and contain high levels of iron and manganese.

Land Use.

The U. S. portion of the Great Lakes-St. Lawrence System comprises 64 percent of the total land area (83.6 million acres). The major land uses within this section are forest lands (47.4 percent), agriculture (38.4 percent), urban development (8.4 percent), and miscellaneous uses (5.8 percent). Eighty percent of the U. S. land area is in private ownership. The remainder is owned by Federal, State, and local Governments, mostly in the form of forest, parks, and recreational lands.

Forest land covers nearly one-half of the region, but it is not uniformly distributed. Much of the present forest lands have been reestablished by natural regeneration and forest management activities.

Extensive agricultural lands exist in Ohio, Pennsylvaia, New York, and lower central Michigan. About 28.6 million acres are in cropland and 3.5 million acres are in pasture range.

Urban development areas have a considerable influence over land use decisions. More than one-third of the total agricultural lands are located within Standard Metropolitan Statistical Areas, where most of the future urban growth is expected. Urban development projections indicate this type of land use will increase from the present 7.0 million acres to 12.1 million acres by the year 2020.

Because of their opportunity for waterborne commerce, water supply, and recreation, shorelands have been the focus of development. This also holds true for the project area. Of the 291 miles of shoreline along the St. Lawrence, approximately 58 percent has seen some type of development, mostly as recreational facilities and summer cottages.

Vegetation.

The natural vegetation patterns of the Great Lakes-St. Lawrence River Basin have been greatly modified by man's activities. Much of the once-forested land area has been replaced by urban, industrial, and agricultural development. Virgin forests have been drastically reduced and are presently limited to small tracts within the north-woods country of Michigan, Wisconsin, and northern Minnesota, and also along the Ontario shores of Lakes Superior and Huron.

The predominant natural vegetation surrounding Lake Erie, Lake Ontario, and the southeastern sections of Lakes Huron and Michigan is the broadleaf deciduous forest. Stands of pine and spruce dominate the western and northern portion of Lake Superior.

Additional vegetation types within the Basin include prairie grasslands along the southwest border of Lake Michigan, wetlands and bogs interspersed among the forest lands, and beach areas which have their own distinct dune vegetation.

A technical report on natural vegetation in the Jefferson and St. Lawrence counties of New York was prepared by the St. Lawrence-Eastern Ontario Commission as part of their shoreline study.7/ 15.1 percent of the land area of these counties are forested, but relatively few undisturbed forests exist. Forests are only one of six vegetation types listed in the report. The other five and the percent of the study area they represent are as follows: disturbed areas (agriculture and developed land areas), 45.8 percent; successional fields (abandoned agricultural lands), 21.7 percent; rock outcrop vegetation, 13.2 percent; wetlands, 4.0 percent; and dunes, 0.2 percent.

The report also identifies 20 unique vegetational areas where rare or endangered species or cover types persist. The Federal list of endangered plants as published in the Federal Register, Vol. 44, No. 127, 17 January 1979, indicates only one plant found in New York as being "threatened" - northern wild monkshood (Aconitum noveboracense). This plant according to Grays Manual of Botany (Fernald, 1970) and Manual of Vascular Plants (Gleason and Cronquist 1963) is found in rich woods shaded ravines and damp slopes in se New York, in the Catskill Mountains.

New York State has over 34 genera of plants on its protected list. Among these plants are all species of orchids, clubmosses and ferns - except bracken fern (Pteridium aquilium), hay-scented fern (Dennstaedtia punctilobula) and sensitive fern, (Onoclea sensibilis). Even though the State has a concise list of protected plants, to date there are no reports or published mappings of specific locations of these plants.

7/ St. Lawrence-Eastern Ontario Shoreline Study, St. Lawrence-Eastern Ontario Commission, 1972.

Fisheries.

The Great Lakes-St. Lawrence River Basin contains more than 237 species and subspecies of fish. Most of these species are indigenous to the Basin, having entered the lakes during the period of Pleistocene glaciation. During the development of the Great Lakes-St. Lawrence River System, there existed a water connection between the lakes and the following drainages: Hudson Bay and Upper Mississippi River; the Ohio and Middle Mississippi Rivers; and the Mohawk, Hudson, and Susquehanna Rivers. Each of these watersheds now share some common species with the Basin. In addition, exotic species are present, having been either purposely or inadvertently introduced by man. These introductions, along with poor fishery management practices, have led to significant changes in the fishery resources of the Basin.

Prior to the mid-1920's, lake sturgeon, lake herring, and lake white-fish comprised the bulk of the commercial fishery. By the late 1920's, these species declined. This decline led to heavier utilization of the large predatory species such as lake trout and blue pike.

In 1932 the Welland Canal opened its newest version. The significance of this new system was that the sea lamprey and the alewife, previously restricted by the Niagara Falls, were alledgedly able to invade the upper four Great Lakes.

The sea lamprey first attacked the lake trout and burbot, both deep water predatory species, with visible declines noticeable in the fishery in the 1940's. When these stocks became low, both the sea lamprey and the fishermen focused on the remaining whitefish and the larger of the chubs (ciscoes) inhabiting the upper lakes. The smaller bloater chub then became of commercial importance. Alewifes took advantage of the food base left open by the declining chub population and greatly increased in numbers. The rainbow smelt, having been introduced into the Lake Michigan watershed around 1912, had suffered a great decline during the early 1940's, possibly due to a bacterial or viral disease. This species recovered and along with the increasing alewife population formed a competitive base retarding the natural reestablishment of the large chubs.

In the past two decades, yellow perch, rainbow smelt, carp, catfish, suckers, walleye, sheepshead, and, to some extent, whitefish have dominated the commercial fishery. Lake trout stocks have been reinforced through hatchery stockings, and the fishery is on the climb. Other salmonids, such as coho-salmon, chinook-salmon, and rainbow trout (steelhead), have been introduced mainly for the sport fishery. Toxic materials such as heavy metals and pesticides are presently jeopardizing these and other species in the System.

In the project area, some 99 species have been captured and identified. There is a healthy and vigorous sport fishery in the region. Eleven species are of economic importance, attracting numerous fishermen:

smallmouth bass	white perch	yellow perch
white bass	northern pike	pumpkinseed sunfish
brown bullhead	largemouth bass	muskellunge
walleye	rock bass	

Along with these species are the alewife, rainbow smelt, slimy sculpin, and other fishes which make up the forage base for the game species.

Wildlife.

Of the 84 million acres of total land area in the U. S. portion of the Basin, 75 million acres (roughly 90 percent) are habitat or resource base lands.[8] More than two-thirds of the 610,000 acres of shoal waters in the U. S. territory are important wildlife areas, and all of the open waters of the Basin are utilized from time to time by migrating waterfowl.

The portion of the Basin north of the 43°N latitude line is forested and only lightly settled. The supply of wildlife habitat (other than croplands) is generally good in this region. Below the 43rd parallel or below the imaginary line between Milwaukee and Buffalo, the Basin is heavily settled and has seen extensive industrial and agricultural development. Cropland habitat is the dominant type in this region.

There are eight types of wildlife habitat in the Great Lakes-St. Lawrence River Basin. These are northern wilderness forests, farmland woodlots, eastern woodland forests, river-bottom woodlands, scrub and brush lands, open fields and meadow lands, croplands, and freshwater wetlands.

The most important big game animal is the white-tailed deer. White-tails are found throughout the Basin, with some locally high populations. Black bear, turkey, moose, and elk are the other big game animals (listed in descending order of importance).

There are 11 small game animals, nine furbearers, and ten nongame animals recognized within the Basin (Table 2-1). (Rare, threatened, or endangered species will be discussed in the next section of this report).

The Basin's principal waterfowl areas are shore and inland marshes of western Lake Erie; Lake St. Clair, Saginaw Bay, MI; Green Bay, WI; inland southern Wisconsin marshes including Horicon; Lake Ontario and St. Lawrence River marshes; St. Marys River; eastern inland Upper Michigan Peninsula marshes; and southwestern Michigan marshes.

The most important factor affecting Basin wildlife and habitat is the increasing human population. Ironically, increased human populations also mean an increased demand for wildlife resources. Accelerated attrition of habitat is occurring over most of the Basin, especially along the southern portions where urbanization is greatest.

An inventory of wildlife resources in the project area revealed 357 vertebrate species (excluding fish) including 278 birds, 50 mammals, 17 reptiles, and 12 amphibians. There are no less than 35 different unique and/or important wildlife habitat areas along the St. Lawrence River. Being either biologically productive, or economically and aesthetically valuable, these areas have been highly recommended for preservation by the regional planning board (St. Lawrence-Eastern Ontario Commission).

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[8] Of varying degrees of quality.

Rare and Endangered Species.

The List of Endangered and Threatened Wildlife and Plants, published in the Federal Register on 14 July 1977, in accordance with the Endangered Species Act of 1973 (Public Law 93-205), contains fifteen endangered species which have known distribution within the Great Lakes-St. Lawrence River Basin. These species, along with other species found in the Basin which are either rare or of undetermined status, are discussed in detail in Appendix A of this report.

Recreation.

The Great Lakes-St. Lawrence River Basin has 17.8 million acres of public recreation areas. There is a great diversity of outstanding natural features such as forests, meadows, marshes, shorelines, islands, streams, and lakes. Many of these areas have exceptionally scenic, wilderness, and aesthetic qualities which make them nationally significant.

Table 2-1 - Important Small Game, Furbearer, and Nongame Animals of the Great Lakes-St. Lawrence River Basin

Small Game	Furbearers	Nongame
Cottontail Rabbit	Muskrat	Woodchuck
Ruffed Grouse	Beaver	Red Fox
Snowshoe Hare	Raccoon	Bobcat
Sharp-tailed Grouse	Skunk	Red Squirrel
Mourning Dove	Badger	Coyote
Hungarian Partridge	Mink	Porcupine
Ring-necked Pheasant	Weasel	Gray Fox
Gray Squirrel	Otter	Crow
Fox Squirrel	Opossum	Raven
Woodcock		Raptors
Bobwhite Quail		Songbirds

In 1970 there were 1,378 acres in national park and wilderness areas and over 540,000 acres of State and local parks. The 1970 estimate of 637.1 million recreation days is expected to increase to 861.3 million user days by 1980 and to 1,863.6 million days by the year 2020. (These figures do not include the man-days spent for fishing, hunting, and trapping, or the recreation days for the use of such all weather terrain vehicles such as snowmobiles.)[9]

Recreational problems include land-use competition, high acquisition costs for lands, overuse of existing areas, and environmental degradation. This last category is one of the greatest problem areas adversely affecting the Great Lakes-St. Lawrence River Basin recreational resources.

There are some 250 recreational facilities (combined public and private) within the project area. The majority of these facilities have been developed since the 1938 opening of the Thousand Island Bridge. In 1938, there were seven marinas and eight State parks in the region. By 1970, these facilities have grown to 40 marinas and 22 State parks. The State parks can handle up to 800,000 campers each summer, and they attract more than one million visitors annually.

Most of the recreational facilities are water-related. Water oriented activities include swimming, boating, water skiing, fishing, and waterfowl hunting. The extensive water areas also supply an aesthetic backdrop for the activities located along their shores, such as camping, sunbathing, picnicking, hiking, and golfing, to name a few. In addition, the fisheries and wildlife resources of the area attract vacationing sportsmen and naturalists, and the close proximity of an international border and close range views of ocean-going vessels attract visitors along the St. Lawrence Seaway.

Archeological and Cultural Resources.

Historically, the Great Lakes-St. Lawrence System has served as a major corridor for access to the resources of the interior of the North American Continent. There are numerous historic and prehistoric sites along the shores of the Basin, many of which have not been scientifically recorded and studied. Some of the more well known archeological and historic sites of the Basin are discussed in the Great Lakes Basin Framework Study, Appendix 22, "Aesthetic and Cultural Resources."

In addition to sites of historic interest there are many scenic areas along the St. Lawrence River. The St. Lawrence-Eastern Ontario Commission, in its shoreline study technical report #7, Recreation Resources,[10] listed seven unique scenic resources and 198 historic sites.

HUMAN ENVIRONMENT

Historical Development.

The development of the Great Lakes-St. Lawrence River Basin has historically relied greatly on its water and related land resources. The importance of the Great Lakes as a navigation route was demonstrated by early European

[9] Source: Great Lakes Basin Framework Study, Appendix No. 21, Outdoor Recreation," 1976, Great Lakes Basin Commission.

explorations. Jacques Cartier's discovery of the St. Lawrence River in 1536 was followed by successive navigation improvements over a 275-year period beginning in 1700 to the present. These improvements eventually led to the construction of the St. Lawrence Seaway; ending the inland isolation and inland waterway nature of the Great Lakes.

Early exploration and settlement of the region was first motivated, in the 1600's, by the exploitation of the beaver and other fur trade. Wars among the French, British, Indians and Americans, added further impetus to the exploration and settlement of this region. Outpost and forts along the Great Lakes were established for strategic reasons. With the increase in trading vessels plying the waters of the lakes, these small coastal settlements developed into major port cities, such as at Chicago, Detroit, Cleveland and Buffalo. As this interlake commerce expanded, so did the service industries, which in turn attracted a great number of immigrants. Another factor in the early years which also induced settlement of the region, was the abundance of copper and iron ore in the Lake Superior area. As mines grew, so did the number of people, but as the ore deposits were exhausted, many of the mined-out areas fell on hard times economically.

By 1850 expoitation of the mineral, timber, and agricultural resources had begun, making the Great Lakes one of the main commercial waterways of the U. S. Railroads also came to the Great Lakes during this time; bringing more people. Lock and canals were built during the 19th Century opening up new opportunities for growth of the port cities. They also brought new settlers who originally came as laborers and stayed on after completion of the canals. In 1829 the Welland Canal Feeder was completed, followed in 1847 with the development of the original shallow-draft canal system on the St. Lawrence River. These two canal systems added new dimension to the Great Lakes trade and associated industry.

The lakes have also supported a thriving commercial fishing industry, especially in the early 1900's. Overfishing and the introduction of the sea lamprey with canalization, have led to drastic setbacks to the industry. However, in recent years with the introduction of new species of fish of high commercial value and the control of the sea lamprey, the pattern of decline is changing.

Further expansion of the Welland Canal and development of the St. Lawrence portion of the Seaway has opened the Great Lakes to world trade and made it the nation's "fourth seacoast." Great Lakes ports are now able to serve the economic vitality of the country on a par with saltwater ports; opening up new markets for the industrial and agricultural heartland of the North American continent.

10/ St. Lawrence-Eastern Ontario Shoreline Study, St. Lawrence-Eastern Ontario Commission, 1972.

Great Lakes Basin.

Existing Conditions - The Great Lakes Basin is centrally located between the nation's important agricultural production regions of the north central States and the heavily populated eastern markets. A heavy dependence upon forest and mineral resources has developed in northern parts of the basin but this area is also the beneficiary of a heavy, seasonal inflow of recreationists and tourists. Low levels of family income are found in this part of the Basin - a predictable result of a poor farming base experiencing a net outmigration of population.

Manufacturing activity is concentrated within the central part of the Basin. Along the lakeshore there are centers of iron and steel, chemical and petroleum production. Agricultural activity is pursued throughout the Basin although the most productive areas are found in the southern part of the Basin. Specialized crops can also be found along various lakeshore areas which experience delayed initial frosts in the fall and a later than usual spring thaw - commonly known as "lake effect."

Early economic development and population growth in the Basin has been attributed to the vast fresh water resources in the Great Lakes. By the middle of the eighteenth century, iron, copper, timber, and agricultural resource development led to a need for transportation of bulk commodities within and between each Great Lake subbasin. This began an era of social investment in Great Lakes navigation facilities which has continued to date. Railroad linkages to major cities and ports along the five lakes also encouraged economic growth. This geographic region has all the attributes necessary for sustained long term economic growth: fresh water supply, mineral resources and waterways and connecting channels capable of waterborne movement of bulk commodities at low cost.

Future Conditions - Forecasts of alternative futures for the Basin are based upon the Great Lakes Framework Study. This report was the first comprehensive study undertaken by the Great Lakes Basin Commission (GLBC), a State-Federal organization established by Executive Order No. 11345 under the authority of Section 201 of Public Law 89-80, the Water Resources Planning Act of 1965. Under this act the GLBC is designated as the principal agency for the coordination of planning for water and related land resources in the Great Lakes Basin among the various Federal, State, local and nongovernmental entities. The authority of the GLBC, and the scope of their Framework Study, is limited to the Great Lakes Basin within the United States down to and including the point at which the St. Lawrence River ceases to be the international boundary. The purpose of their multi-volume Framework Study is to consolidate sufficient information relating to economic and demographic characteristics, and its water and related land resources, to permit an understanding of the existing situation and to delineate the problems and needs confronting the residents of this geographic area in terms of conservation, development, and utilization of existing water resources. The Framework Study provides most of its information broken down by State, Lake Basins, and by planning subareas or river basin groups. Their projections of various levels of economic activity for the Basin assume that the Federal Government will implement fiscal and monetary policies necessary to maintain full employment, that no major wars occur which may distort levels of economic activity at several key target dates and that water resources will play the same role in stimulating or depressing economic growth in the area that it has in the past.

The Great Lakes Basin Commission has divided their study area in five major subbasins which are named after each Great Lake. The five sub-basins are drainage areas which lie wholly in United States territory. The most easterly subbasin planning area of Lake Ontario includes that portion of the St. Lawrence River which comprises the international boundary.

Since a great deal of the socio-economic information in the Framework Study needed for water resources planning was available only by counties, without regard to drainage basin boundaries, the aggregation of counties inside the Basin limits and those additional counties having an important economic relationship to the Basin has been defined as the Great Lakes Region. This Region is subdivided into five subregions having a similar county-boundary relationship to the five Great Lakes Basins. Each subregion has been defined as a Plan Area.

Population - Most of the 29 million residents within the Basin are located within urban port areas along the shores of the lower Great Lakes (Michigan and Erie). Major urban developments include Milwaukee, WI; Chicago, IL; Detroit, MI; Cleveland, OH; and Buffalo, NY. More than 80 percent of the Basin can be found in these major urban centers. The contribution of each Plan Area to total population distribution in 1970 is summarized below in Table 2-2.

Table 2-2 - Great Lakes Region Population and Urban Population by Plan Area, 1970

Plan Area	1970 Population	Percent of Great Lakes Region	Urban Population	Percent of Region Population
1.0—Lake Superior	533,539	1.8	315,789	1.1
2.0—Lake Michigan	13,516,965	46.1	11,186,960	38.1
3.0—Lake Huron	1,236,265	4.2	702,813	2.4
4.0—Lake Erie	11,513,853	39.3	9,727,303	33.2
5.0—Lake Ontario	2,531,673	8.6	1,593,390	5.4
TOTAL	29,332,295	100.0	23,526,255	80.2

The northern and inland portions of the Basin are more sparsely populated relative to other areas located along or near the Great Lakes shoreline. Population densities are lowest in the northern portions of Minnesota, Wisconsin, Michigan, and New York; this characteristic may be attributed to the geographic isolation and more severe winters.

The Great Lakes Basin has contained 14 to 15 percent of the U. S. population over the period 1950 to 1975. During this interval, the Lake Michigan Plan Area included about 45 percent and the Lake Erie Plan Area contained approximately 39 percent of the total population in the Great Lakes Basin. The remaining three Plan Areas (Ontario, Huron and Superior) contained nine, four and two percent respectively.

In the future, the Basin's share of total U. S. population is anticipated to decrease slightly from 14.1 percent in 1980 to 13.5 percent in 2020. A comparison of Great Lakes to U. S. population, employment and income growth is included in Table 2-3. Nearly 24.9 million of the Basin's total population of 29.3 million resided in Standard Metropolitan Statistical Areas (SMSA's) in 1970. This proportion is projected to remain stable during the 1980-2020 period. Five of the Basin's 32 SMSA's contained more than 1 million people. These areas are Chicago, 7.0 million; Detroit, 4.2 million; Cleveland, 2.1 million; Milwaukee, 1.4 million; and Buffalo, 1.4 million.

Employment - Employment trends for the eight States bordering the five Great Lakes have paralled national employment shifts for most major employment sectors during the period 1940-1970. Declines in employment have been concentrated in the primary sector (agriculture and mining) while strong gains in the secondary and tertiary sectors contributed to increases in total employment both in the Great Lakes region and in the United States.

Table 2-3, which includes existing and projected levels of employment for the nation and the Great Lakes Basin, indicates that the Basin's share of national employment will fall slightly over the project planning period from about 15 percent to a low of 13.8 percent in 2020.

Income - Historically, total personal income and per capita income within the eight States bordering the Great Lakes can be attributed to a heavy concentration of industrial activity. Basin personal income per capita has averaged from 10 to 20 percent above the national average during the period 1950 to 1970. Economic centers which lead the Basin in per capita income are the metropolitan areas of Chicago, Detroit, Cleveland and Rochester.

Table 2-3 - Population, Employment and Income - United States and Great Lakes 1950-2020[1/]

	United States	Great Lakes Basin	Percentage[2/]
Population			
1950[3/]	151,236,648	21,617,012	14.3
1962[3/]	185,708,000	26,719,499	14.4
1970[3/]	203,857,864	29,112,481	14.3
1980	223,532,000	31,580,200	14.1
1985	234,517,300	32,854,400	14.0
1990	246,039,000	33,674,100	13.7
2000	263,830,000	36,350,700	13.8
2020	297,830,000	40,168,300	13.5
Employment			
1950	57,221,773	8,614,414	15.1
1962	66,372,649	9,734,946	14.7
1970	79,306,527	11,378,925	14.3
1980	96,114,000	13,840,400	14.4
1985	101,121,100	14,445,700	14.3
1990	106,388,000	15,080,500	14.2
2000	117,891,000	16,582,100	14.1
2020	130,534,000	18,063,100	13.8
Personal Income[4/]			
1950	31,147,612	53,459,019	17.1
1962	480,053,606	76,285,557	15.9
1970	708,583,931	110,131,348	15.5
1980	1,068,496,000	164,560,700	15.4
1985	1,273,226,200	193,937,100	15.2
1990	1,517,173,000	228,590,300	15.1
2000	2,154,266,000	320,003,600	14.9
2020	3,931,928,000	569,055,000	14.5
Per Capita Personal Income[4/]			
1950	2,064	2,470	119.7
1962	2,585	2,860	110.6
1970	3,476	3,780	108.7
1980	4,700	5,210	110.9
1985	5,400	5,910	109.4
1990	6,100	6,790	111.3
2000	8,100	8,810	108.8
2020	13,200	14,170	107.3

1/ 1972-OBERS Projections, Vol. 3, U. S. Water Resources Council
2/ Great Lakes Basin as percentage of total United States
3/ Mid-year population
4/ Value of dollar in 1967

Future growth in total personal and per capita income will follow the same trends as population and employment and decline during the 1980-2020 period. The Basin's share of national personal income is anticipated to drop from 15.4 percent (1980) to 14.5 percent (2020).

Plan Areas Huron and Ontario will exceed the national rate of total industry earnings primarily due to increased levels of economic activity in the industrial areas of Detroit, MI and Rochester, NY. Industrial sectors contributing strongly to Great Lakes economic activity are listed in order in Table 2-4. The predominance of electrical and nonelectrical machinery manufacture and fabricated metals activity can be attributed to the proximity of major iron and steel producing districts.

Most Probable Future.

Lake Superior - This planning area is the least populated of any Great Lakes Basin region. Future population levels are projected to remain relatively low in comparison to other economic regions. The Lake Superior region is expected to experience the lowest rate of growth in total industry and manufacturing earnings of any planning area. Duluth-Superior, MN-WS is the center of industrial activity for that portion of these two States within the Great Lakes Basin and should retain its dominant economic role over the project planning period.

Lake Michigan- Population in this plan is expected to grow at an annual rate of 0.6 percent, a rate equal the Basin average but below the national average of 0.7 percent. Manufacturing has been among the more rapidly growing sectors of the local economy. Most of this employment growth can be found within the Chicago metropolitan area on the south shore of Lake Michigan. An increasing percentage of total population in this plan area can be expected to reside in major metropolitan areas of Milwaukee, Chicago, South Bend and Grand Rapids which are also the historical economic centers.

Lake Huron - Most of this plan area consists of the eastern half of the State of Michigan adjacent to Lake Huron. Three major urban areas in this region are Saginaw, Bay City and Flint, MI. The remaining area is predominantly rural in nature. Major employment sectors include paper products, fabricated and primary metals and chemicals. These important industrial sectors have been projected to grow at an average annual rate of 3 to 4 percent per year.

Lake Erie - This planning area includes eight SMSA's and can be considered to be the most densely populated and industrialized area in the Basin. Population and employment levels have traditionally increased more rapidly than the Basin average.

Table 2-4 - Major Industrial Sectors in the Great Lakes States[1/]

State[4/]	Value Added by Manufacture[2/]	Major Industrial Sector[3/] Industry	SIC[5/]
Illinois	1,916.1	Electrical Machinery	36
	1,635.3	Machinery, except elec.	35
	1,617.3	Food and kindred prods.	20
Indiana	293.2	Machinery, except elec.	35
	188.9	Petroleum and coal prods.	29
	168.7	Transportation equipment	37
Michigan	5,805.8	Transportation equipment	37
	2,750.4	Machinery, except elec.	35
	1,987.7	Fabricated metal prods.	34
Minnesota	27.6	Food and kindred prods.	20
	13.3	Printing and publishing	27
	7.3	Machinery, except elec.	35
New York	1,714.2	Instruments and related prods.	38
	999.6	Machinery, except elec.	35
	590.2	Primary metal industries	33
Ohio	1,365.6	Machinery, except elec.	35
	1,168.8	Fabricated metal prod.	34
	971.6	Transportation equipment	37
Penn.	91.2	Electrical machinery	36
	87.7	Fabricated metal prod.	34
	78.1	Machinery, except elec.	35
Wisconsin	1,182.1	Machinery, except elec.	35
	547.0	Food and kindred prod.	20
	530.9	Electrical Machinery	36

1/ Great Lakes Basin Framework Study, Appendix 19, "Economic and Demographic Studies"
2/ In millions of dollars
3/ Includes only top three industrial sectors ranked by value added
4/ Includes only those counties which lie within Great Lakes Basin limits
5/ Standard Industrial Classification Manual, 1972

There is a high degree of urbanization within the limits of this planning area. Employment forecasts for the manufacturing, chemical and paper products indicate that this area should remain a relatively prosperous economic region during the project planning period.

Lake Ontario - The levels of economic activity in this plan area has been traditionally influenced by the economic health of the Rochester and Syracuse, NY SMSA's. Strong gains have occurred in the manufacturing sector as a result of employment growth in instruments and related products (Rochester) and machinery manufacture and chemicals and allied products (Syracuse). The eastern end of the Lake Ontario subbasin is predominately rural and depends heavily upon seasonal economic activities related to the influx of tourists from outside the region. Primary economic activities (agriculture, lumbering and mining) comprise the economic base of this part of the Lake Ontario Plan Area.

St. Lawrence River Basin.

The Eisenhower and Snell Locks and the Wiley-Dondero Ship Canal, the components of the U. S. portion of St. Lawrence Seaway facilities, located in the vicinity of Massena, NY-St. Lawrence County comprise two of the seven locks required for modern-day commercial navigation of the St. Lawrence River between Montreal, Quebec, and Lake Ontario.

A socio-economic profile of this portion of New York State has been developed based upon documents published by four planning agencies: St. Lawrence-Eastern Ontario Commission, Black River-St. Lawrence Economic Development Commission, New York State Economic Development Board, and the U. S. Water Resources Council.

The St. Lawrence-Eastern Ontario Commission is active in planning for its coastal service area of 23 towns and two cities in a four county area: St. Lawrence, Jefferson, Oswego, and Cayuga Counties. Since 1969, the Commission has investigated the nature and distribution of natural, economic and human resources associated with land and waters in the four county service area. However, their planning has been focused on the protection, rehabilitation and proper use of coastal resources. The latest publication available from this agency is titled "Report on Coastal Resources."

The Black River-St. Lawrence Economic Development Commission was incorporated in 1966 and functions as an economic development commission serving four Upstate New York counties of Franklin, Jefferson, Lewis, and St. Lawrence. This geographic district lies primarily in the drainage basins of the Black and St. Lawrence Rivers and comprises a major portion of the New York State and Canadian border. Their document, "Overall Economic Development Program," published in 1976, was used as a primary reference document for socio-economic statistics and long-term growth trends which may take place in the future.

The New York State Economic Development Board has recently developed demographic projections by county to the year 2005. These statistics represent the "most probable future" for the affected area along the St. Lawrence River and contiguous interior regions.

U. S. Water Resources Council projections of various social and economic variables included in "Series E-OBERS Projections," have been used in estimating future levels of economic activity for the region which includes the U. S. components of the Seaway. Statistics included in Volume 3 have been aggregated by Bureau of Economic Analysis areas (BEA's). There are 173 BEA's established by the U. S. Department of Commerce for data gathering and analysis purposes. BEA-007 contains 12 counties in central and northern New York including the two counties adjacent to the St. Lawrence River (St. Lawrence and Jefferson), those counties adjacent to the eastern portion of Lake Ontario (Oswego and Cayuga), and eight other contiguous counties (Franklin, Lewis, Herkimer, Oneida, Madison, Onondaga, Tompkins and Cortland). Their forecasts of economic activity were used as a general guideline in extending short-term county demographic data (up to the year 2005) to levels of population which can reasonably be expected to prevail by the end of the project planning period. Projections of economic activity are required in this analysis of Corps water resource planning since the expected useful life of most engineering works often equals or exceeds 50 years.

The economic base of most northern New York counties has been historically influenced by an abundance of natural resources. Levels of primary industrial activity (forestry, farming and mining) have declined over the last few decades and now there are large tracts of land which are not utilized at their maximum potential. The St. Lawrence and Lake Ontario lake plain region, the traditional center for regional agricultural pursuits - especially dairy farming activity, has followed national agricultural trends of decreasing agricultural acreage and declining number of farms. Outputs of this phenomena are increasing average farm size and increased levels of food and fiber production.

Population - Total population of St. Lawrence and Jefferson counties which border the immediate project area in 1970 was 200,499. St. Lawrence County had the larger population of the two, with 111,991, while Jefferson County had a population of 88,508. The city of Ogdensburg, with a population of 14,554, the village of Massena, with a population of 14,042, both of which are located in St. Lawrence County, and the city of Watertown, located in Jefferson County and with a population of 30,787, comprise the major political subdivisions in the area. As of 1970, racial minorities accounted for less than one percent of the total population in both counties. St. Lawrence County experienced a population increase from 1950 to 1960 of more than 12,000, but had only a modest net gain of 752 from 1960 to 1970. Rural residents of Jefferson County, as of 1970, constituted approximately 61 percent of the total population, while about 56 percent of St. Lawrence County's residents were classified as rural.

Employment - The combined number of employed persons in Jefferson and St. Lawrence Counties, as of 1970, was 67,543 out of a total labor force of approximately 71,557. Of those employed, approximately 68 percent were classified as private wage and salary workers, 10.6 percent were self-employed and less than one percent were classified as unpaid family workers. Operatives represented the largest single occupation group, accounting for

17.5 percent of the total, followed by clerical workers (15.4 percent), craftsmen and foremen (14.7 percent), service workers (14.1 percent), and professional and technical workers (13.5 percent). Operatives also constituted the single largest occupation group in St. Lawrence County (17.1 percent), followed closely by service workers (17 percent), professional and technical workers (15.3 percent), clerical workers (13.9 percent), and craftsmen and foremen (13.6 percent).

Business concerns engaged in manufacturing represented the largest single source of employment for workers in Jefferson County (23.4 percent), followed by professional and related services (19.2 percent), and retail trade establishments (17.4 percent). Professional and related services accounted for 28.7 percent of employed persons in St. Lawrence County in 1970, followed by manufacturing concerns (20.4 percent) and retail trade establishments (15.2 percent).

Income - As of 1969, median income for the 21,707 families in Jefferson County was $8,696. Of these, the largest percentage (26.5 percent) fell into the $10,000 to $14,999 income range, while 24.7 percent of these families had incomes of $7,000 to $9,999. Among persons 14 years and older in Jefferson County who had some income, more than 52 percent had incomes of less than $4,000. Median income for the 24,765 families in St. Lawrence County, as of 1969, was $8,667 and 51.2 percent of these were evenly divided between the $7,000 to $9,999 and the $10,000 to $14,999 income categories. Both counties lagged well behind New York State in median income for both families and individuals, with the exception of the village of Massena in St. Lawrence County, which closely compared to Statewide median income for both categories.

Transportation Resources - There are four commercial airports and seven general purpose airstrips in this area. Two limited-access highways serve the region - Interstate 81 connects the largest city on the eastern side of Lake Ontario (Watertown, NY) to the Syracuse Metro-Area to the south. This highway provides the main linkage between the Thousand Islands area with population centers located in central portion and in the Southern Tier of New York State and the north-central portion of Pennsylvania. The second major highway is the Adirondack Northway (Interstate 87) and is roughly parallel but on the far eastern edge of northern New York. This highway is the principal means of passenger car and truck movements between population and manufacturing centers in the Province of Quebec and eastern New York State. East-west highway routes are local and county roads which are often not maintained during severe winter conditions.

Rail service in the region is limited to freight handling. The main rail line is provided by ConRail service which connects Syracuse to Massena via Watertown with a side connection to Ogdensburg. Branch lines primarily serve a few inland mining centers. There are only a few Canadian railway linkages serving the northeastern part of Franklin County near Malone, NY.

Water transportation to and through the region is comprised of St. Lawrence Seaway improvements and the Oswego Canal in conjunction with the New York State Barge Canal. Seaway facilities completed in 1959 are the latest version of a long line of attempts at overcoming impediments to commercial navigation on the St. Lawrence River. The present Seaway is composed of seven locks, only two of which lie within U. S. territory. Construction was completed in 1959 and has stimulated levels of traffic on the river, but at the expense of the port facilities which quickly lost their traditional function of a "lake head" transshipment point as commerce was now able to be shipped directly to markets or to other ports further downriver (Montreal, Quebec) for transshipment to larger oceangoing vessels. This structural dislocation resulted in a decline in the use of the inter-regional rail and highway networks.

Port facilities at Oswego, NY, are located at the mouth of the Oswego River and service the local area as well as the manufacturing center of Syracuse, NY. The Oswego Port Authority maintains and operates general cargo and bulk terminals including facilities for unloading grains and other dry bulk cargoes. Several piers and wharfs have railroad lines to them. Current port activity includes grain elevator storage and operations, general cargo warehousing and handling, marina and restaurant leases to private operators, cement and petroleum distribution by private operators on port owned land. Construction of an aluminum rolling mill inland from the port has contributed to a steady flow of aluminum ingot receipts. All of the alumina ore for the mill arrives via train from Arvida, Quebec.

Port facilities at Ogdensburg, NY, are situated on the St. Lawrence River about one-quarter mile from the Seaway channel and 62 miles by water from Lake Ontario. Federal project depths at Ogdensburg are between 19 and 21 feet with the exception of a small entrance channel of 27 feet which was constructed in 1921 and is currently maintained by the Port Authority. General cargo berths capable of unloading petroleum products and some dry bulk cargoes are available. More than eight acres of land are available for open dry bulk storage. A satellite facility located downriver at Waddington, NY, is also owned and operated by the Port Authority. Depth of water at this downriver site is reported to vary between 14 and 18 feet. Fuel oil receipts at the new Port Authority terminal was initiated in 1974 upon completion of a pipeline and this traffic currently represents a high percent of total commercial activity at the terminal. Another private dock facility is located downriver near Massena, NY, at the Metropolitan Petroleum Company Inc. site. The facilities are located approximately 150 yards from the Seaway channel and are utilized exclusively for receiving of seaway vessels delivering oil products to the terminal.

Power Resources - Regional characteristics of low population density, vast open and yet undeveloped areas and easy access to the shoreline of Lake Ontario makes this part of the Lake Ontario subbasin conducive to power generation stations. Of the 29,971 MW of power currently produced in New York State, 2,605 MW or 8.7 percent is produced along the eastern shoreline of Lake Ontario and the St. Lawrence River. In addition to major facilities along the shoreline, many small hydroelectric plants are located along the rivers which enter the area from adjoining upland areas. The Power Authority of the State of New York (PASNY) accounts for 60 percent of the total power produced from this area.

PASNY owns and operates two facilities, the James A. Fitzpatrick nuclear plant (770 MW) at Nine Mile Point (Oswego County) and the Moses-Saunders Power Dam (800 MW) at Massena (St. Lawrence County). Six privately owned power units are located on the southeastern edge of Lake Ontario. Five of these are fossil-fueled units operated by the city of Oswego, NY, while the other unit is a nuclear plant which is owned and operated by Niagara Mohawk Power Corp. located at Nine Mile Point (Oswego County). Additional power stations are planned in this area for this general area.

SECTION 3

PROBLEMS AND NEEDS

ST. LAWRENCE SEAWAY - ADDITIONAL LOCKS STUDY

SECTION 3

PROBLEMS AND NEEDS

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SECTION 3

PROBLEMS AND NEEDS

Since the opening of the St. Lawrence Seaway to deep-draft navigation in 1959, vessel transits and numbers have declined; vessel size and tonnage throughout has increased. The shift to larger vessels, laker and ocean, has been faster than the rate of growth in tonnage demand for carriage. Various studies agree that the long-term outlook is for continuing traffic increases for future years. This traffic is steadily approaching the capacity of the existing system and as it nears this capacity, delays to shipping will be encountered. This in turn will manifest itself as increases in transportation costs.

Economies of scale are also being demonstrated on the system and in the world fleet. Larger ships are more efficient in relation to their size and as such are able to transport more cargo at a reduced rate. The present size restriction is presently limiting the size of vessel which can utilize the system. This not only limits the potential savings of the larger vessel but also the competitiveness of the Great Lakes in the world market. This is especially evident in view of the ever increasing size of ocean vessels in the world fleet.

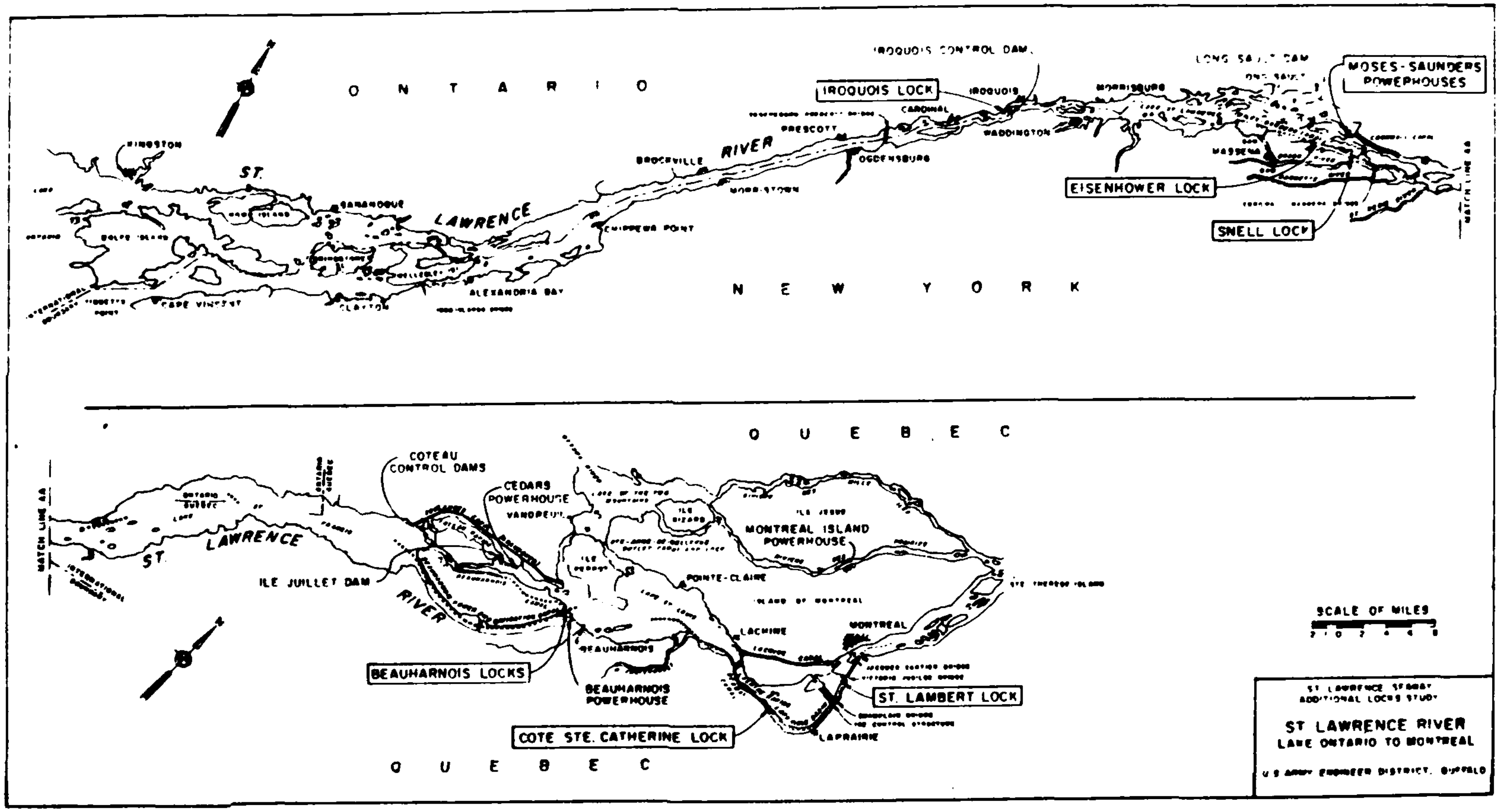
STATUS OF EXISTING PLANS AND IMPROVEMENTS

The St. Lawrence River flows northeast 527 miles from Lake Ontario to its mouth at Father Point, Quebec. From Tibbets Point, the start of the St. Lawrence River at Lake Ontario to St. Regis, NY, the river forms the border between New York State and Canada (113 miles). From there it flows eastward entirely within Canada for 414 miles. The International Section of the river is operated for commercial navigation purposes as a joint venture of the St. Lawrence Seaway Development Corporation and the St. Lawrence Seaway Authority of Canada. The Corporation is authorized, under its enabling act, Public Law 358, 83rd Congress, approved 13 May 1954, as amended, to develop, construct, operate, and maintain that part of the Seaway within the territorial limits of the United States and to collect tolls and other charges for the use of its facilities. The St. Lawrence Seaway Authority is authorized by the St. Lawrence Seaway Authority Act to perform similar functions in the Canadian waters of the Seaway.

The river between Lake Ontario and Montreal, shown in Figure 3-1, is commonly described as the seaway portion of the river and can be divided into two major sections, the International Section and the Canadian Section. The Canadian Section is composed of three subsections, the Lachine, Soulanges, and Lake St. Francis subsections. There are two components of the International Rapids subsection and the Thousand Islands subsection.

In the 169 miles of river between Montreal and Quebec City the fall is about 25 feet at low tide. Below Quebec City, the river gradually widens into the St. Lawrence estuary and finally the Gulf of St. Lawrence. The navigation channel at and below Montreal is referred to as the St. Lawrence Ship Channel with an advertised depth of 35 feet at low water datum.

FIGURE 3-1


ONTARIO
NEW YORK
QUEBEC
ST. LAWRENCE RIVER
KINGSTON
GANANOQUE
CAPE VINCENT
CLAYTON
ALEXANDRIA BAY
CHIPPEWA POINT
BROCKVILLE
MORRISTOWN
PRESCOTT
OGDENSBURG
IROQUOIS LOCK
IROQUOIS CONTROL DAM
IROQUOIS
CARDINAL
WADDINGTON
MORRISBURG
LONG SAULT DAM
MASSENA
EISENHOWER LOCK
SNELL LOCK
MOSES-SAUNDERS POWERHOUSES
MATCH LINE AA
COTEAU CONTROL DAMS
CEDARS POWERHOUSE
VAUDREUIL
ILE JUILLET DAM
BEAUHARNOIS LOCKS
BEAUHARNOIS
BEAUHARNOIS POWERHOUSE
COTE STE. CATHERINE LOCK
MONTREAL ISLAND POWERHOUSE
POINTE-CLAIRE
LACHINE
MONTREAL
ST. LAMBERT LOCK
LAPRAIRIE
SCALE OF MILES
ST LAWRENCE SEAWAY
ADDITIONAL LOCKS STUDY
ST LAWRENCE RIVER
LAKE ONTARIO TO MONTREAL
U S ARMY ENGINEER DISTRICT, BUFFALO

Canadian Section.

Lachine Subsection - This subsection is approximately 31 miles in length and allows marine traffic to bypass the Lachine Rapids and rise more than 50 feet above the level of Montreal Harbor. Two locks - the St. Lambert, opposite Montreal and the Cote Ste. Catherine, eight and one-half miles upstream - are used to overcome the vertical differences between the harbor facility at Montreal and Lake St. Louis.

The St. Lambert Lock is the most easterly of the locks built for the St. Lawrence Seaway. It was constructed by the St. Lawrence Seaway Authority on the south shore of the St. Lawrence River opposite the city of Montreal and adjacent to the city of St. Lambert, Quebec. The St. Lambert Lock (22 feet above sea level) overcomes the difference of about 15 feet between the level of water in Montreal Harbor and Laprarie Basin located about three miles upstream. Marine vessels proceeding upstream lock through the St. Lambert Lock, travel through the South Shore Canal about 8.5 miles to the Cote Ste. Catherine Lock.

Cote St. Catherine, the second lock, lifts vessels about 30 feet from the level of the Laprarie Basin to the elevation of Lake St. Louis. The function of this lock is to bypass the Lachine Rapids which has been a traditional barrier to commercial navigation in this part of the river. After passing through this lock, vessels proceed 12 miles upstream via dredged channels to the head of Lake St. Louis.

Soulanges Subsection - This portion of the Canadian section of the St. Lawrence River is about 16 miles long and consists of the Beauharnois Locks and the length of the Power Canal to Lake St. Francis. There are two locks in flight which provide a vertical lift of about 82 feet to Lake St. Francis.

At the head of Lake St. Louis, a widening in the St. Lawrence River southwest of Montreal, the St. Lawrence Seaway Authority has constructed two locks. The two locks, Upper and Lower Beauharnois, are built just outside of the town of Beauharnois, Quebec. These locks are connected by a three-quarter-mile-long canal and allow vessels to overcome the difference in height between Lake St. Louis and the Beauharnois Canal. This canal is about 16 miles long, 3,300 feet wide and includes a 27 feet deep channel 600 feet wide. The Beauharnois Canal is a power canal and carries a major flow of the St. Lawrence River to the Beauharnois Powerhouse which is owned and operated by Hydro-Quebec. The Beauharnois Canal replaces the Soulanges Canal, located on the north shore of the river, as the connecting link between Lakes St. Louis and St. Francis.

Lake St. Francis Subsection - This third subsection is about 29 miles long and terminates just east of Cornwall, Ontario. This stretch of the river has no locks but required extensive channel improvements to satisfy the channel requirements of commercial vessels. This subsection is the last of the three all-Canadian subsections in the Canadian Section of the Seaway.

International Section.

This portion of the St. Lawrence River is subdivided into two parts: The International Rapids Subsection and the Thousand Islands Subsection.

International Rapids Subsection - Cornwall, Ontario, is located at the upper end of Lake St. Francis which is a widening of the St. Lawrence River. This subsection contains two locks, located on the United States side of the St. Lawrence River, which were constructed by the U. S. Army Corps of Engineers for the St. Lawrence Seaway Development Corp. Vessels proceeding upstream enter the Bertrand H. Snell Lock which has a lift of about 46 feet to the level of the Wiley-Dondero Ship Canal which connects the two locks. The other U. S. facility further upstream is the Dwight D. Eisenhower Lock which completes the lift of vessels to the level of Lake St. Lawrence, the power pool impounded behind the Moses-Saunders Dam and Powerhouse. The total difference in level between Lake St. Lawrence and Lake St. Francis is almost 90 feet. The power pool, created by the Moses-Saunders Dam which connects New York State and the Province of Ontario and the Long Sault Control Dam, is a man-made lake of 100 square miles in area. There is a navigation channel of typical Seaway dimensions across Lake St. Lawrence. Proceeding upstream from the Eisenhower Lock there is a Canadian control lock at Iroquois, Ontario. This facility is located at the head of Lake St. Lawrence and was constructed by the St. Lawrence Seaway Authority and allows commercial vessels to bypass the Iroquois Control Dam. This control structure, and the Moses-Saunders and Long Sault dams are used individually or in combination, to control the outflow from Lake Ontario. The upstream extent of the International Rapids Subsection (Chimney Point) is located just downstream of Ogdensburg, NY.

Thousand Islands Subsection - This remaining subsection of the St. Lawrence River extends from Chimney Point upstream to Tibbetts Point Light located at the head of the St. Lawrence River. Vessels transiting this 65-mile subsection do not encounter any locks, dams, or other man-made water control structures. There are no rapids in this subsection but numerous rock shoals were removed when navigation channels were widened or deepened during the construction of the Seaway Project.

Lake Ontario and the Welland Canal.

Lake Ontario is the smallest of the Great Lakes in area. It is approximately 180 miles long and 50 miles wide. The regulation of Lake Ontario is in accordance with the International Joint Commission's Order of Approval of 29 October 1952, and the Supplementary Order of 2 July 1956, and is under the direct supervision of the Commission's International St. Lawrence River Board of Control. The Welland Canal, 28 miles long, provides a waterway between Lakes Ontario and Erie. It bypasses Niagara Falls and the river gorge with a series of eight locks, which raise or lower vessels 326 feet. Seven lift locks are located in an eight-mile section in the vicinity of the escarpment. Each of these locks has an average lift of 46.5 feet. An eighth lock at Lake Erie (Port Colbourne, Ontario) is a shallow lift guard lock which varies from one to four feet to make the final adjustment to the lake level.

PROBLEMS ATTENDING NAVIGATION

Capacity.

Traffic volume has fluctuated with national and international market conditions of supply and demand for bulk and general cargo commodities. Although traffic moving through the Welland Canal and St. Lawrence River has fluctuated from year to year, the long-term trend since 1959 has been in a generally upward trend. About one-third of the total U. S. traffic movements through the Welland consist of U. S. - Canada movements of coal from Lake Erie ports to Canadian Lake Ontario power plants and grain moving from lakehead terminals (Duluth-Superior and Thunder Bay) to Canadian ports on Lake Ontario and lower St. Lawrence River ports for domestic consumption and export transshipment. Canadian to U. S. traffic is almost exclusively iron ore moving upbound from Canadian Labrador mines to steel producing U. S. ports on Lake Erie and Lake Michigan. Downbound exports of grain and upbound shipments of iron and steel products are largely responsible for growth in U.S. foreign traffic.

The capacity of a navigation system is determined by the system's most constraining element. For the Great Lakes/St. Lawrence Seaway navigation system the most constraining elements are the locks. Existing locks at the Soo, Welland, and in the St. Lawrence River restrict the physical size of the vessels that either enter the system at Montreal Harbor or move between each major Great Lake (i.e., Lake Superior and Lakes Michigan, Huron, and Erie, and Lake Erie and Lake Ontario). Increasing levels of commercial traffic over time result in a greater demand for service (i.e., tonnage to be transported) which can be expected to result in longer vessel waiting times and longer vessel queues as the physical limits of lock capacity are approached.

Each lock system has unique characteristics which determine the maximum amount of tonnage throughput. Variations in lock cycle time, number and size of individual locks and the volumes of tonnage plus fleet characteristics are all interrelated in the capacity analysis.

Revised capacity estimates for the three critical lock nodes in the GL/SLS are summarized in Table 3-1. These estimates are based upon the traditional navigation season and the Great Lakes fleet currently in use. The Welland Canal is expected to reach near-capacity conditions in the next few years followed by the Soo and St. Lawrence Seaway Locks.

Table 3-1 - Estimates of Capacity[1/]

Lock System	Approximate Navigation Season	Date of Capacity	Annual Tonnage [2/]
Soo Locks	1 April - 31 December 9 months	1990	163,800,000
Welland Canal	15 April - 15 December 8 months	1980	75,500,000
St. Lawrence River	15 April - 15 December 8 months	2000	95,000,000

[1/] Lock capacity criteria is defined as 87.5 percent mean lock utilization, 4-hour mean vessel waiting time, mean vessel queue of three vessels, and continued levels of vessel utilization (i.e., backhaul factors) that were observed during 1976.

[2/] Tonnage in short tons. Estimates of capacity are based on Arctec Lock Capacity Report, April 1979, pg 5-37 (Table 5.10).

Practical capacity for any waterway increases over time due to increasing average ship size, improved traffic control techniques and operational procedures, increases in the number of loaded backhauls (i.e., new commodity flows may develop where none existed before) or the number of noncommercial lockages for specified peak use period may be discouraged.

Table 3-2 shows projected traffic flow over a 50-year planning horizon for both the Welland Canal and the St. Lawrence section of the Seaway. These projections represent the traffic flows at the Welland and St. Lawrence assuming no constraints develop at the three critical lock systems (Soo Locks, Welland Canal, and the St. Lawrence Seaway) or major connecting channels such as the St. Mary's, St. Clair, and Detroit Rivers. This of course is an ideal condition which does not presently exist within the GL/SLS system. Constraints do exist at the above locks due to their physical dimensions and their limitation as to the number and size of vessels which can operate within the system.

Benefits can be realized from increasing system capacity by constructing additional or larger locks at those critical points within the system which will reach their maximum physical capacity. The initial constraint within the system will be reached at the Welland Canal in about 1980. Construction of additional or larger locks will allow more traffic to move through the canal and the GL/SLS. Under existing conditions, traffic will be constrained to about 75,500,000 tons assuming no major change in physical lock cycle times or vessel management techniques at the Welland Canal. Beyond this point, additional tonnage would have to be moved by either alternate transportation modes albeit at higher costs or the traffic forecasted beyond 1980 would incur substantial delay costs to both the cargo and the vessel owner/operators. A conceptual diagram of the potential benefits that may be realized by a Federal plan of improvement is shown in Figure 3-2.

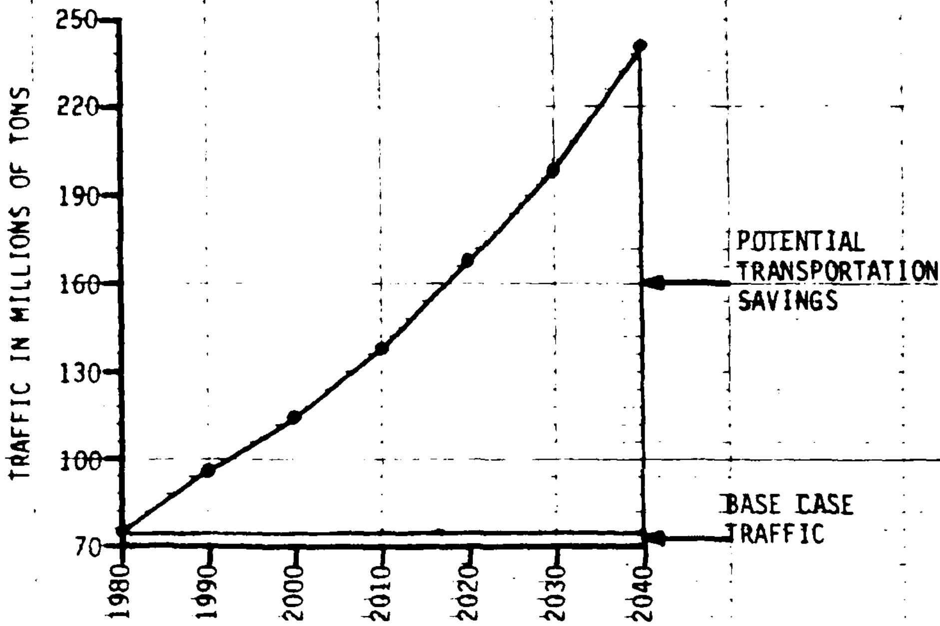
The interrelationships between the systemwide traffic flows and the location of the constraining elements (i.e., locks and connecting channels) are best illustrated in Figure 3-3. Several traffic flows pass through all three lock subsystems while other traffic flows require transit through only one set of locks. Estimates of system capacity have been developed without consideration of the interdependence of the three lock systems upon one another. Therefore, the projected near term capacity condition at the Welland Canal may limit the projected increases in grain, general cargo, and other bulk tonnage at the Soo or St. Lawrence River.

Limitations of Lock Size.

Vessels wishing to enter or exit the Great Lakes are limited to a length of 730 feet, a beam of 76 feet, and a draft of 26 feet 0 inches below low water datum (LWD). These limitations are imposed by the size of the locks on the Seaway and the controlling depth of the channels which is 27 feet below low water datum.

In 1966 only three vessels in the world merchant fleet exceeded a length of 1,000 feet. By 1970 this had grown to 81 vessels, practically all tankers. However, in 1970, 99.9 percent of the freighters in the world fleet were

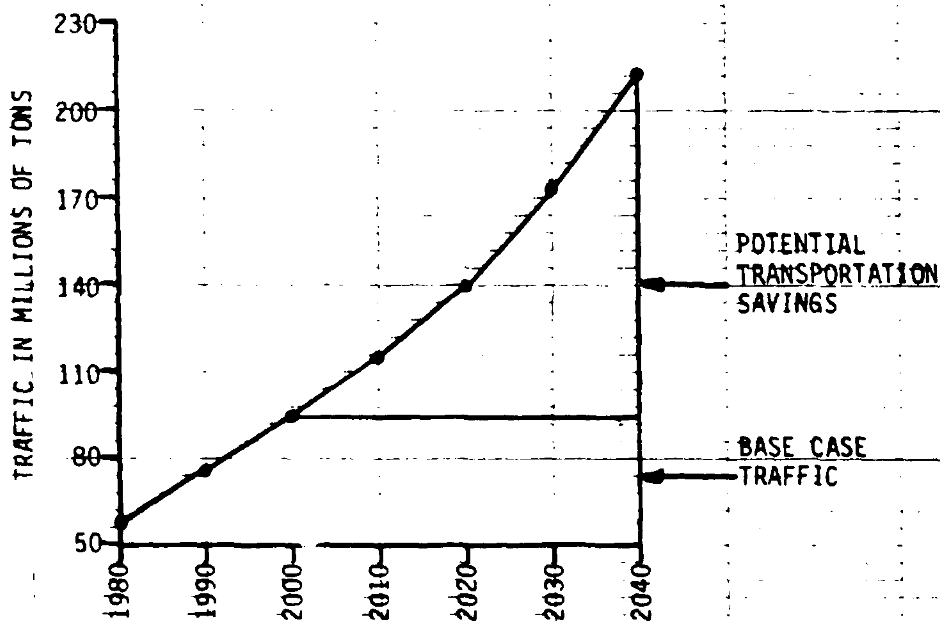
WELLAND CANAL - UNCONSTRAINED TRAFFIC - NORMAL SEASON



PROJECT PLANNING PERIOD

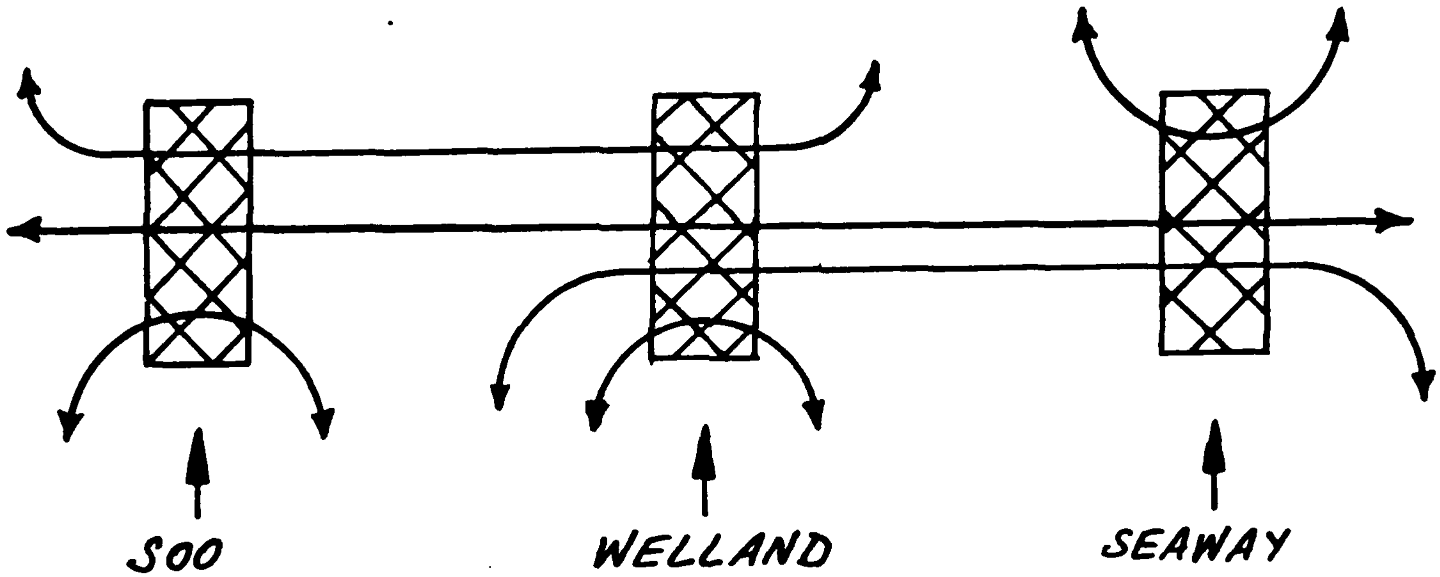
FIGURE 3-2

ST. LAWRENCE SEAWAY - UNCONSTRAINED TRAFFIC - NORMAL SEASON



PROJECT PLANNING PERIOD

FIGURE 3-3



CREDIT: FIGURE TAKEN FROM "[illegible]TEC LOCK CAPACITY ANALYSIS, VOL I", PERFORMED FOR NORTH CENTRAL DIVISION, CORPS OF ENGINEERS. REPORT DATED: 2 APRIL 1979.

TRAFFIC FLOWS WITHIN THE GL/SLS SYSTEM

FIGURE 3-4

Table 3-2 - Projected Waterborne Traffic for the Welland Canal and St. Lawrence Seaway[1/]
(Unconstrained System)

	Projected Flow in Thousands of Short Tons					
	1980	1990	2000	2010	2020	2030
I. WELLAND CANAL						
Soo/St. Clair/Welland/SLS	22,758	27,114	31,327	34,992	38,839	42,752
Soo/St. Clair/Welland	8,286	9,279	11,000	12,433	14,128	16,142
St. Clair/Welland/SLS	17,232	22,436	29,428	38,176	48,654	60,720
St. Clair/Welland	2,072	2,674	3,342	4,061	4,880	5,683
Welland/SLS	13,525	17,560	22,213	26,685	35,334	45,956
Welland	14,291	17,558	20,793	23,559	25,960	28,640
Total Welland Canal	78,164	96,621	118,103	139,906	167,795	199,893
II. ST. LAWRENCE SEAWAY						
Soo/St. Clair/Welland/SLS	22,758	27,114	31,327	34,992	38,839	42,752
St. Clair/Welland/SLS	17,232	22,436	29,428	38,176	48,654	60,720
Welland/SLS	13,525	17,560	22,213	26,685	35,334	45,956
SLS	8,075	10,850	14,897	18,309	22,313	27,246
Total St. Lawrence Seaway	61,590	77,960	97,865	118,162	145,140	176,674

1/ Computer forecast was developed by NCD-ADP in June 1979 and is based on an assumption of 9-month navigation season for upper four lakes and 8-month season for Lake Ontario and St. Lawrence River.

under 700 feet. Thus, the limiting length (730 feet) of the Seaway locks is not a problem to ocean going general cargo vessels, but does represent a problem for the larger dry bulk carriers, both laker and ocean going types, which over the years have increased in the 700-1,000-foot range. Containerships are also expected to increase in length in the 1,000-foot range and with the increased amount of container traffic on the Seaway, the locks will represent a limitation on their size.

The beam limitation of 76 feet is more critical to the ocean going fleet than is length. In recent years an increase in vessel beam has characterized the new ocean going fleet. The beam limitation thus limits more and more of the ocean going fleet which can utilize the Seaway. With the newer and more efficient vessels unable to utilize the system, the existing ocean going fleet on the Seaway will be characterized more and more by older and less efficient vessels. This in turn manifests itself by decreasing the competitiveness of the Seaway in world trade. The beam limitation is most important to containerships and ocean going bulk vessels. Most of the conventional breakbulk or general cargo (98.1 percent in 1970) have beams less than 76 feet and thus are not severely limited.

The 26 feet 0 inches draft restriction imposed by the Seaway locks is the most severe of the size restrictions. In 1969, less than half (47.5 percent) of the total world fleet, and in 1970, only 58 percent of the total world freighter fleet, had a usable draft greater than the permitted 26 feet 0 inches. In 1976, 66 percent of the ocean going vessels using the Seaway were restricted from using their full capable draft by the depth of the channels and locks. Though draft is not an absolute restriction, since vessel can vary their loading, it does restrict optimal use of the vessels. This is an important factor in determining transportation rates and thus in competing with other trade routes.

Weather and Ice Conditions.

Climate has both short and long term impacts on navigation. The most noticeable of these is ice formation. This is a long term impact which closes the Seaway from about 15 December to approximately 1 April. Ice formation is a consequence of the geographic location of the St. Lawrence and as such is not significantly controllable through human endeavors. Navigation at this time of year is dependent upon available ice breaking techniques and a dedicated program on a systemwide basis of winter navigation as is being pursued under the GL-SLS Navigation Season Extension Program.

During the 3-1/2 winter months that the Seaway is closed to navigation, money is lost as large fleets of expensive ships and dock facilities are immobilized, crews and longshoremen are unemployed, materials have to be stockpiled, and cargoes are rerouted to other modes of transport. General or break bulk cargo is particularly sensitive to this latter impact.

Long term fluctuations in the amount of precipitation in the Great Lakes basin cause corresponding fluctuations in lake levels. These fluctuations are most critical in harbors and channels. High water levels are bonuses, allowing vessels to load above normal drafts in the upper lakes, i.e. above the Welland Canal. Conversely, low levels limit drafts below the norm and represent a loss to the shipper. The water level on Lake Ontario manifest itself on the St. Lawrence in an entirely different way. With a high level on Lake Ontario, as has been experienced in recent years, larger amounts of water have to be discharged into the St. Lawrence which in turn increases velocities within the navigation channel. A decrease in speed for upbound vessels and a loss of controllability for downbound vessels are resultant consequences of the increased discharge from Lake Ontario.

Snow and fog are weather conditions which affect visibility severely, especially in confined channels, often halting navigation for days. Snow of course is limited to the colder months of the navigation season, during early April, November, and December. It is also during November and December that the St. Lawrence experiences its problems with fog. The water of the St. Lawrence River, having come from Lake Ontario, is warmer than the air. This condition causes fog which may last for days, although generally it is only a problem during the night and morning hours. These delays, again, equate to loss in transit time and reflect as a loss to the shipper.

Channels.

A vessel which is underway experiences a phenomenon known as "squat." This is actually a lowering of the water level around and behind a vessel. This causes the vessel to lie lower in the water than the surrounding undisturbed water. The present 27-foot channels have a maximum allowable draft of 26 feet 0 inches, thus allowing one foot for this squatting of the vessel. Although squat occurs in the open sea, it is much more pronounced in restricted or shallow waterways where its effects are more critical.

As a general rule, vessels attempt to track the centerline of restricted channels. When they deviate from the centerline, as they do in passing or overtaking another vessel and when correcting for eddy action, currents or course correction, they experience another phenomenon, "bank suction." This creates a powerful side force and yawing moment which increases with the distance from the centerline. The water level between the bow and the near bank will build up above its normal level and tend to force the bow away from the near bank, thus turning the bow of the ship towards the center of the channel.

As the water flows aft to fill the void left by the ship, the current generated by the ship in the confined area between the hull and the near bank is greatly increased. This results in a drop in water level and pressure, and the stern of the vessel is forced towards the near bank. Bank suction can be rather sudden and quite severe and can be the cause of groundings and collisions. Its effects can be further aggravated by poor steering characteristics of the vessel and shallow depth under keel. Pilots on the St. Lawrence Seaway have expressed their concern as to the dimensions of the channels and their respective impacts on the controllability of the vessels.

Currents.

Currents present a problem to navigation in a couple of areas in the International Section. With the creation of Lake St. Lawrence by construction of the Moses-Saunders Power Dam and control works the previous river valley was flooded. The navigation channels, requiring as straight a course as possible, were constructed across what had been bends in the river. The old river channel still carries the majority of the water and where it crosses the navigation course, causes cross currents. The current tends to push the vessel out of the navigation chnanel resulting in grounding of the vessel or possible collision. This may result in a delay to the vessel or posibly halt navigation altogether until the channel can be cleared. This can be a very critical problem especially when approaching a lock where control and maneuverability are essential.

Structural Integrity of Eisenhower Lock.

Eisenhower Lock has experienced a long history of concrete problems, particularly those relating to serious concrete deterioration. The first evidence of this deterioration was noted in April 1962, at the downstream miter gate recesses in the lock walls. Additional deterioration was found near diffuser openings, in the lower sill, and along the lower lock walls in the lock chamber. An inspection of the filling and emptying culverts in December 1962 disclosed some minor erosion damage near the valves and valve bulkhead slots and a large rock pocket in the ceiling of one of the culverts but no serious deterioration. During the 1962-1963 and 1963-1964 winter shutdowns, repairs were made to some of the damaged concrete in the culverts but there was still no report of serious deterioration occurring in the lock structure. However, when the locks were dewatered at the end of the 1964 navigation season, widespread and deep-seated deterioration of concrete was discovered in the culverts as evidenced both by erosion of up to 10 inches or more of concrete in some areas and the existence of hollow-sounding and cracked concrete in other areas.

A major concrete investigation program was consequently conducted by the Saint Lawrence Seaway Development Corporation and the Corps of Engineers during the winters of 1965-66 and 1966-67 to determine the extent and cause of the deterioration. On the basis of a Corps of Engineers in-depth analysis, the poor performance of the concrete in Eisenhower Lock is attributed to freezing and thawing damage of an inferior quality concrete. The inferiority of the concrete is considered to be related to the use of an inert natural cement as a replacement for part of the cement component. This had the effect that the exposed concrete at Eisenhower Lock was of the quality intended to be used in the interior, and the interior concrete was of an inferior quality not intended to be used anywhere in the project.

Repairs to the deteriorated concrete have been accomplished both by contract and by work forces of the St. Lawrence Seaway Development Corporation since deterioration was first noted in 1962, with major rehabilitation being performed during the winters of 1967-68 and 1968-69. Repairs have generally consisted of removal of deteriorated concrete to reasonably sound original material and/or a specified depth and replacement to original lines using conventional concrete placement or shotcrete with necessary reinforcement. All repairs have been effective in that they have accomplished their intended purpose.

Pilotage.

Prior to opening of the Seaway, pilotage was, for the most part, limited to the coasts and the section of the St. Lawrence below Montreal. With the opening of the Seaway to foreign vessels which were unfamiliar with the narrow channels and the Rules of the Road of the Great Lakes, it became evident to the governments of the U.S. and Canada that a pilotage system was needed. With the passage of the Great Lakes Pilotage Act of 1960 in the U.S. and the Canada Shipping Act, two parallel pilotage systems evolved.

Both acts require compulsory pilotage on the GL/SLS system with the exception of U.S. and Canadian vessels engaged exclusively in cargo movements west of the mouth of the St. Lawrence River. Because all segments of the system are not equally hazardous, they have been classified as either designated waters or undesignated waters. Designated waters, essentially the connecting channels, Welland Canal, and St. Lawrence Seaway, require that a pilot navigate the vessel. Undesignated waters, the Great Lakes, require that the pilot be on board the vessel but not necessarily navigating. From Montreal to Duluth there are eight pilotage zones, four of which are served exclusively by Canadian Pilots and four are served by both U.S. and Canadian pilots. The Great Lakes Pilotage Authority (GLPA), Ltd, a Canadian crown corporation, administers the Canadian pilotage system above Montreal and oversees four pilotage groups. The Great Lakes Pilotage Staff (GLPS) of the U. S. Department of Transportation administers the U.S. pilotage system on the Great Lakes and St. Lawrence Seaway. There are three groups administered by GLPS; St. Lawrence Seaway Pilots Assocociation (Snell Lock through Lake Ontario), the Lake Pilots Association, Inc. (Port Colborne to Lake Huron), and the Upper Great Lakes Pilots, Inc. (Lakes Huron, Michigan, Superior, and the connecting channels).

There are four districts above Montreal, one is all Canadian waters, the other three are international. Within these international districts the provision of pilots is shared equitably between the U.S. and Canadian pilot groups serving that district. Rotation of assignments between U.S. and Canadian pilotage groups is established by the Secretary of Transportation of the U.S. and the Minister of Transport of Canada through the Memorandum of Arrangements, Great Lakes Pilotage.

All U.S. pilots are entrepreneurs and although they operate at the direction of the Coast Guard, they are not employees of the Federal Government. Their incomes are dependent upon the pilotage services they provide and as such are directly proportional to the number of vessels served. Canadian pilots on the other hand, are civil servants in the employ of the Great Lakes Pilotage Authority.

This difference in the sources of income between U.S. and Canadian pilots has generated conflicts in the past. This was especially evident during the 1977 season. The Corp. of St. Lawrence River and Seaway Pilots, are the only pilots serving the reach between St. Lambert and Snell Locks. Prior to 1977 only one pilot was required for the trip from St. Lambert to Snell Lock. Following contract negotiations in 1977, the same segment was halved, requiring one pilot from St. Lambert Lock to Beauharnois and a second pilot from Beauharnois to Snell Lock. The requirement of additional pilots for this reach was not offset by the employment of additional pilots. During peak periods this need for additional pilots coupled with the fact that incomes of the pilots were not dependent on number of vessels served, caused delays. Vessels were required to lie at anchor until a pilot was available. Thee vessels, usually container or general cargo types, are very capital intensive, whereby delays caused by a lack of pilots may be more expensive than the piotage fee itself. This additional cost reduced the competitiveness of the system.

Other.

As the vessels in the world fleet increase in size, fewer are able to use the Seaway because of its size restrictions. The vessels which are able to enter the system are the older, lower powered vessel which do not reflect new advances in vessel design and performance. On a system which includes confined and twisting channels, currents, ice, fog, wind, and locks, all of which tax the controlability and maneuverability of the vessels, the outlook of continued deterioration (age and performance) of the vessel points to a greater risk of accidents and possible catastrophe such as oil or hazardous cargo spills. Presently, vessel inspections and enforcement of regulations help to control this problem by employing minimum standards for vessels entering the system.

OTHER RESOURCE PROBLEMS, NEEDS, AND OPPORTUNITIES

Although the study authority limits the investigation to the needs of present and future commercial navigation, it is important that the study also be cognizant of other resource problems, needs, and opportunities. The study will attempt to identify and solve other resource problems and needs as best it can in formulating plans for commercial navigation. Where the study is unable to solve or only partially solve other resource problems, it will make every attempt so as not to aggravate them.

Environmental.

Since the opening of the St. Lawrence Seaway in the mid-1950's many changes have taken place throughout the Great Lakes System. The seaway has allowed ocean going vessels access to the Great Lakes. This increased commerce has brought with it environmental problems, one of which is a higher incidence of oil pollution. This oil pollution has been from actual tanker accidents and also from bilge oil being illegally pumped out by ships while in the system.

The increased commerce has spurred development and with this development increased population throughout the basin system has occurred. This increased population has caused more demand for energy production. This demand has caused numerous new power plants - both fossile and nuclear powered - to be constructed. These power plants could be a potential contributing factor to alteration of natural water temperatures and air quality along the Lake Ontario and St. Lawrence shorelines.

The increased population and industrial development throughout the Great Lakes hinterland has brought greater amounts of both chemical and human wastes that must be disposed of. Many of these wastes are indirectly and directly being dumped into Lake Ontario. Since the St. Lawrence is a primary exit for water flows from Lake Ontario, the wastes are contributing toward degrading water quality along the river.

All of the preceding factors have caused stress on the existing natural system and can cause imbalances resulting in eutrophication of important shallow embayed areas. These shallows are used by numerous aquatic organisms during various stages of their life cycle and play a critical role in the total lake-river system ecology. Associated with such a eutrophic state, are negative impacts that detract from the natural aesthetic appearance of the aquatic and riparian environment along the shoreline.

Fisheries have been disturbed by man's action as well. The once original fish population has become unbalanced by overfishing, pollution, and habitat destruction. The result is the existence of a fish community dominated by three forage fish, the alewife, white perch, and rainbow smelt. The St. Lawrence area must rely on current management techniques to maintain a productive fisheries (SLEOC 1972 [1/]; 1978 [2/]).

Recreation.

The St. Lawrence River valley affords a unique opportunity for recreating by providing many attractions. These include the river, its islands and fisheries, visual contrasts of topography, scenery, vegetation, and the shoreline itself. Superimposed cultural and historic features, such as the international border, Seaway shipping, and historic sites, also contribute to this recreational opportunity.

As more people are attracted to this area to recreate, development of facilities must keep pace. Boat launching sites, marinas, boat storage, supply facilities, beaches, and fishing piers are required.

1/ SLEOC. 1972. Report on Coastal Resources. St. Lawrence-Eastern Ontario Commission. Watertown, NY: 317 Washington Street. 92 p.

2/ SLEOC. 1978. Coastal Resources - The Areas Fishery (Technical Report Series). St. Lawrence-Eastern Ontario Commission. Watertown, NY: 317 Washington Street. 193 p.

Accommodations for one night, weekends, and all summer, usually in sight of water or with access to, are furnished by State parks, campgrounds, cabins, cottages, motels, and resorts. Supportive activities such as gift shops, bait shops, boat tours, guides, museums, golf courses, and sporting goods stores also abound. All of these activities or developments contribute to the economic vitality of the area and make recreation a major contributor to the income of the region.

Figures supplied by New York State Parks and Recreation for the coastal zone of Jefferson and St. Lawrence counties, indicate that of the major recreational activities, only camping has a demand in the year 2000 exceeding the present capacity. This most likely will be remedied by increasing the present capacity as the needs warrant. Therefore, it appears that supply and demand for facilities is not a problem.

The problem arises that with increased development in response to the recreational influx, there is an accompanying use of the shoreline and water resources to the extent that their damage and destruction may result. It is feared that continued development of the shoreline following present trends will continually deteriorate the quality of the coastal resources to a point that they are no longer attractive to the recreationist.

Erosion and Shoreline Damage.

Prior to the building of the Moses-Saunders power dam and associated control structures and navigation facilities, the majority of the shoreline along the St. Lawrence River in the International Section was rock and nonerodible. With the construction of the Seaway and creation of Lake St. Lawrence along with an accompanying rise in water surface elevation, the shoreline and to some extent the lake bottom is now composed of erodible soil. Erosion of the shoreline can be attributed to wind generated waves on the lake, currents, and vessel generated waves. The degree and severity of each is not known at this time but is the subject of studies proposed under the Navigation Season Extension Program.

In the Thousand Islands section, in particular the Upper Narrows and Alexandria Bay area, erosion is not a problem because of the nonerodible shoreline, but because of the narrow channels and the resulting proximity of shore structures to the navigation channel, damage caused by natural wind generated waves and the wakes of passing vessels can become important. This is a potential problem during the latter part of the navigation season when ice adheres to shore structures. Waves generated by natural wind generated waves and the wakes of passing vessels can cause the ice to uplift resulting in piling and dock supports being pulled out.

SECTION 4

FORMULATING A PLAN

ST. LAWRENCE SEAWAY - ADDITIONAL LOCKS STUDY

SECTION 4

FORMULATING A PLAN

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SECTION 4

FORMULATING A PLAN

Because of the interrelationship of the various components of the GL/SLS system, any plan for additional locks and modifications to the channels in the U.S. section of the St. Lawrence Seaway must be formulated in light of compatible improvements to the other components of the system. Thus, such plans formulated by this study will include all Canadian locks and channels on the Montreal-Lake Ontario section of the St. Lawrence Seaway and compatible modifications to the Welland Canal section to include an alternate Lake Erie-Lake Ontario waterway paralleling the Welland Canal in U.S. territory.

CONCERNS

The concerns of the public regarding issues related to water and related land resources have been identified for this stage of the study. These concerns serve two purposes: (1) along with problems, needs, and opportunities, national objectives, and local goals and objectives, they aid in defining the planning objectives for this study, (2) they may equate to a possible impact, and as such, define data or information that must be obtained during the study to analyze such possible impact. With this latter purpose in mind, these concerns have been categorized into functional areas, thus enabling easier analysis and grouping for consolidation of required data and information needs. Appendix F presents a more detailed description of these concerns and provides a cross reference to work items to be performed during the study. At this point in the study, the following summary of concerns represents those which have been gleaned from past public involvement efforts of past studies and various Great Lakes agencies.

<u>Environmental Concerns</u>.

Environmental concerns, as they relate in particular to the St. Lawrence River area, are interrelated with the economic and social concerns of the area, and in many cases are difficult to separate. The important fish and wildlife, cultural, and aesthetic resources of the St. Lawrence form the primary base for the tourist and recreation industries which comprise a large portion of the area economy. These industries are regionally and locally important. Environmental degradation poses a threat to their economic stability. Any decrease in the environmental quality of the St. Lawrence may also impact the life style of the residents and how they view their own "quality of life."

<u>Environmental Concerns Related to Construction</u>:

- Physical disruption of benthic communities.

- Turbidity and pollution by resuspended sediments.

- Disposal of dredge spoil and excavated material.

- Inshore and deep water erosion.

- Effect of water levels on wetlands.

- Determination of significant habitats in the area which require inventory and investigation.

- Determination of short and long term restrictions to boating, swimming, fishing, etc.

- Relationship of navigation development on the St. Lawrence with the need for systemwide changes.

Socio-Economic Concerns

Social concerns which have been expressed are in many cases also related to economics. Therefore, these two sections have been combined.

- Effects of further navigation improvements on the economy of the St. Lawrence region and the Great Lakes system.

- Cost, environmentally and economically, to the local region for the benefit of mid-America.

- Impacts on employment directly associated with any further development and subsequent impacts on the local economy.

- Impacts on other modes of transportation.

- Full use of intermodal transportation networks.

- Needs for further development must be valid.

- Who benefits?

- Who will pay?

- Distribution of benefits and costs among system components, and the U.S. and Canada.

- Effects of tolls.

- Effects of larger ships on economy of smaller ports.

- Optimize navigation development of the entire GL/SLS system.

- Reliability of economic projections.

- U.S. - Canadian coordination of future needs.

- Regional and national transportation policy.

- Need for larger vessels.

- Effects of navigation season extension on the needs for further development of the Seaway.

- Coordination with other on-going studies.

- Effects of increased water usage on power production.

- Energy conservation.

- Effects on adjacent Indian reservation.

Engineering Concerns.

- Relationship of Canadian and U.S. locks on the St. Lawrence and the Welland Canal.

- Non-structural and low-scale structural means of accomplishing capacity increases.

- Effects on water levels.

- Navigation aids for precise and all-weather navigation.

- Increase lock utilization through vessel communication and traffic management developments.

- Channel widths and depths should reflect present state-of-the art for channel design.

- Effects of larger vessels on shore erosion and shore structures.

- Concrete deterioration at Eisenhower Lock.

- Effects of speed restrictions on vessel controllability.

- Effects of larger vessels on the number of vessels using the system and accident risk.

- Lock design should try to reduce transit time, improve safety, and limit damage to vessels and locks.

- Impacts of changing ocean transportation technology on lock and channel design.

- Changes in vessel size of the future fleet.

These concerns will be expanded and refined as the study progresses and plans are developed.

PLANNING OBJECTIVES

A set of planning objectives was established as guidelines for subsequent formulation of alternative plans. Each plan will be evaluated as to if and how well it addresses these objectives. These objectives have been identified by analyzing the problems, needs, opportunities and concerns of the project and study areas vis-a-vis the national objectives of economic development and environmental quality, and the authority for the study. The planning objectives to be used in directing the formulation of alternative plans for this study are:

- to develop a plan for the entire Great Lakes-St. Lawrence Seaway System, and specifically the St. Lawrence Seaway which would enhance national economic development and maximize the environmental quality, and would contribute to the regional development and social well-being of the Great Lakes area;

- to increase the capacity of the present Great Lakes-St. Lawrence Seaway System in terms of both tonnage and vessel transits;

  - decrease the risk of vessel accidents and groundings;

  - maintain the structural integrity of the existing Dwight D. Eisenhower and Bertrand H. Snell locks;

  - decrease the occurrence of shore erosion and shore structure damage due to vessel produced waves;

  - preserve and enhance the quality of the environment within the Great Lakes-St. Lawrence River basin.

  - determine recreational boating impacts on commercial navigation.

As planning progresses, these planning objectives will be continuously reanalyzed and refined as new problems and needs are identified or regional objectives change.

Study authority limits the study objectives to those related to commercial navigation. For the study to be truly responsive to the nation it must also be cognizant of the problems, needs and opportunities of other water and related land resources. This recognition is displayed in identifying the formulation and evaluation criteria in the following section.

FORMULATION AND EVALUATION CRITERIA

Policy for multiobjective planning, derived from legislative and executive authorities, establishes and defines the national objectives for water resources planning, these being National Economic Development (NED) and Environmental Quality (EQ). It also specifies the range of impacts that must be assessed, and sets forth the conditions and criteria which must be applied when evaluating plans. Plans must be formulated with due regard to benefits and costs, both tangible and intangible, and effects on the ecology and social well-being of the region.

The study planning process uses a framework established in compliance with the Water Resource Council's Principles and Standards for Planning Water and Related Land Resources, which requires the systematic preparation and evaluation of alternative solutions to problems, under the objectives of National Economic Development (NED) and Environmental Quality (EQ). This process requires that the impacts of a proposed action be measured and the results displayed or accounted for in terms of contributions to four accounts: NED, EQ, Regional Development (RD), and Social Well-Being (SWB). The formulation of alternative solutions must be conducted without bias as to structural and nonstructural measures.

The following criteria were developed in full recognition of those problems and needs of the study area which because of the study authority cannot be addressed as primary objectives of this study. They are thus expressed here as criteria and as such are given full consideration in the formulation of plans which address the study or planning objectives. These criteria were developed to set forth the specific constraints and parameters which bear directly upon the formulation of plans, and measure their responsiveness to the study objectives for evaluation purposes.

Size limitations, expressed under Technical Criteria, are the result of a Maximum Vessel Size Study (MVSS) completed January 1978 by the North Central Division, Corps of Engineers. This study is an economic screening of various vessel sizes and the GL/SLS system required to support them. From a U.S. standpoint, the size of an optimal system is dependent upon the degree it relates to depth of channels and locks. Due to funding limitations, only two of the many potential U.S./Canadian cost scenarios were analyzed. Analysis of additional scenarios will be evaluated during Stage 2-Development of Preliminary Plans. These scenarios are described in Appendix D which also furnishes a summary of the MVSS. The size limitation expressed in the following criteria will be modified at that time.

Technical Criteria.

a. Maximum size vessel for consideration on both the Welland Canal and Montreal-Lake Ontario sections of the Seaway is 1,000 feet long with a beam of 130 feet.

b. Length of navigation season for the Seaway from Lake Erie to Montreal is assumed to be eight months without season extension, 11 months with season extension and without additional locks, and 12 months with season extension and with additional locks.

c. Alternative plans must be engineeringly feasible, practicable and sound.

d. Structural plans will be adequate to provide a project life of 50 years.

e. Existing facilities will be utilized to the maximum extent possible.

f. Resultant flows of the St. Lawrence River for a plan of improvement must meet with criteria established by the Orders of Approval for the Regulation of Lake Ontario and Downstream Physical Constraints and subsequent Plan 1958-D for the regulation of Lake Ontario.

g. Additional navigation facilities will minimize water usage so as to cause the smallest possible reduction in power generation.

h. Construction techniques will not impair the use of the system.

Economic Criteria.

The economic criteria which are applied in formulating and evaluating a plan are those specified in Principles and Standards for Planning Water and Related Land Resources adopted by the Water Resources Council, 25 October 1973, and are as follows;

a. Tangible benefits exceed project economic costs.

b. Each separable unit of improvement provides benefits at least equal to its cost.

c. The scope of the development is such as to provide the maximum net benefits (benefits minus costs); however, intangible considerations could dictate a project which would forego a relatively small percentage of net benefits.

d. There is no more economical means, evaluated on a comparable basis, of accomplishing the same purpose or purposes which would be precluded from development if the plan were undertaken. This limitation refers only to those alternative possibilities that would be physically displaced or economically precluded from development if the project were undertaken. The plan resulting from application of the foregoing criteria provides a baseline for consideration of the numerous other factors which are not reflected in quantifiable economic terms, but which may warrant modification of the plan.

e. Benefits will be derived from a comparison of the projected "without-project" conditions to the projected "with-project" conditions.

f. Intangible benefits will be evaluated in quantified terms, where possible, and will be included in the impact assessment.

g. The costs for alternative plans of development will be based on preliminary layouts, estimates of quantities, and price levels current at that time.

h. The benefits and costs should be in comparable economic terms to the fullest extent possible.

i. The plan should enhance the economic vitality of the Great Lakes-St. Lawrence Basin.

Environmental and Socioeconomic Criteria.

a. Increase the opportunity for recreational use of the St. Lawrence River basin consistent with the area's resources.

b. Protect and enhance the scenic and aesthetic resources of the basin.

c. Conform to regional land use and development plans.

d. Available sources of expertise will be utilized to identify forms of fish and wildlife which might be endangered, damaged, or destroyed by plan implementation.

e. The use of natural resources to effect implementation of a plan will be minimized.

f. Activities attracted to the project area after plan implementation should be consonant with activities of the surrounding area, and be environmentally and socially acceptable.

g. Plans should minimize and, if possible, avoid destruction or disruption of community cohesion, injurious displacement of people, and disruption of desirable community growth.

h. Protect historical, archeological, and other public interest areas.

i. Investigate system design alternatives which would decrease the chances for an oil or toxic substance vessel spill.

j. Plans should maximize the beneficial and minimize the adverse effects of the project on man-made resources, natural resources, and air, water, and land pollution.

k. Plans should avoid detrimental environmental effects to the extent feasible. Unavoidable adverse environmental impacts should be fully noted, analyzed quantitatively when possible and qualitatively when not, so that knowledgeable decision making would be possible and feasible mitigating features for such effects can be included.

l. A plan is acceptable only if it is supported by some significant segment of the public. Every attempt will be made to eliminate, to the extent possible, unacceptability to any significant segment of the public.

POSSIBLE SOLUTIONS

The following is a description of measures which in whole or part are possible solutions to problems attending navigation on the St. Lawrence Seaway. Because of the interrelationships of the various sections of the Seaway, all measures and subsequent plans will address the entire St. Lawrence Seaway from Lake Erie to Montreal.

Capacity.

Modification of Existing System. This measure would make modifications to the existing locks and channels in length, width, and depth. This does not appear to be a feasible measure because the existing system, which consists of a series of locks with their connecting channels, would have to be closed to navigation over a prohibitive length of time. If any such schemes were considered they could require changes to the present regulation plan for Lake Ontario. Any changes to the preent regulation plan would require approval of the International Joint Commission before implementation.

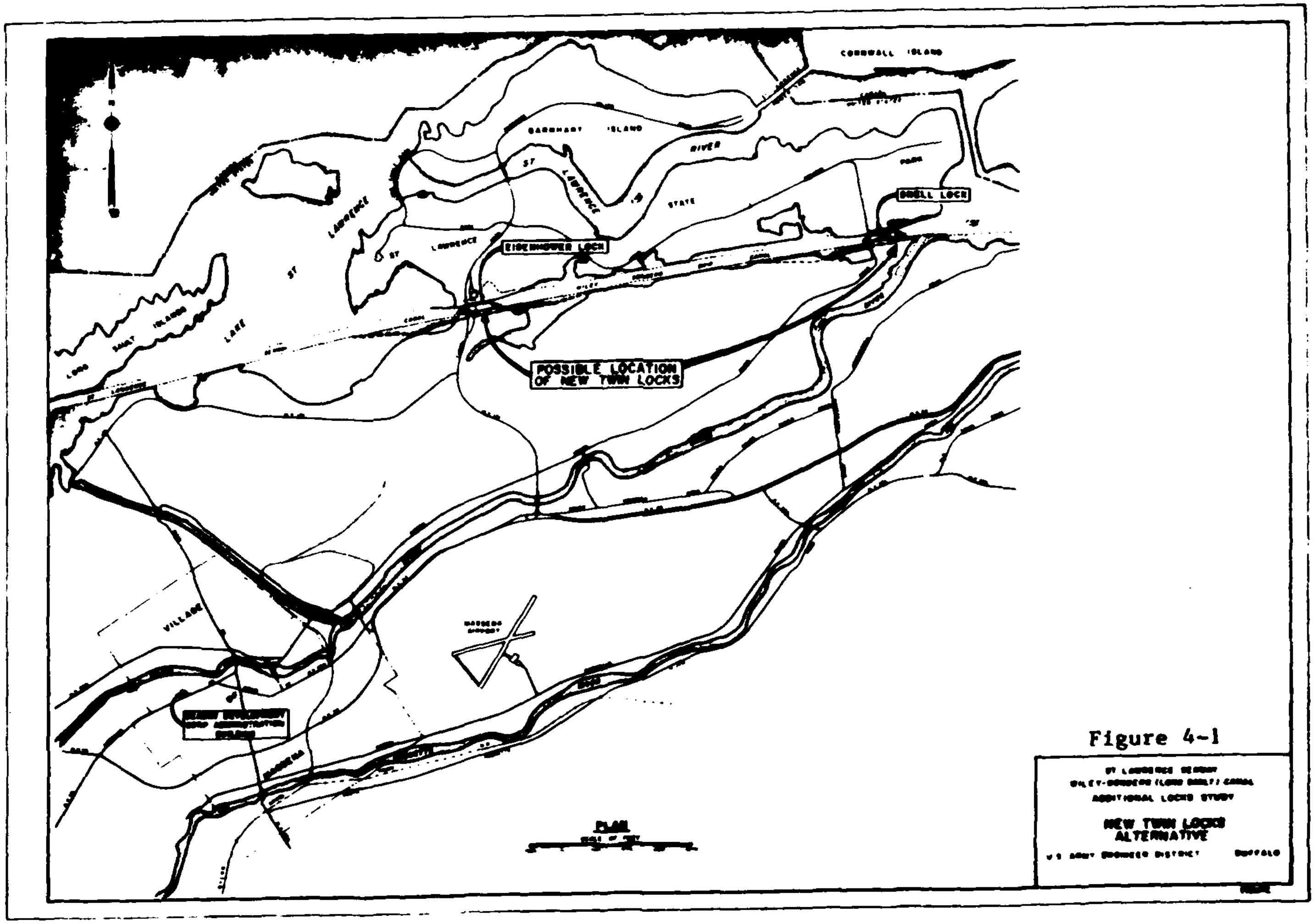
Additional Locks. This measure would address increasing the capacity of the existing locks with additional ones of the same or larger size. If a larger size is deemed necessary, it will require channel modifications also.

Various schemes for each lock site will be investigated. In addition to plans for additional locks on the Welland Canal, a plan for a canal (Lake Erie - Lake Ontario Waterway) in U.S. territory will be considered. At Iroquois, both an additional Canadian and U.S. lock will be considered as respective plans. The Snell and Eisenhower locks will be expanded by consideration of parallel locks, and a new canal and high-lift lock in U.S. territory (Figures 4-1 and 4-2). Formulation of plans for the Upper and Lower Beauharnois, Cote Ste. Catherine, and St. Lambert Locks will warrant further investigation and coordination with Canada.

All-Weather Navigation. This measure will be addressed singularly and in conjunction with other measures. This measure includes navigational aids and aids to navigation. St. Lawrence Seaway Development Corporation is presently investigating a Precise All Weather Navigation System (PAWNS) under the Navigation Season Extension Program.

Operating Procedures. This measure would evaluate present operating procedures at the individual locks and sections of the system, in particular, vessel monitoring and vessel processing procedures. The incorporation of a Great Lakes-St. Lawrence Seaway computerized monitoring system would enable scheduling and processing of vessels through the locks and constricted channels so as to get the optimum performance from the present or future system.

Season Extension. This measure would extend the amount of time when the existing locks are available for use by extending the navigation season. The present operating period is 8-1/2 months. The Detroit District, Army Corps of Engineers is presently involved in a survey level study entitled, "Great Lakes and St. Lawrence Seaway Navigation Seaway Extension." This study is investigating several alternatives ranging from the present season to an 11-month navigation season. By extending the navigation season the effective capacity of the system could be increased without closing down the existing facilities for a prohibitive length of time or the expense of additional locks. This altenrative may only prolong the issue as capacity will probably be reached at a latter date.


CORNWALL ISLAND
BARNHART ISLAND
ST LAWRENCE RIVER
STATE PARK
SNELL LOCK
EISENHOWER LOCK
LAKE ST LAWRENCE
POSSIBLE LOCATION OF NEW TWIN LOCKS
VILLAGE
PLAN
ST LAWRENCE SEAWAY
WILEY-DONDERO (LONG SAULT) CANAL
ADDITIONAL LOCKS STUDY
NEW TWIN LOCKS ALTERNATIVE
U S ARMY ENGINEER DISTRICT BUFFALO
Figure 4-1

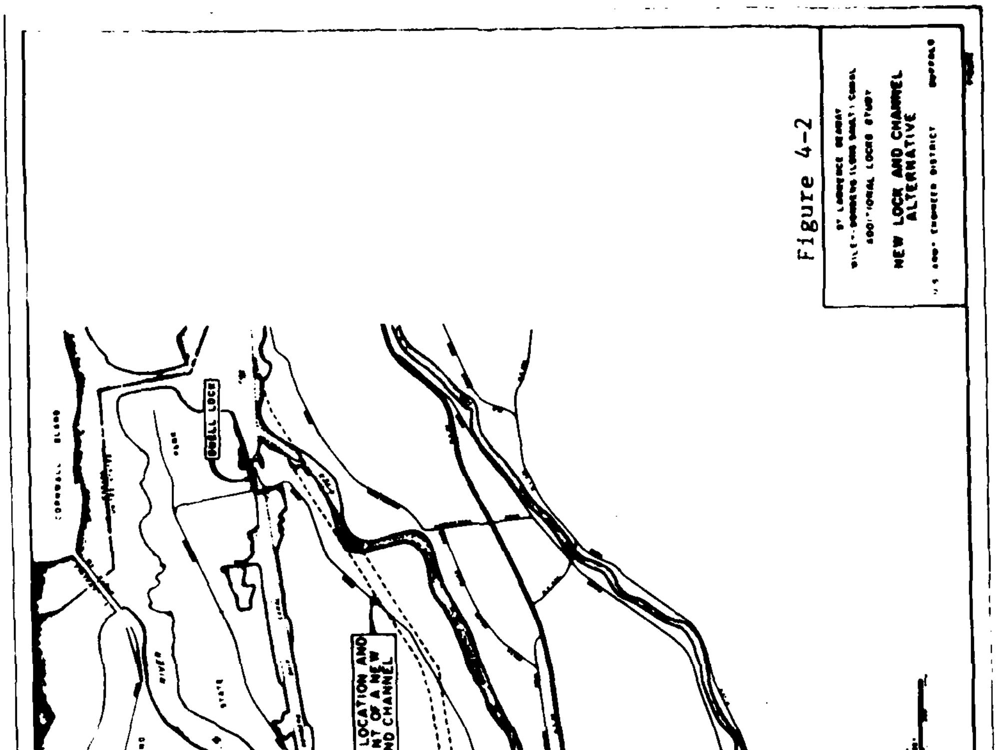


Figure 4-2
NEW LOCK AND CHANNEL ALTERNATIVE
POSSIBLE LOCATION AND ALIGNMENT OF A NEW LOCK AND CHANNEL
SNELL LOCK
EISENHOWER LOCK
PLAN

Great Lakes Connecting Channels and Harbors Study. This study will initially determine the engineering, economic, environmental and social feasibility of providing needed navigation channel, harbor, and lock improvements up to the maximum size permitted by the St. Marys Falls Canal, in the Great Lakes Connecting Channels and Harbors. (i.e., The study will address the determination of optimum channel and harbor improvements to be compatible with the future and prospective needs of deep-draft commercial navigation with emphasis on environmental, social, economic, and engineering acceptability.) Studies would then be made to determine if additional improvements would be necessary, or warranted, for larger vessels.

Alternate Trade Route. This measure considers the use of an alternate trade route which would be more advantageous to certain commerce using the Seaway. Such a consideration is the New York State Barge Canal and Hudson River, or from Oswego, NY to the Atlantic via the Oswego and Erie Barge Canals and the Hudson River. Because this study does not have the authority to make recommendations for development of the Barge Canal, this measure will be limited to assumptions of levels of development, i.e. deep draft ship canal and deep draft barge canal at various depths and for various sizes of ships and barges. Impacts of either Barge Canal configuration on the level of forecasted traffic for the GL/SLS route and the subsequent need for improvements on the Seaway will be investigated. Plans of development and their costs will be considered only to the point of determining the viability of such assumed development and will be cursory in nature.

Marine Shunter System. This measure addresses capacity by decreasing lockage time and thus allowing more vessels to use the system. The shunter system utilizes specially designed tugs or shunters in combination with a precise guidance system. The tugs attach to the aft or bow of a vessel and guide them through the locks. This system eliminates the use of the guide wall for entry and the need for mooring while waiting for entry to the lock and during the lockage itself. Presently, prototypes are under construction for testing on the Welland Canal during the 1979 shipping season. Preliminary studies indicate a 20-25 percent savings in total lockage time. Kevels and mules will also be investigated.

Currents and Channels.

Modifications to the existing channels might include control and diversion measures and dredging are possible solutions for currents. To aid controllability and maneuvering problems channels may require widening and deepening using new advances in the state-of-the-art of channel design.

Structural Integrity of Existing U.S. Locks.

Measures for addressing this problem warrant additional investigations into the problems of concrete deterioration and remedies. An interim report is being prepared on this subject and should be available in the near future.

Pilotage.

This is an institutional concern which falls within the jurisdiction of the U.S. Coast Guard. Thus, solutions will not be investigated during this study.

Other.

Measures which address the deterioration (age and performance) of the present fleet using the system are in essence the same measures previously mentioned. By increasing the size of the locks and channels, newer, more modern vessels which are safer and more dependable will be able to use the system. An increase in size will require fewer vessels thus reducing the chance of accidents and spills. Also, more modern vessels will reflect newer design such as double hulls, etc., which reduce the chance of oil and hazardous cargo spills.

ECONOMIC BENEFITS AND COSTS

Methodology.

Economic justification of proposed plans will be determined by comparison of equivalent average annual charges for interest, amortization, plus operation and maintenance, with the average annual transportation related benefits estimated to be realized during the economic life of the proposed engineering works. The values given to benefits and costs at the time of their accrual will be made comparable by converting the actual stream of undiscounted benefits and costs to an equivalent basis by using the discount rate applicable to public works projects.

The Great Lakes-St. Lawrence Seaway Traffic Forecast Study, which was developed under contract for North Central Division, Corps of Engineers, will be used extensively to determine the following components for the economic analysis:

a. Projections of water-susceptible traffic in the Great Lakes hinterland over the next 50 years.

b. Great Lakes waterborne transportation rates and overland mode transportation rates; rate savings for waterborne shipments are an input into the calculation of the GL/SLS market share of potential traffic derived above.

c. The share of total potential traffic that could be attributed to the GL/SLS system based upon a variety of improvement scenarios (i.e., lock twinning, larger locks, season extension).

A range of scenarios will be used in the economic evaluation of proposed improvements that will increase the capacity of the Montreal to Lake Erie section:

a. No modification to the existing locks and channels at the Welland Canal or St. Lawrence River; under these conditions the Welland Canal becomes the initial constraint on the growth of traffic.

b. Duplicate locks (lock twinning) which will enable more annual transits and tonnage by existing "Seaway" class vessels, followed by season extension activities.

c. Additional (larger) locks which will enable large vessels now confined to the Upper Great Lakes or ocean vessels prohibited from entering the system to navigate between Montreal and Lake Erie into the Upper Great Lakes; followed by season extension.

d. Non-structural improvements which will focus upon improved vessel control techniques, reduced lock cycle times with some degree of extended season operations in effect.

e. In order to establish some guidelines for the economic evaluation of the additional locks alternative, a preliminary screening of vessels and season extension up to 11 months; followed by duplicate locks.

f. Season extension up to 11 months, followed by additional (larger) locks.

An analysis of alternative system sizes was performed by Artec, Inc. under contract to Chicago District, Corps of Engineers. North Central Division staff served as representatives for the Contracting Officer and as Technical Project Managers. The study entitled "Maximum Vessel Size Study," is included in Appendix D. This study includes both the St. Lawrence Seaway locks and the locks at Sault St. Marie. The report was based upon total U.S. traffic only (i.e. it only deals with benefits to traffic with a U.S. Great Lakes port as the Origin/Destination of the traffic) and the analysis was broken down into two scenarios; season extension in effect prior to introduction of larger locks and vessels and construction of larger ships and locks preceding season extension. It was assumed in this report that larger facilities would not be constructed until the existing system capacity is reached; a point in the future which depends upon the sequence of improvements just discussed above.

Improvements that would lower the cost basis of waterborne transportation would generate benefits to current tonnage now moving in the study area. In addition, the Great Lakes system should also enjoy an increased market share by virtue of tonnage diverted from alternative modes of transport.

Capacity calculations for the existing locks and channels at the Welland Canal and St. Lawrence River are now under study based upon a contract between North Central Division and Arctec, Inc. The results of their analysis will be a quantitative estimate of the existing capacity and the sensitivity of this value to length of the navigation season.

Costs.

A summary of project costs (Federal and non-Federal) for the various improvements associated with the proposed plans will be presented. First costs of all improvements will include both initial capital costs and replacement costs discounted to present worth as of the base year for the study.

Annual interest and amortization charges will be based on the current Federal interest rate and an assumed life of 50 years. A typical cost summary for an improvement alternative is illustrated below.

Total First Costs	$ xxx
Interest During Construction	xx
Total Investment Cost	$ xxx
Annual Costs (Interest and Amortization)	$ xx
Annual Costs (Operation and Maintenance)	x
Total Annual Costs	$ xx

The measurement of Canadian traffic flows and benefits received by Canada for any plan of improvement will be considered at parity with U.S. traffic flows and benefits. Fluctuations in the relative value of Canadian dollars for the period 1970-1977 was not considered significant for separate treatment of each benefit flow. The average dollar exchange rate between the two countries was .9897 U.S.

Discount rates to be used in the economic evaluation of future system improvements are based upon statutory interest rates. This rate is defined as the average interest rate for long-term (maturity date of 15 or more years in the future) interest-bearing marketable securities of the U.S. Government. Similar structures issued by the Canadian Government paid an interest rate of 8.7 percent as of 1977. To overcome this discount rate dichotomy and still acknowledge the difference in the cost of capital for social investment, the economic evaluation will be conducted at the appropriate U.S. discount rate but include a sensitivity analysis based upon the Canadian interest rate prevailing at that time. This compromise would serve to establish the relative efficiency of other water resource options available to each nation.

Transportation Rate Savings.

Non-Structural Improvements. Season extension activities are presently under study and are pursuing a three phase approach to implementing season extension on the GL/SLS system. Phase I included implementation of season extension to 31 January (± 2 weeks) on the upper four Great Lakes using only existing operational measures. An interim report for this geographic area has been prepared and forwarded to the Secretary of the Army's Office for review and subsequent transmission to the Office of Management and Budget and to Congress. Phase II consists of the feasibility of all-year round navigation on the upper three Great Lakes and extension to 31 December on the Welland Canal-Lake Ontario-St. Lawrence River. Phase III is all-year navigation on the St. Clair-Lake St. Clair-Detroit River-Lake Erie subsystem and on the Welland Canal-Lake Ontario-St. Lawrence River portion of the system. Canadian participation in extended season activities has not yet been secured for those specific system segments which are critical for system-wide improvements. The extent and timing of season activities within the Montreal-Lake Erie portion of the system will be further assessed in a report being prepared by Detroit District, Corps of Engineers for submission to North Central Division in FY 79.

Increases in practical capacity of the locks, as determined by simulation models, will be compared to existing traffic forecasts to obtain an estimate of the additional traffic allowed to move on the system as a result of these improvements. Benefits are measured as the product of transportation rate savings, the rate differential between the current waterborne rate and the best alternate (R_w -R_{alt}), and the incremental tonnage able to use the improved locks and channels.

Non-structural measures (assumed to be all applicable measures short of new lock construction, channel improvements, etc.) may include such items as ice management, shunter tugs, ice booms and improved vessels communications and vessel handling techniques.

Non-structural improvements may also be implemented in conjunction with season extension activities. Season extension activity has a two-fold impact; extended season activity changes the shippers perception of the existing system and may induce traffic from other alternative transportation modes due to a change in the improved service factors. Lower rates due to improved vessel utilization also makes the waterborne mode more competitive and contributes to higher traffic forecasts.

Practical capacity of the non-structurally improved system also increases after implementation of extended season activity. Each interval of season extension (i.e., one week, two weeks, three weeks, etc.) has historically been considered in earlier Corps of Engineers capacity studies as resulting in a proportional increase in annual tonnage through-put. Although this may be the most optimistic of assumptions, the conclusion remains that an extension in the length of season defers the problem of lock capacity into the future.

Structural Improvements. Construction of a duplicate or additional lock contributes to increased capacity in two ways: The incremental practical capacity rises as a result of the capability to lock more vessels through the existing facilities; in addition, duplicate/larger locks also provides the existing system with the potential for year-round navigation. Shippers using the GL/SLS would now perceive the improved system as offering a longer navigation season than before, hence, induced traffic flows would also benefit from the structural improvement.

Duplicate Locks.

Transportation rate savings, assuming construction of duplicate locks, would be measured as the additional annual tonnage projected to move during the normal season multiplied by the existing rate differential between waterborne and best alternate mode. Additional rate savings on induced traffic would also be credited to construction of a duplicate lock. This additional traffic consists of that traffic which would develop as a result of improved service (i.e., longer navigation season) and lower rates (i.e., due to improved fleet utilization) which would be available for the remainder of the project planning period.

Larger Locks.

Construction of larger locks would produce benefits to existing traffic projected to move during the planning period, traffic induced to move on the GL/SLS as a result of lower freight rates attributed to larger vessels, and to the induced traffic which would develop as a result of year-round navigation potential.

Secondary Regional Impacts.

Secondary regional impacts of increased capacity on regional economic activity (including the St. Lawrence River hinterland) will be addressed. Levels of traffic flows under constrainted and unconstrained scenarios will be forecast and the economic impacts (positive and negative) will be delineated.

Energy.

Contributions of waterborne bulk movement towards conservation of national energy supplies will be developed. Increasing maximum tonnage throughout at the Welland and St. Lawrence River will allow more bulk and general cargo to move to/from GL/SLS harbors and their economic hinterland. This will contribute positively to conservation of national energy supplies and reflects the inherent efficiency of the waterborne mode related to alternate modes. Comparison of the energy efficiencies of the various modes of transport are summarized in Table 4-1.

Table 4-1 - Relative Energy Efficiency of Freight Transportation by Mode

Mode	BTU's per ton-mile	Ton-miles per gallon
Pipeline	-	300.0
Waterway (Barge-Towboat)	500	250.0
Railroad	750	200.0
Truck	2,400	58.0
Airplane	63,000	3.7

Source: The Great Lakes Transportation System, Univ. of Wisconsin Sea Grant Program, Jan. 1976

Rising costs for fuel, a trend which is expected to continue into the future, is changing the relationship between fuel costs and the other elements of cost in providing transportation for bulk and general cargoes. Costs and availability of fuels affect the various alternate modes to varying degrees. Modal choice of the shipper is increasingly reflective of the relative fuel efficiency and costs of the transportation services offered by each mode. Except for pipe-lines when they are available, waterway transportation is usually the most energy efficient of the several modes available to shippers.

Under existing conditions, fuel and energy savings accrue to our economy as a result of deep-draft (27 ft.) channels in the Seaway. However, as traffic levels increase over time and congestion and vessel queues develop at lock exit and entry points, the level or growth in these fuel savings may be jeopardized. Increases in system capacity resulting from structural or nonstructural modifications to the existing system may make positive contributions to energy conservation efforts.

SECTION 5

SELECTING
A PLAN

ST. LAWRENCE SEAWAY - ADDITIONAL LOCKS STUDY

SECTION 5

SELECTING A PLAN

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SECTION 5

SELECTING PLAN

The selection process is accomplished through the completion of two primary tasks. These tasks are "Impact Assessment" and "Evaluation." The tasks are carried out initially for all alternatives which address one or more of the planning objectives. This process is then repeated in more detail to again select the best of the remaining plans. This iterative impact assessment and evaluation process is continued until a single best plan is selected. One of the results of each iteration is the determination of the type and depth of further studies required to continue the selection process.

IMPACT ASSESSMENT

Impact assessment is the identification, description, and, if possible, measurement of the effects of the different alternative plans on the base year condition. Impact assessment provides for analyzing the significant effects of each alternative. These are the economic, social, or environmental consequences of an alternative which would be likely to have a material bearing on the decision-making process. Impact assessment requires forecasting where and when significant primary, and higher order effects could result from ilmementing a given alternative. This determination requires analyzing and displaying monetary and nonmonetary changes in an objective manner based on professional and technical assessment of the resources. The absence of change or no net change from the base condition could also be a significant impact in certain instances, and care will be taken to surface such information during this task. Describing impacts does not reflect societal preferences; these preferences are determined through subsequent evaluation. Activities to be carried out in impact assessment are as follows:

Determine Source of Impacts. The aspects of each alternative that could cause significant impacts will be identified and specified. This requires analyzing the inputs, measures, and outputs associated with the alternatives to determine causative factors that could impact on elements of the base condition.

Identify and Trace Impacts. The causative factors related to each alternative should be compared to the elements of the base condition for the purpose of identifying impacts. Identifying impacts requires forecasting whether these factors could cause significant changes from the base. Accomplishing this requires cause and effect analysis to identify and trace through those impacts which are significant.

Specify Incidence of Impacts. The geographical location of each impact should be identified. In addition, it will be necessary to establish when impacts are expected and their duration.

Measure Impacts. As precisely as possible, the magnitude of each impact will be determined. The impacts will be quantified using appropriate monetary or nonmonetary units or concisely characterized in a written description.

The following is a preliminary listing of effects to be evaluated during this process. Other effects may be added to the list as required by the particular alternatives being evaluated.

Social and Cultural Effects.

- Noise
- Displacement of People
- Esthetic Values
- Community Cohesion
- Community and Area Growth

Economic Effects.

- Revenues
- Property Values
- Public Facilities
- Public Services
- Regional Growth
- Employment/Labor Force
- Business and Industrial Activity
- Displacement of Farms
- Energy Consumption
- Benefits
- Costs
- Benefit/Cost Ratio
- Intermodal Gains/Losses

Environmental Effects.

- Man-made Resources
- Natural Resources
- Air Quality
- Water Quality

EVALUATION

Evaluation is the analysis of each plan's impacts against the "without condition" and against the other plans. Whereas impacts are identified, through an objective undertaking, largely on professional analysis, evaluation determines the subjective value of these changes. This is accomplished by conducting "with and without" analysis of the alternative plans and ascribing values to the impacts based on the public's perceptions of them. The process begins by establishing the contributions of each alternative in relation to the planning objectives and the National Development and Social Well-Being of the study area. Then the response of the alternatives to specified evaluation criteria will be determined. From this information, judgments will be made concerning the beneficial and adverse nature of the contributions of an alternative to establish its overall desirability. After this has been done for each alternative, plans that do not result in an improvement over the "without" condition will be eliminated from further consideration. The relative merits of each remaining alternative in comparison with the other remaining alternatives will then be established. By so doing, evaluation will surface information which will be incorporated in succeeding iterations so as to more fully achieve beneficial contributions while reducing adverse contributions.

The selection process, described in the above paragraphs, forms the basis for selecting one of the detailed plans, and, if appropriate, recommending it for implementation. Plan selection is the designation of that alternative considered to be the most desirable, based on the results of this study.

The selected plan will be in the best public interest based on the public response to the detailed plans carried through the final stage. This response will include the views of those who participated in the study. The product of evaluation will be presented as a basis for public inputs to plan selection.

SECTION 6

STUDY MANAGEMENT

ST. LAWRENCE SEAWAY - ADDITIONAL LOCKS STUDY

SECTION 6

STUDY MANAGEMENT

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SECTION 6

STUDY MANAGEMENT

The District Engineer, Buffalo District Corps of Engineers, is responsible for the conduct and management of the St. Lawrence Seaway - Additional Locks Study. A study team within Buffalo District is drawn from the Study Management, Economics, and Environmental Sections of the Planning and Reports Branch, and Public Affairs Office. The Study Team consists of a study manager, an economist, an environmentalist, and a public involvement specialist. Additional expertise from the Design Branch, Hydraulics Branch, and other units of the District will be assigned to the study and utilized on an "as needed basis." Appropriate augmentation will be provided through retention of outside consultants. A direct liaison at the working level will be maintained with the agencies and organizations and interested citizenry during the course of the study to obtain their input. Under an agreement between the Corps of Engineers and the U.S. Fish and Wildlife Service, the latter agency is responsible for furnishing planning aid documents at timely intervals throughout the study and for formal review of the study results.

WORK COMPLETED TO DATE

Funds for initiation of the study were allotted in December 1967. An initial public hearing was held on 6 June 1968 in Chicago, IL, to solicit input of Great Lakes transportation interests. In 1968 photogrammetric mapping and subsurface explorations were conducted in the vinicity of Snell and Eisenhower Locks. The subsurface explorations were continued in 1970. A Plan of Study was initiated in 1970 along with preliminary designs of locks for Snell and Eisenhower twinning and for a one lock - new canal plan. From 1971 to the present, the majority of study funds were directed to the development of economic tools. These tools, in the form of computer models, will be used in determining lock capacities and projecting future traffic potential. These models were developed with a view to addressing the entire Great Lakes-St. Lawrence Seaway system. Further description of these models is given in Appendices C and H and identified there as "Waterways Systems Simulation and Great Lakes Simulation Studies" and "Great Lakes-St. Lawrence Seaway Navigation Systems Study." Another study, completed in January 1978, was conducted in conjunction with the Great Lakes Connecting Channels and Harbors Study (GLCCH). This study, described in Appendix D, was a preliminary screening of vessel sizes on the Great Lakes-St. Lawrence Seaway system with a view to determining, based on system economics alone, the maximum size of vessels which could be justified by improvements to the various components of the system. The Maximum Vessel Size Study will be refined in Stage 2 through additional scenarios to determine the maximum vessel size which will be considered in plan formulation for the SLS-AL and GLCCH studies respectively and collectively. An interim report was started in 1973 to investigate navigation problems which existed in the South Cornwall Channel just downstream of Snell Lock at Polly's Gut. Because of the urgency of this problem, this report was forwarded to Congress as an interim to the Additional Locks Study. It recommended extension of a spur dike which has subsequently been constructed by the St. Lawrence Seaway Development Corporation through funding by PASNY and Ontario Hydro. Included in the interim study was a physical model of the channels at Polly's Gut. This model was constructed at the Corps' Waterway Experiment Station at Vicksburg, MS, to model flows and test alternative plans of improvement.

WORK TO BE PERFORMED

The following is an identification of work items and investigations which are required for the conduct of this study through the Phase II and Phase III levels. The general areas of investigation or items of work that must be accomplished in meeting the requirements of Principles and Standards and adhering to sound engineering, economic, and environmental principles are categorized as follows:

Engineering Studies.

These items represent technical investigations required to formulate and design alternative plans of improvement and to assess their impacts from an engineering standpoint.

Channel Design Criteria - This study is required to develop channel design criteria which is not presently available. This will require a detailed research of the present state-of-the-art to determine information needed and model test of channel dimensions, vessel size and vessel controlability. The end product of the investigation will be the establishment of criteria which will be used in the design of restricted channels for this and subsequent navigation studies. This will be a joint study with the Great Lakes Connecting Channels and Harbors Study.

Hydraulic Studies - Included in these studies will be the hydraulic design of the locks and channels. They will address such aspects as filling and emptying of locks, surge basins, discharge conditions, and effects of channelization on the total discharge and flow regime of the St. Lawrence River. Channel modifications for purposes of increased draft and improved channel design will be considered in conjunction with lake regulation in the interest of riparian flood control and shoreline damage, and power production. This effort will be coordinated with other ongoing studies of this nature in an effort that any plan developed during this study is in the best interest of all users of the system.

Soil and Geology - Foundation explorations and geophysical surveys of the area in and around both Snell and Eisenhower locks for the twinning scheme have been completed. Their results will require evaluation along with the need for further testing. This information will be used in the design of locks and channels.

Vessel Generated Waves - This item of work will investigate vessel generated waves in confined channels and their effect on shoreline erosion and structure damage. Previous studies by the Detroit District and St. Lawrence Seaway Development Corp. will be analyzed and augmented as needed. This investigation will incorporate field data for those sizes of vessels currently operating on the GL/SLS system and theoretical extrapolation for future vessel sizes.

Design and Cost Estimates - This item will encompass a major portion of the work effort throughout the study. It will include the design and cost estimates of all alternative plans and components thereto, to the detail necessary to make a recommendation to Congress concerning to the feasibility of improvements and the advisability of more detailed studies jointly with Canada. During Stage 3, it will also determine the quantity and source of construction materials, and the real estate needed to be acquired for implementation of each plan.

Operations and Regulations - This item will evaluate operations and regulations of the existing and future systems with a view to increasing capacity through nonstructural means and optimizing the functioning of any improved system. The adequacy of operations and regulations pertaining to hazardous cargoes will also be analyzed in addition to contingency plans for oil and hazardous cargo spills. Past operating records will be analyzed with specific reference to accidents, their location and cause, to identify high accident prone areas and solutions for their alleviation. Regulations concerning speed limits will be evaluated in view of hazardous cargoes and vessel controllability of present and possibly larger vessels. The safety of the system will be a prime aspect of this item and will be analyzed vis-a-vis the above items, and number, size, and age of the vessels. Vessel performance and design will also be analyzed to determine their relevance to the safety and capacity of the present and future systems for possible inclusion in future regulations on the system.

Environmental Studies.

Studies by the USF&WS have begun to determine a base-year condition for the project area. These studies will supply necessary information to assess the impacts of the engineering alternatives and requirements for mitigation. USF&WS earlier furnished planning aid letters to aid in development of this report. Their letter, dated 8 June 1978, outlines the fish and wildlife baseline studies it feels are necessary for the SLS-AL Study. In addition to the studies outlined in the letter of 8 June 1978, several other studies were recommended in conjunction with the coordination on the Navigation Season Extension Study. These studies are:

- Effects of vessel tracks and ice suppressors on terrestrial wildlife and waterfowl migration and their utilization of navigation routes;

- Effects of noise resulting from vessel traffic through ice on the aquatic fauna;

- Effects of winter traffic on behavioral patterns of fish;

- Effects on recreational user patterns: e.g., winter ice fishing.

St. Lawrence River Ecosystem Baseline Studies - These studies will review all prior and ongoing studies, reports, and documentation on the physical, chemical, and biological characteristics of the river and shoreline areas. These studies will identify gaps in the existing data, identify ongoing or proposed studies to fill these gaps, and accomplish those investigations necessary to complete a baseline inventory. Those identified by USF&WS are:

- Baseline biological studies along the St. Lawrence River; significance, distribution, and abundance of mammals.

- Baseline data collection in the St. Lawrence River; physical characteristics.

- Baseline biological studies along the St. Lawrence River; use of the St. Lawrence River habitats by resident and migratory birds; paying special attention to any Federally Endangered Species or New York State Protected Species.

- Baseline biological studies along the St. Lawrence River; food chain contribution of the riverine reptiles and amphibians.

- Baseline biological studies along the St. Lawrence River; significance of aquatic insects as food chain components.

- Baseline biological studies at validation sites along the St. Lawrence River; distribution and abundance of benthic invertebrates.

- Baseline biological studies along the St. Lawrence River; the movement and significance of detritus and associated organisms within the river system.

- Baseline biological studies along the St. Lawrence River; characterization of fish stocks and movement throughout the river system.

- Baseline biological studies along the St. Lawrence River; determination of existing or potential fish spawning areas as well as fish feeding ecology.

- Baseline biological studies along the St. Lawrence River; distribution, abundance, and habitat relationships of larval fish.

- Baseline biological studies along the St. Lawrence River; determination of primary and secondary production.

- Baseline biological studies at validation sites along the St. Lawrence River; determination of physical and chemical properties.

- Baseline biological studies at validation sites along the St. Lawrence River; productivity and environmental relationships of aquatic macrophytes in the littoral and wetland habitats.

- Identification and characterization of critical habitats and unique vegetative types, which may be impacted by additional locks and other navigational improvements.

- Physical, chemical, and biological features of critical channel reaches in the St. Lawrence River.

- Physical, chemical, and biological features of harbors subject to potential change within the St. Lawrence River system.

- Development of a contingency plan to minimize the impact of oil and toxic substances spilled as a result of navigation.

- Coordination and censuses of baseline data to generate an aquatic model for the St. Lawrence River; to include a determination of the historical distribution of shoreline wetlands along the St. Lawrence River.

- Coordination and censuses of baseline data to generate a terrestrial-riverine model for shoreline communities along the St. Lawrence River.

- Development of a computer-based data storage, geographic indexing, and impact characterization system for the St. Lawrence River.

- Determination of the potential effects of oil and toxic substance vessel spills.

Detailed Environmental Studies - Identification of these studies will depend on the baseline inventory and formulation of alternative plans. USF&WS will determine these requirements at the end of Stage 2 (PFR).

Sediment Analysis - This item will most probably be conducted by EPA, or at least under their direction, and will include the sampling and chemical analysis of bottom sediments and soil samples. This is required to determine the advisability of spoil disposal and the need for confined disposal sites for polluted materials.

Cultural Resources - This item is a reconnaissance designed to identify districts, sites, buildings, structures and objects of interest or importance in architecture, history, or prehistory which might be affected by alternative plans. This will be in the form of literature research, local interviews, and field investigations. The study will also identify areas for further testing and testing. The initial coordination with the Office of Archeology and Historic Preservation, Heritage and Recreation Service, and the New York State Historic Preservation Officer has been performed (letters appear in Appendix G).

Mitigation and Enhancement - This item, utilizing results of baseline and reconnaissance studies, will identify types and locations of mitigation and enhancement measures which could possibly be incorporated into the various alternative plans. During Stage 3, the results of this work item will be utilized in developing a plan for mitigation if one is deemed necessary.

Sociological Studies.

Social Studies - Factors pertaining to social impacts and effects shall be considered as prescribed by Principles and Standards and Public Involvement procedures. Initial and continued social profiling procedures will serve as a preliminary basis for social study analysis and evaluation. As the study progresses and additional information and alternatives are presented, additional analysis and evaluation studies will be developed relative to specific needs. Social impact analysis from a commodity flow-employment allocation standpoint may be examined by using economic traffic forecast and employment impact model data. Such analysis should be made relative to national, regional, sub-regional, and local levels as deemed necessary through public concerns and study procedure and management. Particular emphasis shall be given to social analysis at the local or port community level including analysis of alternative impacts on the existing quality of life.

Institutional/Policy Analysis - Institutional and policy analysis should be performed to provide insight as to other parties' interests, position, jurisdiction, and policies regarding proposed actions. This is incorporated to a great extent into the public and institutional involvement process.

Economic Studies.

Regional Economic Studies - Analysis of the most probable future for the geographic area adjacent to the St. Lawrence River within the United States is required in order to evaluate the water resource needs and opportunities that will exist during the project planning period. The region's capability to supply the necessary goods and services, from a logistics point of view, to support major structural improvements must be evaluated. Existing planning documents published by the appropriate regional planning agencies will be reviewed as the initial step in filling the existing data gaps and to avoid duplication of study efforts. Areas of interest (income, employment, population, industrial base, municipal infrastructures, etc.) which have not yet been analyzed will be investigated in the Corps Economic Baseline Study. Secondary sources of information or other State or Federal agencies would also be canvassed to accelerate this item of future work.

An objective of this study will be to establish the benefits derived by the region from project construction, operation and long-term maintenance. Detrimental aspects associated with an improved Seaway will be acknowledged and will use the economic changes that have occurred since 1959 as a general guideline. Post-Seaway activities resulted in significant employment gains within the primary metals sector based upon the availability of cheap hydropower from the Moses-Saunders Power Station. Future Seaway improvements are unlikely to result in similar industrial growth, but may prevent or slow any declines in the regional economy by increasing the competitiveness of the existing industrial base by providing a lower waterborne transportation rate attributed to larger vessels using larger locks and deeper channels.

Impacts upon the tax base, employment, natural resource utilization and levels of commerce will be acknowledged in this study and will also provide intermediate inputs into the environmental assessment documents that will likely be prepared concurrently. The overall objective of this future item of work is to quantify the tangible gains and losses to the region or qualitatively address intangible concerns that were presented to the Corps study group at public meetings.

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Recreation Study - Because of the importance of recreation to the area economy and its dependence upon the quality of the environment, this item is closely allied to the economic and environmental baseline studies. The recreation study will provide information necessary to assist in the formulation, assessment, and evaluation of alternative plans vis-a-vis their impacts on the recreational opportunity and subsequently on the area economy. This information will include an inventory of existing facilities and activities, and user patterns. It will also evaluate the role of recreation in the area economy and identify impacts of same.

Traffic Forecasts and Rate Studies - The Great Lakes Traffic Forecast Model has been designed for use in navigation improvement studies for the Great Lakes Region. Output from the model is in the form of tonnage forecasts by decade for period 1980-2030. Improvement alternatives can lower the cost basis of users or stimulate traffic through improved levels of service. Output from the model is a measurement of the effect upon tonnage levels of the above improvements. Traffic forecasts and transportation rates are inputs into a portion of the systems model to establish the benefits attributed to each navigation improvement scheme. Transportation savings are based on savings over the least cost alternate mode for traffic able to use the existing (constrained) system.

North Central Division, Corps of Engineers, has already used this model in the analysis of the Maximum Ship Size Study and in the Season Extension Program. In addition, the St. Lawrence Seaway Development Corporation has used traffic forecasts from the model in establishing the United States position in recent United States-Canada joint toll negotiations.

The basic theory behind the use of the model is to split water transportation sensitive traffic to the route with a favorable service and cost pattern after deducting that volume of cargo which is reserved for a Great Lakes or alternate mode routing due to long-term contractual, legal, or ownership of landfeeder modes and waterfront facilities.

Lock nodes consist of the Welland Canal, Soo Locks, St. Lawrence River or other connecting channels. Nodal capacity estimates have been defined in terms of annual cargo tons and are based upon earlier navigation planning. Traffic forecasted to move in the future that is presently constrained under existing conditions, and appropriate rate differentials, are used by the benefit analysis subroutine portion of the model to derive the annual cost savings for each plan of improvement.

Lock Capacities - Recently, lock capacities have been revised and tonnage estimates for the three lock systems have been summarized in Appendix C, "Capacity." Numerous input variables were considered in developing the future tonnage estimates that would produce "capacity" conditions at the locks. These factors include levels of vessel utilization, fleet mix, and other vessel characteristics, physical lock characeristics plus other variables.

All input variables can be changed during the conduct of this study to reflect changes in the GL/SLS fleet, operating procedures at the locks and other capacity related factors. New capacity estimates will be produced for plan formulation and selection purposes when conditions warrant.

Energy - This work item will be based upon a review and modification of the energy consumption studies made by the Detroit District, Corps of Engineers, for their Navigation Season Extension Program. Their analysis concentrated on the potential energy savings that may be realized by shipping additional tonnages during the normal season or shipping "extended season" commodities during the winter months.

Energy savings attributed to construction of additional or larger locks are based upon the incremental traffic that can move by water in the future which would otherwise be transported by alternate modes. Technical characteristics, including levels of fuel consumption for ship sizes not now operating, expected to use an improved Seaway system that will be based upon the preliminary vessel designs developed by the University of Michigan for the Maximum Ship Size Study. Future delays to shippers using the existing system are also expected to result in unnecessary fuel consumption. Generalized impacts of an improved Seaway system on the nation's use of energy to transport the forecasted traffic volumes will be considered. A summary of the losses or gains in hydropower generation from the existing power plants in the St. Lawrence River will also be developed.

Intermodal Impacts - A future constraint will be reached at the Welland Canal and Seaway locks under existing conditions. Growth in traffic beyond the estimated date of capacity will result in a long-term decline in the GL/SLS market share of total potential traffic expected to move into or out of the 19-State hinterland. Total transportation costs over the long run will rise over time as higher cost alternate modes move an increasing percentage of the total potential traffic.

Construction of more locks of the same size at the Welland Canal or in the St. Lawrence River would result in greater levels of annual traffic moving by water. This scenario would result in the GL/SLS maintaining its present market share over the planning period. No adverse effects on alternate modes are likely to occur under this alternative. However, if additional locks are operated over a longer period each year, season extension impacts may also occur. These impacts include inducing traffic volumes to move on the GL/SLS at the expense of alternate modes due to change in service factors or change in shipper perceptions.

Construction of larger locks will alter the present balance between waterborne and alternate modes of traffic. This shift is attributable to a reduction in the cost basis of the water leg of the total origin-destination-commodity flow routing. Decrease in costs due to the use of larger vessels results in a greater split of the total potential traffic moving via the GL/SLS. A shift in the market share towards the GL/SLS is likely to be at the expense of alternate modes.

Tonnage diverted from alternate modes is likely to have financial impacts upon affected carriers. The methodology developed by Detroit District, Corps of Engineers, for measuring the financial impacts upon alternate modes will be reviewed for possible use in this study. Estimates of the economic impact upon the base case required freight rate (RFR) will be based upon the work accomplished by the University of Michigan, Department of Naval Architecture and Marine Engineering for the Maximum Ship Size Study (Appendix D of this Plan of Study). Percentage reductions in the RFR will be used as input to the route split portion of the GL/SLS Traffic Forecast Model and will vary with the size of the locks to be constructed in the future.

Savings due to larger ships and deeper channels result in some tonnage now moving via unit trains of general cargo moving by rail cars to other coastal parts diverting to the GL/SLS route. This traffic shift will produce future financial losses to trucks, railroads, and barges.

Operation of larger locks will also have season extension impacts as a result of the change in future shippers' perception of the GL/SLS. Regional losses to alternate modes would only represent a regional transfer of income away from other transport modes and regions of the country to the Great Lakes region and, as such, will not be credited to any proposed plan of improvement.

Benefits to Great Lakes Ports - Long-term growth in the level of bulk and general cargo traffic at Great Lakes ports will have a positive economic impact. This contribution to regional economic development and social well-being is limited by the years remaining before capacity is reached at the three lock systems. Beyond this point in time, growth in traffic movements will be restricted due to saturation of available lock capacity.

Port cargo handling capacity will not likely be reached under existing conditions. Employment gains resulting from terminal operation, materials handling and related port jobs will be limited as forecasted traffic for those years beyond the date of lock capacity incurs increasing levels of delay, cost per ton, and traffic shifts over to alternate modes.

Additional or duplicate locks would contribute towards higher levels of operations of these ports and create some degree of employment growth within the region.

Detroit District, Corps of Engineers, has completed a "Regional Economic Benefits Study" for their season extension survey report. This study attempted to measure the regional benefits and employment which might accrue directly to Great Lakes ports, as well as the regional economies surrounding these ports. Their methodology will be reviewed and revised as appropriate to reflect the regional economic impacts that might be attributed to increasing the capacity of locks in the U.S. Section of the St. Lawrence River.

PUBLIC INVOLVEMENT

It is the policy of the Corps of Engineers that civil works projects under the authority of the Corps be conducted in an atmosphere of public understanding, trust, and mutual cooperation. This is accomplished through actively involving the public in water resources studies by opening and maintaining channels of communication.

The process of identifying water resources issues, exploring alternatives, and selecting a feasible and desirable plan requires a continuous two-way communication process between the study planners and identifiable publics--public officials, public and private groups, and the study area citizenry. The main goal of a public involvement program is to establish this two-way communication process which will:

- Acquire sufficient information from the broadest practical cross-section of concerned citizens, groups, and governmental agencies to identify area problems, issues, needs, priorities, and preferences regarding alternative resource usage, development, and management strategies;

- Inform the public and promote full public understanding of the St. Lawrence Seaway-Additional Locks Study--the study process, progress, implications, and results; and

- Develop a process of interaction and instill in the public a desire to participate and become involved in the study.

The Process.

Public involvement will be a continuous process throughout all phases of this study. Agencies and groups will be asked to provide information about problems and issues in the region and to suggest alternative solutions to such problems. Individuals and representatives of groups and agencies will also be asked to evaluate plans and suggest modifications that would make the plans more responsive to area needs. Evaluation of the study process, progress, and results will also be open to public review. The public involvement process for the study will consist of four major tasks:

- Identifying the publics. This task will involve developing a mailing list for sending out information and initiating contacts; establishing methods to identify additional individuals and groups as the study progresses; and periodically updating the mailing list.

- Establish Purpose for Communication. This task involves determining the need for involving the public at each point in the study; establish the desired effect of such involvement; and develop the message or information which must be transmitted to the public to accomplish the desired effect.

- Determining the Channel of Communication. This involves determining the medium or forum through which communications with and/or participation of the public will be accomplished; establishes a program for diffusing information to and educating of the public; and collection of information or feedback from the public.

- Analysis and Evaluation. This task summarizes and analyzes the feedback to determine its meaning and relative importance, and the relation of the feedback to the desired effect of the communication; evaluates the effectiveness of the communication process; and makes subsequent changes to the public participation program if evaluation shows them advisable.

Criteria.

Two important criteria were considered in the design of the public involvement program. First, the public involvement program should be designed to obtain information from the public which will be useful in meeting study objectives. There will be a purpose for each contact with the public, so that information collected will be pertinent to the study.

The needs of the study change as planning progresses, and as various planning tasks become more or less important. Therefore, some kinds of public involvement techniques will be more useful than others at various stages of the study. For example, the major objective during this Plan of Study preparation is to obtain information rather than seek solutions to area problems; so small informal meetings and workshops, interviews, and requests for comments on the Plan of Study, mostly from agencies, are utilized to determine public views. As the study progresses, the major objective changes from obtaining information on problems, to examining alternative solutions; so workshops, where people and agencies can interact to resolve differences, may be one of the techniques used. Some involvement techniques, such as mass media coverage, meet the needs of the study at any stage and will be used throughout.

Second, the public involvement program will attempt to satisfy the needs of the public. The individuals and groups participating in the study must be well-informed, and need to feel that they are being heard when expressing opinions or voicing concerns over problems.

Needs of the publics vary, depending on many factors, such as people's interests, place of residence, education, age, and so on. Because the publics respond differently to different public involvement techniques, several techniques will be utilized to satisfy public needs. For example, small group workshops are appropriate techniques for both special interest groups and general citizenry. Coverage in mass media is an especially good technique to reach the general public that may not participate in other involvement activities. Personal interviews and small informal meetings are effective techniques for canvassing public officials. Newsletters are effective in dispensing information to public officials, special interest groups, and individuals. Appendix E discusses public involvement more thoroughly and presents a generalized schedule for involving the public in the study.

CANADIAN COORDINATION

The St. Lawrence Seaway is an international waterway, the majority of which lies solely within Canadian territory. It should also be noted that the U.S. portion of the Seaway, Snell, and Eisenhower locks and the Wiley-Dondero Canal, lies between two sections of Canadian improvements; four locks downstream and one lock upstream on the Lake Ontario-Montreal section and the entire Welland Canal section consisting of eight locks. It goes without saying that improvements to the St. Lawrence Seaway in U.S. territory must be accompanied by compatible improvements to the Canadian sections. Thus, coordination with Canada throughout this study is paramount. This feasibility study, the first of two phases of study, will look at improvements to the entire St. Lawrence Seaway to determine, from a U.S. standpoint, whether improvements are economically and environmentally feasible and whether there is a Federal interest in their development. If improvements are found warranted, a second phase of study will be sought. The first phase, a U. S. study, will require informal coordination with Canada through the Seaway entities (i.e. SLSDC/SLSA). This will be a joint study with Canada. It will encompass exchange of data and information, unofficial attendance at meeting, review of study documents, and input of Canadian publics into a public involvement program. The second phase, a joint study, will require formal coordination.

Due to diplomatic protocal, (except that between the two Seaway entities, SLSDC/SLSA), all coordination with Canadian agencies and publics must be approved by the U.S. State Department and the Canadian Ministry of External Affairs. In its letter of 11 April 1978, the Canadian Embassy indicated the willingness of Canada to participate informally in the SLS-AL and GLCCH studies. This participation will be accomplished through the St. Lawrence Seaway Authority for the SLS-AL study and the Canadian Coast Guard for the GLCCH study. The Ministry of External Affairs will keep provincial authorities informed about the studies.

ENVIRONMENTAL IMPACT STATEMENT

An Environmental Impact Statement (EIS), as required by Section 102(2)(c) of the National Environmental Protection Act, will be prepared in conjunction with the study report. The EIS will be an integral part of the interdisciplinary plan formulation process and will serve as a summation and evaluation of the effects, both beneficial and adverse, that each alternative action would have on the environment. It will also serve as an explanation and objective evaluation of the finally recommended plan.

The environmental statement will fully discuss the primary and secondary environmental effects including the social and economic impacts of the various alternative plans. The interdisciplinary environmental investigations carried on throughout the study and leading to the preparation of impact assessment and EIS will be undertaken simultaneously with and to the same depth and scope as study related engineering, economic, and technical studies. The EIS is considered as an integral part of the study planning process and as such, is one of the documents upon which a decision on a Federal action is based. It will be written so as to substantively stand on its own and will be submitted as a separate document for review by the public and other governmental agencies.

The first document prepared during the development of the EIS is the Summary of Environmental Considerations (SEC) and will accompany the Preliminary Feasibility Report (PFR) at the end of Stage 2 - Development of Intermediate Plans (See Figure 1-I - Plan Development Stages). The SEC is a summary, based on information developed in the study related environmental inventory or baseline studies. The SEC will be attached to the announcement for the public meeting at the end of Stage 2 in order to facilitate meaningful and thorough discussion during the meeting. The SEC will be updated throughout Stage 3 - Development of Detailed Plans and again presented for discussion at any public meetings held during this stage.

At the end of Stage 3, a Draft Environmental Impact Statement (DEIS) will be prepared and circulated for review and comment along with an appropriate number of copies of the Draft Final Feasibility Report (DFFR). It will present and discuss the anticipated environmental effects of the plan which may be recommended by the District Engineer along with the probable environmental impacts of the alternative plans considered in the study.

Once comments have been received and addressed, and any revisions to plans or plan selection are made, the Final Feasibility Report (FFR) and Revised Draft Environmental Impact Statement (DEIS) are prepared addressing the final study recommendation. These documents are sent to higher authority to serve as the decision documents for ultimate recommendation to Congress. Following review and comment and just prior to forwarding to Congress, the final EIS is prepared addressing the recent comments.

STUDY SCHEDULE AND COST

Schedule.

The study schedule diagram is presented in APPENDIX I - STUDY SCHEDULE AND COST. The study schedule for Stage 2, requires 18 months due to the scope of the work items involved. The environmental studies required by U.S. F&WS are assumed to be commensurate in scope and detail with the other economic and engineering studies.

A second variable in the study schedule is the Great Lakes Navigation Season Extension Program and its environmental studies for the St. Lawrence River. The study schedule assumes that certain environmental information will be available from that program when needed.

	Milestone	Schedule Completion
01	Study Initiation	December 1967
02	Approval of Plan of Study (OCE)	September 1978
02A	Completion of Revised Plan of Study	November 1979
03	Submission of Stage 2 Documentation	April 1981
04	Stage 2 Checkpoint Conference	May 1981
05	Completion of Action on MFR	July 1981
06	Submission of Draft Survey Report & DEIS	September 1982
07	Stage 3 Checkpoint Conference	October 1982
08	Completion of Action on MFR	November 1982
09	Coordination of Draft Survey Rpt & DEIS	January 1983
10	Submission of Final Survey Rpt & RDEIS	May 1983
11	Release of Div. Engr.'s Public Notice	June 1983

Cost.

A PB-6 for the subject study is provided in APPENDIX I. This study cost is cursory in nature and heavily dependent upon further agency and GLCCH study coordination, and further research of available information. Environmental studies will play the most variable role whereby the study cost may in fact vary in magnitude. USF&WS submitted a planning aid letter dated 8 June 1978 which further defines these studies. This letter is included in Appendix G.

The present study cost estimate of $2,571,000 assumes that the study will be pursued under the 2-Stage authorization procedure. As such, it incorporates that level of study detail which is sufficient to determine the desirability, feasibility, and level of development which is in the best interest of the U.S. and to enable Congress to determine the advisability of authorizing a joint study with Canada on such development. It should be noted that through October 1977, $863,000 had been previously funded and $1,708,000 represents those funds necessary to accomplish the three stages of study development, to include this report.

AUTHORIZATION OPTIONS

Prior to 1974, there were two means by which major water resources development studies by the Corps were authorized for construction. The first of these types of authorization procedures was established by Congress in Section 201 of the Flood Control Act of 1965 (PL 89-298). This law permits the Secretary of the Army to administratively authorize water resources development projects where the estimated cost is less than $15 million. Approval by the Congressional Public Works Committees is required prior to appropriation of funds. The expected cost for any future development of the Seaway is expected to exceed the $15 million limitation, therefore, this type of authorization will not be pursued during the course of this study.

The second, more conventional, type of authorization procedure for a major development project requires specific authorization by legislative action of the Congress. The actual legislation may be in the form of a special act authorizing a particular project. Normally though, the studies are accumulated and included together in an omnibus authorization bill, usually at two-year intervals.

In both of these cases, the feasibility report serves as the authorizing document. The authorization rendered is for advance engineering and design, construction, and operation of the plan recommended by the feasibility report.

Section 1 of the Water Resources Development Act of 1974 (PL 93-251) established a new procedure for authorization of water resource development projects. This new concept was continued and reinforced by the Water Development Act of 1976 (PL 94-587). These two actions by Congress have indicated its apparent intent to speed up the authorization process, enhance planning continuity, and insure that the project constructed is the same as when it was authorized. This procedure provides for two-step authorization. The first step includes authority by Congress, via a separate or omnibus act, to undertake Phase I advance engineering and design on the basis of a feasibility report. The second step, authorization of construction by Congress, would be provided via the previously mentioned conventional method, using the Phase I GDM report as the authorizing document.

It is the position of the Corps of Engineers that until Congress changes the purpose of a survey or feasibility study, each investigation will be pursued under Section 201 or the conventional authorization procedures, unless there is compelling reason to adopt or recommend the two-step method.

The two-step authorization procedure is deemed appropriate for this study. Future development of the St. Lawrence Seaway will require joint efforts by the U.S. and Canada as it was during the development of the present system. The determination of this development will also require a joint effort, thus a joint study. Prior to such a joint study, it is necessary to determine the desirability, feasibility, and level of development which is in the best interest of the U.S. The two-step procedure provides the best mechanism for accomplishing this. During the first step or stage, being the survey or feasibility study, the feasibility and desirability of future Seaway development which is in the best interest of the U.S., will be determined. If such a development is advisable, it will be recommended that Congress authorize a joint study which will serve as the basis for Congressional consideration and authorization of construction and operation. This Plan of Study has been developed with the objective of achieving sufficient level of detail during this unilateral survey study to determine the desirability, feasibility, and level of development of the St. Lawrence Seaway which is in the best interest of the United States and to enable Congress to determine the advisability of authorizing a joint study with Canada on such development.

RECOMMENDATION

It is recommended that this Plan of Study be approved cognizant of its development based on the two-step authorization procedure.

APPROVAL

The draft Plan of Study was tentatively approved subject to incorporation of comments by North Central Division in July 1978, and those received by other agencies. This revised Plan of Study is submitted as the required documentation for completion of Stage I planning.

APPENDIX A

NATURAL ENVIRONMENT

APPENDIX A

NATURAL ENVIRONMENT

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APPENDIX A

NATURAL ENVIRONMENT

The Great Lakes-St. Lawrence Seaway System consists of Lakes Superior, Michigan, Huron, Erie, and Ontario, their connecting channels and the St. Lawrence River above Montreal, Quebec, (Figure A-1). The System spans more than 2,300 miles and has a water surface, United States and Canada combined, of over 95,000 square miles. The connecting channels of the System proceeding from west to east are: The St. Marys River - Lake Superior to Lake Huron; the Straits of Mackinac - Lake Michigan to Lake Huron; the St. Clair River/Lake St. Clair/Detroit River - Lake Huron to Lake Erie; the Niagara River - Lake Erie to Lake Ontario; and the St. Lawrence River - Lake Ontario to the Atlantic Ocean. The international boundary between the United States and Canada passes through all of the Great Lakes and their connecting channels except Lake Michigan, which is wholly within United States territory. Any effects from modifications and/or alterations on the United States side of the System may therefore have possible effects to the Canadian portion.

The St. Lawrence River is the longest east-west river on the North American Continent, coursing a distance of 527 miles from the outlet of Lake Ontario to the Gulf of St. Lawrence. The area under consideration in this study is the upper 113 miles of the river. This section forms the international boundary between the United States and Canada. The "International Section" spans from Tibetts Point near Cape Vincent, NY, to the mouth of the St. Regis River northeast of Massena, NY. This reach of the river is under joint navigation control of the St. Lawrence Seaway Authority of Canada and the St. Lawrence Seaway Development Corporation, a corporate agency of the United States.

Included within this section are three navigation locks, one in Canada and two in the United States. The two U. S. Locks are the Eisenhower and the Snell. These locks, connected by the Wiley-Dondero Ship Canal, are located on the eastern end of the international section between Massena, NY, and Cornwall, Ontario. The Eisenhower lock has a lift of 38 to 42 feet and the Snell lock a lift of 45 to 49 feet. The Iroquois lock is on the Canadian side of the river at Iroquois, Ontario, approximately 35 miles upriver from the mouth of the St. Regis. The lock has a lift of one to six feet. The locks are all 860 feet from gate pintle to gate pintle and 80 feet wide, permitting a maximum vessel of 730 by 76 feet to transit the locks. The navigation channels in the international section have a controlling depth of 27 feet and can accommodate a maximum vessel draft of 26 feet. (Although the locks have more than 27 feet of water over the sills, channel depths are the controlling factor for vessel draft. Lock length and width are the controlling factors for these ship dimensions.)

Also located within the international sections are the Iroquois Control Dam, the Long Sault Spillway Dam, and the Moses-Saunders Power Dam. The latter is a large power complex operated by the Power Authority of the State of New York and Hydroelectric Power Commission of Ontario.

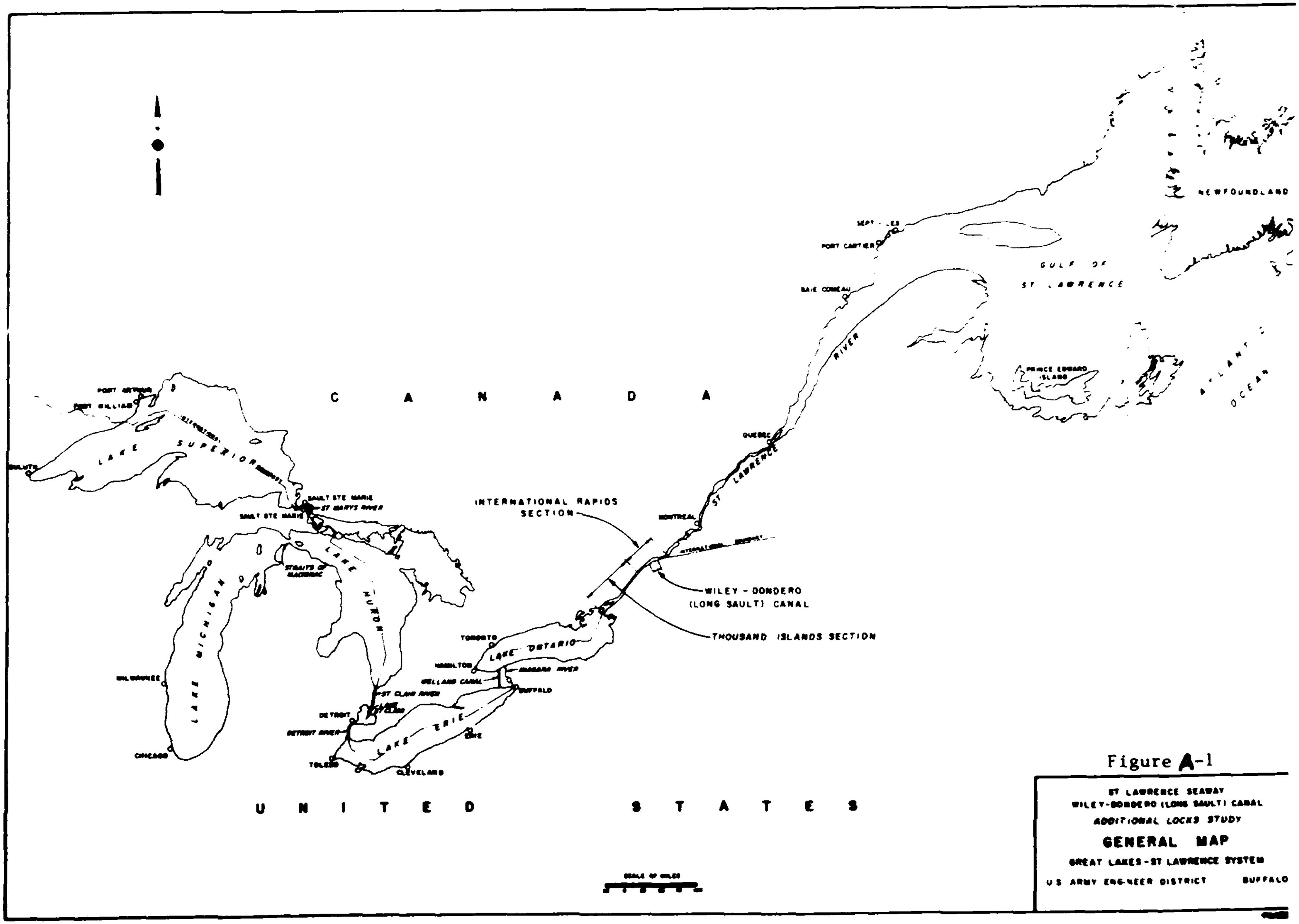


Figure A-1

ST LAWRENCE SEAWAY
WILEY-DONDERO (LONG SAULT) CANAL
ADDITIONAL LOCKS STUDY
GENERAL MAP
GREAT LAKES-ST LAWRENCE SYSTEM
U S ARMY ENGINEER DISTRICT BUFFALO

Topography.

The Great Lakes-St. Lawrence Seaway System spans two major physiographic provinces. Lake Superior, the St. Lawrence River, and part of the north shore of Lake Huron lie in the Laurentian Uplands Province, characterized by low-lying swamps, poorly drained areas, and occasional ranges of hills. Lake Michigan and most of Lakes Huron, Erie, and Ontario lie in the Interior Lowlands Province. This province is best identified with the Niagara Escarpment, a more or less continuous ridge extending from the Door Peninsula of Lake Michigan, through the Bruce Peninsula and Manitoulin Island of Lake Huron, to the Niagara Region of New York and Ontario.

In general, the topographical features of the System were created by Pleistocene glaciation. Continental ice sheets, up to 2,000 feet thick, repeatedly advanced and declined, scouring glacial valleys. As the glaciers receded, both large deposits of debris and vast sections of eroded bedrock were irregularly exposed along their paths. The present topography reflects this irregularity, having rolling hills and ridges, depressions with lakes and marshes, and both flat and sloping plains. Elevations within the System range from over 1,900 feet above sea-level at Mt. Curwood in the Huron Mountains to 152 feet above sea-level at Cornwall, Ontario. The major stream areas have a flat profile, and many of the tributary streams have reversed their flows in recent geological times.

Absent from the project area are such strong relief features as mountains, great cliffs, volcanic formations, and sharp-cut valleys. The moderate relief reaches a maximum of less than 150 feet above area water level. Despite the monotony of relief, however, there is enough system or pattern in the topography of the covering earthy formations to guide all of the rivers of the region, even the St. Lawrence, which simply follows a connecting chain of original depressions in handling the overflow from the Great Lakes. It simply spilled over from one depression to another, not always in a very direct line, sometimes in violent rapids and in certain portions of its course occupying a broad valley-like depressed area with interior hilly patches which thereby became islands surrounded by stream water.

Not only does the St. Lawrence follow a course made for it instead of making its own valley to lie in, but all three of the main tributaries on the south side also follow valleys that were made for them by glacial deposits. All of them flow northward off of the Adirondack highlands, turn aside eastward upon approaching the St. Lawrence trough, and follow elongated depressions between morainal ridges which guide them over comparatively long courses in that direction before joining the master stream.

The tributary stream system, therefore, exhibits a characteristic pattern also, with a significance of its own, and not more strikingly developed anywhere.

Upon first casual notice of the surprising uniformity of courses of these streams, and especially their sharp change of direction and thereafter their equally striking parallelism, one is likely to suspect a deformation control.

But search of the area shows that there are no displacements of enough consequence to accomplish this effect, and there is no evidence whatever of other causes than that of the original pattern imposed on the deposits left by the ice sheet when its thawing led to the making of morainal and outwash deposits along its southerly margin as it haltingly took one resisting stand after another.

In unraveling the history of this district, the topographies of the different members of the overburden are of greater importance than usual because they have been developed one after the other, so that the irregularities of topography of one period make opportunity for deposition of each succeeding member, creating in each case a new topography. Thus it happens that the deposits of stony glacial till, which is the first member of the earthy mantle or overburden, were in the first place very unevenly distributed in hills and ridges. In that state, the surface had its greatest variety of relief which was characterized by a morainal pattern. The next member, the outwash, carried from the front of the ice by the meltwaters and rain, formed deposits along the margin of the glacial till, spreading over their lower slopes and reaching into adjacent low places. In that stage, the morainal relief pattern was somewhat subdued by the partial filling thus accomplished, but the topography was still very uneven so that when the invasion of marine waters flooded the area the deposits of that time continued to accumulate in the low spots. In this stage the relief became still more subdued, accomplished only by covering up parts of the earlier deposits. In this manner all of the hill country was surrounded by slopes of outwash sands and flats of marine clay.

Since the continent was raised enough for stream erosion to begin, these weaker marine deposits have been dissected and partially removed, accomplished chiefly by trenching along the stream courses and by rain on the hillsides. Therefore, the topography now is a complex representing in part the original irregularities of the deposits themselves and in part the erosion effects of recent time.

Thus, as one traverses the district all of these features of different origin are repeatedly encountered, part of them just as they were formed in glacial time and part as they were left by the marine flood; whereas in still other parts, chiefly along the stream courses the weak marine deposits are trenched, sometimes even to bedrock, as these streams have vigorously attacked the easily removable material.

Geology and Soils.

Prior to the Ice Age, the Great Lakes were nonexistent. The region was comprised of well drained valleys and divides of several large rivers. The continental ice cap scoured these preglacial valleys, eroding the bedrock and entrianing the debris in the ice mass. The last of the four major advances of the ice cap was the Wisconsin Glaciation. As this final ice sheet retreated to the north, vast irregular deposits of overburden were laid down and sections of bedrock were exposed. Preglacial valleys were deepened in some areas and filled-in in others, ultimately forming the Great Lakes-St. Lawrence River Basin.

As the ice receded northward, there was ponding of the melt waters between the ice and the glacial deposits. These first lakes were at greater elevations than present lake levels (hundreds of feet greater in places). The levels and patterns of the lakes changed during development as new lower outlets were uncovered. The present outlets flow over either bedrock (St. Marys River and Niagara River) or glacial overburden (St. Clair, Detroit, and St. Lawrence Rivers).

The bedrock of the Great Lakes-St. Lawrence River Basin consists of a succession of sedimentary formations overlying a Precambrian rock base. These formations usually have their exposure points at the east and west extremities of the basin and their greatest depths near the basin's center. (Somewhat analogous to a series of graded bowls stacked one inside the next.) The major bedrock features include the exposure of the Precambrian base along most of Lake Superior on the west and at points along the St. Lawrence River to the east; the Ordovician and Silurian stratas which approach the surface on the west shore of Lake Michigan and around most of Lake Ontario; the shallow Devonian platform at the southern tip of Lake Michigan and along Lake Erie and the southeastern portion of Lake Huron; and, finally, the deep sedimentary basin of Mississippian formation centered under most of the State of Michigan.

Overburdened or unconsolidated sediments blanket the bedrock surface of the Great Lakes-St. Lawrence River Basin. These sediments are glacial and alluvial deposits, ranging from very deep (1,100 feet) deposits in Michigan and buried bedrock valleys of New York and Wisconsin to very thin or nonexistent deposits in Minnesota, and parts of Wisconsin and New York, where bedrock is close to the surface or exposed.

The composition of the overburden ranges from large boulders to fine silts and clays. The lacustrine deposits represent the former boundaries of early glacial lakes and also presently border the Great Lakes. Deposits of sand and gravel were formed by meltwater streams which sorted the glacial materials. Where meltwater streams were long lived, only the boulders remain. Boulders are also present in areas where unsorted glacial tills were deposited directly by melting blocks of ice.

The soils of the Great Lakes-St. Lawrence River Basin reflect the changing of the levels of the early glacial lakes. As new lower outlets were uncovered by the receding glacial ice, sediments were deposited at each lake level, resulting in extensive flat areas with fine-textured lake deposits being exposed with each lowering.

These soils of glacial origin include the Iron River, Gogebic, Ontonagon, and Tremary soils in Minnesota, Wisconsin, and the Upper Peninsula of Michigan. Some parts of Wisconsin and most of Michigan have the Rubvicon, AuGres, and Roscommon soils. Southern Michigan, Indiana, western Ohio, and the eastern edge of Wisconsin include soils in calcarious glacial till and outwash. The Wooster-Mahoning soils occur in eastern Ohio and Pennsylvania. The Ontario and Lordstown soils occupy much of western New York. Other areas in upper New York have Gloucester soils.

The international section of the St. Lawrence River lies in the south-central portion of the St. Lawrence Valley physiographic province. This province composes the lowland area between the Adirondack Mountains in New York and the Laurential Upland in Canada. The topography in this province is gently rolling and is characterized by erratically distributed hilly and ridge-like elevated portions between which are irregular or valley-like depressions. Surface elevations for the most part are less than 500 feet above sea level, and relief at most places is less than 150 feet. St. Lawrence River in the South Channel around Cornwall Island is about 150 feet.

The region about the international section of the St. Lawrence River was covered by continental glaciers or ice sheets at various times during the Pleistocene Epoch and covered by the waters of Lake Iroquois and its successor, the Champlain Sea, at the close of the Pleistocene as the ice sheet retreated northward. Bedrock in the area is largely blanketed by a thick cover of glacial drift that was left by the ice and of marine clay that was deposited in the Champlain Sea. The glacial drift is mostly compact to very compact till composed of a heterogeneous mixture of clay, silt, sand, gravel, cobbles, and boulders. The relative proportions of the constituent materials in the till vary from place to place, and the upper part of the till in general, is more bouldery and less compact than that beneath. The hilly and ridge-like elevated portions of the present day topography are composed for the most part of glacial drift, and the depressions between the hills are partly filled with the marine clay that was deposited around and over the glacial material. The marine clay is soft and silty. The course of the St. Lawrence River has been determined largely by low depressions between hills and ridges of glacial material. Erosion since Pleistocene time has been largely in the easily erodable marine clay and is evidenced by entrenchment of the streams where they cross areas of clay.

Bedrock in the area is principally dolomite belonging to the upper part of the Beekmantown Formation, which is Ordocivian in age. Limestone belonging to the overlying Chazy Formation outcrops beneath the glacial and the marine clay materials. Bedrock in general is nearly flat-lying.

The soils along the international section of the St. Lawrence River are extremely diverse. They are strongly influenced by glaciation and a high seasonal water table. In general, the soils of the western most portion of this section (primarily Jefferson County) were formed in calcareous lacustrine deposits. Many of these soils have a typical silty-loam surface, a silty-clayey loam subsoil and underlying material of varied silt and clay. These soils are often shallow and lie directly on bedrock.

The predominant soils around the central and eastern areas of the international section (principally St. Lawrence County) were formed in calcareous glacial till deposits and are normally capped with post-glacial lake deposits of sand and fine sandy loams. St. Lawrence County soils are generally deeper than those found in Jefferson County.

Drainage patterns vary according to soil types. The silty-clayey soils of Jefferson County are generally poorly drained, while the sandy-loams of St. Lawrence County are rapidly permeable. Table A-1 is provided as an example of the diversity of the soil types in the project area. This table decribes some of the soil associations found along the St. Lawrence River in St. Lawrence County.

Table A-1 - Soil Associations and Their Descriptions for Nine Soil Types Along the St. Lawrence River

Description
Greenville-Hogansburg
This association has loam and fine sandy loam surface textures. The soils are found on nearly level to rolling and hilly topography. Grenville soils are well drained and Hogansburg soils are moderately well drained. Permeability is moderate. Where the Grenville and Hogansburg kinds of soils are 20 to 40 inches to bedrock, moderately shallow variants of these soils occur. Kars soils occur in association with these soils and they are well to excessively drained high lime glacial outwash soils with rapid permeability. Minor inclusions are the very poor to poorly drained sun soils and the somewhat poorly drained Massena soils.
Vergennes-Kingsbury
This association is surface texture clay loam and loam. These soils occur on nearly level to sloping topography in the lake plain. Vergennes soils are moderately well drained. Kingsbury soils are somewhat poorly drained. Permeability is very slow. Minor soils are the very poorly drained Livingston soils and the poorly drained moderately shallow Covington soils, a variant of the Vergennes soils present in some places.
Elmwood-Swanton
This soil association consists of soils that have sands over clay. They are found on nearly level to undulating areas in the lake plain. Permeability in the sandy portion is rapid. Permeability in the underlying clays is slow. Elmwood soils are moderately well drained, sandy deposits 18 to 30 inches over clays. Swanton soils are somewhat poor to poorly drained, sandy deposits, 18 to 30 inches. Also included in the association are Kingsbury, Livingston, and Covington soils. Whately soils are very poorly drained sands over clay. Kingsbury, Covington, and Livingston are wet clayey, somewhat poorly through poorly drained soils.
Fahey-Trout-River-Empeyville
This association has loam, loamy fine sand, and loamy sand surface textures. These soils occur on level to sloping topography. Fahey are moderately well drained outwash soils. Trout River soils are similar to Fahey soils, except that they are excessively drained. Empeyville soils which are moderately well drained soils developed on glacial till, are associated with the Fahey and Trout River soils.

Table A-1 - Soil Associations and their Descriptions for Nine Soil Types Along the St. Lawrence River (Cont'd)

Description
Permeability in the Fahey and Trout River soils is rapid. The underlying till at three to six feet depth has moderately slow to slow permeability. Minor soils are the Covertown, which is similar to Fahey and Trout River, excepting somewhat poorly drained. Also, the well drained Worth soils, developed in glacial till, is included.
Massena-Sun
This association has stony loam surface texture. These soils are found on level to gently sloping areas in the glaciated uplands and on the edge of the lake plain. Permeability is slow, Massena soils are somewhat poorly drained and Sun soils are poorly to very poorly drained. Minor inclusions are moderately well drained Hogansburg and Bombay soils.
Made Land
This miscellaneous land type is composed of excavated materials, most of which have been dredged from the major waterways in the county. The excavated material is mainly composed of clay lake sediments from river deposits.

The St. Lawrence-Eastern Ontario Commission in cooperation with the United States Soil Conservation Service and county soil and water conservation districts has conducted an accelerated soil mapping program along the shoreline of the St. Lawrence River. The data from this study will be available in FY 1978 as a Technical Report to the Commission's "Report on Coastal Resources" published by the Commission and funded under the Coastal Zone Management Act of 1972.

Earthquake History.

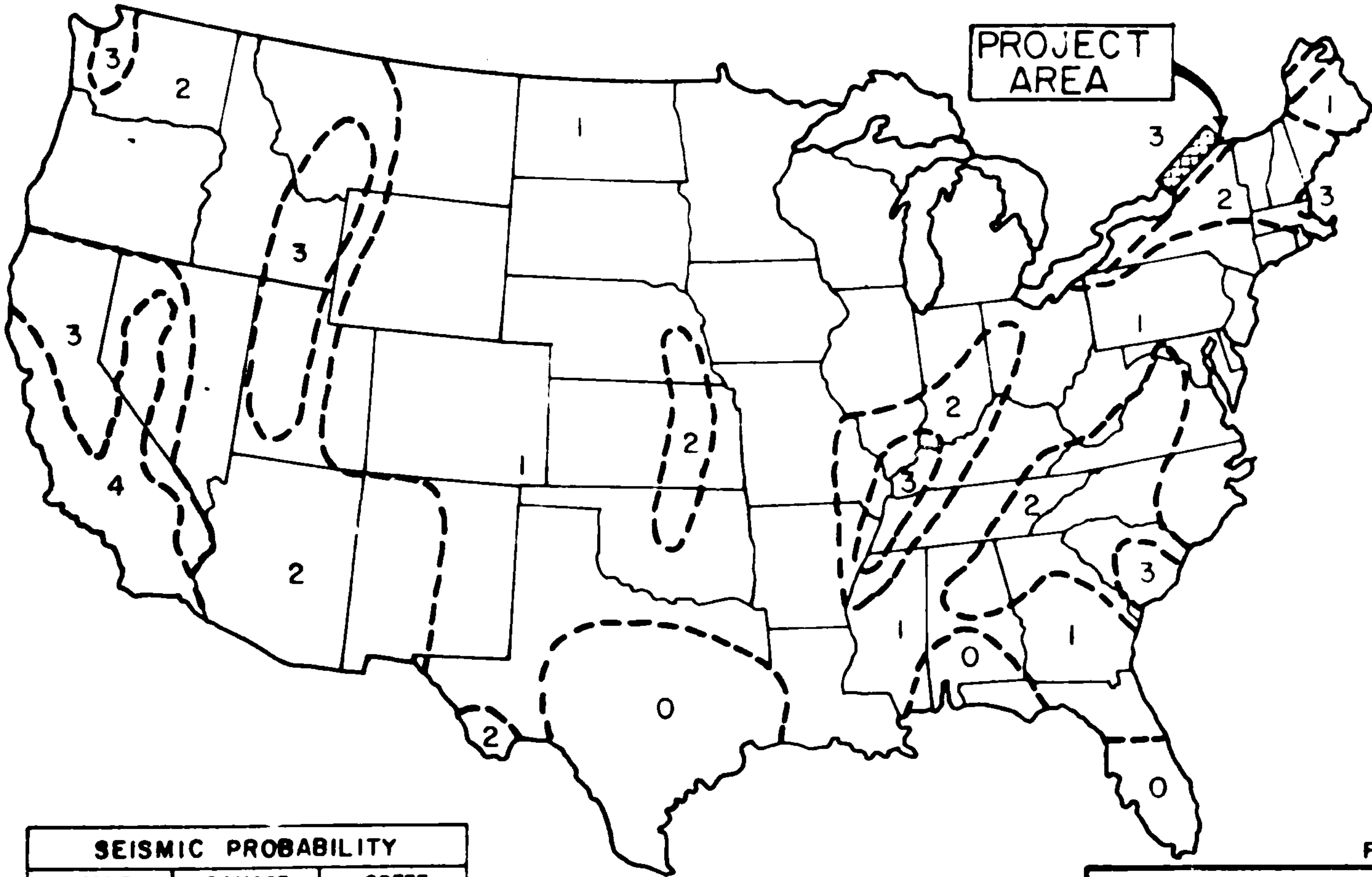
The St. Lawrence region is subject to sporadic seismic shocks, that probably represent readjustments in the earth's crust still going on as a result of removal of the ice load since the Pleistocene epoch. The seimic risk map (Figure A-2) published in Corps of Engineers ER 1110-2-1806 (Apr 1977) for continental U.S.A. indicates that the project area lies within a "Zone 3" seismic risk zone. Zone 3 marks an area within which major destructive earthquakes may occur. A fault is located just upstream of the Snell lock; its strike runs northeast-southwest. While this fault is geologically ancient, it is a potential zone of weakness. There is evidence that it has undergone movement in comparatively recent times.[1]

Some of the severe earthquakes thus far known to have occurred in eastern Canada and northeastern United States have been distributed along the line following the St. Lawrence Valley and its continuation to the southwest. Some of the earthquakes of moderate to severe intensity which have occurred in the St. Lawrence region are listed in Table A-2. The intensity listed in this table is based on the modified Mercalli intensity scale. An abridged version of this scale is listed in Table A-3.

In additon to the earthquakes listed in the table, no less than 25 small to moderate earthquakes have occurred in the St. Lawrence River region since 1946.[2]

[1] A Geological Study of the Massena-Cornwall Earthquake, Sept 5, 1944, and its Bearing on the Proposed St. Lawrence Project, 1945, U. S. Army Engineer District, New York.

[2] "Earthquakes of the United States," U. S. Department of Commerce Annual Reports 1946 to 1974.



SEISMIC PROBABILITY		
ZONE	DAMAGE	COEFF.
0	NONE	0
1	MINOR	0.025
2	MODERATE	0.05
3	MAJOR	0.10
4	GREAT	0.15

FIGURE A-2

ST. LAWRENCE SEAWAY
ADDITIONAL LOCKS STUDY

SEISMIC ZONE MAP
OF CONTIGUOUS STATES

U.S. ARMY ENGINEER DISTRICT, BUFFALO

Table A-2 - Moderate to Severe Earthquakes in the St. Lawrence Valley Region[1]

Date	Location	Intensity[2]	Area (Sq Mi)
1663, 5 February	St. Lawrence Region	Severe	750,000
1903, 25 December	Ogdensburg, NY	V	1,500
1913, 28 April	Potsdam, NY	VI-VII	3,000
1917, 22 May	St. Lawrence Region	IV-V	15,000
1925, 28 February	St. Lawrence Region	VIII	2,000,000
1927, 17 March	Canton, NY	V	NE[3]
1928, 18 March	Northeast New York	VI	12,000
1929, 5 June	Malone, NY	IV-V	Local
1931, 3 November	Canton, NY	IV-V	NE
1937, 10 March	Canton, NY	IV-V	NE
1944, 5 September	Massena, NY	VII	Very Large Area
1957, 30 November	Massena, NY	IV	NE
1958, 11 January	Massena, NY	IV	NE
1958, 29 September	Malone, NY	IV	NE
1961, 20 April	Massena, NY	V	NE
1961, 29 September	Massena, NY	IV	NE
1962, 2 October	Northern New York	IV	Wide Area
1964, 29 March	Massena, NY	V	Local
1964, 16 June	Malone, NY	IV	NE
1969, 9 October	Massena, NY	IV	Wide Area

1 "Earthquake History of the United States" U. S. Department of Commerce, National Oceanic and Atmospheric Administration Publiction 41-1, 1970.
2 Based on Modified Mercalli Scale.
3 NE: No Estimate of Area Given.

Table A-3 - Modified Mercalli Earthquake Intensity Scale

I	Not felt except by a very few under specially favorable circumstances.
II	Felt only by a few persons at rest, especially on upper floors of buildings. Delicately suspended objects may swing.
III	Felt quite noticeably indoors, especially on upper floors or buildings, but many people do not recognize it as an earthquake. Standing motorcars may rock slightly. Vibration like passing of truck. Duration estimated.
IV	During the day, felt indoors by many, outdoors by few. At night, some awakened. Dishes, windows, doors disturbed; walls make creaking sound. Sensation like heavy truck striking building. Standing motorcars rocked noticeably.
V	Felt by nearly everyone, many awakened. Some dishes, windows, etc., broken; a few instances of cracked plaster; unstable objects overturned. Disturbances of trees, poles, and other tall objects sometimes noticed. Pendulum clocks may stop.
VI	Felt by all, many frightened and run outdoors. Some heavy furniture moved; a few instances of fallen plaster or damaged chimneys. Damage slight.
VII	Everybody runs outdoors. Damage negligible in buildings of good design and construction; slight to moderate in well-built ordinary structures; considerable in poorly built or badly designed structures; some chimneys broken. Noticed by persons driving motorcars.
VIII	Damage slight in specially designed structures; considerable in ordinary, substantial buildings, with partial collapse; great in poorly built structures. Panel walls thrown out of frame structures. Fall of chimneys, factory stacks, columns, monuments, walls. Heavy furniture overturned. Sand and mud ejected in small amounts. Changes in well water. Persons driving motorcars disturbed.
IX	Damage considerable in specially designed stuctures; well-designed frame structures thrown out of plumb; great in substantial buildings, with partial collapse. Buildings shifted off foundations. Ground cracked conspicuously. Underground pipes broken.

Table A-3 - Modified Mercalli Earthquake Intensity Scale (Cont'd)

X	Some well-built wooden structures destroyed; most masonry and frame structures destroyed with their foundations; ground badly cracked. Rails bent. Landslides considerable from river banks and steep slopes. Shifted sand and mud. Water splashed (slopped) over banks.
XI	Few, if any, (masonry) structures remain standing. Bridges destroyed. Broad fissures in ground. Underground pipelines completely out of service. Earth slumps and land slips in soft ground. Rails bent greatly.
XII	Damage total. Waves seen on ground surfaces. Lines of sight and level destroyed. Objects thrown upward into air.

Climate.

The Great Lakes-St. Lawrence River Basin is considered to be in the temperate zone climate, but there are some unique features in the region. While the Basin has a variety of precipitation types and sources, there is little month-to-month variation in precipitation amounts; there is a marked temperature contrast across the 750 miles of latitude; and the Great Lakes strongly influence the continental air masses within the basin.

The basin has relatively temperate summer and winter temperatues, with an average annual range from 39°F on Lake Superior to 48.7°F on Lake Erie. Minimum monthly temperatues occur in January/February. The monthly average temperatures for January is from a low of 8.7°F at Duluth, MN, to a high of 27.6°F at Cleveland, OH. Maximum monthly temperatures occur in July and range from 64.6°F at Sault Ste. Marie, Ontario, to 75.6°F at Chicago, IL. Average daily highs for July are greatest at Buffalo, NY, reaching 84.1°F.

Mean annual precipitation for the entire basin is about 31 inches. Average annual rainfall varies from 26 inches in northeastern Minnesota, to as much as 46 inches at the eastern end of Lake Ontario. The number of days with measurable precipitation ranges from an average of 169 days east of Lake Ontario and 155 days along the southern shore of Lake Superior to 119 days at the southern end of Lake Michigan.

The international section of the St. Lawrence River is a region of cold winters and sunny summers. Lake Ontario has a noticeable influence on the St. Lawrence River area. The prevailing westerly winds, which traverse the entire length of the lake, temper the heat of summer and the cold of winter. The springs are cold and the autumns are comparatively warm. Frequent winter storms and cold waves make for a very severe winter season. The St. Lawrence River Valley is a favored storm tract throughout the year.

The St. Lawrence River area has an average annual rainfall of 34 inches and an average annual snowfall of 80 inches. Additional climatological data are given in Table A-4 for three weather stations along the St. Lawrence River.

Table A-4 - Climatological Data at Three Selected Weather Stations Along the St. Lawrence River[1]

	Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
ALEXANDRIA BAY WEATHER STATION (Jefferson County)													
Ground Elevation - 260 Feet													
Mean Temperature[2]	46.3	19.2	21.1	31.1	44.7	55.8	65.6	70.8	69.2	61.9	51.5	39.6	24.9
Normal Precipitation (Inches)[3]	36.94	2.78	2.58	2.72	2.97	3.97	2.55	3.12	3.21	3.42	3.22	3.67	3.31
Normal Degree days[4]	7,694	1,420	1,220	1,051	609	360	128	193	171	163	419	762	1,143
OGDENSBURG WEATHER STATION (St. Lawrence County)													
Ground Elevation - 285 Feet													
Mean Temperature	44.7	16.3	18.6	29.3	43.9	55.1	64.9	69.9	68.0	60.2	50.0	37.7	22.5
Normal Precipitation (Inches)	30.72	2.02	1.85	1.98	2.52	2.97	2.62	3.08	2.90	2.80	2.57	2.82	2.59
Normal Degree Days	8,194	1,510	1,299	1,107	633	139	182	187	196	465	819	1,318	
MASSENA AIRPORT (St. Lawrence County)													
Ground Elevation - 202 Feet													
Mean Temperature	43.2	14.5	16.7	27.6	42.2	54.1	64.3	69.0	66.7	59.2	48.5	35.9	20.1
Normal Precipitation (Inches)	31.17	1.92	1.91	1.90	2.53	2.92	2.50	3.20	3.08	2.92	2.56	2.93	2.80
Normal Degree Days	8,580	1,566	1,352	1,159	684	362	135	168	167	210	512	873	1,392

1 Source: U. S. Department of Commerce, Nationasl Oceanic and Atmospheric Administration In: Northern Area Business Fact Book, Part 1, "Business and Manufacturing," 1976 edition.

2 "Mean" values are averages based on a varying number of years.

3 Precipitation includes all forms, measued after melting the frozen types.

4 "Normal" values are averages based on the period from 1941-1970.

Hydrology.

The Great Lakes-St. Lawrence Seaway System has a total drainage basin of 298,000 square miles, including 95,000 square miles of surface water. The stream patterns within the system differ from that of other river basins in that the streams are often short, with relatively small drainage areas, and that many streams flow directly into the lakes. The system constitutes a series of large reservoirs which moderate the rates of runoff from their sources to the head of the St. Lawrence River. Because of the natural storage ability of the Great Lakes, the system's discharge into the St. Lawrence River is relatively stable (roughly 240,000 cubic feet per second).

Approximately one-third of the average annual precipitation, nearly 12 inches, becomes runoff and reaches the system. The remaining two-thirds of the precipitation is distributed among surface evaporation, transpiration, soil moisture needs, and to recharging ground water aquifers.

Nearly half of the land portion of the Great Lakes-St. Lawrence River Basin is underlain with aquifers. Most recharging of these aquifers occurs during the spring snowmelt period, with only minimal recharging occurring during the summer because of the high evapotransportation needs. While precipitation is the direct agent for recharging the ground water, surface waters make indirect contributions. The relatively high water table in the basin limits these indirect inputs to rare instances when either the water table is down below the stream level, or when pumping of wells near streams reverses the water table gradient so that water moves from the streams toward the wells. Deep bedrock aquifers are normally recharged in their outcrop areas, but recharge may also occur downward through overlying formations where fractures or permeable zones exist.

The Basin's low topographic relief and the abundances of lakes, marshes, and peat bogs reflect the poor development of regional drainage systems. This, plus the lack of major tributaries flowing into the Great Lakes, emphasizes the importance of the ground water contributions to the Great Lakes-St. Lawrence River System. The average annual yield from ground water is estimated at 26 billion gallons per day or 17 percent of the total discharge of Lake Ontario into the St. Lawrence River.

The flow rate of the St. Lawrence River is relatively stable, averaging 240,000 cfs at Ogdensburg, NY. Extreme flows have been recorded as great as 40 percent above and below this level, but they are rare. The relative stability of the flow is due to the large capacity of the Great Lakes which collectively act to dampen or moderate the Basin's runoff. The daily average flow rate for the river, 155 million galions, is five times greater than all of the water used for all purposes throughout the Great Lakes Basin.

The St. Lawrence River Basin is made up of several large river subbasins. From west to east, they are: the Indian-Oswegatchie Rivers, the Grasse River, the Raquette River, the St. Regis-Salmon River, Trout River, and the Chateauagay River. In almost every case, these rivers flow first perpendicular to the St. Lawrence, and then turn northeast, flowing parallel to the river before joining it.

The region has a relatively high water table. Average well yields range from 10 to 40 gallons per minute from the ground water supply.

Water Levels and Flows.

The water levels of the Great Lakes are dynamic, constantly changing. However, due to the natural regulation afforded by the large surface area of the lakes and the restrictive nature of the connecting channels, these changes are gradual.

Three types of water level fluctuations occur: long-term, seasonal, and short-term.

1. Long-term changes. Extreme high level to extreme low level and vice-versa, are noncyclical, occurring over long periods of time (usually greater than ten years). The long-term variations reflect changes to the total water supply, mainly precipitation.

2. Seasonal changes take the form of high levels in the spring and low levels in the fall. During the winter months, precipitation is stored in the form of snow and ice. As the weather becomes warmer in the spring, this stored water is released as runoff. In the summer and into the fall, this runoff decreases and evaporation increases, resulting in lower water levels.

3. Short-term fluctuations are caused by external forces, such as wind, acting upon the lake surface. These variations are usually local. They do not generally affect the volume of water in the lake, and they do not affect the lake surface uniformly. An extreme example of this type of change occurred during a storm on Lake Erie on 3 November 1955. During the storm, a 13.2-foot difference in water level elevation was recorded between Buffalo, NY, and Toledo, OH.

Man has attempted limited regulation of Lake Superior and Lake Ontario by building control structures in the St. Marys River and the St. Lawrence River, respectively. The regulation is carried out under prescribed rules set forth in the Order of Approval for each lake. The Orders are established by the International Joint Commission (IJC). The control structure in the St. Marys River was completed in 1921. The Order of Approval provides that the operations maintain the level of Lake Superior as nearly as possible between elevation 600.5 feet and 602.0 feet (International Great Lakes Datum, 1955). The mean lake level since construction of the control works has been 600.5 feet, the lower limit as provided by the Order.

In 1952, the Governments of Canada and the United States sought approval from the IJC to construct hydroelectric power facilities in the International Rapids Section of the St. Lawrence River between Massena, NY, and Cornwall, Ontario. The IJC approved the proposed works, subject to the conditions in the Order of Approval. The Order included directives stating that the monthly mean elevation of Lake Ontario be regulated within a range of 242.8 feet (navigation season) to 246.8 feet (all seasons), as nearly as may be; that navigation and riparian interests downstream are to be provided no less protection than would have occurred without the project; and that the lake level be regulated to benefit shoreline property owners on Lake Ontario by reducing the extremes of stage which had been experienced. During periods when water supplies to the lake are in excess of the supplies of the past (1860-1954), the control works are to be operated to provide all possible relief to riparian owners upstream and downstream. When the supplies are less than those of the past, operations are to provide all possible relief to power and navigation interests.[1]

The Regulation Plan under the Order of Approval for Lake Ontario has been modifed a number of times since 1955. The current plan, Regulation Plan 1958-D, has been in effect since October of 1963. A detailed analysis of how this plan operates along with an analysis of effectiveness of regulation during the recent period of high water on the Great Lakes (1972-74) is contained in the report by the St. Lawrence-Eastern Ontario Commission, "Lake Ontario and the St. Lawrence River: Analysis of and Recommendations Concerning High Water Levels."[2]

On 7 October 1964, the Governments of Canada and the United States requested the IJC to study the factors affecting water level changes on the Great Lakes and to determine if further regulation was practical. The IJC established the International Great Lakes Levels Board in December of 1964 to carry out the study. The Board's final report was submitted to the IJC in December of 1973. While the report did not recommend any specific changes to the current regulation of Lake Ontario, it did find that the physical dimensions of the St. Lawrence River were not adequate to accommodate the record supplies received by Lake Ontario during 1972-73 and still satisfy the criteria of the IJC Order of Approval. The Board concluded that further study to improve the regulation of Lake Ontario was necessary.[3]

Ice jams during the winter have historically presented problems to level and flow regulations. Power entities have installed ice booms across critical sections of the river to aid the formation of stable ice cover to reduce flowing ice and subsequent ice jams. When ice jams occur, they tend to form hanging ice dams resulting in high water levels upstream and reduced water flows downstream of the jam. One of the major problems of an extended navigation season on the St. Lawrence River is the ability to modify the existing ice booms to provide for safe navigation without altering the level and flow properties of the river.

Water Quality.

The development within the Great Lakes-St. Lawrence River Basin has exacted a high price in the deteriorating quality of its water resources.

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1 International Joint Commission. 1976. Further Regulation of the Great Lakes.

2 St. Lawrence-Eastern Ontario Commission. 1975. Lake Ontario and the St. Lawrence River: Analysis of and Recommendations Concerning High Water Levels, SLEOC, Watertown, NY 200+pp.

3 International Great Lakes Levels Board, 1973. Regulation of Great Lakes Water Levels: Report to the International Joint Commission. 294 pp. + appendices.

The basin's water supply, mineral resources, and transportation routes combined to create major industrial and population centers at port cities. The streams and lakes have been heavily damaged by discharges of wastes, by polluted runoff from urban, agricultural, and mine development, and by accelerated siltation, erosion, and sedimentation. Man-induced eutrophication has led to the characterization of Lake Erie as a "dead lake." The once-thriving commercial fishery for whitefish, lake trout, and other species in the lakes are greatly reduced by over-fishing and parasitism, and present attempts to reestablish the fishery are being hampered by heavy-metal and pesticide contamination. Federal, State, and local efforts to remedy existing water pollution problems and to prevent further deterioration of water quality vary within lake and river basins because of varying situations and availabilities of required resources and technologies. The governmental program for the control of water pollution in the country was completely revised by the Federal Water Pollution Control Act Amendments of 1972 (Public Law 92-500). The two major goals set by the above legislation are:

a. To achieve water that is clean enough for swimming and other recreational uses, and clean enough for the protection of fish, shellfish, and wildlife, wherever possible, by July 1983; and

b. To have no discharges of pollution into the nation's waterways by 1985.

Water quality standards and present water quality conditions for each of the five Great Lakes and their connecting channels are thoroughly discussed in the Great Lakes Basin Framework Study, Appendix No. 7, "Water Quality."

The St. Lawrence River presently has more than enough high quality water to meet the projected demands of the major users in or near the study area. The river carries a Class "A" rating; suitable water supply for drinking or food processing. The highest classification of the tributaries of the river is Class "C" or water suitable for fishing. Table A-5 indicates these New York State water quality classifications which are based on usage. Reasons for this lower rating include among others: disposal of human and industrial wastes (treated or untreated), nonpoint source pollution such as runoff from rural and urban lands and highways, and erosion runoff from agriculture and construction locations.

Carrying a Class A rating, the river serves as the major water supply for communitiies along its banks. Table A-6 shows eight community water districts along the St. Lawrence. All but one, Waddington, uses the river water. Waddington utilizes ground water for its water source.

As part of the "1976 St. Lawrence River Ecological Studies" carried out by the U. S. Fish and Wildlife Service, physical and chemical parameters were examined at three areas along the St. Lawrence River: Cape Vincent, Chippewa Bay, and Lake St. Lawrence. The data indicate that the river has a well developed calcium carbonate buffering system and can be classified as as hardwater river. Low levels of phosphorus during the summer months indicate

Table A-5 - New York State Classifications and Standards of Water Quality and Purity

Quality Standards for Class "A" Waters: Items	Quality Standards for Class "A" Waters: Specifications	Quality Standards for Class "C" Waters: Items	Quality Standards for Class "C" Waters: Specifications
1. Coliform	The monthly median coliform value for one hundred ml of sample shall not exceed five thousand from a minimum of five examinations and provided that not more than twenty percent of the samples shall exceed a coliform value of twenty thousand for one hundred ml of sample and the monthly geometric mean fecal coliform value for one hundred ml of sample shall not exceed two hundred (200) from a minimum of five examinations.	1. Coliform	The monthly geometric mean total coliform value for one hundred ml of sample shall not exceed ten thousand and the monthly geometric mean fecal coliform value for one hundred ml of sample shall not exceed two thousand from a minimum of five examinations. This standard shall be met during all periods when disinfection is practiced.
2. pH	Shall be between 6.5 and 8.5.	2. pH	Shall be between 6.5 and 8.5.
3. Total Dissolved Solids	Shall be kept as low as practicable to maintain the best usage of waters, but in no case shall it exceed 500 milligrams per liter.	3. Total Dissolved Solids	None at concentrations which will be detrimental to the growth and propagation of aquatic life. Waters having present levels less than 500 milligrams per liter shall be kept below this limit.
4. Dissolved Oxygen	For cold waters suitable for trout spawning, the DO concentration shall not be less than 7.0 mg/l from other than natural conditions. For trout waters, the minimum daily average shall be not less than 6.0 mg/l. At no time shall the DO concentration be less than 5.0 mg/l. For non-trout waters, the minimum daily average shall not be less than 5.0 mg/l. At no time shall the DO concentration be less than 4.0 mg/l.	4. Dissolved Oxygen	For cold waters suitable for trout spawning, the DO concentration shall not be less than 7.0 mg/l from other than natural conditions. For trout waters, the minimum daily average shall not be less than 6.0 mg/l. At no time shall the DO concentration be les than 5.0 mg/l. For non-trout waters, the minimum daily average shall not be less than 5.0 mg/l. At no time shall the DO concentration be less than 4.0 mg/l.
5. Phenolic Compounds	Shall not be greater than 0.005 milligrams per liter (Phenol).		

Source: New York State (1967-1974) Official Compilation Codes, Rules, and Regulations of the State of New York. 162 Washington Avenue, Albany, NY 12231.

Table A-6 - Public Water Supply Data for Major Communities Along the St. Lawrence River [1]

Municipaly or District	Source	Number of Households or Establishments Served	Population Served[2]	Disinfection[3]	Filtration	Other Treatment	Average Daily Production (thousand gallons)	Distribution Storage (thousand gallons)
Alexandria Bay	S	400	1,900	X			300	250
Cape Vincent	S	400	750	X			200	190
Clayton	S	768	2,100	X			425	750
Massena	S	4,200	17,670	X	X	L	1,700	1,000
Morristown	S	120	526	X	X	L	66	100
Ogdensburg	S	4,500	14,358	X	X	F	3,160	0
Thousand Island Park	S	325	1,500	X			200	175
Waddington	G	300	948			C	95	200

Legend: G - Ground Water, S - Surface Water, C - Aeration, F - Flouridation, L - Limesoda softening.

1 Source: Northern Area Business Fact Book, Part 1 "Business and Manufacturing," U. S. Dept. of Commerce, 1976 Edition.
2 As of 1974.
3 Disinfection by Chlorine or Chlorine Compound.
4 Amount of fully treated water available for immediate distribution.

that this element is most likely the primary nutrient controlling production in this river system. Dissolved oxygen levels were not depressed in bottom waters at any sampling sites.

The intensively developed shoreline and the valuable and extensive natural resources make the St. Lawrence highly vulnerable to damage from oil spills. On 23 June 1976, the New England Petroleum Company Barge (NEPCO) No. 140 ran aground in the fog off Wellesley Island near Alexandria Bay, NY. The barge spilled some 300,000 gallons of number six fuel oil into the river. River currents spread oil well downstream of Massena, NY.

While this spill was not large when compared to major oil spills which have occurred in the oceans, it was the most expensive in the history of this country. Direct clean up charges reached $9 million and some $46 million are pending or under litigation for damage claims.

Besides the potential oil spill hazards posed by the numerous shoals and embayments of the Thousand Island area, additional water quality problems exist.

Most visibly, nuisance aquatic plants (particularly the alga, Cladophora) are found along the shorelines. The excessive growths of aquatic plants are greatest near the Lake Ontario outflow.

A portion of the St. Lawrence River in the Ogdensburg, NY, area has a Class D rating, which is water best suited for agricultural uses or any use other than fishing, bathing, drinking water, or food processing. This area is in the vicinity of the Diamond National Corporation industrial waste discharge. Treatment facilities are under construction at this industrial plant to resolve this problem. Also, secondary treatment facilities for the city of Ogdensburg are to be completed in 1978. A sediment analysis carried out by the U. S. Environmental Protection Agency in 1976 determined that the Ogdensburg Harbor sediments were grossly polluted, particularly with respect to volatile solids, COD (Chemical Oxygen Demand), grease and oil, and zinc.

At Massena, NY, the Aluminum Company of America (ALCOA) discharges 20 million gallons per day (MGD) of effluent from a setting and oil separation lagoon into the lower Grasse River. ALCOA is in the final stages of converting to a dry processing operation which will replace the lagoons.

Water quality for ground water resources vary along the project area. While man-induced pollution is relatively minor, it is a significant concern in local areas where septic systems encounter the water table. Infiltration of septic system effluents occur where fractures and solution fissures in the limestone bedrock allow leaching into the aquifer. Ground water resources in carbonate bedrock may have excessive hardness and contain high levels of iron and manganese.

Water quality degradation has had and is presently having a negative effect upon the fisheries of the St. Lawrence region. A deteriorating water quality reduced the number of suitable spawning habitats for cold water species, especially in the tribuary streams of the river. A salmon and trout restoration program for Lake Ontario got underway with the stocking of over 826,000 fish in 1973 (mostly coho and chinook salmon and brown, rainbow, and lake trout). This salmonid fishery program was hit in 1974 when polychlorinated biphenols (PCB's) were found in concentration in some sport fish so as to prompt health officials to issue warnings. In September 1976, Mirex, another chlorinated hydrocarbon, was found in very high levels in fish from Lake Ontario. New York State Department of Environmental Conservation had placed a complete ban on the possession of salmonids, catfish, small mouth bass, and alwifes from Lake Ontario and its tributaries. This ban was modified to allow possession of some trophy class fish. The restrictions on possession of fish from Lake Ontario, as of April 1977 is listed in Table A-7.

On 31 March 1978, the New York State DEC lifted the ban on possession of Lake Ontario fish. The main reasons for this action appear to have been:

a. The difficulty of enforcing the ban,

b. The lack of a ban by Canadian authorities, and

c. Public pressure from upstate New York legislators and sport-fishing interests.

While the New York State Health Department did not comment on the decision, they did issue a new warning that eating fish from Lake Ontario may be a health hazard, especially for infants, young children, and pregnant or lactating females. This warning is similar to the actions taken by the Canadian authorities.

Air Quality.

Air pollution has historically been a problem in the Great Lakes Basin. Industrial development occurred along the lake's shoreline because of the plentiful water resource and ease of access and shipping of both raw and finished goods. These heavily industrializd areas developed severe local air quality problems. Today, it is well recognized that air pollution affects suburban and rural areas as well as these urban areas. Air pollution can have a harmful effect on human health, aesthetic and cultural resources, property, wildlife, water quality, and vegetation.

The Clean Air Act of 1975 (40 CFR 55:1975) strongly established the leadership of the Federal Government in developing programs to prevent and control air pollution. The U. S. Environmental Protection Agency is the administrator of the Federal program. State authorities had to establish plans designed to meet the air quality standards set by the EPA under the Act. All of the Great Lakes States have air quality standards set by the EPA under the Act. All of the Great Lakes States have air quality control plans acceptable to meet the Federal standards. There are over 200 Air Quality Control Regions (AQCR) in the United States. Since air pollution does not necesarily follow State or municiple boundaries, these AQCR's allow a group of communities to be treated as a unit for setting limitations on concentratione of atmospheric pollutants. The AQCR's around the Great Lakes are identified in the Great Lakes Basin Commission's Framework Study "Appendix 23 - Health Aspects."

Table A-7 - Restrictions on Possession of Lake Ontario Fish Species*

Species	Restrictions
Coho Salmon	Under 21 inches, no restriction on possession. From 21 to 31 inches, may not be possessed. 31 inches and above, may be possessed under permit.**
Brown Trout	Under 18 inches, no restriction on possession. From 18 to 21 inches, may not be possessed. 21 inches and above, may be possessed under permit.**
Rainbow-Steelhead	Under 25 inches, no restriction on possession. From 25 to 27 inches, may not be possessed. 27 inches and above, may be possessed under permit.**
Chinook Salmon	Under 35 inches, may not be possessed. 35 inches and above, may be possessed under permit.**
Smallmouth Bass	Under 18 inches, may not be possessed. 18 inches and above, may be possessed under permit.**
Lake Trout	May not be possessed.
American Eel	May not be possessed.
Catfish (Other than Brown Bullhead)	May not be possessed.
Alewife-Herring	May be taken for bait purposes only.

*As of April 1977.
**Each licensed angler may apply for three free tags per license year permitting possession of three trophy-sized fish. These tags, to be used only once, permit legal possession of coho salmon 31 inches and larger, brown trout 21 inches and larger, rainbow-steelhead 27 inches and larger, chinook salmon 35 inches and larger, and smallmouth bass 18 inches and larger.

Source: NYS Department of Environmental Conservation

Not only does air pollution cross municipal and State boundaries, it also affects the air quality of neighboring countries. The International Joint Commission (IJC) of Canada and the United States has been attempting to solve this problem. The problems associated with transboundary air pollution as studied by the IJC are summarized in the report "Transboundary Air Pollution: Detroit and St. Clair River Areas" published by the IJC in 1972.

General air quality within the region of the St. Lawrence River is good. The majority of the communities along the international section of the river are resort centers, with Massena and Ogdensburg being the most urbanized areas. Massena depends on heavy industry for its economic base. The Reynolds Metals Company, General Motors Corporation, and ALCOA all have plants in Massena. Air quality data from the Massena Water Pollution Control Plant's air quality monitoring station indicated that suspended particulate levels in the area are below the acceptable standards.

NYSDEC has classified Ogdensburg as a Level II air quality area, which indicates that local air quality would be typical of an area of limited development and sparse settlement. Local levels of suspended particulates (various types of dust, combustion waste particles, etc.) remained below the State's Level II standard and exhibited a general decreasing trend during the 1967 through 1974 period of record.

Land Use and Development.

The U. S. portion of the Great Lakes-St. Lawrence System comprises 64 percent of the total land area (83.6 million acres). The major land uses within this section are forest lands (47.4 percent), agriculture (38.4 percent), urban development (8.4 percent), and miscellaneous uses (5.8 percent). Eighty percent of the U. S. land area is in private ownership. The remainder is owned by Federal, State, and local Governments, mostly in the form of forest, parks, and recreational lands.

Forest land covers nearly one-half of the region, but it is not uniformly distributed. Most of the basin was forested prior to the early 1800's. Initial cutting and clearing was for agricultural use, but by the last half of the 19th century, increased development of lumbering and other wood-using industries took place. By the early 1900's this resource was depleted, and these industries moved to other areas. Much of the forest lands have been reestablished by natural regeneration and forest mamagement activities.

Extensive agricultural lands exist in Ohio, Pennsylvania, New York, and lower central Michigan. About 28.6 milion acres are in cropland and 3.5 million acres are in pasture range. Potatoes, fruit crops, truck crops and dairying dominate the agricultural scene.

While representing only 8.4 percent of the total land use, urban development areas have a considerable influence over land use decision. More than one-third of the total agricultural lands are located within Standard Metropolitan Statistical Areas, where most of the future urban growth is expected. Urban development projections indicate this type of land use will increase from the present 7.0 million acres to 12.1 million acres by the year 2020.

Shorelands, with their opportunity for waterborne commerce, water supply, and recreation, have been the focus for development in the region. Of the 432 miles of shoreline along the St. Lawrence (islands included), approximately 58 percent has some type of development. Recreational facilities and summer cottages represent the bulk of this activity. Frequently this development has occurred within the first 200 to 300 feet inland of the water's edge, with the most inland areas being used for agriculture or left undeveloped.

In a technical report entitled, "Development Suitability" the St. Lawrence-Eastern Ontario Commission (SLEOC) classified the region's shorelands as either least suitable or most suitable for development with few cases in between. The report states that rapid land use change is occurring in the area due to highway construction, decreasing farm viability, and increasing demands for seasonal homes and recreational facilities. The SLEOC study examined a shoreline strip approximately one mile wide extending the entire reach of the St. Lawrence River and Eastern Lake Ontario. The study excluded those areas which were already developed or which had been given a high priority use for environmental protection by the New York State Office of Planning Services. The report did mention however, that much of the previous development had occurred on poorly suitable sites.

There are over 250 recreational facilities within the project, mostly all of which are water-oriented. The majority of these have been developed since the 1938 opening of the Thousand Islands Bridge. There was an increase from seven marinas and eight State parks in 1938 to 40 marinas and 22 State parks in 1970. At the present time, Cape Vincent, Clayton, Alexandria Bay, and Thousand Island Parks Area are the major resort centers in the region. These centers contain both public and private recreational facilities and have taken the heaviest development pressure. The State parks alone can handle 800,000 campers, and they attract more than one million visitors annually.

Vegetation.

The natural vegetation pattern of the Great Lakes-St. Lawrence River Basin have been greatly modified by man's activities. Much of the once-forested land area has been replaced by urban, industrial, and agricultural development. Virgin forests have been drastically reduced and are presently limited to small tracks within the northwoods country of Michigan, Wisconsin, and northern Minnesota, and also along the Ontario shores of Lakes Superior and Huron.

The predominant natural vegetation surrounding Lake Erie, Lake Ontario, and the southeastern sections of Lakes Huron and Michigan is the broadleaf deciduous forest including the following: oaks, hickories, maples, yellow poplars, and some 50 other plant species. Stands of pine and spruce dominate the western and northern portion of Lake Surperior hardwoods of the south, and east is a transition zone with a mixture of maples, yellow birches, pines, and hemlocks.

Additional vegetation types within the basin include prairie grasslands along the southwest border of Lake Michigan, wetlands and bogs interspersed among the forest lands and beach areas which have their own distinct dune vegetation (predominantly grasses, spruce, balsam fir, and cedar).

Plant communities along the St. Lawrence generally fall into one of three categories: littoral, wetland, or upland communities. (The following discussion on natural vegetation along the project area is taken, for the most part, from Geis and Luscombe (1972)[1], Geis and Kee (1977)[2], and Geis et al (1973).[3]

Littoral communities are located along the islands and mainland and also at shoal areas within the river.

Rooted aquatic vegetation is found in areas generally less than six meters in depth. Major plant species in these communities are eel grass (Vallisneria americana), flat stem pond weed (Potamageton zosteriformis), coontail (Ceratophyllum demersum), water star flower (Heteranthera dubia), and waterweed (Elodea canadensis). In the more shallow areas, such submergent macrophytes as duckweed (Lemna trisulca) and additional pond weeds (Potamogeton spp.) become abundant. Pond lillies (Nymphaea taberosa and Nuphar variagatum) are common in the most shallow of the areas. These plants have floating leaves and tend to cause a reduction in the numbers of submergent species where they (the lillies) occur. The shoal areas are extremely important because of their location. Shoals are generally associated with rocky areas in the river proper. They tend to trap detritus out of the water column, making it available as food for migratory waterfowl.

Turbidity, current velocity, ice dredging/scouring, water level changes, and wave action are important environmental factors which influence the distribution and density of these communities. Very little information is available on how the present St. Lawrence Seaway System has impacted on littoral vegetation. A study to determine the impact of natural ice-dredging on the composition of littoral plant communities will be conducted during 1978 (January-September). The study is part of a package designed to supply the necessary information for the environmental assessment of the Winter Navigation Demonstration Program on the St. Lawrence River.

Wetland communities form the transition zone between the water and land environments. Wetlands serve multiple functions in nature. They serve as spawning and nursery habitat for fish, provide feeding and nesting areas for waterfowl and other fauna, support uncommon or rare species of plants and animals, improve water quality by filtering organic and inorganic sediments and pollutants, moderate flooding frequencies by storing flood waters, and act to recharge ground water aquifers. Also, they generally increase the aesthetic and recreational potential of a region.

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1 Geis, J. W. and S. Luscombe, 1972, Technical Report of Neutral Vegetation, St. Lawrence-Eastern Ontario Shoreline Study, SUNY College Environ. Sci. Forestry, Suracuse, NY, 20 pp.

2 Geis, J. W. and J. L. Kee, 1977, Coastal Wetland along Lake Ontario and St. Lawrence River in Jefferson County, NY SUNY-CESF, Syracuse, NY, 130 pp.

3 Geis, J. W., N. P. Hyduke, B. A. Gilman, P. Ruta, and M. E. Faust, 1977, Plant Committee Along the St. Lawrence Shoreline in New York State. P; 111-139 In: Biological Characteristics of the St. Lawrence SUNY-CESF, Syracuse, NY.

It is difficult to define wetlands without reference to the vegetative characteristics. Cowardin et al (1976, 1977) point out that certain wetlands may be non-vegetative due to disruptions such as wave actions, water currents, turbidity, and water level fluctuations, but that vegetation would predictably develop in those units if the disruptions were not present. This concept is included in the definition of the term "wetland" found in the Excutive Order 11990 of 24 May 1977 signed by President Carter:

"The term "wetlands" means those areas that are inundated by surface or ground water with a frequency sufficient to support and under normal cicumstances does or would support a prevalence of vegetative or aquatic life that requires saturated or seasonally saturated soil conditions for growth and reproduction. Wetlands generally include swamps, marshes, bogs, and similar areas such as sloughs, pot holes, wet meadows, river overflows, mud flats, and natural ponds."[1]

Wetlands along the St. Lawrence River can generally be classified into one of the four types described below:

Typha Marsh: Marshes along the river usually bound by a zone of cattails (*Typha* spp.). Additional species such as willows (*Salix* spp.), rushes (*Juncus* spp.), and grasses may be mixed in with the *Typha* along the upland borders.

Graminoid Marsh: Extensive marshes dominated by sedges (*Carex* spp.), rushes, and grasses; sites are usually drier than the *Typha* zone.

Shrubby Marsh: Woody shrubs dominate the landward edges of open bays and depressions in upland fields. Species such as dogwoods (*Cornus* spp.), spirea (*Spirea* spp.), and willows (*Salix* spp.) dominate.

Bogs: Typically these are closed drainage ponds with dense growths of *Sphagnum* moss.

A more complete description of wetland plant communities is given in Geis and Kee (1977) along with an in depth survey of the wetlands in Jefferson County, NY.

Fluctuating water levels are one of the most important environmental factors affecting wetland communities within the Great Lakes-St. Lawrence River Basin. While sometimes appearing to have negative impacts, water level fluctuations are often necessary to maintenance of the long-term health of the wetlands. These are called "pulse-stable" communities.[2] The community oscillates between hydric and xeric conditions, never completing a successional climax from open water to upland community. Extreme high levels, such as occurred during the early 1950's and the early 1970's tend to kill off those species less tolerant of inundation: emergent species die off and give way to submergent zones, shrubs and trees along the upland border die

1 Executive Order 11990, "Protection of Wetlands," issued 24 May 1977 by President Carter.

2 "Analysis of the International Great Lakes Board Report on Regulation of Great Lakes Water Levels: Wetlands, Fisheries, and Water Quality." 1976 Institute Environmental Studies, Univ. Wisconsin, Madison Working Paper #30. 9 pp.

off and give way to emergents and wet-meadow species. Extreme low levels (1930's, 1960's) allow the return of earlier vegetation patterns, but if the low levels remain for extended periods, upland species encroach upon the wetland.

Areas of die-off along the St. Lawrence during the 1972-74 period of high water partially recovered by the 1976 season.[1] Geis and Kee (1977) state that it takes 2-3 years for reestablishment. It appears that either continuous high water periods or frequent rapid fluctuations (eg: daily, weekly, etc. . .) may not allow the vegetation to recover. Extended low periods are more devestating to fishery resources than to the plant community. During such periods, the vegetation may change towards upland climax community types, but this is a very long process. Species of fish utilize the shallow water areas of the marsh each spring for spawning. Rapid short-term fluctations also affect the fisheries by leaving the spawned eggs exposed to the air.

There is an ongoing study titled, "Impact of Lake Levels on Coastal Marshlands of the Great Lakes," done by the Eastern Michigan University. It is scheduled for completion in September, 1978.[2] This study should yield significant information on the relationship between water level changes and Great Lakes wetlands.

Upland communities range from recently cultivated farmlands to natural forests. The general succession from cleared land to forest is a very long process. All of the interim stages are represented in the area. Recently abandoned agricultural lands are dominated by introduced grasses and native herbaceous plants. Normal woody plants take 15 to 25 years to become established and are first categorized as shrublands or shrubby fields. Major species of shrubs in these areas are dogwoods (Cornus spp.), branbles (Rubus spp.), viburnums (Viburnum spp.), and apple (Pyrus malus). Tree species include elm (Ulmus americana), ash (Fraxinus americana), and cherries (Prunus spp.).

Mature forests are rare and undisturbed forests are probably absent from the study area. The mature forests, when present, are the result of long-term successional development, reforestation, protection by the owners, or exist because the terrain is too steep or too rough to allow harvest. Forests dominated by aspens (Populus spp.), birches (Betula spp.) and white pine (Pinus strobus) are indicative of successional forests on either abandoned agricultural lands or areas which have been logged or burned.

White pines are also associated with coniferous forests which are more prevalent in St. Lawrence County or the downstream area of the river. Additional

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[1] Gies, J. W., and J. Kee. 1977. Coastal Wetlands along Lake Ontario and the St. Lawrence River in Jefferson County, NY, SUNY-CESF, Syracuse, NY, 130 pp.

[2] Raphael, C. N., E. Jaworski, B. Williamson, and J. M. Worthington. "Impact of Lake Levels on Coastal Marshlands of the Great Lakes." Eastern Michigan University, Deaprtment of Geography, Ypsilanti, MI.

coniferous type forests include hemlock (Tsuga canadensis), balsam fir (Abies balsamea), and white spruce (Picea glauca). Hardwood forests in the area are dominated by sugar maple (Acer saccharum), red oak (Quercus rubra), beech (Fagus grandifalia), basswood (Tilia americana), and elm (Ulmus americana).

A preliminary list of plant species along the St. Lawrence River is avaialble in the U. S. Fish and Wildlife Service report "St. Lawrence River Ecological Study, 1976: Biological Characteristics."

Fish and Wildlife Resources.

The Great Lakes-St. Lawrence River Basin contains more than 237 species and subspecies of fish, representing most of the important families of fresh water fishes in North America. Most of these species are indigenous to the basin, having entered the lakes during the period of Pleistocene glaciation. During the development of the Great Lakes-St. Lawrence River System, there existed a water connection between the lakes and the following drainages: Hudson Bay and Upper Mississippi River; the Ohio and Middle Mississippi Rivers; and the Mohawk, Hudson, and Susquehanna Rivers. Each of these watersheds now share some common species with the basin. In addition, exotic species are present, having been either purposely or inadvertently introduced by man. These introductions, along with poor fishery management practices, have led to significant changes in the fishery resources of the basin.

Prior to the mid-1920's, lake sturgeon, lake herring, and lake whitefish comprised the bulk of the commercial fishery. By the late 1920's, these species declined. Lake sturgeon were over-harvested; lake herring suffered from over-harvest and degrading water quality; lake whitefish were exploited by the introduction of new deep-trap nets. (When these nets were prohibited from use, whitefish were attacked by the invading sea lamprey, never having a chance to fully recover.) The decline of these three species led to heavier utilization of large predatory species such as lake trout and blue pike.

In 1932 the Welland Canal opened its newest version. This canal had eight high-lift locks and a working depth of 27 feet (previous version had 26 locks and a 14-foot depth). The significance of this new system was that the sea lamprey and the alewife, previously retricted by the Niagara Falls, were alledgedly able to invade the upper four Great Lakes.

The sea lamprey first attacked the lake trout and burbot, both deep water predatory species, with visible declines noticable in the fishery in the 1940's. When these stocks became low, both the sea lamprey and the fishermen focused on the remaining whitefish and the larger of the chubs (ciscoes) inhabiting the upper lakes. The smaller bloater chub then became of commercial importance. Alewifes took advantage of the food base left open by the declining chub population and greatly increased in numbers. The rainbow smelt, having been introduced into the Lake Michigan watershed around 1912, had suffered a great decline during the early 1940's, possibly due to a bacterial or viral disease. This species recovered and along with the increasing alewife population formed a competitive base retarding the natural reestablishment of the large chubs. (The bloater chub is still harvested in Lakes Superior and Michigan.)

In the past two decades, yellow perch, rainbow smelt, carp, catfish, suckers, walleye, sheepshead, and, to some extent, whitefish have dominated the commercial fishery. Lake trout stocks have been reinforced through hatchery stockings, and the fishery is on the climb. Other salmonids, such as coho-salmon, chinook-salmon, and rainbow trout (steelhead), have been introduced mainly for the sport fishery. Toxic materials such as heavy metals and pesticides are presently jeopardizing these and other species in the System (See also Water Quality).

The portion of the basin north of the 43°N latitude line is forested and only lightly settled. The supply of wildlife habitat (other than croplands) is generally good in this region. Below the 43rd parallel or below the imaginary line between Milwaukee and Buffalo, the basin is heavily settled and has seen extensive industrial and agricultural development. Cropland habitat is the dominant type of wildlife habitat in this region.

There are eight general types of wildlife habitat in the Great Lakes-St. Lawrence River Basin. These are northern wilderness forests, farmland woodlots, eastern woodland forests, river-bottom woodlands, scrub and brush lands, open fields and meadow lands, croplands, and freshwater wetlands.

The wildlife that inhabit the above areas fall into one of the following categories: big game, small game, furbearers, waterfowl, wading birds, shorebirds, song birds, amphibians, and reptiles.

The basin's principal waterfowl areas are shore and inland marshes of western Lake Erie; Lake St. Clair, Saginaw Bay, MI; Green Bay, WI; inland southern Wisconsin marshes including Horicon; Lake Ontario and St. Lawrence River marshes; St. Marys River; eastern inland Upper Michigan Peninsula marshes; and southwestern Michigan marshes.

The most important factor affecting basin wildlife and habitat is the increasing human population. This problem leads to two major concerns, habitat degradation and habitat loss. Ironically, increased human populations also mean an increased demand for wildlife resources. Accelerated attrition of habitat is occurring over most of the basin especially along the southern portions where urbanization is greatest.

The fish and wildlife of the St. Lawrence River area represent the greatest natural resources of the region. The fishery itself is a multimillion dollar industry. In summarizing their 1972 shoreline study, the St. Lawrence-Eastern Ontario Commission stated "The St. Lawrence-Eastern Ontario area . . . is important mainly because of its natural resources. Therefore, preservation and maintenance of the area's natural resources cannot be overstressed."[1]

[1] "St. Lawrence-Eastern Shoreline Study," 1972. St. Lawrence-Eastern Ontario Commission, Watertown, NY (No emphasis added).

For these reasons, a somewhat detailed survey of the fish and wildlife resources of the river area is given herein.

Aquatic Ecology.

All production in an ecosystem stems from the energy in organic substances that autotrophic organisms create from inorganic raw material. In the St. Lawrence River, phytoplankton is one of the major autotrophic groups which fix energy. This energy is passed along to zooplankton or directly to herbivorous fish, then on to other fish, and ultimately to birds, furbearers, and man. One method of monitoring the energy flow through such a system is by measuring the primary and secondary production of that system, as well as the standing stock or biomass of the organisms within the system.

A U. S. Fish and Wildlife Service Report on the biological characteristics of the St. Lawrence River System[1] listed species compositions for the phytoplankton, zooplankton, periphyton, aquatic macrophyte, and benthic invertebrate communities. Estimates of biomass and productivity were also made.

These data are of a preliminary nature, and, as such, are not yet adequate for an environmental assessment of the proposed project and its alternatives. Some of these data are taken from the above mentioned report and summarized in the following paragraphs. This information is provided herein to give the reader a general feeling for the aquatic ecosystem along the St. Lawrence River.

Additional information on primary and secondary productivity, including benthic invertebrates, will be collected during 1978 for an environmental assessment of the Winter Navigation Demonstration Program on the St. Lawrence River. This information should be a significant addition to the existing data-base on the aquatic ecology of the St. Lawrence.

Sampling during the summer of 1976 resulted in 103 species of phytoplankton being identified from three sampling locations. These locations, listed in order from highest number of species to lowest, are Cape Vincent, Chippewa Bay, and Lake St. Lawrence. Species of green algae (Chlorophyta) and diatoms (Chrysophyta-Bacillariophyceae) were the most abundant throughout the river. Members of the blue-green algae group (Cyanophyta) were more abundant during late summer. Estimates of phytoplankton biomass showed the same trend as did the species composition data with highest estimates at the Cape Vincent station and lowest at the Lake St. Lawrence location. The data indicate that a substantial input of phytoplankton biomass is provided by Lake Ontario and that a gradual decline occurs moving downriver in both population density and makeup.

[1] St. Lawrence Ecological Studies, 1976: Biological Characteristics, U. S. Department of Interior, Fish and Wildlife Service, Cortland Area Office, Cortland, NY. 227 pp.

Primary productivity estimates were made at Chippewa Bay. Average chlorophyll concentrations ranged from 4 to 5 milligrams per cubic meter.

The Periphyton algae community was examined in Chippewa Bay. In general, periphyton algae are an important group of primary producers in an aquatic ecosystem, and in shallow water areas may be the major autotrophic group. Diatoms and green algae were the dominant forms of periphyton algae in Chippewa Bay. Cladophora, the dominant green algae, was found attached to the aquatic macrophytes (vascular aquatic plants). The ratio of Cladophora weight, to the weight of the aquatic macrophytes increased during the summer, reaching a high of 1.8 grams of Cladophora per gram of macrophytic plant in August.

Twelve (12 species of aquatic macrophytes were collected from six (6) sampling locations varying in depth from 1.5 to 21.5 feet. Chippewa Bay showed the highest number of plant species present, and Goose Bay showed the highest biomass of macrophytes. Myriophyllum exalbescens, a water milfoil, was the most dominant plant species in five of the samples, with pond weeds (Potamogeton spp.), eel grass (Vallisneria americana), and water star flower (Heteranthera dubia) being dominant in at least one of the sampling locations.

Zooplankton are considered the primary consumers in an aquatic ecosystem, transferring the energy fixed by the primary producers to the next higher trophic level, usually planktivorous fish. Twenty-one (21) species of zooplankton were identified from samples collected at three sites along the St. Lawrence River: Cape Vincent, Chippewa Bay, and Lake St. Lawrence. The species collected fell into the following taxonomic groups: Calanoid copepods (1), cyclopoid copepods (2), cladocerans (5), and rotifers (13). Biomass estimates were similar in some respect to those for the phytoplankton, with Cape Vincent having the highest biomass and Lake St. Lawrence the lowest. Again, it appears that Lake Ontario supplies a substantial amount to the standing stock of planktonic organisms in the St. Lawrence River.

Benthic invertebrates were sampled at Cape Vincent, Chippewa Bay, and Lake St. Lawrence. Amphipods (scuds), tubificids (sludgeworms), Trichopterans (caddisflies), and Chironomids (midges) were the most important components of the bottom fauna. The amphipods were also found in high densities within the aquatic macrophytes. A major problem was encountered in quantifying the data, as great variations in bottom strata resulted in a patchy distribution of organisms.

Fishery Resources.

General - Preliminary baseline studies on the fisheries of the St. Lawrence River were initiated in 1976 by the U. S. Department of Interior, Fish and Wildlife Service[1] under the Demonstration Program for Navigation Season Extension on the Great Lakes-St. Lawrence River. A brief summary of

[1] St. Lawrence Ecological Studies, 1976; Biological Characteristics, U. S. Department of Interior, Fish and Wildlife Service, Cortland, NY. 227 pp.

selected elements of the studies follows. Again, these data are preliminary, and more detailed information will be required for an environmental assessment of the project.

A report on larval fishes and ichthyoplankton of the St. Lawrence River summarized the available literature on the topic, identifying data gaps for the area. The report indicated that sampling techniques for larval fishes in dense vegetation areas are lacking and that new methods must be developed. Weedy areas provide both food and protection for young fish, and being relatively shallow areas, they are more subject to effects from environmental perturbations. Likewise, the larval fishes, as pointed out in the report, are also extremely susceptible to environmental perturbations.

A preliminary study on feeding ecology of St. Lawrence fishes indicated that aquatic invertebrates of the Amphipoda, Chironomidae and Zooplankton groups were the most important food item (for fish species less than 100 millimeters in length). Adult fishes were characterized as largely planktivores (alewife), piscivores (smallmouth bass, largemouth bass, and northern pike), or generalists (brown bullhead, yellow perch, rock bass, black crappie, pumpkin seed, and white perch).

Preliminary data for species composition and distribution along the river were gathered through gill netting, trapping, and tagging of fish. Where 99 species have been captured and identified from the international section of the river, only 67 species were collected during the 1976 field season. Table A-8 is a summary of the life histories of the major sport and commercial fish in the region. (Note: See also the sections on Water Quality and Recreation for additional fishery-related information.)

Additional information on the St. Lawrence River Fisheries will be collected during 1978 as part of the baseline biological studies for the assessment of Winter Navigation Demonstration Program on the St. Lawrence River.

Amphibians and Reptiles (Herptiles).

Amphibians and reptiles, collectively called herptiles, form a group of organisms that bridge the gap between aquatic and terrestrial environments. Amphibians usually have early life history requirements completed in water, while adults may live part of their life on land; reptiles lay their eggs on land, but many adults live in the water.

Herptiles are an important component of the biotic community. They are represented by herbivores, carnivores, and omnivores, eating such items as plants, insects, fish, shellfish, rodents, and other herptiles. Their eggs, larvae, and adults are common food items for predators of both the aquatic environment (pike, muskies, bass, etc.) and the terrestrial environment (hawks, owls, racoons, weasels, etc.). Because of their secretive nature and the fact that they are cold-blooded animals, herptiles may be less visible in their habitat than other vertebrate groups such as birds. They are not, however, less important. They play an active role in the energy flow and transformations within the food web of the community.

Table A-8 - Life History of Major Sport and Commercial Fish in St. Lawrence-Eastern Ontario Area

Species	Adult Habitat Spring	Adult Habitat Summer	Adult Habitat Fall/Winter	Adult Food Supply	Spawning Period	Spawning Habitat	Young Habitat	Young Food Supply
				WARM-WATER FISH*				
Northern Pike	Shallow weedy areas of creeks wetlands	Weedy bays, slow moving rivers	Weedy bays, slow moving rivers	Vertebrates, mainly fish	April to early May	Shallow wetland areas, weedy bays	Remain near spawning grounds, move out in July	Zooplankton, fish after one week
Muskellunge	Wetlands, weedy bays	Weedy bays, slow moving rivers	Weedy bays, slow moving rivers	Vertebrates, mainly fish	Late April to early May	Shallow wetland areas, weedy bays	Remain near spawning grounds, move out in July	Zooplankton, fish after 3-4 weeks
Smallmouth Bass	Shallow inshore waters	Seek deeper water	1 to 30-foot range	Insects, crayfish, fish	Late May to early June	Shallow gravelly bottom areas of lake, some streams	Same as adult	Insects, crayfishes by time they reach 50 mm length
Yellow Perch	Shallow inshore waters	Open lake in areas of moderate vegetation (under 30' deep)	Under 30-foot depth, school in lake, active in winter	Insects, invertebrates, fish	Mid-April to May	Shallows of lake and tributary rivers	Shallow water near vegetation	Insects, invertebrates
Brown Bullhead	Shallow bays, slow moving rivers	Shallow bays and streams	Open bays	Insects, leeches, worms, plant material	April to June	Mud or sand in shallow water of lake and streams	Same as adult	Same as adult
Rock Bass	Shallow inshore waters	Shallow water, associated with bass	Shallow water, associated with bass	Aquatic insects, crayfishes, small fish	Spring to early summer	Inshore gravel bottom areas	Same as adult but with more vegetation	Same as adult
Pumpkinseed	Shallow inshore waters	Cover of submerged vegetation	Cover of submerged invertebrates	Insects and other	Late spring to early summer	6-12 inches of water along lake shore with vegetation	Same as adult but with more vegetation	Same as adult
American Eel	Shallow inshore waters	Inshore shallow areas in vegetation	Inshore shallow areas in vegetation	Fish and Invertebrates	Fall	Vicinity of Sargasso Sea	Drift in ocean for year	Unknown

Table A-8 - Life History of Major Sport and Commercial Fish in St. Lawrence-Eastern Ontario Area (Cont'd)

Species	Adult Habitat Spring	Adult Habitat Summer	Adult Habitat Fall/Winter	Adult Food Supply	Spawning Period	Spawning Habitat	Young Habitat	Young Food Supply
				COLD-WATER FISH**				
Lake Trout	Move inshore, but away from shallows	Below thermocline	Move shoreward during fall	Alewives, smelt, sculpin	September to November	Rocky shoals at depths less than 120 feet	Seek deep water within one month	Sculpins
Rainbow Trout	Close to shore, in and near spawning streams	Scattered throughout lake in thermocline area	Move inshore in fall, some ascend stream with salmon	Bottom invertebrates plankton, forage fish	Mid-April to late June	Tributary streams with fine gravel areas	Move to lake immediately or remain 1 to 2 years in the stream	Crustaceans and other bottom invertebrates
Brown Trout	Very close to shore	Move just offshore in preferred temperature range	Move inshore with cooling temperature, congregate in shallow bays and streams	Alewives, insects	Late fall to early winter	Shallow gravelly headwaters	Same as adult in the lake	Aquatic and terrestrial insects and larvae, crustaceans
Coho Salmon	Inshore at first, later moving offshore into the open lake	In the open lake, schooling at the thermocline	Move inshore to parent streams, ascend streams to spawn and die	Smelt, alewives, invertebrates	Early September to early October	Parent streams, shallow gravelly areas of tributaries	Remain in streams until smolt stage, move into lake during second spring	Aquatic insects and larvae, small fish
Chinook Salmon	Scattered throughout open lake	Open lake where thermocline meets bottom	Move inshore to spawning streams, spawn and die	Smelt, shad, invertebrates	October to December	Parent streams, larger rivers or tributaries	Move to the lakes as fingerlings during first summer	Invertebrates, mainly insects

*These species are found both in Lake Ontario and the St. Lawrence River and all spawn successfully in nature.
**These species spend most of their lives in Lake Ontario. A limited amount of successful spawning probably occurs with the lake trout, rainbow-steelhead and coho salmon. Brown trout and chinook spawnings are not usually viable.

Source: St. Lawrence-Eastern Ontario Commission," Report on Coastal Resources," 1977, main report, 92 pp.

Table A-9 is a preliminary list of the amphibians and reptiles known to inhabit the St. Lawrence River drainage area. The abundance and distribution of these species within the region are not well documented. A sampling program under the Winter Navigation Demonstration Program will be conducted during early 1978 along the St. Lawrence River to add to the existing data-base on these organisms. The results of this effort will be included in the report for the next stage of the planning process for this study.

Birds.

Over 260 bird species have been recorded from the St. Lawrence River area, making this the most abundant vertebrate group regularly occurring in the region. Substantial seasonal variation exists, mainly due to migrations. During migrations, many species of birds will avoid crossing large bodies of open water, and instead, will follow the shoreline around the lake. The narrow strip of land (relative to the size of the lake), which is bordered on the west by Lake Ontario and on the east by the Tug Hill Plateau, acts as a funnel, concentrating these birds as they migrate through the area. Because of this, the St. Lawrence-Eastern Lake Ontario region receives concentrations of birds that are equalled by few other areas on the North American continent.

The river is an important nesting and wintering area for waterfowl and is within a major flyway for these birds. Gulls, terns, grebes, and other water-birds, as well as such shore and wading birds as herons, egrets, rails, and sandpipers occur here. Some of the colonial breeding species have important nesting areas in the region. Two such areas are the great blue heron rookery on Ironsides Island in the town of Alexandria, NY, and the ring-billed gull nesting area on Little Galoo Island in eastern Lake Ontario some 15 miles west of Sackets Harbor, NY.

There are a number of environmental considerations on the impacts of water resources development projects on the avian fauna, both positive and negative. As an example, the ice booms on the St. Lawrence facilitate open water areas downstream of the booms which are utilized by resting and wintering water fowl. This type of positive benefit should be optimized. As another example, the nesting sites for the colonial breeding species offer the potential for severe negative impacts solely due to the concentrations of both young and adults. Careless activity here could cause the loss of a whole population.

A preliminary report on the birds of the region was completed as part of the U. S. Fish and Wildlife Service's 1976 study, "St. Lawrence River Ecological Study; Biological Characteristics, 1976." A list of the bird species and their seasonal occurrence can be found in this report.

Mammals.

Numerous large and small mammals occur in the study area. Many of these species are economically important and have been so throughout the period of human history. Europeans were first attracted to the area by its rich population of game animals and furbearers. Table A-10 is a list of the mammals which are known or believed to occur along the St. Lawrence. The phrase "believed to occur" is used because of the paucity of existing scientific information on these organisms. This list is taken from the U.S. Fish and Wildlife Service's 1976 report, "St. Lawrence River Ecological Study: Biological Characteristics, 1976" and the St. Lawrence-Eastern Ontario Commission's 1972 shoreline study, "Technical Report Wildlife Resources". Some of the species listed were the result of personal interviews and not actual observations, or were based on skins and pelts held in local museums. It is possible that some of these species are at the limit of their natural geographical range or are only rare visitors to the area.

In preparation for the proposed 1979 demonstration activities of the Winter Navigation Demonstration Program on the St. Lawrence River, mammal and furbearer studies are being conducted at transect sites along the river. These studies, currently underway, are scheduled for completion in June, 1978. The data is to be summarized into a report with the objective of characterizing these populations and suggesting the effects of construction and operation of this navigation project on these mammals. In view of the limited information presently available, this new information will be a welcome addition.

Table A-9 - Amphibian and Reptile Species Reported from the St. Lawrence River Watershed

Common Name	Scientific Name
Mudpuppy	Necturus maculosus
Jefferson salamander	Ambystoma jeffersoniam
Blue spotted salamander	Ambystoma laterale
Spotted salamander	Ambystoma maculatum
Red spotted newt	Diemictylus viridescens viridescens
Red backed salamander	Plethodon cinereus cinereus
Four-toed salamander	Hemidactylium scutatum
Northern two lined salamander	Eurydea bislineata bislineata
American toad	Bufo americanus
Spring peeper	Hyla crucifer
Gray tree frog	Hyla versicolor
Western chorus frog	Pseudacris trisceriata triseriata
Eastern gray tree frog	Hyla crucifer crucifer
Bullfrog	Rana calesbeiana
Mink frog	Rana septentrionalis
Green frog	Rana clamitans melanota
Pickerel frog	Rana palustris
Wood frog	Rana sylvatica
Northern leopard frog	Rana pipiens
Snapping turtle	Chelydra serpentina
Stinkpot	Sternothaerus odoratus
Map turtle	Graptemys geographica
Midland painted turtle	Chrysemis picta marginata
Blanding's turtle	Emydoidea blandingi
Northern water snake	Natrix sipedon sipedon
Northern brown snake	Storeria dekayi dekayi
Red bellied snake	Storeria occipitomaculata
Eastern garter snake	Thamnophis sirtalis sirtalis
Northern ringneck snake	Diadophis punctatus edwardsi
Smooth green snake	Opheodrys vernalis
Eastern milksnake	Lampropeltis doliata triangulum
Black rat snake	Elaphe obsoleta obsoleta
Northern ribbon snake	Thamnophis sauritus septentrionalis

Table A-10 - Mammals of the St. Lawrence Region

Common Name	Scientific Name
Opossum	Dilelphis marsupialis
Hairytail mole	Parascalops breweri
Starnose mole	Condylura cristata
Masked shrew	Sorex cinereus
Smokey shrew	Sorex fumeus
Northern water shrew	Sorex palustris
Pygmy shrew	Cryptotis parva
Shorttail shrew	Blarina brevicauda
Little brown bat	Myotis lucifugus
Keen's myotis	Myotiskeenii
Indiana myotis	Myotis dedalis
Silver-haired bat	Lasionycteris noctivigans
Eastern pipistrelle	Pipistrellus subflavus
Big brown bat	Eptesicus fuscus
Red bat	Lasiurus borealis
Hoary bat	Lasiurus cinereus
Eastern cottontail rabbit	Sylvilagus floridanus
Eastern chipmunk	Tamias striatus
Woodchuck	Marmota monax
Eastern gray squirrel	Sciurus carolinensis
Red squirrel	Tamiascurus hudsonicus
Southern flying squirrel	Glaucomys volans
Northern flying squirrel	Glaucomys sabrinus
White footed mouse	Peromyscus leucopus
Deer mouse	Peromyscus maniculatus
Boreal redback vole	Clethronomus gapperi
Meadow vole	Microtus pennsylvanicus
Pine vole	Pitymis pinetorum
Muskrat	Ondatra zibethica
Southern bog lemming	Synaptomis cooperi
Black rat	Rattus rattus
House mouse	Mus musculus
Meadow jumping mouse	Zapus hudsonicus
Woodland jumping mouse	Napaeozapus insignis
Porcupine	Erethizon dorsatum
Red fox	Vulpus fulva
Gray fox	Urocyon cinereoargenteus
Raccoon	Procyon lotor
Coyote	Canis latrans
Bobcat	Lynx rufus
Shorttail weasel	Mustela erminea

Table A-10 - Mammals of the St. Lawrence Region (Cont'd)

Common Name	Scientific Name
Longtail weasel	Mustela frenata
Mink	Mustela vison
River otter	Lutra canadensis
Pine marten	Martes americana
Fisher	Martes pennanti
Striped skunk	Mephitis mephitis
Beaver	Castor canadensis
Whitetail deer	Odocoileus virginiana

ENDANGFRED SPECIES

A number of plant and animal species within the Great Lakes-St. Lawrence River Basin are considered threatened or endangered. As such, these species are protected by State and/or Federal regulations. The list of endangered and threatened wildlife and plants published in the Federal Register on 14 July 1977 in accordance with the Endangered Species Act of 1973 contains six animal species which occur or have occurred in the project area. These six, as well as seven additional animal species, are listed in Table A-11. "Endangered" species are those which are in danger of becoming extinct throughout all or a significant part of their range. "Threatened" species are those which are likely to become endangered within the forseeable future throughout all or a significant part of their range. The term "rare" is no longer used as a classification category for animals under Federal definition. Those species listed in Table A-11 as endangered are protected under State and/or Federal laws. Those species listed as threatened are tentatively listed as such by the New York State Department of Environmental Conservation, Division of Fish and Wildlife, not by the New York legislature.

Table A-12 is a list of "vulnerable" plants of New York State. Species listed here are "vulnerable" by being susceptible to devastation for their commercial, medicinal, horticultural, or decorative purposes. These are native plants protected by New York State Environmental Conservation Law 9-1503. Anyone who knowingly picks, plucks, transports or otherwise removes any protected plant without the consent of the owner is subject to a $25 fine under this law. (Unlike wild animals which are property of the State, plants are property of the landowner.)

Table A-11 - Endangered and Threatened Animal Species with Present or Prior Range Within the Project Area.

Name	Protection	Status	Range	Habitat	Remarks
			(MAMMALS)		
Indiana Bat (*Myotis sodalis*)	Federal and State	Endangered	Eastern and Midwestern United States	Limestone Cave Areas	Decline due to habitat destruction by commercialization of caves. Roosting caves known along Black River in Jefferson County, NY.
Eastern Timber Wolf (*Canis lupus lycaon*)	Federal and State	Endangered	Eastern USA and Southeast Canada	Wilderness Forests and Tundra Areas	One specimen taken in Fulton County NY in 1968, believed to have been a captive escapee as last previous state recording was in 1899.
Eastern Cougar (*Felis concolor cougar*)	Federal and State	Endangered	Eastern USA and Canada	Wilderness Areas Such as Adirondack Wilderness	No confirmed sightings this century, last New York record in 1894.
Canada Lynx (*Lynx canadensis*)	State	Endangered	NE, NW USA and Across Canada	Wilderness Forests and Swamps	Decline due to logging and habitat destruction. Recent sightings in Adirondack wilderness.
Pine Marten (*Martes americana*)	State	Threatened	Northern USA and Canada	Fir, Spruce, Hemlock Forests; Cedar Swamps	Decline due to logging, trapping and habitat destruction. Occurs in spruce forests in Adirondack wilderness.
Fisher (*Martes pennanti*)	State	Threatened	Northern USA and Canada	Extensive Mixed Hardwood Forests, Cutover	Making strong comeback in New York and New England; common occurrence in
Wilderness Areas	Adirondack wilderness areas.				
			(BIRDS)		
Peregrine Falcon (*Falco peregrinus*)	Federal and State	Endangered (Two Subspecies)	Nearly Cosmopolitan Most N & S Amer.	Nests on cliffs, artic subspecies nests in tundra areas.	Occasional migrant along Lake Ontario and St. Lawrence River. Presently no known nesting in New York. Pesticides main reason for decline.

Table A-11 - Endangered and Threatened Animal Species with Present or Prior Range Within the Project Area. (Cont'd)

Name	Protection	Status	Range	Habitat	Remarks
Bald Eagle (Haliaeetus leucocephalus)	Federal and State	Endangered	Most of N. America	Nests in trees along rivers, lakes, and oceans. Feeds on fish and carrion; generally a scavenger.	Formerly a common spring and fall migrant along Lake Ontario and St. Lawrence. Six birds (2 adults, 4 juveniles) reported from the Thousand Islands area of St. Lawrence, January to March 1978.
Osprey (Pandion haliaetus)	State	Endangered	Nearly Cosmopoliton in N. America	Feeds on fish, nests near lakes, still water, and beaver flows. Individual nests used for many years.	Observed statewide; St. Lawrence R. valley a known breeding area; apparent reversion of nesting success due to restrictions on pesticide use.
Golden Eagle (Aquila chrysaetos)	State	Threatened	Throughout N. Amer; in east from Ontario south to Tenn.	Nests in high rocky cliffs near open area with water and meadow.	First banding of nestling of this species in eastern N. America was in 1957 from nest in Adirondacks of NY. Six sightings at Derby Hill in 1967
Raven (Corvus corax)	State	Threatened	Holarctic; Northern Canada to NY & New Eng.	Nests in wilderness forest area in trees; feed on insects, small animals and bird eggs.	Common in Adirondacks prior to 1900 with nesting areas in St. Lawrence Co. Decline associated with lumbering of virgin forests. Last nesting pair reported from NY in 1968.
(AMPHIBIANS)					
Bog Turtle (Clemmys muhlenbergi)	State	Endangered	Disjunct pop. in northern and central USA.	Sphagnum bogs, swamps wet meadows; always in very shallow water open to sunlight.	Over harvest by pet dealers and destruction of habitat by drainage of wet areas for development are major reasons for decline.
(FISH)					
Blue (Pike) Walleye (Stizostedion vitreum glaucom)	Federal and State	Endangered	Lake Erie and Lake Ontario.	Moderately Cold, deep waters of large lakes.	Once commercially fished in Lake Erie and Lake Ontario. Over harvest and physical, chemical, and biological changes to environment are reasons for decline. May be extinct.

Table A-12 - Vulnerable Native Plants of New York State Protected Under NYS Environmental Conservation Law 9-1503

Scientific Name	Common Name(s)
Arisaema dracontium	Dragonroot
	Green-dragon
Asclepias tuberosa	Butterfly-weed
	Chigger-flower
	Orange Milkweed
	Pleurisy-root
Campanula rotundifolia	Bluebell
	Harebell
Celastrus scandens	Bittersweet
	Waxwort
Chimaphila spp.	Pipsissewa
	Prince's-pine
	Spotted Evergreen
	Spotted Wintergreen
	Waxflower
Cornus florida	Flowering Dogwood
Drosera spp.	Daily-dew
	Dewthread
	Sundew
Epigaea repens	Ground Laurel
	Mayflower
	Trailing Arbutus
Euonymus spp.	Burning-bush
	Bursting-heart
	Strawberry-bush
	Wahoo
Filices (*Filicinae*; *Ophioglossales* & *Filicales*)	All ferns, including:
	Adder's-tongue
	Azolla
	Buckhorn

Table A-12 - Vulnerable Native Plants of New York State Protected Under NYS Environmental Conservation Law 9-1503 (Cont'd)

Scientific Name	Common Name(s)
Filices (Filicinae; Ophioglossales & Filicales) (Cont'd)	Cliff Brake Curly-grass Fiddleheads Hart's tongue Maidenhair Moonwort Polypody Rock Brake Salvinia Spleenwort Walking-leaf Wall-rue Water-spangle Woodsia But excluding Bracken (Pteridium aquilinum); Hay-scented Fern (Dennstaedtia punctilobula); Sensitive Fern (Onoclea sensibilis)
Gentiana spp.	Ague-weed Blue-bottles Gall-of-the-earth Gentian
Hydrastis canadensis	Golden Seal Orange-root Yellow Puccoon
Ilex spp.	Bitter Gallberry Black Alder Holly Hulver Inkberry Winterberry
Kalmia spp.	Calico-bush Lambkill Laurel Spoonwood Wicky

Table A-12 - Vulnerable Native Plants of New York State Protected Under NYS Environmental Conservation Law 9-1503 (Cont'd)

Scientific Name	Common Name(s)
Lilium spp.	Lily
	Turk's-cap
Lobelia cardinalis	Cardinal-flower
	Red Lobelia
Lycopodium spp.	All Clubmosses, including:
	Bear's-bed
	Buckhorn
	Bunch Evergreen
	Christmas-green
	Coral Evergreen
	Creeping Jenny
	Ground Cedar
	Ground Fir
	Ground Pine
	Heath Cypress
	Running Evergreen
	Staghorn Evergreen
	Trailing Evergreen
	Wolf's-claws
Mertensia virginica	Bluebell
	Roanoke-bells
	Tree Lungwort
	Virginia Bluebell
	Virginia Lungwort
	Virginia Cowslip
Monarda didyma	American Bee-balm
	Indian-heads
	Oswego Tea
	Scarlet Bee-balm
Myrica pensylvanica	Bayberry (Northern)
	Candleberry
Nelumbo lutea	Lotus
	Lotus Lily
	Nelumbo
	Pond-nuts

Table A-12 - Vulnerable Native Plants of New York State Protected Under NYS Environmental Conservation Law 9-1503 (Cont'd)

Scientific Name	Common Name(s)
Nelumbo lutea (Cont'd)	Water Chinquapin Wonkapin Yellow Lotus
Opuntia humifusa (O. compressa, p.p.)	Indian Fig Prickly Pear Wild Cactus
Orchidaceae	All Orchids, including: Adam-and-Eve Adder's mouth Arethusa Beard-flower Bog-candle Calopogon Calypso Coral-root Cypripedium Dragon's-mouth Fairy-slipper Grass-pink Kirtle-pink Ladies'-tresses Lady's-slipper Lattice-leaf Malaxis Moccasin-flower Nerve-root Orange-plume Orchis Pearl-twist Pogonia Putty-root Rattlesnake-plantain Scent-bottle Screw-auger Snake-mouth Soldier's-plume Swamp-pink Three-birds Twayblade Whipporwill-shoe

Table A-12 - Vulnerable Native Plants of New York State Protected Under NYS Environmental Conservation Law 9-1503 (Cont'd)

Scientific Name	Common Name(s)
Orontium aquaticum	Golden-club
Panax quinquefolius	Ginseng Sang
Pyrus coronaria	Wild Crab Apple
Rhododendron spp.	Azalea Election-pink Great Laurel Honeysuckle Pinxter Pinxter-bloom Rhodomandron Rhodora Rosebay White Laurel
Sabatia spp.	Bitterbloom Marsh-pink Rose-pink Sabatia Sea-pink
Sanguinaria	Bloodroot Puccoon-root Red Puccoon
Sarracenia purpurea	Huntsman's-cup Pitcher-plant Sidesaddle-flower
Silene caroliniana	Wild Pink
Trillium spp.	Bethroot Birthroot Squawroot Stinking Benjamin Toadshade Trillium Wake-robin
Viola pedata	Bird's-foot Violet Pansy Violet

Recreation.

The Great Lakes-St. Lawrence River Basin has 17.8 million acres of public recreation areas. There is a great diversity of outstanding natural features such as forests, meadows, marshes, shorelines, islands, streams and lakes (both the Great Lakes and inland lakes). Many of these areas have exceptional scenic, wilderness, and aesthetic qualities which make them nationally significant. Recreational resources are not evenly distributed, being mostly located in the drainages of Lake Superior, Lake Ontario, and the northern parts of Lakes Michigan and Huron. Tourism reflects this uneven distribution, with most of the popular tourist areas being found in these drainages.

In 1970, there were 1,378 acres in national park and wilderness areas and over 540,000 acres of State and local parks. The 1970 estimate of 637.1 million recreation days is expected to increase to 861.3 million user days by 1980 and to 1,863.6 million days by the year 2020. (These figures do not include the man-days spent for fishing, hunting, and trapping, or the recreation days for the use of all weather terrain vehicles such as snowmobiles.)[1]

Recreational problems include land-use competition, high acquisition costs for lands, public opposition and legal restraints on recreational development, overuse of existing areas, inadequate planning, and environmental degradation. This last category is one of the greatest problem areas. Since 1961, a number of Great Lakes beaches have been closed due to polluted waters. Soil erosion and sedimentation, disposal of dredge spoils, solid waste disposal, thermal waste disposal, and air pollution are a few of the contamination sources adversely affecting the Great Lakes-St. Lawrence River Basin recreational resources.

There are some 250 recreational facilities (combined public and private) within the project area (Table A-13). Virtually all of these facilities are directly or indirectly water-related. The majority of these facilities have been developed since the 1938 opening of the Thousand Island Bridge. As an example, in 1938, there were seven marinas and eight State parks in the region. By 1970, these facilities have grown to 40 marinas and 22 State parks. The State parks can handle up to 800,000 campers each summer, and they attract more than one-million visitors annually.

As mentioned, most of the recreational facilities are water-related. The water oriented activities include swimming, boating, water skiing, fishing, and waterfowl hunting. The extensive water areas also supply an aesthetic backdrop for the activities located along their shores, such as camping, sunbathing, picnicking, hiking, and golfing, to name a few. In addition, the fisheries and wildlife resources of the area attract vacationing sportsmen and naturalists, and the close proximity of an international border and close range views of ocean-going vessels attract visitors along the St. Lawrence Seaway.

[1] Source: Great Lakes Basin Framework Study, Appendix No. 21, Outdoor Recreation," 1976, Great Lakes Basin Commission.

The sportfisheries resource is a major attraction for tourists and is a multi-million dollar industry. The anglers fishing the St. Lawrence River in 1973 spent an estimated $4.9 million in the area in fishing related expenses, $2.0 million in outside area travel expenses, and $5.0 million for major equipment expenditures (e.g. boats, campers, special clothing) used mainly for fishing.[1]

The St. Lawrence River ranks first among New York State waters for harvest of largemouth bass, northern pike, and muskellunge, and second for smallmouth bass, panfish, and bullheads.

Ice fishing accounts for almost 98 percent of all winter use of the St. Lawrence.[2] Several annual ice fishing derbies are held within the region. Over 2,800 people registered (collectively) for the five derbies held during the winter of 1975-76.

Boating and its support activities are an important part of the recreational-based economy along the St. Lawrence. A 1974 inventory of marinas and boatyards by the New York Office of Parks and Recreation showed 65 commercial and 25 public facilities located along the river.

Hunting is another substantial recreational activity. Waterfowl is the most sought after type of game, with big game (deer and bear) and small game (pheasants, rabbits, squirrels and varmints) ranking second and third, respectively.

Camping is another major recreational activity. It serves as either the primary activity or as a base for other activities (e.g. boating, fishing, etc.). There are numerous public and private facilities along the St. Lawrence River, including 19 State parks. Tables A-14 and A-15 list the attendance, facilities, acreage, and revenue of these parks for 1976.

Archeological and Cultural Resources.

Historically, the Great Lakes-St. Lawrence System has served as a major corridor for access to the resources of the interior of the North American Continent. There are numerous historic and prehistoric sites along the shores of the basin, many of which have not been scientifically recorded and studied. Some of the more well known archeological and historic sites of the basin are discussed in the Great Lakes Basin Framework Study, Appendix 22, "Aesthetic and Cultural Resources."[3]

Although early sites are rare, man could have lived in the Great Lakes Basin between 13,000 and 11,000 years ago, as the lakes gradually assumed their

[1] Ecological Studies for Navigation Season Extension on the St. Lawrence River, 1976. USFWS, Cortland, NY.
[2] The St. Lawrence River: Winter Recreation Activity as Related to an Extended Navigation Season, prepared by St. Lawrence-Eastern Ontario Commission for the U. S. Department of Interior, Bureau of Outdoor Recreation, July 1976.
[3] St. Lawrence-Eastern Ontario Shoreline Study, St. Lawrence Eastern Ontario Commission, 1972.

present configuration. Most of the early sites are relatively small hunting and gathering camps. Fish were an important part of the diet, and water was the primary mode of transportation. As a result, many sites are located along the lakes and tributaries. The waterways also facilitated trade as indicated by the fact that copper from Lake Superior is found in sites along the St. Lawrence.

In the late prehistoric period, as agriculture became more important to the subsistance of the inhabitants of the Great Lakes, there was a shift in the location of sites to more inland areas. Trails became more important for transportation. Some of these trails such as Ridge Road in New York were used by the early European explorers. Many modern cities such as Conneaut, OH, are located on sites previously inhabited by prehistoric people.

Samuel de Champlain is credited as being the first European to discover the Great Lakes in the year 1615. The first settlers were primarily trappers, traders, or military personnel who established forts and villages at strategic points such as Ogdensburg, Fort Niagara, and Detroit. More stable farming communities did not develop until the late 1700's, and the opening of the Erie Canal in 1825 was a major spur to the settlement of Cleveland, Chicago, and other western Great Lakes cities. Besides providing transportation means, water also supplied the power for the numerous saw and grist mills that were found in most settlements. Despite the development of a vast rail network, the lakes were primary transportation routes for grain from the interior to the east. By the 1900's, the Great Lakes became a major trade route for coal and iron ore.

The region which once supported a small, scattered, French, English, and Indian population in the late 18th century developed a diversified economy with a heterogenous population of 29,458,900 in 1970. Roughly 80 percent of the 1970 population resided in urban areas. The Basin's population is expected to increase to over 53,000,000 by the year 2020.

In addition to sites of historic interest there are many scenic areas along the St. Lawrence River. The St. Lawrence-Eastern Ontario Commission, in its shoreline study technical report #7, Recreation Resources,[1] listed seven unique scenic resources and 198 historic sites. The unique scenic resources were selected for their unusual and striking visual characteristics. Among the area chosen are scenic highways such as New York State Routes 3 and 12 and the Thousand Island section of the St. Lawrence River. The historic sites listed in the report have been divided into four basic types: (1) Indian sites, (2) early military forts, (3) homes of prominent settlers and/or founding fathers, and (4) examples of local architecture.

[1] St. Lawrence-Eastern Ontario Shoreline Study, St. Lawrence-Eastern Ontario Commission, 1972.

Table A-13 - Recreation Supply in the Coastal Zone of Jefferson and St. Lawrence Counties[1]

Number of Recreation Sites	Total	Jefferson	St. Lawrence
Federal		-	-
State	30	21	9
County	-	-	-
Municipal	29	19	10
Quasi-Public, Non-Profit or Community Service Organization	6	1	5
Private (Closed to Public)	8	4	4
Commercial (Open to Public)	205	154	51
Total	278	199	79

Percentage of Recreation Sites	Jefferson	St. Lawrence
Federal	-	-
State	11%	11%
County	-	-
Municipal	10%	13%
Private	2%	5%
Commercial	77%	71%

1 Source: New York State Parks and Recreation, Office of Planning and Operations; Coastal Zone Management Data

APPENDIX B

HUMAN ENVIRONMENT

APPENDIX B

HUMAN ENVIRONMENT

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APPENDIX B

HUMAN ENVIRONMENT

BASIN DESCRIPTION

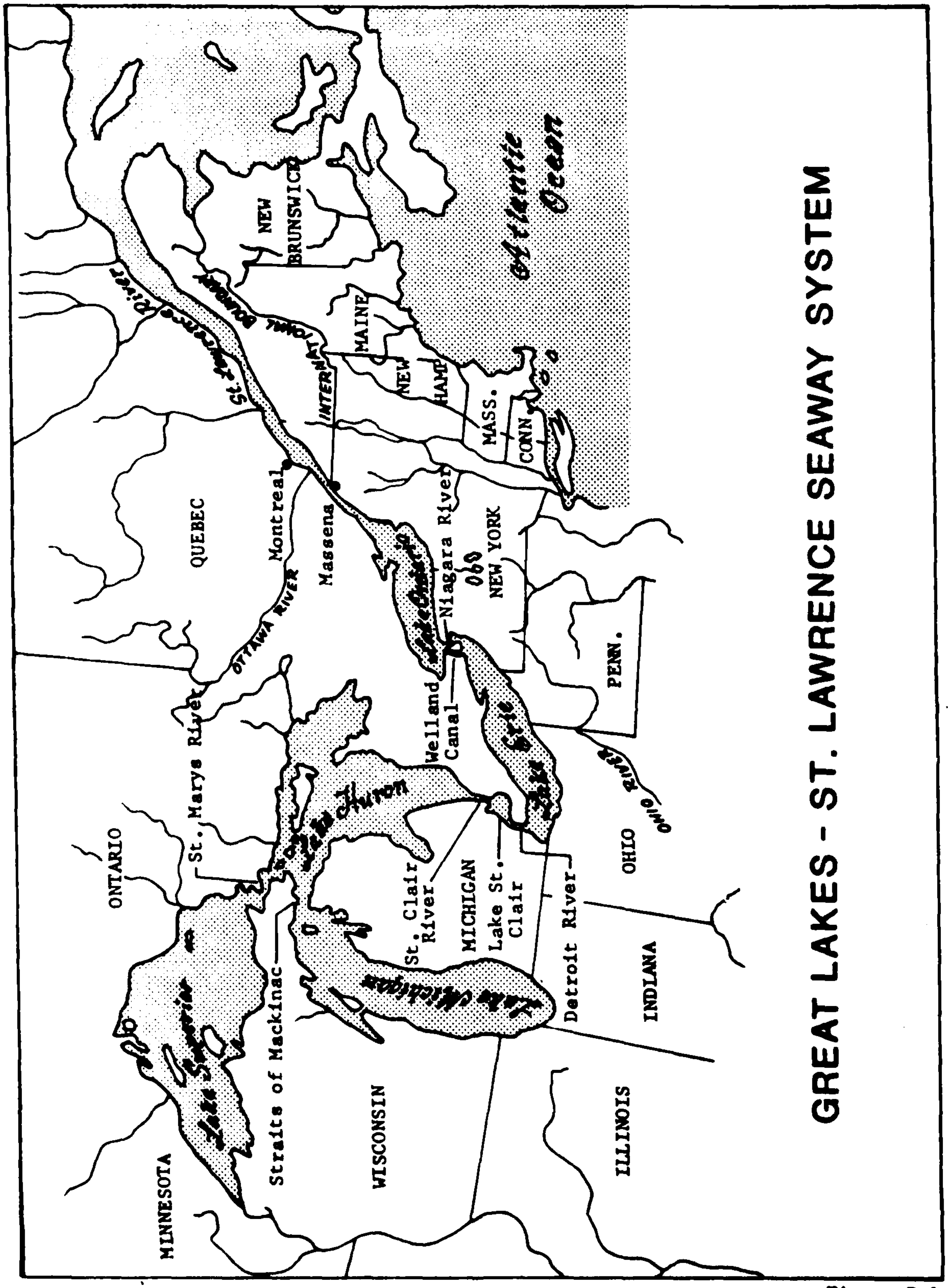
The physical environment of the Great Lakes Basin has exerted a strong influence over the level and distribution of population and type and distribution of economic activities. The most significant single element is the existence of the five Great Lakes, the largest series of freshwater lakes in the world. This source of water, in addition to abundant mineral resources and large agricultural potential found in the area, has allowed a highly industrial and agricultural area to develop which supports 14 percent of the U. S. population and four percent of the total U. S. surface area and contributes a more than proportional share of national economic activity.

The Great Lakes Basin is located in the eastern portion of the north central United States along the boundary with Canada between 40°30' and 48°20' north latitude and 74°30' and 93°10' west longitude. The Basin extends nearly 900 miles from west to east and 525 miles between its north-south extremes. A descriptive overview of the Great Lakes system and its connecting channels can be found in Tables B-1, B-2, and B-3. The Great Lakes Basin is shown in Figure B-1.

Five Great Lakes and the St. Lawrence River comprise a navigation network which provides access to many important industrial centers and agricultural production areas in the north-central section of the United States. Two Canadian provinces, Ontario and Quebec, and eight States border the Great Lakes-St. Lawrence Seaway System. The geographic area contains almost 61 million people and has developed a commercial navigation pattern which moves large amounts of bulk and general cargo between international trading areas. There are many ports and connecting channels which have been constructed and improved over time due to increasing tonnages of grains, iron ore, coal, and manufactured goods.

There are 50 U. S. commercial harbors on the Great Lakes that have received some type of Federal support and their depths range from 16 to 28 feet. In addition, there are 15 private deep-draft harbors along the Great Lakes. A list of these harbors is included in Table B-4, while the major ports can be located by reference to Figure B-2. Locks have been constructed in three locations: in the St. Marys River (between Lakes Superior and Huron); in the Welland Canal (between Lakes Erie and Ontario); and in the St. Lawrence River (between Lake Ontario and the St. Lawrence estuary).

Lake Superior. Lake Superior is the largest of the Great Lakes and represents the greatest geographical penetration of the Great Lakes into the economic heartland of the United States and Canada. The distance which vessels must navigate from the head of the lake (Duluth, Minnesota) to the entrance of the St. Marys River (Point Iroquois) is about 383 miles. This lake has the highest surface elevation, the most irregular shoreline and the greatest depth of any of the Great Lakes.



GREAT LAKES - ST. LAWRENCE SEAWAY SYSTEM

Figure B-1

Table B-1 - Descriptive Data on the Great Lakes

Lake	Monthly Mean Water Stages Above Mean Sea Level (1)			Low Water Datum (LWD)(1)	Dimension			Water Surface Area
	Low	Mean	High		Length	Breadth	Maximum Depth	
	Feet	Feet	Feet	Feet	Miles	Miles	Miles	Square Miles
Lake Superior	598.23	600.39	602.06	600.0	350	160	1,333	31,750
Lake Michigan	575.35	578.70	581.94	576.8	307	118	923	22,300
Lake Huron	575.35	578.70	581.94	576.8	206	101	750	23,100
Lake St. Clair	569.86	573.09	575.70	571.7	26	24	27.5(2)	490
Lake Erie	567.49	570.41	572.76	568.6	241	57	210	9,910
Lake Ontario	241.45	244.77	248.06	242.8	193	53	802	7,600

(1) Internationasl Great Lakes Datum, 1955.
(2) Lake St. Clair has a natural depth of about 21 feet; the figure above is the depth of the navigation channel traversing Lake St. Clair. It is commonly referred to as part of the St. Clair River - Lake St. Clair - Detroit River connecting channel system.

Source: Plan of Study for Great Lakes-St. Lawrence Seaway Navigation Season Extension, U. S. Army Corps of Engineers District, Detroit, July 1976.

Table B-2 - Physical Dimensions of the Great Lakes-St. Lawrence Seaway

Reach	Lakes and Channels: Open Waters (Miles)	Lakes and Channels: Channels & Canals (Miles)	Lakes and Channels: Depth (Min.) (Ft.)	Locks: Number	Locks: Year Completed	Locks: Size (Ft.) Length x Width	Locks: Depth Over Sill (Ft.)	Locks: Lift (Ft.)
Atlantic Ocean to Father Point, Quebec	700	-	-	-	-	-	-	-
Father Point to Montreal	300		35					
Montreal to Lake Ontario (includes St. Lawrence Seaway)	189	91	27	5 (Can.)	1958	800 x 80	30	226
				2 (U.S.)	1958	800 x 80	30	226
Lake Ontario to Welland Canal	160	-	-	-	-	-	-	-
Welland Canal	-	27	27	8	1932	800 x 80	30	326
Welland Canal to Detroit River	236	-	27	-	-	-	-	-
Detroit River, Lake St. Clair, and St. Clair River	-	77	27	-	-	-	-	-
Lake Huron, St. Clair River to St. Marys River	223	-	-	-	-	-	-	
St. Marys River (includes Soo Locks)	70	2	27	2 (U.S.)	1919	1,350 x 80	23.1	22
				1 (U.S.)	1943	800 x 80	31.0	22
				1 (U.S.)	1968	1,200 x 110	35.0	22
				1 (Can.)	1895	900 x 59	16.8	22
Lake Superior, St. Marys River to Duluth	383	-	-	-	-	-	-	-

Source: Great Lakes Basin Framework Study, Appendix C9 Commercial Navigation (1975).

Table B-3 - General Great Lakes Information
(Area in Square Miles)

	Drainage Basin (Land & Water)			Water Surface			Land Surface (1)		
	U. S.	Canada	Total	U. S.	Canada	Total	U. S.	Canada	Total
Lake Superior	37,500	43,500	81,000	20,600	11,100	31,700	16,900	32,400	49,300
Lake Michigan	67,900	0	67,900	22,300	0	22,300	45,600	0	45,600
Lake Huron	25,300	49,500	74,800	9,100	13,900	23,000	16,200	35,600	51,800
Lake St. Clair	2,370	4,150	6,520	162	268	430	2,208	3,882	6,090
Lake Erie	23,600	9,880	33,500	4,980	4,930	9,910	18,620	4,950	23,600
Lake Ontario	16,800	15,300	32,100	3,460	3,880	7,340	13,340	11,420	24,700
Total to Lake Ontario Outlet	173,470	122,330	295,800	60,602	34,078	94,680	112,868	88,252	201,100(3)
Lake Ontario Outlet to Moses-Saunders Dam	1,685(2)	1,325(2)	3,010	120(2)	115(2)	235	1,565(2)	1,210(2)	2,775
Total(3)	175,200	123,600	298,800	60,720	34,190	94,910	114,430	89,450	203,900
Grass-Raquette St. Regis	3,200						3,200		
Total Basin Study Area	178,350			60,720			117,630		

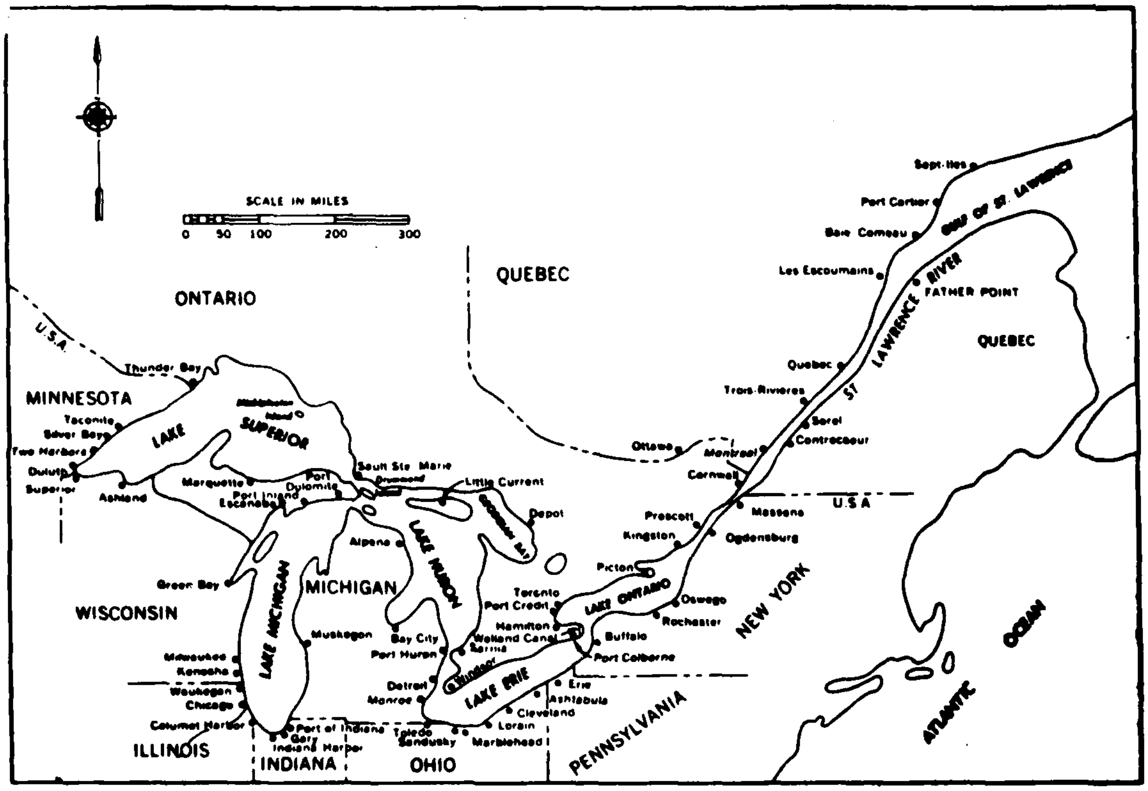
(1) Difference between total basin area and water area.
(2) Estimated breakdown between U. S. and Canada.
(3) Rounded.
Source: Great Lakes Bassin Framework Study, Appendix-1 "Alternative Framework," Great Lakes Basin Commission, 1975
NOTE: The drainage basin area in both U. S. and Canada, above the mouth of the St. Regis River is approximately 302,000 square miles.

Table B-4 - U. S. Great Lakes Commercial and Private Harbors

Commercial		Private
Lake Superior	**Lake Michigan (Cont'd)**	**Lake Superior**
Grand Marais, MN	Frankfort, MI	Taconite, MN
Two Harbors, MN	Charlevoix, MI	Silver Bay, MN
Duluth-Superior, MN-WI		
Ashland, WI	**Lake Huron**	**Lake Michigan**
Ontonagon, MI		
Presque Isle, MI	Alpena, MI	Oak Creek, WI
Marquette, MI	Cheboygan, MI	Buffington, IN
Keweenaw Waterway, MI	Saginaw, MI	Gary, IN
	Harbor Beach, MI	Port Dolomite, MI
Lake Michigan		Port Inland, MI
	St. Clair/Detroit Rivers	Escanaba, MI
Menominee, MI & WI		Petoskey Penn Dixie
Green Bay, WI	Marysville, MI	Harbor, MI
Sturgeon Bay, WI	Port of Detroit, MI	
Kewaunee, WI	Detroit River	**Lake Huron**
Two Rivers, WI	Rouge River	
Minitowoc, WI	Trenton Channel	Calcite, MI
Sheboygan, WI	Monroe, MI	Stoneport, MI
Port Washington, WI		Port Gypsum, MI
Milwaukee, WI	**Lake Erie**	Alabaster, MI
Racine, WI		Drummond Island, MI
Kenosha, WI	Toledo, OH	
Waukegan, IL	Sandusky, OH	**Lake Erie**
Chicago, IL	Huron, OH	
Calumet Harbor, IN & IL	Lorain, OH	Marblehead, OH
& Lake Calumet	Cleveland, OH	
Indiana Harbor, IN	Fairport, OH	
Burns Waterway, IN	Ashtabula, OH	
Michigan City, IN	Conneaut, OH	
St. Joseph, MI	Erie, PA	
South Haven, MI	Port of Buffalo, NY	
Holland, MI		
Grand Haven, MI	**Lake Ontario**	
Manistique, MI		
Gladstone, MI	Rochester, NY	
Muskegon, MI	Great Sodus Bay, NY	
White Lake, MI	Oswego, NY	
Ludington, MI	Ogdensburg, NY	
Manistee Harbor, MI		

Source: Draft Plan of Study for G.L./S.L.S. Navigation Season Extension, December 1977.

Figure B-2 - Major Harbors on the Great Lakes - St. Lawrence Navigation System



Source: Appendix C9 - Commercial Navigation, Great Lakes Basin Framework Study

U. S. harbors which have been improved to 27-foot draft capacity are located at Duluth and Two Harbors, MN; Superior and Ashland, WI, and Marquette and Presque Isle, MI. Two other harbors constructed by private interests are located in Minnesota on the north shore of Lake Superior at Silver Bay and Taconite Harbor. Both of these facilities are used for the shipment of iron ore. In addition, an important shipping center (Lakehead Harbor) exists at Thunderbay, Ontario, for the transshipment of grains which originate from inland U. S. and Canadian agricultural production areas. Duluth-Superior Harbor, located at the southwesterly tip of Lake Superior, is an important commercial harbor at the western limit of the lake. This harbor has 50 miles of lake frontage, 39 active docks, and 17 miles of dredged channel areas. Duluth-Superior Harbor is the first harbor to freeze up and the last harbor to thaw in the spring.

St. Marys River. The St. Marys River is the natural outlet for Lake Superior and leaves the lake at Point Iroquois and flows generally in a southeasterly direction through several channels over a distance of about 63 miles to Lake Huron. The water surface profile of this river descends about 22 feet before entering Lake Huron. Most of this vertical drop occurs at St. Marys Falls at Sault St. Marie. Navigation facilities in the river consist of numerous dredged channels and locks which allows navigation to circumvent St. Marys Falls. Four of the locks lie in United States canals while one lock is located in a Canadian canal. A summary of the dimensions of these man-made improvements is included in Table B-5.

The natural control of the outflow from Lake Superior was a rock ledge at the head of St. Marys River but has subsequently been replaced over time by the above-mentioned locks, regulatory works, and powerhouses. The end result of these man-made improvements is control of the volume released from and level of Lake Superior.

This river is also characterized by numerous islands (Sugar, Lime, Neebish, and Drummond Islands) which are inhabited by year-round residents. Transportation between these islands and the mainland during winter has traditionally been over the ice or via ferry service through an ice-free track.

Sugar Island is located in the St. Marys River near Sault Ste. Marie and is separated from the United States mainland by the Little Rapids Cut channel of the St. Marys River. The channel has a width of approximately 600 feet. Through this channel pass all commercial vessels entering or leaving Lake Superior. Sugar Island is approximately 15 miles long with a maximum width of 8-1/2 miles. The island has approximately 300 permanent residents, but this number is increased manyfold during the summer. Travel to and from this island is accomplished by means of a ferry.

Lime Island, located in the St. Marys River approximately 35 miles downstream from Sault Ste. Marie, is separated from the mainland by three miles of water. The principal activity on the island is the operation of a fueling station for the Great Lakes freighters which stop for fuel at the Lime Island dock during the normal navigation season. Seven operators of the fueling dock, together with their families, live on the island.

Table B-5 - Principal Features of Locks, St. Marys River

Principal Features	Locks				
	MacArthur	Sabin	Davis	Poe	Canadian
Width, feet	80	80	80	110	59
Length between mitre sills, feet	800	1,350	1,350	1,200	900
Depth on upper mitre sill, feet	31	24.3	24.3	32	16.8
Depth on lower mitre sill, feet	31	23.1	23.1	32	16.8
Lift, feet	22	22	22	22	22

Source: Plan of Study for Great Lakes-St. Lawrence Seaway Navigation Season Extension, U. S. Army Engineer District, Detroit - July 1976.

Lakes Huron and Michigan. Lakes Huron and Michigan are hydraulically considered to be a single lake system because the Straits of Mackinac which connect the lakes is so broad and deep that the lake surfaces are essentially at the same elevation. Vessels must transit approximately 321 miles from the Chicago area at the south end of Lake Michigan to the Straits of Mackinac at the north end. Upon entering Lake Huron from the Straits, vessels then travel 253 miles to the head of the St. Clair River. Major harbors on Lake Huron in the State of Michigan include Calcite, Stoneport, Alpena, Alabasier, Bay City, Saginaw, and Port Huron. Other large harbors on Lake Michigan are Port Inland, Escanabas, Muskegon, and Grand Haven, MI; Green Bay and Milwaukee, WI; Chicago and Calumet City, IL; Buffington, Gary, and Indiana Harbor, IN. Canadian harbors include Sarnia and Goderich, Ontario.

On the west shore of Lake Huron is a large indentation called Saginaw Bay. The bay is 26 miles wide at its mouth between Point Aux Barques and Au Sable Point, and 51 miles long from the midpoint of the line between these two points to the mouth of the Saginaw River. There are several islands in the bay, the most prominent is Charity Island. A navigation channel in the bay is 350 feet wide with a project depth of 27 feet and extends from the mouth of the Saginaw River in a northeasterly direction for a distance of about 15 miles.

St. Clair River, Lake St. Clair, and Detroit River. The connection between Lakes Huron and Erie extends for about 75 miles and can be divided into three distinct geographic portions: The St. Clair River, which has a length of 46 miles; Lake St. Clair with a length of 17 miles and lies between the mouth of the St. Clair River and the head of the Detroit River; and the Detroit River which extends another 12 miles to Lake Erie. A drop of about five feet occurs between the surface level of Lake Huron and Lake St. Clair; an additional drop of three feet occurs between Lake St. Clair and Lake Erie. No rapids or falls are found in either the St. Clair or Detroit River. The authorized project depth of Lake St. Clair is 27 feet and navigation works in these two rivers consist of dredged channels which provide for safe draft of 26.0 feet at low water datum (IGLD 1955). Harbor facilities can be found on each side of the Detroit River at Detroit, MI, and Windsor, Ontario.

Lake Erie. Lake Erie is the shallowest of the Great Lakes and is considerably smaller than the three lakes above. The distance from the mouth of the Detroit River to Buffalo, where the Niagara River leaves the lake is about 233 miles. Major harbors on Lake Erie are located at Toledo, Sandusky, Huron, Lorain, Cleveland, Fairport, Ashtabula, and Conneaut, OH; Erie, PA; and Buffalo, NY.

The Niagara River is about 36 miles long and is the natural outflow for Lake Erie and connects Buffalo, NY with Niagara-on-the-Lake, Ontario. The elevation of the river drops almost 326 feet between these two points; about half of the total occurs as the river passes over an escarpment at Niagara Falls, NY.

The Black Rock Canal has a depth of 21 feet and provides an alternate route around the constricted and shallow portions of the upper Niagara River. The Black Rock Lock, which has a lift of five feet, is located near the lower end of the canal. From Tonawanda, NY, to Niagara Falls, NY, there is a navigation channel with minimum depth of 12 feet below LWD maintained. The New York State Barge Canal also joins the Niagara River at Tonawanda Harbor, NY. This canal extends eastward to the Hudson River near Albany, NY. An extension of the canal runs northward to Lake Ontario at Oswego Harbor.

The Black Rock Lock and canal parallels the upper reach of the Niagara River and links Buffalo Harbor to Tonawanda Harbor, NY. The navigation channels were initially constructed to allow delivery of iron ore, coal, and limestone to a steel producing facility in Tonawanda, NY. Other important commodities historically moving into Tonawanda, NY, were logs and other wood products. The steel facility is now defunct and utilization of the lock and canal, as measured by tonnage throughput for the Black Rock Lock, has declined drastically.

The Welland Canal, which allows Great Lakes vessels to circumvent the Niagara Escarpment, consists of eight locks, and interconnecting canals between Lake Erie (Port Colborne, Ontario) and Lake Ontario (Port Weller, Ontario). This facility is about 27 miles long and contains seven lift locks and one guard lock. Ships not exceeding 730 feet in overall length and 76 feet in width transit the canal.

Lake Ontario. Lake Ontario is the smallest of the Great Lakes in area. It is approximately 180 miles long and 50 miles wide. The Welland Canal, 28 miles long, provides a waterway between Lakes Ontario and Erie. It bypasses Niagara Falls and the river gorge with its series of eight locks, which raise or lower vessels 326 feet. Seven lift locks are located in an eight-mile section in the vicinity of the escarpment. Each of these locks has an average lift of 46.5 feet. An eighth lock at Lake Erie (Port Colborne, Ontario) is a shallow-lift guard lock. A summary of the physical limitations of the Welland Canal is presented in Table B-6.

St. Lawrence River. The St. Lawrence River flows northeast 527 miles from Lake Ontario to its mouth at Father Point, Quebec. From Tibbett Point, Lake Ontario, the river forms the border between New York State and Canada (113 miles). From there, it flows eastward entirely within Canada for 414 miles. The river is under the joint navigational control of the St. Lawrence Seaway Development Corporation, a corporate agency of the United States, and the St. Lawrence Seaway Authority of Canada. The St. Lawrence River is shown in Figure B-3.

In the 169 miles of river between Montreal and Quebec City, the fall is about 25 feet at low tide. Below Quebec City, the river gradually widens into the St. Lawrence estuary and finally the Gulf of St. Lawrence. The navigation channel at and below Montreal is referred to as the St. Lawrence Ship Channel with an advertised depth of 35 feet at low water datum. Downstream of Quebec City, the present controlling depth is 30.0 feet LNT (Lowest Normal Tide) and these channels are currently being deepened to 41.0 feet (LNT).

The river between Lake Ontario and Montreal is commonly described as the seaway portion of the river and can be divided into two major sections, the

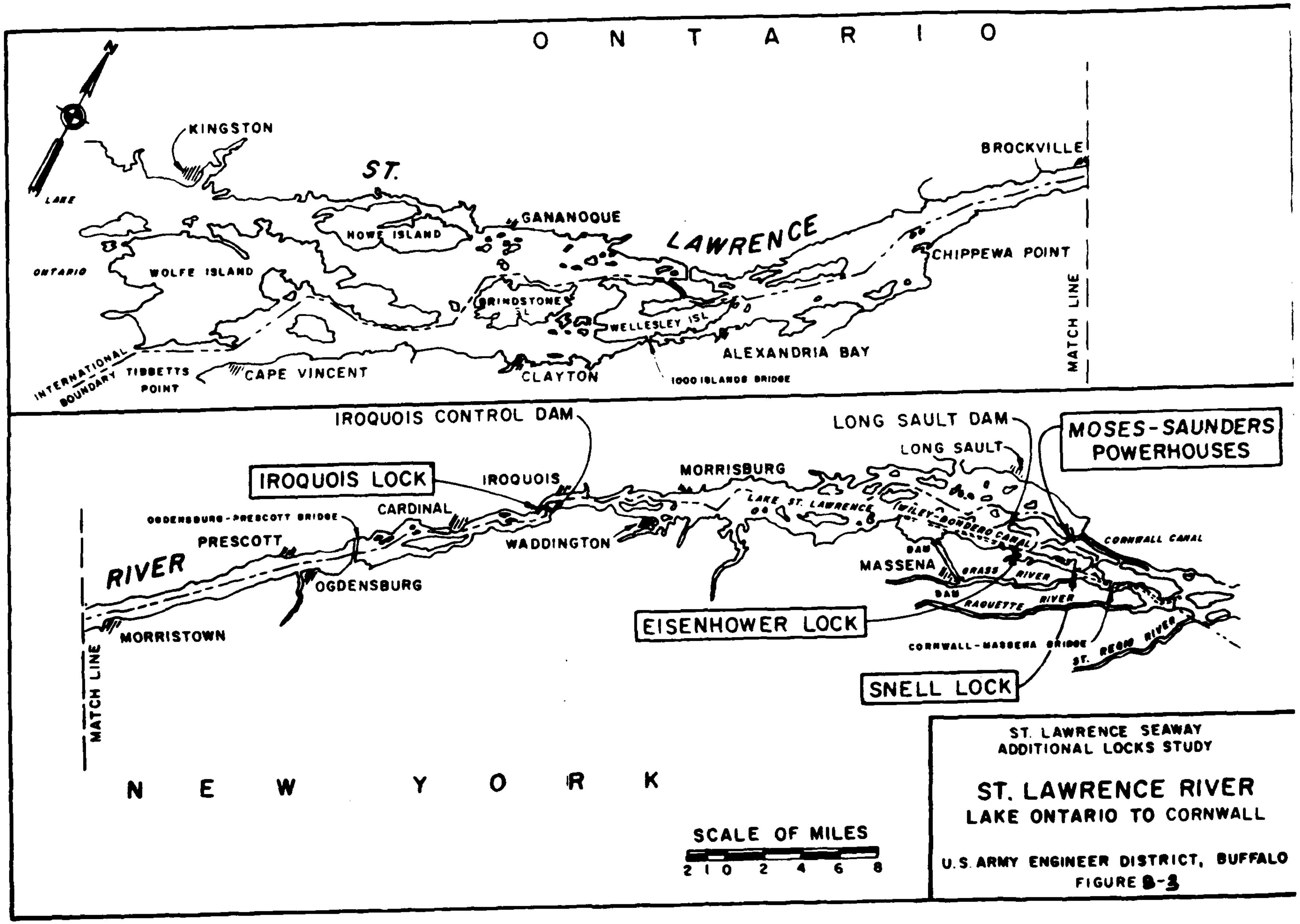

ONTARIO
KINGSTON
LAKE
ONTARIO
WOLFE ISLAND
HOWE ISLAND
ST.
GANANOQUE
LAWRENCE
GRINDSTONE ISL
WELLESLEY ISL
CHIPPEWA POINT
BROCKVILLE
ALEXANDRIA BAY
1000 ISLANDS BRIDGE
CLAYTON
CAPE VINCENT
TIBBETTS POINT
INTERNATIONAL BOUNDARY
MATCH LINE
IROQUOIS CONTROL DAM
IROQUOIS LOCK
IROQUOIS
CARDINAL
OGDENSBURG-PRESCOTT BRIDGE
PRESCOTT
RIVER
OGDENSBURG
MORRISTOWN
WADDINGTON
MORRISBURG
LAKE ST. LAWRENCE
WILEY-DONDERO CANAL
LONG SAULT DAM
LONG SAULT
MOSES-SAUNDERS POWERHOUSES
CORNWALL CANAL
DAM
MASSENA
GRASS RIVER
RAQUETTE RIVER
EISENHOWER LOCK
CORNWALL-MASSENA BRIDGE
ST. REGIS RIVER
SNELL LOCK
MATCH LINE
NEW YORK
SCALE OF MILES
2 1 0 2 4 6 8
ST. LAWRENCE SEAWAY
ADDITIONAL LOCKS STUDY
ST. LAWRENCE RIVER
LAKE ONTARIO TO CORNWALL
U.S. ARMY ENGINEER DISTRICT, BUFFALO
FIGURE B-3

Table B-6 - Description of Welland Canal and Lock System

Lock No.	Lock Data for Welland Canal: Normal Lift Ft.	Usable Length Ft.	Width of Chamber Ft.	Length of Upper Ent. Ft.	Length of Lower Ent. Ft.	General Location
Lock 1	46.0	730	80	1,468	2,756	Port Weller, Ont.
Lock 2	46.5	730	80	1,664	1,503	St. Catherines, Ont.
Lock 3	46.5	730	80	1,582	1,460	Homer, Ont.
Lock 4	47.9	730	80	(1)	952	Thorold, Ont.
Lock 5	47.9	730	80	(1)	(1)	Thorold, Ont.
Lock 6	43.7	730	80	903	(1)	Thorold, Ont.
Lock 7	46.5	730	80	1,327	903	Thorold, Ont.
			80	2,232	2,425	Thorold, Ont.
Lock 8 (Guard Gate)	2.0 to 11.0	1,148	80	1,247	1,135	Port Colborne, Ont.

(1) Locks 4, 5, and 6 are twin locks in flight which permit uninterrupted passage of upbound and downbound traffic.

Source: The Seaway Handbook, (1970) minimum depths on lock gate sills - 30 feet. Controlling channel depths - 27 feet. All locks are equipped with surveillance television.

International Section and the Canadian Section. The Canadian Section is composed of three subsections, the Lachine, Soulanges, and Lake St. Francis subsections. There are two components of the International Section - the International Rapids subsection and the Thousand Islands subsection.

NAVIGATION FACILITIES

Canadian

Lachine Subsection. This subsection is approximately 31 miles in length and allows marine traffic to bypass the Lachine Rapids and rise more than 50 feet above the level of Montreal Harbor. Two locks - the St. Lambert, opposite Montreal and the Cote Ste. Catherine, eight and one-half miles upstream - are used to overcome the vertical differences between the harbor facility at Montreal and Lake St. Louis.

The St. Lambert Lock is the most easterly of the locks built for the St. Lawrence Seaway. It was constructed by the St. Lawrence Seaway Authority on the south shore of the St. Lawrence River opposite the city of Montreal on the north shore and adjacent to the city of St. Lambert, Quebec. The St. Lambert Lock (22 feet above sea level) overcomes the difference of about 15 feet between the level of water in Montreal Harbor and Laprarie Basin located about three miles upstream. Marine vessels proceeding upstream lock through the St. Lambert Lock, travel through the South Shore Canal about 8.5 miles to the Cote Ste. Catherine Lock.

The Cote St. Catherine Lock lifts vessels about 30 feet from the level of the Laprarie Basin to the elevation of Lake St. Louis. The function of this lock is to bypass the Lachine Rapids which has been a traditional barrier to commercial navigation in this part of the river. After passing through this lock, vessels proceed 12 miles upstream via dredged channels to the head of Lake St. Louis.

Soulanges Subsection. This portion of the Canadian section of the St. Lawrence River is about 16 miles long and consists of the Beauharnois Flight Locks and the Beauharnois Power Canal to Lake St. Francis. There are two locks in flight which provide a vertical lift of about 82 feet to the level of Lake St. Francis.

Upper and Lower Beauharnois Locks. At the head of Lake St. Louis, a widening in the St. Lawrence River southwest of Montreal, the St. Lawrence Seaway Authority has constructed two locks. The two locks are built just outside of the town of Beauharnois, Quebec. Each lock is connected by a three-quarter mile-long ship canal and allows vessels to overcome the differnce in height between Lake St. Louis and the Beauharnois Canal. The Beauharnois Power Canal is 16 miles long, 3,300 feet wide and includes a 27-foot deep channel 600 feet wide and carries a major flow of the St. Lawrence River to the Beauharnois Powerhouse which is owned and operated by Hydro-Quebec. The Beauharnois Canal replaces the Soulanges Canal, located on the north shore of the river, as the connecting link between Lakes St. Louis and St. Francis. Principal features of the Canadian locks is found in Table B-7.

Table B-7 - Principal Features of Locks, Canadian Section

Principal Features	St. Lambert Lock (Ft.)	Cote Ste. Catherine Lock (Ft.)	Beauharnois Lock and Power Canal (1) Lower (Ft.)	Beauharnois Lock and Power Canal (1) Upper (Ft.)
Length (Overall)	860	860	860	860
Length (Inside)	768	768	768	768
Width	80	80	80	80
Depth Over Sills (Ft.)	30	30		
Lift (Ft.)	15	30	41	41
Length of Approach Wall				
- Upstream	2,300	1,600	1,029	2,136
- Downstream	2,900	1,600	2,124	1,020

(1) Beauharnois Power Canal is 16 miles long, 3,300 feet wide, and includes a navigation channel 600 feet wide with a 27-foot depth. Canal now carries a major flow of the St. Lawrence River to the Beauharnois Powerhouse where water drops 80 feet to the level of Lake St. Louis.

Source: Fact Sheets, Nos. 1202, 1203, 1204, 1205, 1206, 1208; St. Lawrence Seaway Authority.

Lake St. Francis Subsection. This third subsection is about 29 miles long and terminates just east of Cornwall, Ontario. This stretch of the river has no locks but required extensive channel improvements to satisfy the channel requirements of commercial vessels. This subsection is the last of the three all-Canadian subsections in the Canadian section of the Seaway.

International

This portion of the St. Lawrence River is subdivided into two parts: the International Rapids Subsection and the Thousand Islands Subsection.

International Rapids Subsection. Cornwall, Ontario, is located at the upper end of Lake St. Francis which is a widening of the St. Lawrence River. This subsection contains two locks constructed by the St. Lawrence Seaway Development Corporation on the United States side of the St. Lawrence River. Vessels proceeding upstream, enter the Snell Lock which lifts them about 46 feet to the level of the Wiley-Dondero Ship Canal which connects the two locks. The other U. S. facility further upstream is the Eisenhower Lock which completes the lift of vessels to the level of Lake St. Lawrence, the power pool impounded behind the Moses-Saunders Dam and Powerhouse. The total difference in level between Lake St. Lawrence and Lake St. Francis is almost 90 feet. Figure B-4 illustrates the existing U. S. navigation facilities in the St. Lawrence River. The power pool created by large dams which connect New York State and the Province of Ontario is a man-made lake of 100 square miles. There is a navigation channel of typical Seaway dimensions across Lake St. Lawrence. Further upstream from the Eisenhower Lock there is a Canadian control lock at Iroquois, Ontario. This facility, constructed by the St. Lawrence Seaway Authority, is located at the head of Lake St. Lawrence, and allows commercial vessels to bypass the Iroquois Control Dam. This control structure, and the Moses-Saunders and Long Sault dams are used individually or in combination, to control the outflow from Lake Ontario. The upstream extent of the International Rapids Subsection (Chimney Point) is located just downstream of Ogdensburg, NY.

Thousand Islands Subsection. This remaining subsection of the St. Lawrence River extends from Chimney Point upstream to Tibbetts Point Light located at the head of the St. Lawrence River. Vessels transiting this 65-mile subsection do not encounter any locks, dam, or other man-made water control structures. There are no rapids in this subsection, but numerous rock shoals were removed when navigation channels were widened or deepened during the construction of the Seaway Project.

HISTORICAL AND PROJECTED LEVELS OF ECONOMIC ACTIVITY IN THE GREAT LAKES BASIN

Existing Conditions. The Great Lakes Basin is centrally located between the nation's important agricultural production regions of the north central States and the heavily populated eastern markets. A heavy dependence upon forest and mineral resources has developed in northern parts of the basin, but this area is also the beneficiary of a heavy, seasonal inflow of recreationists and tourists. Low levels of family income are found in this part of the Basin - a predictable result of a poor farming base experiencing a net outmigration of population.

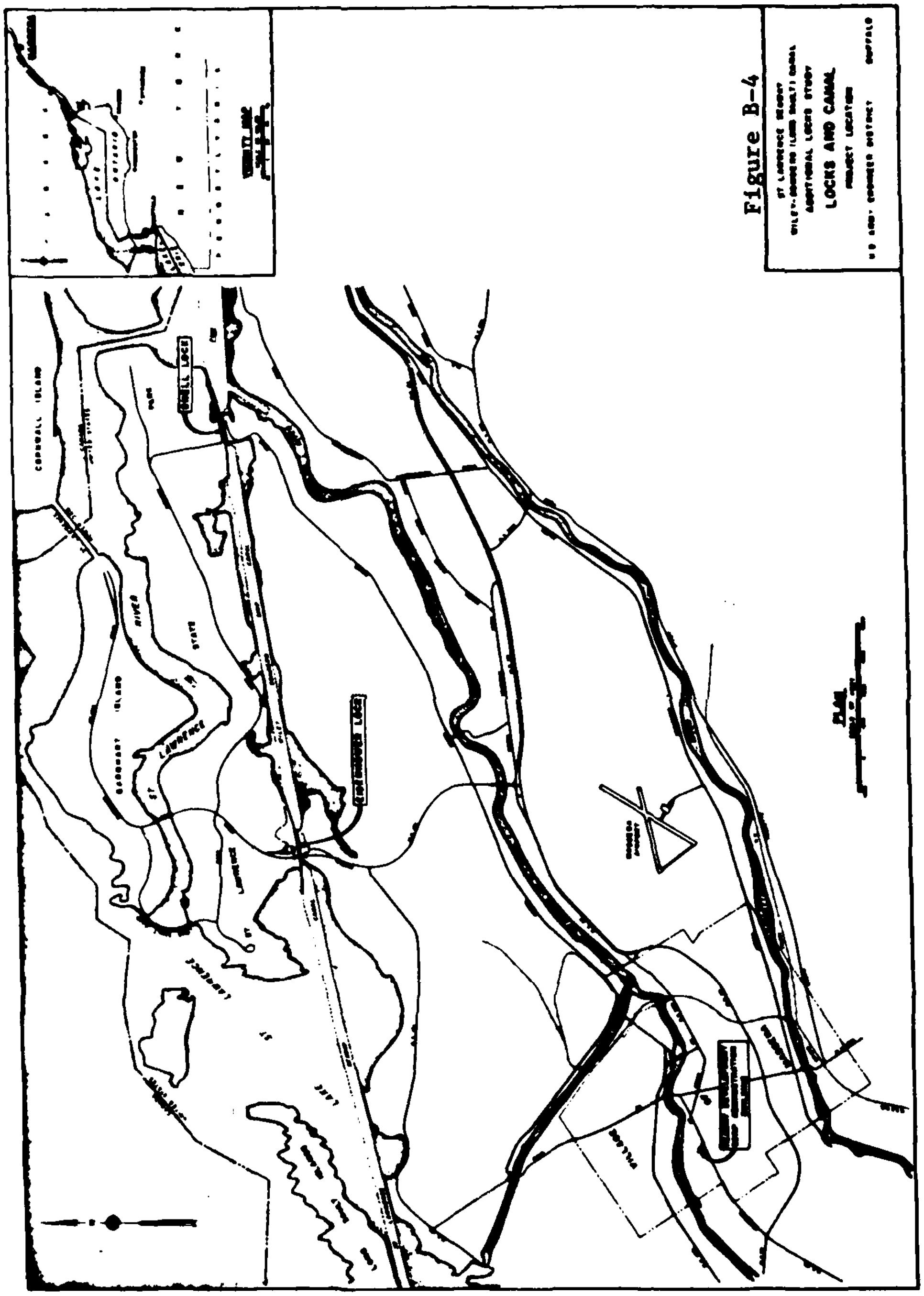

LOCKS AND CANAL
SNELL LOCK
EISENHOWER LOCK
CORNWALL ISLAND

Figure B-4

Manufacturing activity is concentrated within the central part of the Basin. Along the lakeshore there are centers of iron and steel, chemical, and petroleum production. Agricultural activity is pursued throughout the Basin although the most productive areas are found in the southern part of the Basin. Specialized crops can also be found along various lakeshore areas which experience delayed initial frosts in the fall and a later than usual spring thaw - commonly known as "lake effect."

Early economic development and population growth in the Basin has been attributed to the vast fresh water resources in the Great Lakes. By the middle of the Eighteenth Century, iron, copper, timber, and agricultural resource development led to a need for transportation of bulk commodities within and between each Great Lake subbasin. This began an era of social investment in Great Lakes navigation facilities which has continued to date. Railroad linkages to major cities and ports along the five lakes also encouraged economic growth. This geographic region has all the attributes necessary for sustained long-term economic growth: fresh water supply, mineral resources, and waterways and connecting channels, capable of waterborne movement of bulk commodities at a low cost.

Future Conditions. Forecasts of alternative futures for the Basin was the first comprehensive study undertaken by the Great Lakes Basin Commission (GLBC), a State-Federal organization established by Executive Order No. 11345 under the authority of Section 201 of Public Law 89-80, the Water Resources Planning Act of 1965. Under this act, the GLBC is designated as the principal agency for the coordination of planning for water and related land resources in the Great Lakes Basin among the various Federal, State, local, and non-governmental entities. The authority of the GLBC, and the scope of their Framework Study, is limited to the Great Lakes Basin within the United States down to and including the point at which the St. Lawrence River ceases to be the international boundary. The purpose of their multi-volume Framework Study is to consolidate sufficient information relating to economic and demographic characteristics, and its water and related land resources, to permit an understanding of the existing situation and to delineate the problems and needs confronting the residents of this geographic area in terms of conservation, development, and utilization of existing water resources. The Framework Study provides most of its information broken down by State, Lake Basins, and by planning subareas or river basin groups. Their projections of various levels of economic activity for the five major planning areas assume that the Federal Government will implement fiscal and monetary policies necessary to maintain full employment, that no major wars occur which distort levels of economic activity at several key target dates and that water resources will play the same role in stimulating or depressing economic growth in the area that it has in the past.

The Great Lakes Basin Commission has divided their study area in five major subbasins named after each Great Lake. The five subbasins are drainage areas which lie wholly in United States territory. The most easterly subbasin planning area of Lake Ontario includes that portion of the St. Lawrence River which comprises the international boundary.

Since a great deal of their socio-economic information needed for water resources planning was available only by counties, without regard to drainage basin boundaries, the aggregation of counties inside the Basin limits and those additional counties having an important economic relationship to the Basin has been defined as the Great Lakes Region. This Region is subdivided into five subregions having a similar county-boundary relationship to the five Great Lakes Basins. Each subregion has been defined as a Plan Area. A listing of Basin counties by individual Plan Area is included in Table B-8 and the aggregation of individual Plan Areas are shown in Figure B-5.

Population. Most of the 29 million residents within the Basin are located within urban port areas along the shores of the lower Great Lakes (Michigan and Erie). Major urban developments include Milwaukee, WI; Chicago, IL; Detroit, MI; Cleveland, OH; and Buffalo, NY. More than 80 percent of the Basin can be found in these major urban centers. The contribution of each Plan Area to total population distribution in 1970 is summarized in Table B-9.

The northern and inland portions of the Basin are more sparsely populated relative to other areas located along or near the Great Lakes shoreline. Population densities are lowest in the northern portions of Minnesota, Wisconsin, Michigan, and New York; this characteristic may be attributed to the isolation and more severe winters.

The Great Lakes Basin has contained 14 to 15 percent of the U.S. population over the period 1950 to 1975. During this interval, the Lake Michigan Plan Area included about 45 percent and the Lake Erie Plan Area contained approximately 39 percent of the total population in the Great Lakes Baisn. The remaining three Plan Areas (Ontario, Huron, and Superior) contained nine, four, and two percent; respectively.

In the future, the Basin's share of total U.S. population is anticipated to decrease slightly from 14.1 percent in 1980 to 13.5 percent in 2020. A comparison of Great Lakes to U.S. population, employment, and income growth is included in Table B-10. Nearly 23.5 million of the Basin's total population of 29.3 million resided in urban centers in 1970. This proportion is projected to remain stable during the 1980-2020 period. Five of the Basin's 32 SMSA's contained more than one million people. These areas are Chicago, 7.0 million; Detroit, 4.2 million; Cleveland, 2.1 million; Milwaukee, 1.4 million; and Buffalo, 1.4 million.

Employment. Employment trends for the eight States bordering the five Great Lakes have paralleled national employment shifts for most major employment sectors during the period 1940-1970. Declines in employment have been concentrated in the primary sector (agriculture and mining) while storng gains in the secondary and tertiary sectors contributed to increases in total employment both in the Great Lakes region and in the Untied States. Historical employment shifts in the Great Lakes Region relative to the Untied States is illustrated in Tables B-11 and B-12.

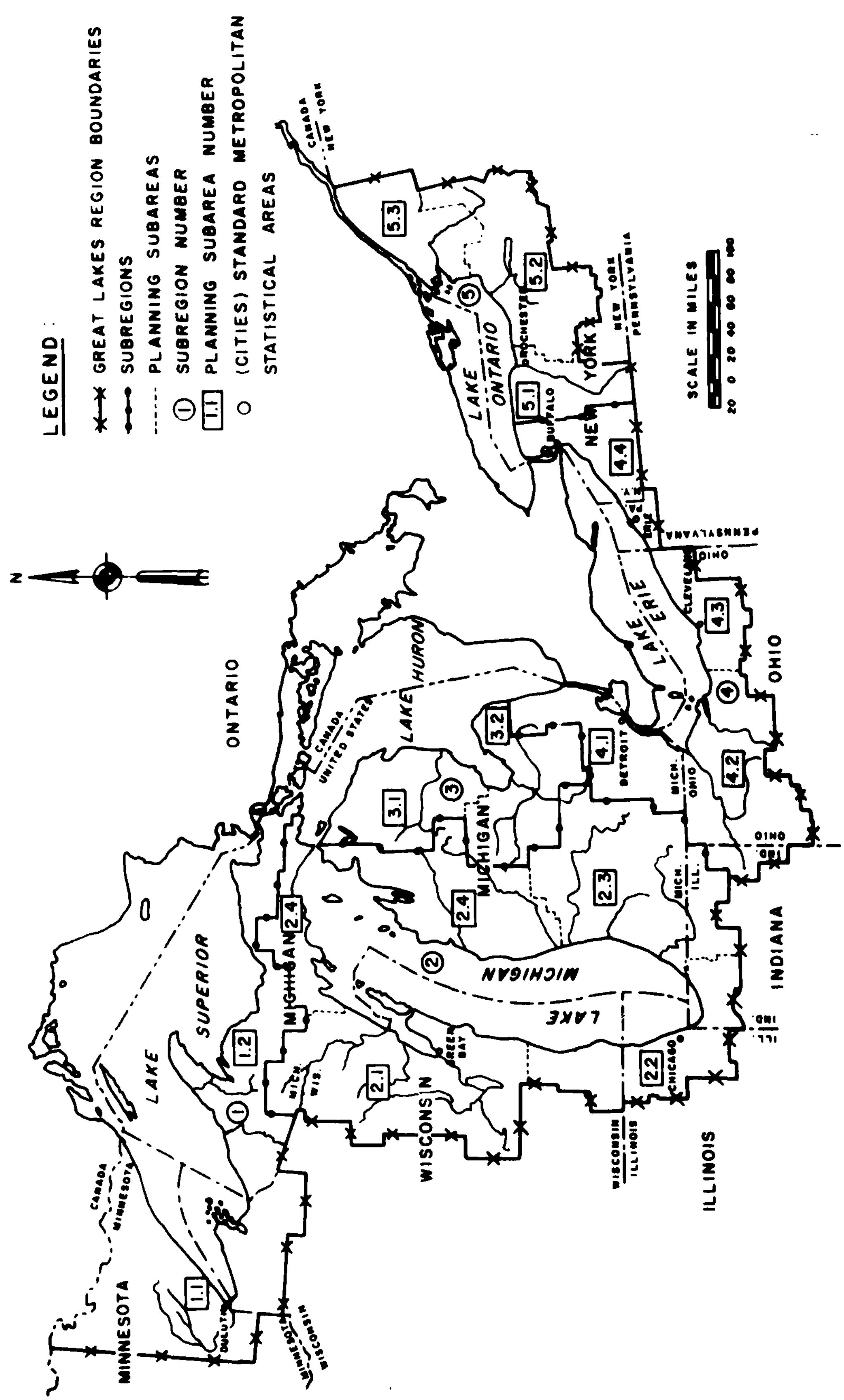
Table B-8 - Counties in the Great Lakes Region by Plan Area

LAKE SUPERIOR -	MICHIGAN	MICHIGAN (Cont'd)	OHIO (Cont'd)
PLAN AREA 1.0	Allegan	Genesee	Geauga
	Antrim	Gladwin	Hancock
MICHIGAN	Barry	Gratiot	Henry
Alger	Benzie	Huron	Huron
Baraga	Berrien	Iosco	Lake
Chippewa	Branch	Isabella	Lorain
Gogebic	Calhoun	Lapeer	Lucas
Houghton	Cass	Midland	Medina
Keweenaw	Charlevoix	Montgomery	Mercer
Luce	Clinton	Ogemaw	Ottawa
Marquette	Dickson	Oscoda	Paulding
Ontonagon	Eaton	Otsego	Portage
	Emmet	Presque Isle	Putnam
MINNESOTA	Grand	Saginaw	Sandusky
Carlton	Hillsdale	Tuscola	Seneca
Cook	Ingham		Summit
Lake	Ionia	LAKE ERIE -	Van Wert
St. Louis	Jackson	PLAN AREA 4.0	Williams
	Kalamazoo		Wood
WISCONSIN	Kalkaska	INDIANA	Wyandot
Ashland	Kent	Adams	
Bayfield	Lake	Allen	PENNSYLVANIA
Douglas	Leelanau	De Kalb	Erie
Iron	Macknac		
	Manistee	MICHIGAN	LAKE ONTARIO -
LAKE MICHIGAN -	Mason	Lenawee	PLAN AREA 5.0
PLAN AREA 2.0	Macosta	Livingston	
	Missaukee	Macomb	NEW YORK
ILLINOIS	Montcalm	Monroe	Allegany
Cook	Muskegon	Monroe	Cayuga
Du Page	Newaygo	Oakland	Genesee
Kane	Oceana	St. Clair	Herkimer
Lake	Osceola	Sanilac	Jefferson
McHenry	Ottawa	Washtenaw	Lewis
Will	St. Joseph	Wayne	Livingston
	Schoolcraft		Madison
INDIANA	Shiawassee	NEW YORK	Monroe
Elkhart	Van Buren	Cattaraugus	Oneida
Lagrange	Wexford	Chautauqua	Onondaga
Lake		Erie	Ontario
LaPorte	LAKE HURON -	Niagara	Orleans
Marshall	PLAN AREA 3.0		Oswego
Noble		OHIO	St. Lawrence
Porter	MICHIGAN	Allen	Schuyler
Starke	Alcona	Ashtabula	Seneca
St. Joseph	Alpena	Auglaize	Tompkins
Steuben	Arenac	Crawford	Wayne
	Bay	Cayuga	Wyoming
	Cheboygan	Defiance	Yates
	Clare	Erie	
	Crawford	Fulton	

Source: Great Lakes Basin Framework, Appendix 1 - "Alternative Frameworks," Great Lakes Basin Commission, 1975

Table B-9 - Great Lakes Region Population and Urban Population by Plan Area, 1970

Plan Area	1970 Population	Percent of Great Lakes Region	Urban Population	Percent of Region Population
1.0 - Lake Superior	533,539	1.8	315,789	1.1
2.0 - Lake Michigan	13,516,965	46.1	11,186,962	38.1
3.0 - Lake Huron	1,236,265	4.2	702,813	2.4
4.0 - Lake Erie	11,513,853	39.3	9,727,303	33.2
5.0 - Lake Ontario	2,531,673	8.6	1,593,388	5.4
TOTAL	29,332,295	100.0	45,459,122	80.2



GREAT LAKES PLAN AREAS

FIGURE B-5

FIGURE B-5

Table B-10 - Population, Employment, and Income
United Statesand Great Lakes
1950 to 2020

	United States	Great Lakes Basin	Percentage (1)
Population			
1950 (2)	151,236,648	21,617,012	14.3
1962 (2)	185,708,000	26,719,499	14.4
1970 (2)	203,857,864	29,112,481	14.3
1980	223,532,000	31,580,200	14.1
1985	234,517,300	32,854,400	14.0
1990	246,039,000	33,674,100	13.7
2000	263,830,000	36,350,700	13.8
2020	297,830,000	40,168,300	13.5
Employment			
1950	57,221,773	8,614,414	15.1
1962	66,372,649	9,734,946	14.7
1970	79,306,527	11,378,925	14.3
1980	96,114,000	13,840,400	14.4
1985	101,121,100	14,445,700	14.3
1990	106,388,000	15,080,500	14.2
2000	117,891,000	16,582,100	14.1
2020	130,534,000	18,063,100	13.8
Personal Income (3)			
1950	312,147,612	53,459,019	17.1
1962	480,053,606	76,285,557	15.9
1970	708,583,931	110,131,348	15.5
1980	1,068,496,000	164,560,700	15.4
1985	1,273,226,200	193,937,100	15.2
1990	1,517,173,000	228,590,300	15.1
2000	2,154,266,000	320,003,600	14.9
2020	3,931,918,000	569,055,000	14.5
Per Capita Personal Income (3)			
1950	2,064	2,470	119.7
1962	2,585	2,860	110.6
1970	3,476	3,780	108.7
1980	4,700	5,210	110.9
1985	5,400	5,910	109.4
1990	6,100	6,790	111.3
2000	8,100	8,810	108.8
2020	13,200	14,170	107.3

(1) Great Lakes Basin as percentage of total United States.
(2) Mid-year population.
(3) Value of dollar in 1967.
Source: 1972-OBERS Projections, Vol. 3, U. S. Water Resources Council

Table B-11 - Historical Employment
Great Lakes Basin

Industry	1940	1950	1960	1970
Agriculture	1,969,992	1,694,832	1,133,954	746,733
Mining	359,818	329,157	166,424	133,802
Contract Construction	822,629	1,207,715	1,311,832	1,451,417
Manufacturing	5,547,648	7,631,071	8,639,079	7,867,820
Transportation, Communication, and Public Utilities	1,418,430	1,920,314	3,263,306	1,924,088
Wholesale and Retail Trade	3,360,903	4,393,311	4,716,289	5,689,440
Finance, Insurance, and Real Estate	717,047	861,094	1,131,803	1,468,088
Services	3,547,678	3,974,302	5,266,277	7,287,730
Total Government	649,376	986,291	1,224,844	1,458,198
Total Employment	18,392,996	22,998,097	25,427,378	29,028,116

Source: Regional Employment by Industry, 1940-1970, U. S. Department of Commerce

Table B-12 - Changes in Historical Employment
Great Lakes and United States
1940-1970

Employment Sector	United States		Great Lakes Region (1)	
	Employment Change	Percent Change	Employment Change	Percent Change (2)
Agriculture	-5,762,450	-3.6	-1,223,259	-3.2
Mining	-296,249	-1.3	-226,016	-3.2
Contract Construction	2,476,739	2.6	628,788	1.9
Manufacturing	9,280,228	2.1	2,320,172	1.2
Transportation, Communication, and Public Utilities	2,033,201	1.7	505,658	1.0
Wholesale and Retail Trade	7,925,889	2.4	2,328,537	1.8
Finance, Insurance, And Real Estate	2,360,167	3.2	751,041	2.4
Services	11,509,991	2.8	3,740,052	2.4
Total Government	4,404,549	4.2	808,822	2.7
Total Employment	33,932,065	1.9	10,635,120	1.5

(1) Includes all eight States bordering Great Lakes.
(2) Average annual compound rate of change.
Source: Regional Employment by Industry, 1940-1970, U. S. Department of Commerce

Table B-13 - Plan Area - Lake Superior

	1950	1962 (1)	1969	1970	1980	1985	1990	2000	2020
Population (midyear)	515,329	550,122	537,064	535,542	531,500	531,100	531,000	528,200	532,200
Per Capita Income (1967 $)	1,715	2,115	2,710	2,820	3,935	4,520	5,190	7,040	11,950
Per Capita Income Relative (U.S. = 1.00)	.83	.82	.79	.81	.84	.84	.85	.87	.91
Total Employment	180,206	174,478	-	182,859	200,500	202,600	204,700	214,600	220,600
Total Personal Income (1967 $000)	884,222	1,162,805	1,456,484	1,508,338	2,091,800	2,400,700	2,756,400	3,720,100	6,358,400
Industry Earnings Forecasts			In Thousands of 1967 Dollars						
Agriculture	27,378	12,746	9,391	7,963	10,000	10,700	11,600	12,900	16,600
Mining	71,149	91,545	120,671	1,591	173,900	180,000	186,300	208,300	265,300
Contract Construction	37,181	55,535	61,846	67,111	105,900	119,700	135,500	176,600	282,400
Manufacturing	141,251	135,481	161,398	158,798	213,800	239,900	269,000	345,600	547,500
Trans., Comm. and Public Utilities	100,989	87,594	99,737	94,868	120,200	132,900	147,200	188,100	302,100
Wholesale and Retail Trade	142,455	149,355	172,203	172,766	225,600	248,900	274,700	348,100	526,300
Finance, Insur. and Real Estate	15,215	24,428	29,895	29,788	45,000	53,400	63,400	89,300	158,600
Services	66,883	100,572	140,291	142,498	240,300	288,700	346,700	503,300	953,600
Government	86,530	213,380	284,219	304,410	432,200	516,300	616,900	883,400	1,654,700
Total Industry Earnings	689,031	870,636	1,079,651	979,793	1,566,900	1,790,500	2,051,300	2,755,600	4,707,100

(1) Employment is for 1960
Source: 1972 OBERS Projections, Vol. 3, U.S. Water Resources Council

Table B-14 - Plan Area - Lake Michigan

	1950	1962 (1)	1969	1970	1980	1985	1990	2000	2020
Population (midyear)	9,988,365	12,338,385	13,386,122	13,551,843	14,709,300	15,281,800	15,877,000	16,862,500	18,630,000
Per Capita Income (1967 $)	2,560	3,050	4,065	3,890	5,330	6,030	6,820	8,950	14,320
Per Capita Income Relative (U.S. = 1.00)	1.24	1.18	1.18	1.12	1.13	1.12	1.12	1.10	1.08
Total Employment	4,111,550	4,675,422	-	5,446,825	6,595,900	6,865,800	7,147,400	7,823,500	8,475,600
Total Personal Income (1967 $000)	25,586,403	37,604,446	54,428,606	52,720,618	78,386,000	92,131,400	108,290,400	150,924,400	266,727,600
Industry Earnings Forecasts	In Thousands of 1967 Dollars								
Agriculture	771,330	528,768	516,235	483,743	551,300	565,400	580,100	639,400	512,100
Mining	99,679	87,510	78,434	71,141	89,200	91,800	94,500	105,100	133,400
Contract Construction	1,206,515	1,793,182	2,890,455	2,671,845	4,045,000	4,649,200	5,344,100	7,113,400	11,551,300
Manufacturing	8,729,236	12,294,436	16,375,191	15,741,440	21,530,400	24,395,500	27,643,400	36,013,100	57,670,400
Trans., Comm. and Public Utilities	1,793,006	2,300,447	3,002,782	3,035,695	4,295,000	4,950,600	5,706,900	7,702,000	13,031,000
Wholesale and Retail Trade	4,212,699	5,561,752	7,394,969	7,404,823	10,279,700	11,739,000	13,406,600	17,942,800	29,505,500
Finance, Insur. and Real Estate	935,346	1,586,870	2,146,915	2,137,872	3,462,800	4,167,300	5,015,500	7,267,100	13,504,000
Services	2,326,689	3,921,209	5,946,210	6,112,647	10,744,700	13,263,100	16,366,400	24,670,000	48,651,200
Government	1,667,858	3,089,467	4,760,717	5,153,896	7,965,300	9,644,700	11,679,600	17,021,000	32,206,100
Total Industry Earnings	21,742,358	31,163,641	43,111,908	42,813,102	62,963,400	73,466,000	85,837,100	118,473,900	206,765,000

(1) Employment is for 1960
Source: 1972 OBERS Projections, Vol. 3, U.S. Water Resources Council

Table B-15 - Plan Area - Lake Huron

	1950	1962 (1)	1969	1970	1980	1985	1990	2000	2020
Population (midyear)	844,052	1,082,382	1,218,622	1,239,877	1,390,900	1,469,500	1,552,800	1,678,500	1,891,800
Per Capita Income (1967 $)	1,990	2,530	3,420	3,245	4,700	5,350	6,090	8,115	13,380
Per Capita Income Relative (U. S. = 1.00)	0.96	0.98	1.00	0.93	1.00	0.99	1.00	1.00	1.01
Total Employment	301,543	355,981	-	431,129	552,700	588,200	626,000	706,700	803,100
Total Personal Income (1967 $000)	1,676,650	2,738,024	4,172,363	4,024,260	6,535,000	7,862,200	9,458,800	13,623,900	25,308,700
Industry Earnings Forecasts			In Thousands of 1967 Dollars						
Agriculture	112,516	78,543	74,815	67,144	74,400	75,400	76,300	84,100	104,400
Mining	7,464	7,135	6,838	6,204	23,800	25,700	27,600	32,200	43,500
Contract Construction	60,555	88,455	180,242	161,657	249,800	297,100	353,200	495,600	881,200
Manufacturing	691,395	1,206,273	1,773,299	1,533,860	2,632,200	3,089,800	3,627,000	4,969,200	8,472,000
Trans., Comm., and Public Utilities	69,157	114,709	134,423	135,616	211,900	257,500	312,800	457,100	875,600
Wholesale and Retail Trade	231,796	307,561	478,906	475,750	718,000	841,600	986,600	1,371,300	2,380,500
Finance, Insur. and Real Estate	23,454	43,607	69,391	70,200	126,600	158,500	198,500	303,400	610,700
Services	105,428	192,361	327,122	331,907	624,000	807,600	1,045,400	1,707,800	3,868,700
Government	96,562	228,178	393,084	419,235	640,800	777,600	943,700	1,373,600	2,572,400
Total Industry Earnings	1,398,327	2,266,822	3,438,120	3,201,573	5,301,500	6,330,800	7,571,100	10,794,300	19,809,000

(1) Employment is for 1960
Source: 1972 - OBERS Projections, Vol. 3, U. S. Water Resources Council

Table B-16 - Plan Area - Lake Erie

	1950	1962 (1)	1969	1970	1980	1985	1990	2000	2020
Population (midyear)	8,558,663	10,697,821	11,453,257	11,547,714	12,442,500	12,932,900	13,444,100	14,262,300	15,679,100
Per Capita Income (1967 $)	2,540	2,840	3,890	3,820	5,250	5,940	6,725	8,850	14,260
Per Capita Income Relative (U. S. = 1.00)	1.23	1.10	1.13	1.10	1.12	1.10	1.10	1.09	1.08
Total Employment	3,368,561	3,801,375	-	4,452,410	5,396,100	5,628,300	5,871,400	6,452,300	7,026,700
Total Personal Income (1967 $000)	21,738,661	30,405,051	44,550,025	44,131,039	65,306,800	76,838,700	90,416,000	126,258,800	223,549,100
Industry Earnings Forecasts			In Thousands of 1967 Dollars						
Agriculture	464,410	357,300	357,988	373,919	422,900	437,100	451,800	501,800	629,800
Mining	27,068	27,883	59,280	40,456	88,700	96,800	105,500	125,700	174,500
Contract Construction	1,044,877	1,235,943	2,345,176	2,118,647	3,051,300	3,537,300	4,101,200	5,545,800	9,264,800
Manufacturing	8,852,407	11,428,664	31,082,900	15,512,179	21,111,800	23,885,500	27,030,300	35,116,500	55,906,800
Trans., Comm., and Public Utilities	1,351,324	1,691,772	2,271,125	2,287,177	3,296,100	3,840,000	4,474,100	6,147,200	10,658,400
Wholesale and Retail Trade	3,144,688	4,041,657	5,681,298	5,706,428	8,059,800	9,187,400	10,474,300	13,980,200	22,706,700
Finance, Insur. and Real Estate	555,303	981,704	1,432,614	4,422,203	2,437,800	2,960,700	3,596,200	5,254,300	9,764,900
Services	1,731,728	2,954,671	4,770,526	4,856,711	8,530,500	10,562,500	13,079,900	19,831,000	39,488,000
Government	1,276,830	2,505,304	3,993,464	4,228,387	6,568,300	7,990,100	9,721,400	14,272,500	27,285,900
Total Industry Earnings	18,448,635	25,224,898	51,994,371	36,546,107	53,567,200	62,497,400	62,560,600	100,775,000	175,879,800

(1) Employment is for 1960
Source: 1972 OBERS Projections, Vol. 3, U. S. Water Resources Council

Table B-17 - Plan Area - Lake Ontario

	1950	1962 (1)	1969	1970	1980	1985	1990	2000	2020
Population (midyear)	1,710,603	2,050,789	2,229,146	2,237,505	2,506,000	2,639,100	2,780,400	3,019,200	3,453,200
Per Capita Income (1967 $)	2,090	2,620	3,430	3,460	4,885	5,570	6,355	8,440	13,715
Per Capita Income Relative (U. S. = 1.00)	1.01	1.01	1.00	1.00	1.04	1.03	1.04	1.04	1.04
Total Employment	651,554	727,690	-	865,702	1,095,200	1,160,800	1,231,000	1,385,000	1,555,100
Total Personal Income (1967 $000)	3,573,080	5,375,231	7,641,060	7,747,093	12,241,100	14,704,100	17,668,700	25,476,400	47,111,200
Industry Earnings Forecasts			In Thousands of 1967 Dollars						
Agriculture	238,925	162,533	193,098	176,738	194,900	201,300	207,700	231,200	291,300
Mining	16,000	15,420	21,737	19,721	33,000	36,300	40,000	48,500	69,400
Contract Construction	148,734	223,558	363,671	328,480	578,600	685,200	811,800	1,135,000	1,988,700
Manufacturing	1,159,532	1,743,069	2,423,835	2,350,517	3,350,900	3,885,900	4,509,200	6,079,500	10,184,600
Trans., Comm., and Public Utilities	198,038	255,321	327,380	342,005	528,100	637,700	770,000	1,112,700	2,068,200
Wholesale and Retail Trade	499,162	683,707	895,231	892,494	1,340,700	1,568,200	1,835,300	2,552,700	4,408,900
Finance, Insur. and Real Estate	82,630	157,524	221,037	218,648	417,100	517,600	642,700	970,200	1,890,500
Services	301,549	524,986	811,940	818,949	1,587,500	2,007,000	2,538,800	3,975,000	8,295,200
Government	282,012	556,223	899,057	971,100	1,566,100	1,924,900	2,366,800	3,526,000	6,828,600
Total Industry Earnings	2,926,582	4,322,341	6,156,986	6,118,652	9,596,900	11,464,100	14,722,300	19,630,800	36,025,400

(1) Employment is for 1960
Source: 1972 OBERS Projections, Vol. 3, U. S. Water Resources Council

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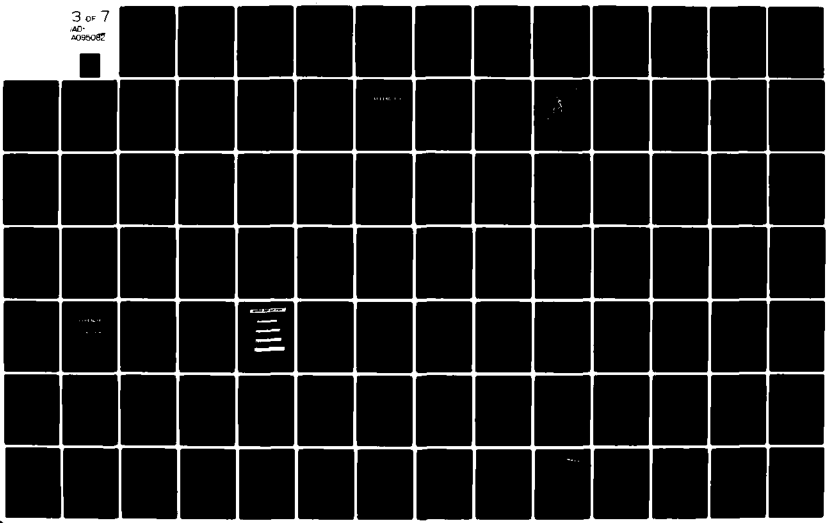

Table B-18 - Plan Areas - Great Lakes

	1950	1962 (1)	1969	1970	1980	1985	1990	2000	2020
Population (midyear)	21,617,012	26,719,499	28,824,211	29,112,481	31,580,200	32,854,400	33,674,100	36,350,700	40,168,300
Per Capita Income (1967 $)	2,470	2,860	3,890	3,780	5,210	5,910	6,790	8,810	14,170
Per Capita Income Relative (U. S. = 1.00)	1.20	1.11	1.13	1.09	1.11	1.09	1.11	1.09	1.07
Total Employment	8,613,414	9,734,946	-	11,378,925	13,840,400	14,445,700	15,080,500	16,582,100	18,063,100
Total Personal Income (1967 $000)	53,459,019	76,285,557	112,248,538	110,131,348	164,560,700	193,937,100	228,590,300	320,003,600	569,055,000
Industry Earnings Forecasts			In Thousands of 1967 Dollars						
Agriculture	1,624,559	1,139,890	1,151,527	1,109,507	1,253,500	1,289,900	1,327,500	1,469,400	1,554,200
Mining	221,360	229,493	286,960	139,113	408,600	430,600	453,900	519,800	686,100
Contract Construction	2,497,862	3,396,673	5,841,390	5,347,740	8,030,500	9,288,500	10,745,800	14,466,400	23,968,400
Manufacturing	19,573,821	26,807,923	51,816,623	35,296,794	48,839,100	55,496,600	63,078,900	82,523,900	132,781,300
Trans., Comm., and Public Utilities	3,512,514	4,449,842	5,835,447	5,895,361	8,451,300	9,818,700	11,411,000	15,607,100	26,935,300
Wholesale and Retail Trade	8,230,800	10,744,032	14,622,607	14,652,261	20,623,800	23,585,100	26,977,500	36,195,100	59,527,900
Finance, Insur. and Real Estate	1,611,948	2,794,133	3,899,852	3,878,711	6,489,300	7,857,500	9,516,300	13,884,300	25,928,700
Services	4,532,277	7,693,799	11,996,089	12,262,712	21,727,000	26,928,900	33,377,200	50,687,100	101,257,400
Government	3,409,792	6,592,552	10,330,541	11,077,028	17,172,700	20,853,600	25,328,400	37,026,500	70,547,700
Total Industry Earnings	45,204,933	63,848,338	105,781,036	89,659,227	132,995,900	155,549,400	182,216,500	252,339,600	443,177,000

(1) Employment is for 1960
Source: 1972 OBERS Projections, Vol. 3, U. S. Water Resources Council

Table B-19 - Plan Area - United States

	1950 (2)	1962 (1)	1969	1970	1980	1985	1990	2000	2020
Population (midyear)	151,236,648	185,708,000	201,298,000	203,857,864	223,532,000	234,517,300	246,039,000	263,830,000	297,146,000
Per Capita Income (1967 $)	2,064	2,585	3,435	3,476	4,700	5,400	6,100	8,100	13,200
Per Capita Income Relative (U. S. = 1.00)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Total Employment	57,221,773	66,372,649	-	79,306,527	96,114,000	101,121,100	106,388,000	117,891,000	130,534,000
Industry Earnings Forecasts				In Thousands of 1967 Dollars					
Agriculture	23,467,939	18,462,090	20,086,322	19,640,721	21,264,000	22,122,800	23,016,000	25,856,000	32,975,000
Mining	5,129,386	4,908,611	5,418,046	5,647,503	6,498,000	6,896,300	7,319,000	8,402,000	11,106,000
Contract Construction	15,370,217	22,990,095	34,359,988	34,457,902	51,910,100	60,857,100	71,347,000	97,584,000	166,004,000
Manufacturing	74,706,597	115,576,453	161,773,451	156,291,199	219,486,000	252,984,700	291,595,000	388,479,000	641,982,000
Trans., Comm., and Public Utilities	21,047,455	28,694,815	38,611,797	39,925,053	58,672,000	69,036,800	81,233,000	112,976,000	200,497,000
Wholesale and Retail Trade	48,774,013	67,565,645	91,431,489	93,080,363	133,912,000	154,867,400	179,102,000	243,455,000	409,485,000
Finance, Insur. and Real Estate	10,886,662	19,805,660	28,875,247	28,880,241	48,461,000	59,224,100	72,377,000	106,885,000	204,488,000
Services	28,797,423	52,608,614	81,997,846	85,077,671	150,270,000	187,755,300	234,589,000	359,761,000	734,985,000
Government	29,316,295	59,386,445	93,988,132	99,310,475	147,017,000	178,255,800	216,133,000	313,934,000	599,377,000
Total Industry Earnings	257,495,988	389,998,433	556,542,319	562,311,127	837,490,000	992,723,000	1,176,711,000	1,657,332,000	3,000,899,000

(1) Employment is for 1960
(2) Alaska and Hawaii excluded
Source: 1972 OBERS Projections, Vol. 3, U. S. Water Resources Council

Table B-20 - Major Industrial Sectors in the Great Lakes States

State[3]	Value Added by Manufacture[1]	Major Industrial Sector[2] Industry	SIC Code[4]
Illinois	1,916.1	Electrical Machinery	36
	1,635.3	Machinery, except elec.	35
	1,617.3	Food and kindred prods.	20
Indiana	293.2	Machinery, except elec.	35
	188.9	Petroleum and coal prods.	29
	168.7	Transportation equipment	37
Michigan	5,805.8	Transportation equipment	37
	2,750.4	Machinery, except elec.	35
	1,987.7	Fabricated metal prods.	34
Minnesota	27.6	Food and kindred prods.	20
	13.3	Printing and publishing	27
	7.3	Machinery, except elec.	35
New York	1,714.2	Instruments and related prods.	38
	999.6	Machinery, except elec.	35
	590.2	Primary metal industries	33
Ohio	1,365.6	Machinery, except elec.	35
	1,168.8	Fabricated metal prod.	34
	971.6	Transportation equipment	37
Pennsylvania	91.2	Electrical machinery	36
	87.7	Fabricated metal prod.	34
	78.1	Machinery, except elec.	35
Wisconsin	1,182.1	Machinery, except elec.	35
	547.0	Food and kindred prod.	20
	530.9	Electrical Machinery	36

1/ In millions of dollars
2/ Includes only top three industrial sectors ranked by value added.
3/ Includes only those counties which lie within Great Lakes Basin limits.
4/ Standard Industrial Classification Manual, 1972

Source: Great Lakes Basin Framework Study, Appendix 19, "Economic and Demographi[c] Studies"

Table B-10, which includes existing and projected levels of employment for the nation and the Great Lakes Basin, indicates that the Basin's share of national employment will fall slightly over the project planning period from about 15 percent to a low of 13.8 percent in 2020.

Income. Historically, total personal income and per capita income within the eight States bordering the Great Lakes can be attributed to a heavy concentration of industrial activity. Basin personal income per capita has averaged from 10 to 20 percent above the national average during the period 1950 to 1970. Economic centers which lead the Basin in per capita income are the metropolitan areas of Chicago, Detroit, Cleveland, and Rochester.

Future growth in total personal and per capita income will follow the same trends as population and employment and decline during the 1980-2020 period. The Basin's share of national personal income is anticipated to drop from 15.4 percent (1980) to 14.5 percent (2020).

Forecasts of industry earnings, based upon Series E OBERS Projections, U.S. Water Resources Council, are summarized by Plan Area in Tables B-13 and B-19. Plan Areas Huron and Ontario will exceed the national rate of total industry earnings primarily due to increased levels of economic activity in the industrial areas of Detroit, MI, and Rochester, NY. Industrial sectors contributing strongly to Great Lakes economic activity are listed in order in Table B-20. The predominance of electrical and nonelectrical machinery manufacture and fabricated metals activity can be attributed to the proximity of iron and steel producing districts.

MOST PROBABLE FUTURE

Lake Superior. This planning area is the least populated of any Great Lakes Basin region. Future population levels are projected to remain stable at about 530,000. Per capita income levels will remain relatively low in comparison to other economic regions. The Lake Superior region is expected to experience the lowest rate of growth in total industry and manufacturing earnings of any planning area. Duluth-Superior, MN-WS, is the center of industrial activity for that portion of these two States within the Great Lakes Basin and should retain its dominant economic role over the project planning period.

Lake Michigan. Population in this plan is expected to grow at an annual rate of 0.6 percent, a rate equal the Basin average but below the national average of 0.7 percent. Manufacturing has been among the more rapidly growing sectors of the local economy. Most of this employment growth can be found within the Chicago metropolitan area on the south shore of Lake Michigan. An increasing percentage of total population in this plan area can be expected to reside in major metropolitan areas of Milwaukee, Chicago, South Bend, and Grand Rapids which are also the historical economic centers.

Lake Huron. Most of this plan area consists of the eastern half of the State of Michigan adjacent to Lake Huron. Three major urban areas in this region are Saginaw, Bay City, and Flint, MI. The remaining area is predominately rural in nature. Major employment sectors include paper products, fabricated and primary metals and chemicals. These important industrial sectors have been projected to grow at an average annual rate of three to four percent per year.

Lake Erie. This planning area includes eight SMSA's and can be considered to be the most densely populated and industrialized area in the Basin. Population and employment levels have traditionally increased more rapidly than the Basin average.

There is a high degree of urbanization within the limits of this planning area. Employment forecasts for the manufacturing, chemical, and paper products indicate that this area should remain a relatively prosperous economic region during the project planning period.

Lake Ontario. The levels of economic activity in this plan area has been traditionally influenced by the economic health of the Rochester and Syracuse, NY, SMSA's. Strong gains have occurred in the manufacturing sector as a result of employment growth in instruments and related products (Rochester), and machinery manufacture and chemicals and allied products (Syracuse). The eastern end of the Lake Ontario subbasin is predominately rural and depends heavily upon seasonal economic activities related to the influx of tourists from outside the region. Primary economic activities (agriculture, lumbering, and mining) comprise the economic base of this part of the Lake Ontario Plan area.

SOCIO-ECONOMIC DESCRIPTION OF THE PROJECT AREA

The location of Eisenhower and Snell Locks and the Wiley-Dondero Ship Canal, the components of the U. S. portion of St. Lawrence Seaway facilities, located in the vicinity of Massena, NY-St. Lawrence County, comprises two of the seven locks required for modern-day commercial navigation of the St. Lawrence River between Montreal, Quebec, and Lake Ontario.

A socio-economic profile of this portion of New York State has been developed based upon documents published by four planning agencies: St. Lawrence-Eastern Ontario Commission, Black River-St. Lawrence Economic Development Commission, New York State Economic Development Board, and the U.S. Water Resources Council.

The St. Lawrence-Eastern Ontario Commission is active in planning for its coastal service area of 23 towns and two cities in a four-county area: St. Lawrence, Jefferson, Oswego, and Cayuga Counties. Since 1969, the Commission has investigated the nature and distribution of natural, economic, and human resources associated with land and waters in the four-county service area. However, their planning has been focused on the protection, rehabilitation, and proper use of coastal resources. The latest publication available from this agency is titled "Report on Coastal Resources."

The Black River-St. Lawrence Economic Development Commission was incorporated in 1966 and functions as an economic development commission serving four upstate New York counties of Franklin, Jefferson, Lewis, and St. Lawrence. This geographic district lies primarily in the drainage basins of the Black and St. Lawrence Rivers and comprises a major portion of the New York State and Canadian border. Their document, "Overall Economic Development Program," published in 1976, was used as a primary reference document for socio-economic statistics and long-term growth trends which may take place in the future.

The New York State Economic Development Board has recently developed demographic projections by county to the year 2005. These statistics represent the "most probable future" for the affected area along the St. Lawrence River and contiguous interior regions.

U. S. Water Resources Council projections of various social and economic variables included in "Series E-OBERS Projections," have been used in estimating future levels of economic activity for the region which includes the U. S.. components of the Seaway. Statistics included in Volume 3 have been aggregated by Bureau of Economic Analysis areas (BEA's). There are 173 BEA's established by the U. S. Department of Commerce for data gathering and analysis purposes. BEA-007 contains 12 counties in central and northern New York including the two counties adjacent to the St. Lawrence River (St. Lawrence and Jefferson), those counties adjacent to the eastern portion of Lake Ontario (Oswego and Cayuga), and eight other contiguous counties (Franklin, Lewis, Herkimer, Oneida, Madison, Onondaga, Tompkins, and Cortland). Their forecasts of economic activity were used as a general guideline in extending short-term county demographic data (up to the year 2005) to levels of population which can reasonably be expected to prevail by the end of the project planning period. Projections of economic activity are required in this analysis of Corps water resource planning since the expected useful life of most engineering works often equals or exceeds 50 years.

The economic base of most northern New York counties have been strongly influenced by an abundance of natural resources. Levels of primary industrial activity (forestry, farming, and mining) have declined over the last few decades and now there are large tracts of land which are not utilized at their maximum potential. The St. Lawrence and Lake Ontario lake plain region, traditional center for regional agricultural pursuits - especially dairy farming activity, has followed national agricultural trends of decreasing agricultural acreage and declining number of farms. Outputs of this phenomena are increasing average farm size and increased levels of food and fiber production.

Population. Total population of St. Lawrence and Jefferson counties which border the immediate project area, as of 1970, was 200,499. St. Lawrence County had the larger population of the two, with 111,001, while Jefferson County had a population of 88,508. The city of Ogdensburg, with a population of 14,554, the village of Massena, with a population of 14,042, both of which are located in St. Lawrence County, and the city of Watertown, located in Jefferson County and with a population of 30,787, comprise the major political subdivisions in the area. As of 1970, racial minorities accounted for less than one percent of the total population in both counties. Median age for St. Lawrence County, at 24.5 was almost six years younger than that of New York State as a whole, while the median age of Jeffeson County's population in 1970 show a very modest growth trend for Jefferson County through 1970, with a net increase of slightly less than 2,000 over the entire 20-year period. St. Lawrence County experienced a considerably greater population increase from 1950 to 1960, at more than 12,000, but had only a modest net gain of 752 from 1960 to 1970. Rural residents of Jefferson County, as of 1970, constituted approximately 61 percent of the total population, while about 56 percent of St. Lawrence County's residents were classified as rural. A historical profile of the distribution of the 1970 urban and rural populations in these two counties is shown below (Table B-21). Historical population changes for the study area are presented in Table B-22.

Table B-21 - Distribution of the Population

	Population (1970)	Urban Pop. (1970)	Rural Pop. (1970)	Percent Urban	Percent Rural
St. Lawrence County	111,991	49,553	62,438	44.2	55.8
Jefferson County	88,508	34,676	53,832	39,2	60.8
Watertown City	30,787	30,787	-	100.0	-
Total	200,499	84,229	116,270	42.0	58.0

Employment. The combined number of employed persons in Jefferson and St. Lawrence Counties, as of 1970, was 67,543 out of a total labor force of approximately 71,557. Of those employed, approximately 68 percent were classified as private wage and salary workers, 10.6 percent were self-employed and less than one percent were classified as unpaid family workers. Operatives represented the largest single occupation group, accounting for 17.5 percent of the total, followed by clerical workers (15.4 percent), craftsmen and foremen (14.7 percent), service workers (14.1 percent), and professional and technical workers (13.5 percent). Operatives also constituted the single largest occupation group in St. Lawrence County (17.1 percent), followed closely by service workers (17 percent), professional and technical workers (15.4 percent), clerical workers (13.9 percent), and craftsmen and foremen (13.6 percent).

Business concerns engaged in manufacturing represented the largest single source of employment for workers in Jefferson County (23.4 percent), followed by professional and related services (19.2 percent), and retail trade establishments (17.4 percent). Professional and related services accounted for 28.7 percent of employed persons in St. Lawrence County in 1970, followed by manufacturing concerns (20.4 percent) and retail trade establishments (15.2 percent). An overview of the employment characteristics in the region can be found in Tables B-23 and B-24.

Income. As of 1969, median income for the 21,707 families in Jefferson County was $8,696. Of these, the largest percentage (26.5 percent) fell into the $10,000 to $14,999 income range, while 24.7 percent of these families had income of $7,000 to $9,999. Among persons 14 years and older in Jefferson

County who had some income, more than 52 percent had incomes of less than $4,000. Median income for the 24,765 families in St. Lawrence County, as of 1969, was $8,667 and 51.2 percent of these were evenly divided between the $7,000 to $9,999 and the $10,000 to $14,999 income categories. Both counties lagged well behind New York State in median income for both families and individuals, with the exception of the village of Massena in St. Lawrence County, which closely compared to Statewide median income for both categories. Family income and the distribution of income by group are included in Tables B-25 and B-26.

Transportation Resources. There are four commercial airports and seven general purpose airstrips in this area. Two limited-access highways serve the region - Interstate 81 connects the largest city on the eastern side of Lake Ontario (Watertown, NY) to the Syracuse Metro-area to the south. This highway provides the main linkage between the Thousand Islands area with population centers located in the central portion and in the Southern Tier of New York State and the north-central portion of Pennsylvania. The second major highway is the Adirondack Northway (Interstate 87) and is roughly parallel but on the far eastern edge of northern New York. This highway is the principal means of passenger car and truck movements between population and manufacturing centers in the Province of Quebec and eastern New York State. East-west highway routes are local and county roads which are often not maintained during severe winter conditions.

Rail service in the region is limited to freight handling. The main rail line is provided by ConRail service which connects Syracuse to Massena via Watertown with a side connection to Ogdensburg. Branch lines primarily serve a few inland mining centers. There are only a few Canadian railway linkages serving the northeastern part of Franklin County near Malone, NY.

Water transportation to and through the region is comprised of St. Lawrence Seaway improvements and the Oswego Canal in conjunction with the New York State Barge Canal. Seaway facilities completed in 1959 are the latest version of a long line of attempts at overcoming impediments to commercial navigation on the St. Lawrence River. The present Seaway is composed of seven locks, only two of which lie within U. S. territory. Construction was completed in 1959 and has stimulated levels of traffic on the river, but at the expense of the port facilities which quickly lost their traditional function of a "lake head" transshipment point as commerce was now able to be shipped directly to markets or to other ports further downriver (Montreal, Quebec) for transshipment to larger oceangoing vessels. This structural dislocation resulted in a decline in the use of the inter-regional rail and highway networks.

Two port and harbors in the project area which have suffered declines in levels of commercial activity are Oswego and Ogdensburg. An analysis of the comparative statement of traffic for the period 1950-1975 (Table B-27), clearly indicate a decline in port utilization which is strongly correlated to completion of Seaway facilities in 1959.

Port facilities at Oswego, NY, are located at the mouth of the Oswego River and services the local area as well as the manufacturing center of Syracuse, NY. The Oswego Port Authority maintains and operates general cargo and bulk terminals including facilities for unloading grains and other dry bulk cargoes. Several piers and wharfs have railroad lines to them. Current port activity includes grain elevator storage and operations, general cargo warehousing and handling, marina and restaurant leases to private operators, cement and petroleum distribution by private operators on port-owned land. Construction of an aluminum rolling mill inland from the port has contributed to a steady flow of aluminum ingot receipts. All of the alumina ore for the mill arrives via train from Arvida, Quebec.

Port facilities at Ogdensburg, NY, are situated on the St. Lawrence River about one-quarter mile from the Seaway channel and 62 miles by water from Lake Ontario. Federal project depth at Ogdensburg is 19 feet with the exception of a small entrance channel of 28 feet dredged and currently maintained by the Port Authority. General cargo berths capable of unloading petroleum products and some dry bulk cargoes are available. More than eight acres of land are available for open dry bulk storage. A satellite facility located downriver at Waddington, NY, is also owned and operated by the Port Authority. Depth of water at this downriver site is reported to vary between 14 and 18 feet. Fuel oil receipts at the new Port Authority terminal was initiated in 1974 upon completion of a pipeline and this traffic currently represents a high percent of total commercial activity at the terminal.

Power Resources. Regional characteristics of low population density, vast open and yet undeveloped areas and easy access to the shoreline of Lake Ontario makes this part of the Lake Ontario subbasin conductive to power generation stations. Of the 29,971 MW of power currently produced in New York State, 2,605 MW or 8.7 percent is produced along the eastern shoreline of Lake Ontario and the St. Lawrence River. In addition to major facilities along the shoreline, many small hydroelectric plants are located along the rivers which enter the area from adjoining upland areas. The Power Authority of the State of New York (PASNY) accounts for 60 percent of the total power produced from this area.

PASNY owns and operates two facilities, the James A. Fitzpatrick nuclear plant (770 MW) at Nine Mile Point (Oswego County), and the Moses-Saunders Power Dam (800 MW) at Massena (St. Lawrence County). Six privately owned power units are located on the southeastern edge of Lake Ontario. Five of these are fossil-fueled units operated by the city of Oswego, NY, while the other unit is located at Nine Mile Point (Oswego County) a nuclear plant owned and operated by Niagara Mohawk Power Corp. Additional power stations are planned in this area for this general area.

Table B-22 - Historical Population Changes

	Number of Persons					Area	Race, 1970 Percentage of Total		
	Total 1970	Total 1960	Total 1950	Urban 1970	Rural 1970	Square Miles 1970	White	Negro	Other
New York State	18,241,266	16,782,304	14,830,192	15,602,486	2,634,481	47,831.0	86.8	11.9	1.3
Northern Area*	375,639	375,087	340,477	142,415	233,224	9,909.0	98.5	0.8	0.7
Jefferson County	88,508	87,835	85,521	34,676	53,832	1,294.0	99.5	0.2	0.3
Watertown City	30,787	33,306	34,350	30,787	0	9.2	99.4	0.3	0.3
St. Lawrence County	111,991	111,239	98,897	49,553	62,438	2,768.0	99.4	0.2	0.4
Ogdensburg City	14,554	16,122	16,166	14,554	0	4.7	99.3	0.2	0.4
Massena Village	14,042	15,478	NA	14,042	0	4.1	99.6	0.1	0.3

*Includes Clinton, Essex, Franklin, Jefferson, Lewis, and St. Lawrence Counties

Source: Business Fact Book, Part 1 and 2, 1976 Edition, New York State Department of Commerce

Table B-22 - Historical Population Changes (Cont'd)

	Age of Population, 1970									Population in Households, 1970		Population in Group Quarters, 1970	
	Median Age	Age Groups - Percentage of Population: 18 and over	Under 5	5-14	15-24	25-44	45-54	55-64	65 and over	Number	Per Household	Inmates of Institutions	All Other
New York State	30.3	68.0	8.2	18.6	16.2	24.2	12.0	10.1	10.8	17,775,236	3.0	218,686	243,045
Northern Area*	26.0	63.3	8.8	21.8	18.3	21.3	10.4	8.8	10.5	356,390	3.3	6,180	13,069
Jefferson County	28.7	63.7	9.0	21.2	15.7	20.7	11.3	9.7	12.4	87,395	3.2	603	510
Watertown City	31.6	67.2	8.1	19.2	16.0	19.6	11.7	10.6	14.9	30,120	2.9	430	237
St. Lawrence County	24.5	64.2	8.4	21.1	21.3	20.4	10.4	8.6	9.8	102,694	3.4	1,933	7,364
Ogdensburg City	33.7	67.3	8.0	19.0	14.6	19.0	11.5	11.4	16.5	12,991	3.1	1,438	125
Massena Village	28.6	62.9	7.9	22.3	15.9	22.2	13.1	9.4	9.2	13,948	3.2	43	51

Source: Business Fact Book, Part 1 and 2, New York State Department of Commerce

Table B-23 - Labor Force Characteristics in Project Area

	Number Employed	Manufacturing			Wholesale Trade	Retail Trade	Agriculture	Mining	Construction	Business, Repair Services	Personal Services
		Total	Durable Goods	Non-Durable Goods							
New York State	7,124,001	24.2	12.9	11.3	4.4	15.1	1.3	0.2	4.8	4.1	4.0
Northern Area*	122,557	20.2	10.2	10.0	2.2	16.1	7.2	1.7	6.7	1.6	5.3
Jefferson County	31,753	23.4	14.1	9.4	2.5	17.4	6.6	0.3	6.1	1.8	5.0
Watertown City	11,727	22.9	16.8	6.1	3.1	19.1	0.3	0.1	4.6	1.7	4.7
St. Lawrence County	35,790	20.4	13.8	6.7	1.9	15.2	7.3	3.0	5.9	1.3	4.4
Ogdensburg City	4,747	18.5	8.4	10.1	3.9	17.3	0.8	0.3	5.5	1.2	4.9
Massena Village	4,729	38.0	35.4	2.6	1.6	17.5	0.9	0.2	2.2	1.6	4.5

*Includes Clinton, Essex, Franklin, Jefferson, Lewis and St. Lawrence Counties.

Source: Business Fact Book, Part 1 and 2, New York State Department of Commerce.

Table B-23 - Labor Force Characteristics in Project Area (Cont'd)

POPULATION 16 YEARS OLD AND OVER CIVILIAN LABOR FORCE									
			Female			Employed Workers Percentage of Total			
Number	Percent in Labor Force	Total	Number	Percent	Number	Private Wages Salary Workers	Government Workers	Self-Employed Workers	Unpaid Family Workers
13,029,286	57.3	7,421,579	2,878,027	38.8	7,124,001	76.7	16.8	6.2	0.3
252,712	53.3	130,549	47,801	36.6	122,557	66.4	22.1	10.6	1.0
59,972	56.8	33,582	12,674	37.7	31,753	70.2	17.6	11.1	1.1
21,835	56.9	12,287	5,241	42.7	11,727	76.0	17.2	6.3	0.5
76,462	50.0	37,975	13,093	34.5	35,790	66.0	23.0	10.2	0.8
10,320	49.4	5,063	2,202	43.5	4,747	63.3	30.1	6.2	0.5
9,487	53.3	4,983	1,741	34.9	4,729	75.8	18.0	6.0	0.2

Table B-24 - Distribution of Employment by Industry

		OCCUPATION GROUPS - PERCENTAGE OF EMPLOYED									
	Number Employed	Professional, Technical	Farmers Farm Managers	Managers Administrators (except farm)	Clerical Workers	Sales Workers	Craftsmen, Foremen	Operatives	Service Workers: Private Household	Service Workers: Other	Laborers (including Farm Foremen)
New York State	7,124,001	16.7	0.6	8.5	22.4	7.5	12.2	15.1	1.1	11.9	4.0
Northern Area*	122,557	14.2	4.3	7.4	14.2	5.7	13.9	17.0	1.9	14.4	6.9
Jefferson County	31,753	13.5	4.3	7.8	15.4	6.7	14.7	17.5	2.2	11.9	5.9
Watertown City	11,727	15.8	0.1	8.5	20.5	7.5	13.3	15.3	1.9	13.6	3.5
St. Lawrence County	35,790	15.3	4.7	6.8	13.9	5.2	13.6	17.1	1.5	15.5	6.3
Ogdensburg City	4,747	13.0	0.1	7.7	12.9	6.5	14.7	15.5	2.0	23.6	3.9
Massena Village	4,729	16.0	0.4	7.7	17.7	7.2	16.8	17.9	1.2	11.6	3.5

*Includes Clinton, Essex, Franklin, Jefferson, Lewis, and St. Lawrence Counties.

Source: Business Fact Book, Part 1 and 2, New York State Department of Commerce.

Table B-24 - Distribution of Employment by Industry (Cont'd)

Professional Related Service	Entertainment Recreation	Finance Insurance Real Estate	Transportation, Communications Total	Transportation	Communications	Utilities	Public Administration
19.8	1.1	7.5	8.1	4.5	1.8	1.8	5.5
23.9	0.7	3.0	5.3	2.6	1.1	1.6	6.0
19.2	0.6	4.3	6.3	3.4	1.3	1.6	6.5
22.0	0.8	5.9	7.7	3.6	1.9	2.2	7.1
28.7	0.4	2.5	5.1	2.2	0.9	2.0	3.8
33.8	0.6	3.6	3.7	1.4	0.9	1.4	5.8
18.6	0.3	3.4	7.7	3.6	1.2	2.8	3.4

Table B-25 - Distribution of Family Income

	Income of Families										
	Median Income, Families and Unrelated Individuals	Median Income	Number of Families	Income Groups - Percentage of Families							
				Under $3,000	$3,000-4,900	$5,000-6,999	$7,000-9,999	$10,000-14,999	$15,000-24,999	$25,000-49,999	$50,000 or more
	$	$									
New York State	8,510	10,617	4,584,616	8.2	8.3	10.6	18.9	27.5	19.7	5.6	1.2
Northern Area*	6,322	8,412	86,534	10.1	11.7	16.0	24.9	24.3	10.6	2.1	0.3
Jefferson County	7,045	8,696	21,707	9.3	11.3	15.1	24.7	26.5	10.8	1.7	0.4
Watertown City	6,776	8,978	7,493	8.4	10.0	15.2	23.0	28.1	12.9	1.8	0.7
St. Lawrence County	5,754	8,667	24,765	9.7	10.6	14.7	25.6	25.6	11.0	2.5	0.3
Ogdensburg City	7,093	8,986	3,148	7.9	10.3	15.0	23.4	32.1	10.3	0.9	0.2
Massena Village	8,253	9,360	3,550	6.7	9.8	11.9	26.9	27.8	15.2	1.2	0.5

*Includes Clinton, Essex, Franklin, Jefferson, Lewis, and St. Lawrence Counties.

Source: Business Fact Book, *Part 1 and 2* New York State Department of Commerce.

Table B-26 - Distribution by Income Group

	Persons 14 Years Old and Over With Income			Income Groups - Percentage of Number With Income								
	Total Number	Number	Median Income	Loss or Under $1,000	$1,000-1,999	$2,000-3,999	$4,000-5,999	$6,000-7,999	$8,000-9,999	$10,000-14,999	$15,000-24,999	$25,000 or More
			$									
New York State	13,695,674	10,424,817	4,920	14.6	12.5	16.3	15.0	13.3	9.7	11.8	4.7	2.1
Northern Area (1)	268,704	197,504	3,593	20.2	15.1	18.2	14.8	12.4	8.6	7.7	2.2	0.7
Jefferson County	63,701	48,855	3,747	17.7	15.1	19.6	15.4	12.7	8.6	8.3	2.0	0.6
Watertown City	22,980	18,221	3,764	16.6	16.5	19.1	15.6	12.5	8.3	8.2	2.4	0.7
St. Lawrence County	81,227	57,946	3,442	22.1	15.6	16.7	13.2	11.7	8.8	8.7	2.5	0.8
Ogdensburg City	10,897	7,985	3,693	18.0	16.3	18.7	18.6	13.2	6.8	7.0	1.1	0.3
Massena Village	10,105	6,909	5,104	15.2	12.3	16.2	12.0	13.6	13.0	13.8	3.2	0.7

(1) Includes Clinton, Essex, Franklin, Jefferson, Lewis, and St. Lawrence Counties.
Source: Business Fact Book, Part 1 and 2, New York State Department of Commerce.

Table B-27 - Comparative Statement of Traffic
(Vessel Traffic in Tons)

Ogdensburg Harbor, NY		Oswego Harbor, NY	
1949	474,257	1949	2,315,599
1950	723,245	1950	2,284,498
1951	774,096	1951	3,022,546
1952	679,267	1952	2,239,689
1953	574,574	1953	2,199,030
1954	523,257	1954	1,983,596
1955	525,353	1955	2,801,358
1956	652,083	1956	2,855,016
1957	539,645	1957	2,576,131
1958	476,936	1958	1,868,755
1959	425,147	1959	819,274
1960	394,309	1960	984,637
1961	333,091	1961	666,970
1962	327,560	1962	1,026,101
1963	345,560	1963	569,694
1964	347,060	1964	246,358
1965	358,200	1965	252,566
1966	541,197	1966	449,154
1967	300,156	1967	342,218
1968	299,931	1968	380,033
1969	287,217	1969	424,312
1970	265,558	1970	473,553
1971	237,557	1971	491,196
1972	215,542	1972	779,417
1973	280,039	1973	930,877
1974	214,944	1974	902,343
1975	235,448	1975	847,987
1976	221,402	1976	1,014,135

Source: Waterborne Commerce of the United States, Part III, 1949-1976

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APPENDIX C

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APPENDIX C

CAPACITY

SYSTEMS APPROACH

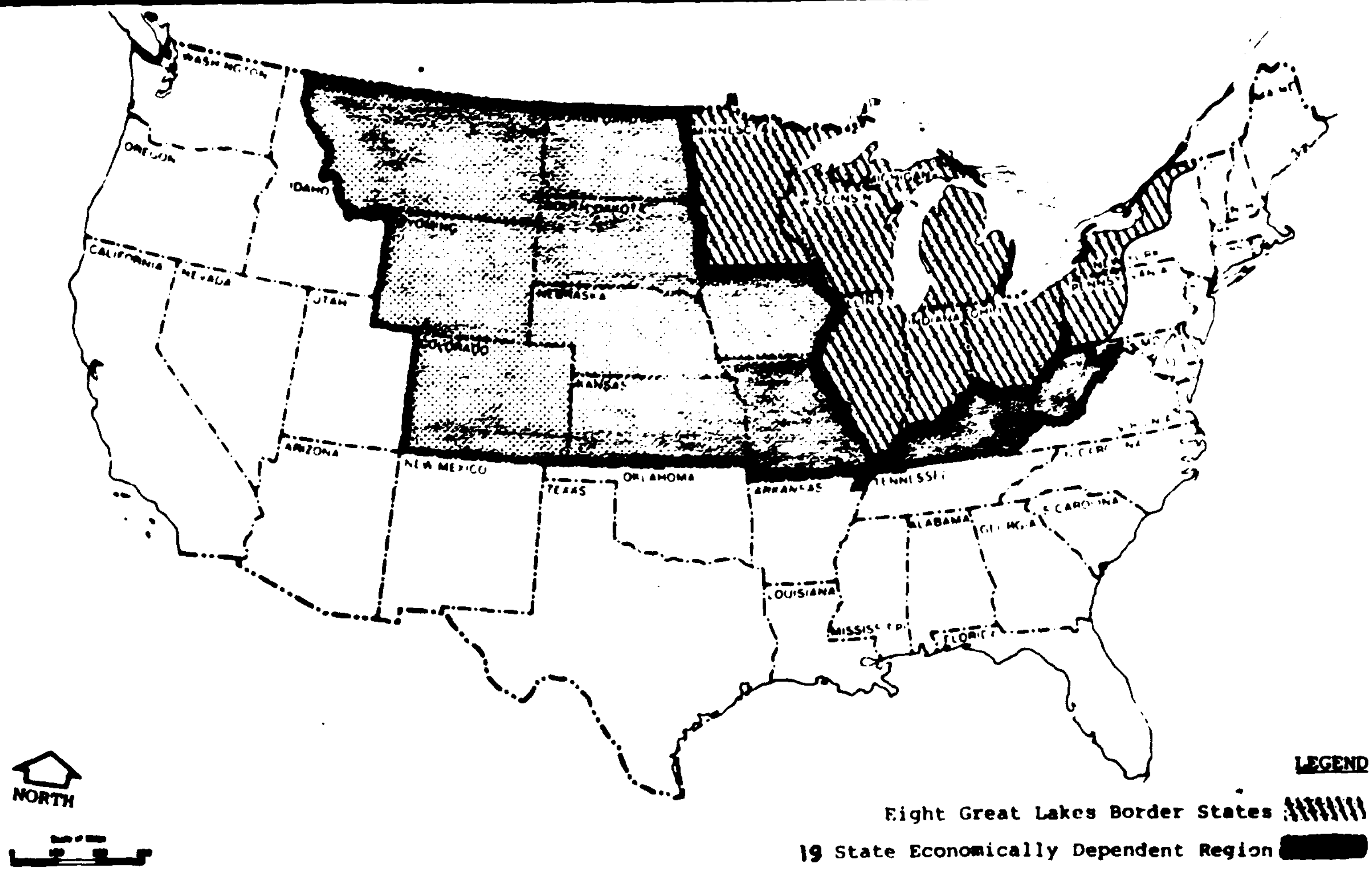
The geographic region commercially and economically tributary to the Great Lakes Region includes eight states bordering the lakes (Minnesota, Wisconsin, Illinois, Indiana, Michigan, Ohio, Pennsylvania, and New York) and 11 contiguous states (Montana, Wyoming, Colorado, North Dakota, South Dakota, Nebraska, Kansas, Iowa, Missouri, Kentucky, and West Virginia). The general area within the United States adjacent to and indirectly served by the GL/SLS is shown in Figure C-1. The provinces of Ontario and Quebec form the northern shoreline of the Great Lakes and St. Lawrence River. Harbors on the Great Lakes are served by commercial transportation networks (railroads, highways, airways, and pipelines) which link the area with other parts of the U.S. and Canada and compete with the waterborne mode for the movement of bulk and general cargoes.

Although alternate modes of transport are competing for the same types of cargo, the various modes move freight to and from the Great Lakes ports and inland origins and destinations. A summary of the ton-miles carried by the Great Lakes is presented in Table C-1. The GL/SLS has averaged more than 100 billion ton-miles annually for this recent period.

Table C-1 - Ton-Mileage of United States Freight Carried on the Great Lakes (Data in 000's)

Year	Total	Foreign		Domestic
		Overseas	Canadian	
1970	114,475,222	10,503,475	23,841,808	80,129,939
1971	105,027,016	14,381,139	19,581,163	71,064,714
1972	108,938,909	15,238,145	19,848,914	73,851,850
1973	125,914,126	15,173,843	26,226,187	84,514,096
1974	107,450,897	8,428,563	19,371,430	79,650,904
1975	99,171,007	9,287,763	20,656,992	69,226,252
1976	105,647,789	10,658,872	23,689,027	71,299,890
1977	90,694,592	14,670,230	23,064,049	52,960,313

Source: Waterborne Commerce of the United States, Part III, U.S. Army Corps of Engineers



GREAT LAKES ECONOMIC REGION

FIGURE C-1

HISTORICAL TRAFFIC

Traffic volume has fluctuated with national and international market conditions of supply and demand for bulk and general cargo commodities. Although there have been short-term increases and decreases in the level of traffic moving over the St. Lawrence River and Welland Canal, the long-term trend has been increasing during the 20 years since project completion. About one-third of the total U.S. traffic movements through the Welland consist of U.S. - Canada movements of coal from Lake Erie ports to Canadian Lake Ontario power plants and grain moving from lake-head terminals (Duluth-Superior and Thunder Bay) to Canadian ports on Lake Ontario and lower St. Lawrence River ports for domestic consumption and export transshipment. Canadian to U.S. traffic is almost exclusively iron ore moving upbound from Canadian Labrador mines to steel producing regions along Lake Erie and Lake Michigan. Downbound exports of grain and upbound shipments of iron and steel products are largely responsible for growth in U.S. foreign traffic.

Most of the Canadian traffic is downbound movements of grains and other farm products. Other bulk commodities are: (1) iron ore, (2) salt, (3) chemicals, (4) fuel oil, and (5) miscellaneous bulk movements. Canadian traffic involving overseas origins and destinations presently plays a relatively small role in the Welland Canal traffic. Tables C-2 and C-3 summarize traffic movements along the St. Lawrence and Welland Canal sections, respectively while Table C-4 indicates the movements of traffic utilizing both sections.

PRESENT TRAFFIC AND SHORT-TERM TRENDS

Commodity groups transported on the Welland Canal and St. Lawrence River during the 1977 navigation season are summarized in Table C-5. Downbound shipments of grain and related agricultural products comprise the major movements at each sector although coal shipments from U. S. ports along Lake Erie through the Welland Canal comprised 33 percent (13.8 million tons) of all downbound shipments in 1977. Upbound traffic at the Seaway Locks and Welland Canal is heavily dominated by iron ore moving from Gulf of St. Lawrence loading points to U. S. steel producing centers on the south shores of Lake Erie and Lake Michigan. Large quantities of manufactured steel products and other miscellaneous finished goods destined for U. S. industrial centers throughout the Great Lakes comprise the major upbound traffic movements at the Seaway Locks and Welland Canal.

Table C-2 - Traffic Summary - Montreal-Lake Ontario Section

	Transits	Cargo/Tons	Type of Cargo			Origin and Destination of Traffic Flows							
						Domestic Traffic Flows				Foreign Traffic Flows			
			Bulk	General	Mixed	CAN/CAN	CAN/USA	USA/CAN	USA/USA	CAN-IMP	CAN-EXP	USA-IMP	USA-EXP
1961	6,892	23,417,720	19,707,171	860,319	2,805,230	9,042,332	4,080,421	2,757,516	107,333	717,189	1,244,835	991,245	4,476,849
1962	6,351	25,593,600	21,264,622	995,721	3,333,257	7,767,197	6,407,255	3,049,401	128,977	906,935	1,166,445	1,164,040	5,003,350
1963	6,285	30,942,890	26,143,543	1,209,840	3,589,507	9,708,377	8,563,878	4,657,271	127,570	993,918	1,333,790	1,515,805	4,042,281
1964	6,779	39,309,029	33,447,904	1,735,247	4,125,878	12,156,369	12,902,296	3,931,399	129,859	1,187,509	1,341,843	2,050,688	5,609,065
1965	7,330	43,382,864	35,430,040	3,865,681	4,087,143	12,802,058	12,697,147	4,273,192	128,411	1,878,814	1,532,368	3,853,482	6,217,392
1966	7,341	49,249,358	41,379,064	3,880,624	3,989,670	16,995,340	14,442,794	3,511,792	123,161	1,757,026	1,371,955	4,098,495	6,948,795
1967	6,921	44,028,638	35,613,192	4,360,421	4,055,025	13,268,576	14,634,867	2,472,571	131,216	1,780,639	1,805,097	4,317,822	5,617,850
1968	6,576	47,953,850	38,397,761	6,362,350	3,193,739	12,851,765	15,894,369	3,828,620	139,783	1,553,036	1,194,281	6,413,322	6,078,674
1969	6,392	41,014,040	32,765,705	5,646,551	2,601,784	10,573,085	10,727,107	4,871,771	118,476	1,808,628	1,199,411	4,782,315	6,933,247
1970	6,277	51,143,168	43,516,201	5,473,348	2,203,619	16,950,669	13,044,706	6,718,872	122,213	1,461,361	1,689,406	4,549,530	6,606,411
1971	6,059	52,948,322	43,291,094	7,173,567	2,483,661	18,154,781	11,578,551	3,858,838	94,525	1,414,649	2,041,849	6,935,500	8,869,629
1972	5,936	53,579,940	44,762,401	6,613,132	2,204,407	17,949,349	11,688,525	3,395,269	108,818	2,120,115	2,396,853	6,263,990	9,657,021
1973	6,125	57,634,137	50,984,567	5,019,544	1,630,026	17,495,976	15,369,401	6,731,155	132,009	1,516,794	1,522,903	5,023,907	9,841,992
1974	4,260	44,146,444	39,243,491	3,972,588	930,365	14,741,346	12,892,691	4,778,691	110,354	908,594	1,606,265	4,353,001	4,755,502
1975	4,704	48,010,403	43,769,644	2,992,200	1,248,559	16,650,443	13,364,716	5,260,551	101,220	1,013,347	1,627,309	3,252,451	6,740,366
1976	4,859	54,397,345	49,330,058	3,940,238	1,127,049	16,096,730	18,838,723	4,690,052	112,379	1,099,774	1,971,087	4,672,008	6,916,592

Table C-3 - Traffic Summary - Welland Canal Section

			Type of Cargo			Origin and Destination of Traffic Flows							
						Domestic Traffic Flows				Foreign Traffic Flows			
	Transits	Cargo/Tons	Bulk	General	Mixed	CAN/CAN	CAN/USA	USA/CAN	USA/USA	CAN-IMP	CAN-EXP	USA-IMP	USA-EXP
1959	7,966	27,156,291	24,547,622	1,119,704	1,488,965	6,430,585	6,937,947	8,477,112	987,602	64,093	509,471	999,505	2,749,976
1960	7,536	29,249,689	26,452,470	1,117,961	1,679,258	6,686,031	5,811,841	9,963,889	1,042,859	110,787	854,432	886,284	3,895,566
1961	7,747	31,454,803	28,248,266	989,535	2,217,002	8,987,687	5,021,632	10,218,740	962,137	67,217	763,267	975,463	4,458,660
1962	7,615	35,406,305	31,831,127	1,148,537	2,426,641	7,757,194	7,962,746	11,781,269	1,051,147	57,209	654,901	1,156,237	4,985,002
1963	7,597	41,303,479	37,420,623	1,265,340	2,617,516	9,449,010	10,031,244	14,438,225	988,003	107,054	775,848	1,487,735	4,026,360
1964	8,304	51,388,512	46,582,740	1,712,528	3,093,244	12,184,586	14,793,429	14,935,339	959,081	182,818	739,938	2,001,391	5,591,930
1965	8,384	53,420,179	46,817,501	3,611,987	2,990,691	11,199,738	14,341,566	15,753,185	897,763	175,784	1,053,545	3,787,402	6,211,196
1966	8,714	59,271,666	52,654,246	3,827,369	2,790,051	14,271,207	16,492,883	15,453,671	984,720	172,842	910,939	4,042,915	6,942,489
1967	7,437	52,809,414	45,628,664	4,200,599	2,980,151	9,998,446	16,289,909	14,288,840	999,622	120,820	1,227,724	4,277,652	5,606,401
1968	7,204	58,074,714	49,701,206	6,206,013	2,167,495	9,428,783	17,765,127	16,611,376	907,668	175,420	741,014	6,366,178	6,079,148
1969	6,863	53,532,336	46,450,138	5,312,431	1,769,767	9,558,004	12,376,102	18,175,049	852,883	258,342	610,953	4,776,043	6,924,560
1970	7,111	62,868,908	56,111,317	5,182,350	1,575,241	15,651,324	14,626,247	19,375,863	874,140	186,424	1,022,474	4,530,319	6,602,117
1971	6,854	62,909,293	54,065,379	6,905,467	1,938,447	16,889,796	12,857,018	14,763,526	745,464	302,320	1,566,892	6,920,424	8,863,853
1972	6,768	64,095,379	56,531,461	6,021,248	1,542,670	17,312,097	12,823,092	15,428,465	665,888	279,911	1,697,448	6,233,883	9,654,595
1973	6,815	67,194,684	61,337,778	4,569,055	1,287,851	15,879,301	16,807,744	17,620,970	570,551	290,441	1,173,413	5,013,450	9,838,816
1974	5,171	52,359,962	48,133,378	3,539,482	687,102	13,804,917	14,363,184	13,288,914	411,004	140,680	1,271,095	4,328,645	4,751,523
1975	6,041	59,849,026	56,323,722	2,687,466	837,838	16,909,355	14,467,897	16,873,564	371,796	167,694	1,138,206	3,181,260	6,739,254
1976	5,892	64,340,198	60,114,314	3,389,466	836,418	15,822,086	19,919,923	15,110,338	377,235	201,652	1,339,073	4,653,299	6,916,592

Table C-4 - Traffic Summary - Montreal-Lake Ontario Section and Welland Canal Section[1/]

			Type of Cargo			Origin and Destination of Traffic Flows							
						Domestic Traffic Flows				Foreign Traffic Flows			
	Transits	Cargo/Tons	Bulk	General	Mixed	CAN/CAN	CAN/USA	USA/CAN	USA/USA	CAN-IMP	CAN-EXP	USA-IMP	USA-EXP
1960	10,276	33,707,410	30,050,394	1,316,044	2,340,972	8,972,341	6,007,502	10,248,880	1,050,347	819,974	1,002,344	1,293,091	4,312,931
1961	10,223	36,207,448	32,280,786	1,067,599	2,859,063	12,142,456	5,209,156	10,451,591	1,005,321	315,835	936,143	1,399,798	4,747,148
1962	9,631	39,645,523	35,131,102	1,177,136	3,337,285	10,341,172	7,944,604	11,983,818	1,090,050	495,882	697,427	1,630,977	5,461,593
1963	9,521	45,570,207	40,634,299	1,334,959	3,600,949	12,307,623	9,788,047	14,563,656	1,010,490	565,139	843,987	1,954,494	4,536,771
1964	10,036	55,779,142	49,589,300	2,033,438	4,156,404	16,266,289	13,268,337	14,928,590	958,436	687,583	770,246	2,603,491	6,296,170
1965	10,558	59,974,988	51,856,524	3,992,638	4,125,826	16,207,717	13,339,370	15,968,675	920,848	1,028,528	1,059,775	4,738,344	6,711,731
1966	10,615	66,940,437	58,906,382	4,028,694	4,005,361	21,408,617	14,802,376	15,527,133	1,038,320	1,031,081	950,222	4,809,632	7,373,056
1967	9,603	60,923,456	52,396,061	4,465,970	4,061,425	17,135,898	14,807,388	14,396,743	1,058,463	1,071,680	1,300,261	5,042,655	6,110,368
1968	9,185	66,401,570	56,712,729	6,472,598	3,216,243	16,026,474	17,376,243	16,815,793	923,424	995,876	749,330	6,993,593	6,520,837
1969	9,094	60,815,992	52,424,902	5,780,040	2,611,050	14,882,242	12,368,456	17,961,374	858,519	1,023,764	740,254	5,567,196	7,414,187
1970	9,115	71,113,672	63,272,224	5,618,455	2,222,990	22,326,708	14,239,962	19,321,036	933,821	813,677	1,149,468	5,182,628	7,146,372
1971	8,428	70,783,202	60,870,263	7,367,922	2,545,017	23,584,451	12,276,241	14,859,968	793,907	716,445	1,580,322	7,640,406	9,331,462
1972	8,288	72,473,115	63,456,670	6,795,304	1,318,759	23,658,557	11,885,605	15,773,660	688,317	1,073,329	1,832,501	7,333,111	10,228,035
1973	8,284	75,169,048	68,512,007	5,027,015	1,630,026	22,743,495	16,154,187	17,765,486	526,609	890,908	1,316,777	5,691,504	10,080,082
1974	6,349	60,136,567	55,232,044	3,974,158	930,365	20,716,219	13,835,615	13,306,364	502,442	590,283	1,418,471	4,747,141	5,020,032
1975	7,099	66,895,989	62,636,903	3,010,527	1,248,559	22,351,012	13,549,266	16,904,895	426,357	560,543	1,327,679	3,727,784	7,048,453
1976	6,932	71,843,204	66,760,499	3,950,318	1,132,387	22,598,925	18,919,292	15,184,381	452,399	543,736	1,564,754	5,247,623	7,332,094

1/ Represents that traffic which utilizes both sections.

Table C-5 - Traffic by Classification and Direction - 1977

Commodity Group	Millions of Tons							
	Welland Canal				St. Lawrence River			
	Upbound		Downbound		Upbound		Downbound	
	Tons	%	Tons	%	Tons	%	Tons	%
Agricultural Products	.055	(1)	25.255	60.7	.042	(1)	24.005	84.8
Animal Products	.033	(1)	.220	(1)	.004	(1)	.246	(1)
Mine Products	22.115	73.3	13.775	33.1	25.292	72.2	2.302	8.1
Forest Products	.002	(1)	.05	(1)	.033	(1)	.075	(1)
Manufactured Products	7.814	26.0	2.182	5.0	9.621	27.4	1.673	5.9
Package Freight	.175	(1)	.083	(1)	.019	(1)	.016	(1)
Total Traffic	30.164		41.565		35.011		28.3	

(1) Less than one-half percent.

Table C-6 - St. Lawrence Seaway
(Welland Canal Section)

Year	% of Total Transit by Length of Vessel								% of Total Cargo Tons Carried by Length of Vessel							
	Less 100 Ft.	100-199	200-299	300-399	400-499	500-599	600-699	Over 700 Ft.	Less 100 Ft.	100-199	200-299	300-399	400-499	500-599	600-699	Over 700 Ft.
1960	2.1	2.5	40.1	14.9	18.3	11.5	8.1	2.5	(0)	0.2	17.5	9.9	18.9	20.2	23.3	9.9
1961	1.5	2.2	33.3	14.8	23.7	12.3	7.5	4.7	(0)	0.1	14.0	9.6	21.7	18.1	19.6	16.9
1962	1.6	3.1	27.7	15.0	25.3	12.3	9.2	5.8	0.0	0.2	10.6	8.5	21.2	16.8	21.6	21.1
1963	4.3	3.1	21.7	14.2	24.3	12.8	10.1	9.5	0.4	0.1	7.6	6.7	17.5	15.6	23.4	28.7
1964	2.0	2.9	19.0	13.8	24.6	17.3	12.0	8.4	0.0	0.1	6.0	5.9	16.0	19.9	24.8	27.3
1965	2.6	3.1	16.7	15.3	23.0	19.0	10.8	9.6	(0)	0.1	5.3	6.4	15.4	22.6	21.8	28.5
1966	2.4	2.9	14.4	15.3	21.7	20.9	11.4	11.0	(0)	0.1	4.5	5.7	13.2	23.8	21.2	31.5
1967	1.8	3.3	13.7	17.0	19.1	18.6	11.2	15.3	0.0	0.2	4.0	6.1	10.9	20.7	19.7	38.4
1968	1.9	3.2	13.4	13.1	17.9	19.1	12.3	19.0	0.0	0.1	3.4	4.7	9.6	21.2	19.3	41.7
1969	1.9	3.6	13.4	14.0	18.3	17.6	9.0	22.1	(0)	0.1	3.1	5.2	9.3	19.7	14.7	48.0
1970	1.8	2.4	11.3	13.8	16.8	18.6	10.9	24.4	0.0	(0)	2.5	4.6	7.8	19.0	16.6	49.5
1971	1.6	2.4	7.7	13.6	17.5	22.0	12.7	22.4	0.0	(0)	1.6	4.5	9.3	22.1	17.7	44.9
1972	1.7	1.9	8.0	12.2	16.0	23.4	13.4	23.4	0.0	(0)	1.6	4.1	8.2	23.3	18.1	44.7
1973	2.5	1.8	7.6	14.0	14.5	20.8	14.7	24.0	0.0	(0)	1.4	5.1	8.0	19.8	19.9	45.8
1974	2.6	2.9	6.3	12.7	12.4	19.8	17.1	26.2	(0)	0.2	1.2	4.9	7.8	20.6	21.0	44.4
1975	3.4	2.3	5.3	11.1	12.8	20.7	16.4	28.0	0.1	0.1	1.0	4.1	8.0	21.3	19.6	45.7
1976	2.9	1.9	3.1	11.5	11.2	22.0	19.4	28.0	0.0	(0)	0.4	3.3	4.3	19.6	23.9	48.5
1977	2.3	1.8	5.1	11.7	10.7	27.5	16.7	24.1	(0)	(0)	0.7	3.4	4.5	27.6	22.1	41.5

(0) Less than .05 percent.

Table C-7 - St. Lawrence Seaway
(Montreal - Lake Ontario Section)

Year	% of Total Transit by Length of Vessel								% of Total Cargo Tons Carried by Length of Vessel							
	Less 100 Ft.	100-199	200-299	300-399	400-499	500-599	600-699	Over 700 Ft.	Less 100 Ft.	100-199	200-299	300-399	400-499	500-599	600-699	Over 700 Ft.
1960	9.0	5.7	44.1	14.5	14.1	8.1	3.0	1.5	(0)	0.3	25.8	14.1	20.8	19.7	12.0	7.3
1961	8.4	2.8	38.1	17.2	18.7	8.3	4.0	2.5	(0)	0.2	19.6	14.5	22.7	16.2	14.2	12.6
1962	6.6	2.5	31.1	19.2	21.7	9.9	5.0	3.9	(0)	0.1	14.0	13.7	23.6	17.1	15.2	16.3
1963	7.0	2.8	24.9	18.7	21.9	10.8	7.7	6.2	(0)	0.1	9.4	10.8	18.8	15.3	22.2	23.4
1964	5.3	3.3	20.9	18.2	23.2	13.4	9.3	6.3	(0)	0.1	6.5	8.7	17.4	17.8	23.6	25.9
1965	8.2	2.9	18.0	19.3	21.5	15.0	7.8	7.3	(0)	0.1	5.5	9.2	17.2	21.9	19.8	26.3
1966	3.7	3.9	16.0	19.6	20.9	16.7	10.2	9.1	(0)	0.1	4.5	7.7	14.6	22.3	21.3	29.5
1967	6.0	4.4	13.0	20.2	18.9	15.8	11.1	10.6	(0)	0.2	4.0	8.4	12.8	20.7	21.4	32.5
1968	3.7	5.8	13.4	16.9	18.0	17.0	11.5	13.8	0.0	0.2	3.3	6.8	11.4	21.8	20.8	35.7
1969	7.5	4.9	14.2	18.6	19.3	16.4	7.2	11.8	0.0	0.2	3.9	8.2	12.4	23.1	15.6	36.6
1970	7.1	3.1	13.2	18.6	18.1	17.3	8.5	14.2	(0)	0.1	3.3	7.1	10.2	20.6	16.2	42.6
1971	2.2	3.1	10.9	18.6	19.6	21.4	10.1	14.1	0.0	0.1	2.1	6.4	11.5	24.1	17.4	38.5
1972	1.6	3.5	11.5	16.1	19.3	23.8	11.0	13.1	0.0	0.1	2.3	5.7	11.3	26.2	18.7	35.8
1973	2.7	3.2	11.5	17.1	16.5	21.4	13.4	14.1	0.0	(0)	2.2	6.5	10.2	21.9	21.3	37.9
1974	3.8	3.2	8.4	16.2	13.7	21.7	15.9	17.1	(0)	(0)	1.1	5.5	7.2	20.7	24.4	41.1
1975	3.0	3.5	4.9	14.5	16.9	21.7	17.2	18.3	(0)	0.1	0.6	4.6	7.8	19.9	24.9	42.2
1976	2.4	3.2	3.3	12.7	16.0	21.7	19.4	21.4	(0)	(0)	0.4	3.8	6.7	20.4	26.3	42.4
1977	2.4	2.8	4.1	12.2	15.4	27.0	16.9	19.1	(0)	(0)	0.5	3.8	7.0	28.7	23.9	36.1

(0) Less than .05 percent.
SOURCE: Traffic Report of the St. Lawrence Seaway, 1960-1977; Prepared by the St. Lawrence Seaway Authority and the St. Lawrence Seaway Development Corp.

Characteristics of the fleet transiting the Welland Canal and St. Lawrence River has changed over time. Larger vessels comprise more of the total annual transits and transport a greater than proportional share of total cargo moving through each of these subsections. A summary of the long-term trends are shown in Tables C-6 and C-7.

Each origin/destination/commodity movement generates a potential return movement of cargo. In some instances, there is traffic available for the return trip while in other places within the GL/SLS, vessels return in ballast. For example, shiploads of grain downbound from the head of the lakes to Montreal can take advantage of the iron ore moving to U. S. steel producing centers on Lake Erie. However, complimentary traffic movements do not always exist within the system. Downbound vessels moving coal through the Welland Canal to Hamilton and Toronto, Ontario do not have much potential for a backhaul cargo movement on the upbound trip. This results in a high level of ballasted (empty) transits at the Welland Canal as a percent of total transits.

The net effect of this unbalanced traffic flow is a large number of wasted transits which lowers the potential maximum tonnage throughput. A similar situation also exists, but to a lesser extent, at the Soo Locks and the St. Lawrence River. An historical summary of ballasted transits are shown in Tables C-8 and C-9.

TRAFFIC FORECAST METHODOLOGY

Future traffic flows for the GL/SLS are developed using the GL/SLS Traffic Forecast Study report published in February 1976 which was developed by A. T. Kearney Management Consultants. The result of this analysis was the development of a computer systems model which estimates potential traffic within/to/from the GL/SLS hinterland and U.S., Canadian, and foreign world trade areas. This potential commodity flow is then allocated to the Great Lakes, or best alternate route after consideration of institutional factors, perceived levels of service, and prevailing freight rates. An outline of the Great Lakes Route Split approach is summarized below.

a. Develop 60-year forecasts of United States and Canadian traffic flows which are potential to the GL/SLS.

b. Survey shippers and other shipping interests to determine their sensitivity to various service factors as they relate to determination of transport routings which do or could potentially move via the GL/SLS. Quantify their responses in matrix form to reflect the amount of additional traffic which would be rerouted from existing routes to the GL/SLS if various improvements altered present service characteristics.

Table C-8 - Distribution of Ballast Traffic
(Welland Canal)

Year	Total Transits	Upbound Transits		Downbound Transits	
		Loaded	Ballast	Loaded	Ballast
1977	6,162	2,026	1,054	2,614	468
1976	5,892	1,736	1,192	2,513	451
1975	6,041	1,453	1,557	2,606	425
1974	5,171	1,529	1,051	2,088	503
1973	6,815	1,962	1,449	2,856	548
1972	6,768	1,968	1,421	2,914	465
1971	6,854	2,052	1,367	2,959	476
1970	7,111	2,065	1,485	3,070	490
1969	6,863	2,102	1,324	2,835	602
1968	7,204	2,554	1,027	2,785	838

Table C-9 - Distribution of Ballast Traffic
(Montreal - Lake Ontario Section)

Year	Total Transits	Upbound Transits		Downbound Transits	
		Loaded	Ballast	Loaded	Ballast
1977	5,185	2,233	361	1,952	639
1976	4,859	1,898	528	1,893	540
1975	4,704	1,635	718	1,873	478
1974	4,260	1,709	431	1,537	583
1973	6,125	2,326	738	2,207	854
1972	5,936	2,408	561	2,168	799
1971	6,071	2,532	491	2,153	895
1970	6,277	2,566	553	2,221	937
1969	6,392	2,538	660	1,954	1,240
1968	6,576	2,898	372	1,917	1,389

c. Develop a rate base which is representative of the commodities moving between origin and destinations as of a base year. This information consists of the Great Lakes freight rate and the best alternate freight rate for movements of various commodity groups between origins and destinations observed as of the base year (1972).

d. Estimate the share of the Great Lakes traffic based upon institutional factors, rates, and service factors of the existing system. The service component is comprised of two basic elements: institutional constraints and service factors.

Institutional constraints are factors which tend to predetermine routes for shippers. Examples of these types of constraints include shore-side facilities and material-handling capabilities, fleet ownership, supply contracts, certain corporate policies and regulatory considerations. The effect of the application of these constraints on a given origin/destination/commodity flow is to reserve a portion of the total flow for that mode/route which is favored by the constraint.

Service-related factors often predispose shippers to route commodities in a given manner. Service factors are in many cases intrinsic to a given route, variable in the short-term and controlled directly by organizations external to the shipper. Examples of service factors include availability of service, transit time, sailing frequency, schedule reliability, shipping infrastructure and transloading efficiency. The extent to which shippers are sensitive to service factors varies by the specified commodity group. Within a commodity group, shippers react in response to a unique set of circumstances such as market position, economic conditions, competitive posture of the shipper, etc.

e. Provide capability for future planning efforts in the form of service related route split switches. Route split service controls are service-related switches which permit analysis of traffic related effects of varying degrees of navigation season extension, service reliability, shipment time, and availability of containerized services. These service switches selectively affect the service reserve functions resulting in relatively higher (or lower) fractional allocations of the cost-sensitive traffic volume for which the GL/SLS can compete with the alternate route on the basis of rates.

For purposes of the model, shipper sensitivity to a given service improvement on a given origin/destination is measured by the increase in annual tonnage that could, from a service standpoint, be available to the GL/SLS as a result of that improvement. This potential tonnage increase would still have to be tested on the basis of rates to determine the extent to which the GL/SLS is economically competitive.

FUTURE TRAFFIC

Forecasts and future commodity flows of an unconstrained GL/SLS system, based upon the existing navigation facilities presently in the system, are summarized by decade and by commodity group in Table C-10. These projections represent the system traffic flow if no constraints develop at the three critical lock systems (St. Mary's River, Welland Canal, and the St. Lawrence River) or major connecting channels. Tables C-11 and C-12 summarize each traffic flow that comprises total future unconstrained traffic flows for the Welland Canal and St. Lawrence Seaway respectively.

Traffic forecasts in Tables C-10, C-11, and C-12 represent ideal conditions which do not presently exist within the GL/SLS System. Constraints to future traffic movements do exist at the major locks (Soo Locks, Welland Canal, and St. Lawrence River). Locks of a particular size (length, width, and depth of water over the lock sills) constrain the size of vessels which may use the system while lock cycle and vessel approach and exit times limit the number of lockages available to commercial vessels for a specified length of navigation season.

WATERWAY SIMULATION AND CAPACITY STUDIES

Pennsylvania Transportation and Traffic Safety Center, Pennsylvania State University.

Extensive research into waterway systems analysis has been conducted by the Pennsylvania Transportation and Traffic Safety Center (PTTSC) during the period 1965-1973. Initially, their efforts were focused upon the Inland Waterway System with the objective of increasing the efficiency of inland waterway operations through better utilization of existing system capacity. Their research results have been published as a major research report, supported by five technical memoranda. A brief summary of those volumes pertinent to deep draft commercial navigation on the Great Lakes is presented below since their studies provide an overview of the existing state of the art on waterways system analysis.

(1) Volume 1. NETSIM: A General Network Simulator. NETSIM is a computer simulation model written in the SIMSCIPT programming language. The purpose of this model is to provide a general simulation capability for any waterway network composed of links and nodes. Required inputs consist of fleet data, run and system-size parameters, and a description of the network configuration and system entities. PTTSC's developmental efforts had two objectives: First, to build a simulation model specifically designed to simulate the performance of a multiple-channel deep-draft canal in which each channel consists of a series of locks and reaches; and, Second, to formulate a methodology for assigning vessels between parallel canals. The model in its present version did not have the capability for total GL/SLS system simulation. This version of NETSIM was eventually used in the analysis of the Welland Canal and represented the first generation of computer simulation models that addressed deep draft navigation systems.

Table C-10 - Route Split Traffic Forecast Unconstrained - GL/SLS System
(Thousands of Tons)

	1980	1990	2000	2010	2020	2030	Annual Growth Rate 1980-2030
Corn	2,005	2,593	3,326	3,980	4,761	5,272	
Wheat	13,041	15,212	16,635	17,399	18,201	19,034	
Soybeans	245	285	330	518	710	849	
Barley & Rye	5,714	6,546	7,137	7,482	7,850	8,232	
Other Cash Grains	606	705	775	813	853	900	
Other Farm Produce	1,301	1,555	1,797	1,934	2,079	2,237	
Subtotal Grain and Other Farm Produce	22,912	26,896	30,000	32,126	34,474	36,524	0.9 Percent
Coal	49,085	67,528	81,052	97,596	107,988	119,359	1.8 Percent
Crude Petroleum	280	407	527	630	729	820	
Fuels	14,867	21,636	28,975	36,121	44,212	52,179	
Other Petroleum Products	990	1,348	1,801	2,304	2,924	3,549	
Subtotal Petroleum and Petroleum Products	16,137	23,391	31,303	39,055	47,865	56,548	2.5 Percent
Limestone	35,629	41,162	48,764	56,389	64,990	73,281	
Building Cement	7,241	9,774	13,213	17,080	22,060	26,922	
Salt	963	963	963	963	963	963	
Other Building Materials	8,796	10,203	11,970	13,984	16,327	18,561	
Other Mined Products	3,375	4,172	5,236	6,637	8,477	10,848	
Subtotal Mining and Non-Metallic Minerals	56,004	66,274	80,146	95,053	112,817	130,575	1.7 Percent
Iron Ore	100,330	125,116	150,634	180,341	211,240	248,129	
Other Ores	563	742	924	1,107	1,331	1,571	
Subtotal Metal Mining	100,893	125,858	151,558	181,448	212,571	249,700	1.8 Percent
Iron and Steel Scrap	2,611	3,046	3,593	4,218	4,959	5,729	
Standard Newspring Paper	605	806	1,082	1,382	1,764	2,152	
Coke, Petroleum Coke	1,550	2,001	2,640	3,333	4,213	5,090	
Pulp	442	534	642	747	874	999	
Subtotal Non-Gravity Flow Bulk Commodities	5,208	6,387	7,957	9,680	11,810	13,970	2.0 Percent
All Other Bulk	3,727	4,953	6,787	8,831	11,470	14,273	2.7 Percent
Subtotal All Bulk Commodities	253,966	321,287	388,803	463,789	538,995	620,949	1.8 Percent
Food and Kindred Products	109	150	206	290	414	607	
Chemicals	44	68	105	164	261	425	
Fabricated Metal Products	62	96	148	231	364	584	
All Other	75	107	152	221	329	496	
Subtotal Prime Container	290	421	611	906	1,368	2,112	4.1 Percent
Food and Kindred	977	1,424	2,087	3,087	4,612	6,992	
Chemicals	305	462	704	1,071	1,637	2,519	
Iron and Steel Products	5,562	7,973	11,479	16,605	24,161	35,393	
Machinery, Except Electrical	51	75	110	160	236	346	
Electrical Machinery & Equip.	8	12	18	27	40	58	
Motor Vehicles, Parts, Equip.	15	24	38	59	92	144	
All Other	136	190	271	391	578	877	
Subtotal Potentially Containerized	7,054	10,160	14,707	21,400	31,356	46,329	3.8 Percent
Chemicals	34	50	74	112	174	277	
Pig Iron	0	0	0	0	0	0	
All Other	15	19	23	29	37	46	
Subtotal Non-Container	49	69	97	141	211	323	3.8 Percent
Non Classified	41	61	93	140	220	359	4.4 Percent
Subtotal General Cargo	7,434	10,711	15,508	22,587	33,155	49,123	3.8 Percent
Total All Commodities	261,400	331,998	404,311	486,376	572,150	670,072	1.9 Percent

(1) Assumes 9-month navigation season on upper four lakes and 8-month season for Lake Ontario and St. Lawrence River. Traffic forecast and route split output based on computer summary dated 6/25/79.

Table C-11 - Projected Annual Tonnage - Welland Canal
Unconstrained Conditions
Navigation Season 15 April to 15 December (1)
(Thousands of Short Tons)

Commodity Group	1980	1990	2000	2010	2020	2030	Annual Rate of Growth 1980-2030 %
Iron Ore	18,430	21,501	24,975	26,787	31,061	35,902	1.3
Coal	11,325	13,605	15,220	17,020	17,820	18,910	1.0
Stone	3,243	4,314	6,094	7,294	8,693	10,366	2.4
Other Bulk	7,508	10,232	13,426	16,940	21,249	26,268	2.5
Grains	29,904	36,062	43,140	50,536	57,738	63,007	1.5
General Cargo	6,665	9,666	14,084	20,565	30,118	44,315	3.8
Total Traffic	77,075	95,380	116,939	139,142	166,679	198,768	1.9

(1) Assumes 9-month navigation season for upper four lakes and 8-month navigation season for Lake Ontario and St. Lawrence River.
SOURCE: Arctec Lock Capacity Report, April-1979

Table C-12 - Projected Annual Tonnage - St. Lawrence Seaway
Unconstrained Conditions
Navigation Season 15 April to 15 December (1)
(Thousands of Short Tons)

Commodity Group	1980	1990	2000	2010	2020	2030	Annual Rate of Growth 1980-2030 %
Iron Ore	15,432	18,775	22,772	24,719	29,584	34,944	1.6
Coal	520	620	720	820	820	820	0.9
Stone	394	479	565	677	749	827	1.5
Other Bulk	8,074	11,347	15,107	18,908	23,398	28,404	2.5
Grains	28,177	34,122	40,945	48,032	54,884	59,853	1.5
General Cargo	7,008	10,214	14,901	21,881	32,374	48,194	3.9
Total Traffic	59,605	75,537	95,032	115,037	141,809	173,042	2.1

(1) Assumes 9-month navigation season for upper four lakes and 8-month navigation season for Lake Ontario and St. Lawrence River.
SOURCE: North Central Division, Corps of Engineers. Traffic forecast for unconstrained conditions at all locks and channels.

(2) Volume 2. Lake Erie - Lake Ontario Navigation: A Simulation Study of Alternative Subsystems. This report applies the model described in volume one to the Lake Erie-Lake Ontario Navigation Subsystem and presents the findings and conclusions of a computer simulation study of the Welland Canal and proposed alternatives. The objective of this study was to establish the limits of service for alternative structural and nonstructural improvements in terms of delay and transit time. Waterborne transport demand through the year 2030 was considered in the analysis, demand being represented by two factors, traffic density, and fleet composition. The results of the study were portrayed as a series of transit time response curves for each configuration, plotted as a function of the transport demand. Forecasts of traffic and the fleet mix required to move this volume, by decade, were provided as input to the model in order to obtain an estimate of capacity for the existing Welland Canal. Existing facilities at the Welland, modeled as a set of six reaches under a 1971 traffic load, served as the base run for subsequent analysis of various other "improved" configurations. Determination of capacity at the Welland is based upon the relationship between vessel arrival rate and longest lock service time. As the ratio of these two items approaches unity, or 100 percent, the existing system is said to have reached its nominal capacity.

The term nominal capacity refers to the maximum theoretical capacity and is determined by the maximum number of vessels that can be locked through in any time period. The occurrence of random arrivals, however, imposes an increasing delay cost as the system approaches nominal capacity. Thus, what is needed is a practical capacity which takes into account this delay function. The definition of practical capacity is to a certain extent arbitrary and is truly a function of a number of factors, each of which may be different for various individuals in various systems under various circumstances. For the purpose of this study, practical capacity was defined as that point when the system reaches 75 percent of its nominal capacity.

Nominal capacity of the existing Welland was shown to be 40 lockages per day. Practical capacity as defined above was reached as early as 1990 under accelerated growth and as late as 2010 under normal growth.

Nonstructural improvements in the Welland Canal leading to a reduction in lock cycle time significantly increased the economic capacity of the system. Given the traffic projections, the capacity of the system was increased by almost a decade from that given above. However, the conclusions stated above are qualified on the basis that:

(a) The model as developed does not forecast the future status of the subsystem; future conditions can be discerned only by forecasting future values of the simulation input.

(b) The results are conditional upon the accuracy of the traffic forecast; transport demand for future years was based upon the assumption that both average vessel size and frequency of trips would gradually increase.

(c) Capacity analysis, using any queuing model, is very sensitive to the length of lock cycle times and the vessel arrival rate.

(3) Volume 3. Great Lakes - St. Lawrence Seaway Simulation Studies: Summary Report. This document describes the computer simulation model developed to study the operating characteristics of the Great Lakes and St. Lawrence Seaway. This model, designated as NETSIM II, is an improved version of NETSIM I described in earlier research reports (see Volume 1 above). Major features of the model include the ability to simulate bi-directional traffic flows through lakes, channels, locks and ports, and the ability to balance supply and demand of transportable commodities and transport equipment units (vessels) within the system.

A simulation was developed of the GL/SLS system based upon a hypothetical configuration of 18 ports, nine locks and 15 reaches and five Great Lakes. Traffic was classified into seven commodity groups, while vessels operating in the system consisted of dry bulk, liquid bulk, and saltwater vessels. Since most of the input to this experiment was only estimates of actual performance data, no output analysis of simulation results was possible. Future utility of the systems simulation model is based upon an expanded data base more representative of real world conditions.

(4) Volume 4. NETSIM II and PROSIM: A Waterway Simulation Package. This report is a detailed description of the computer simulation package designed for the GL/SLS navigation system summarized in Volume 3. Expansion of the data base required for operation of the systems simulation model was considered to be the next logical step necessary for increasing the utility of the model. Attempts at systems simulation by PTTSC did not take place after December 1973.

Corps of Engineers.

(1) Review of Reports on Lake Erie-Lake Ontario Waterway, N.Y. studies the need for major waterway improvements between Lake Erie and Lake Ontario to allow continued growth of waterborne commerce on the GL/SLS system. Simulation studies of the existing Welland Canal and a nonstructurally improved Welland against structural alternatives to Canadian facilities were conducted. A simulation model developed by PTTSC (see Volume 2 above) served as the basis for the economic analysis. Capacity was estimated to be reached at the Welland Canal between 1995 and 2000.

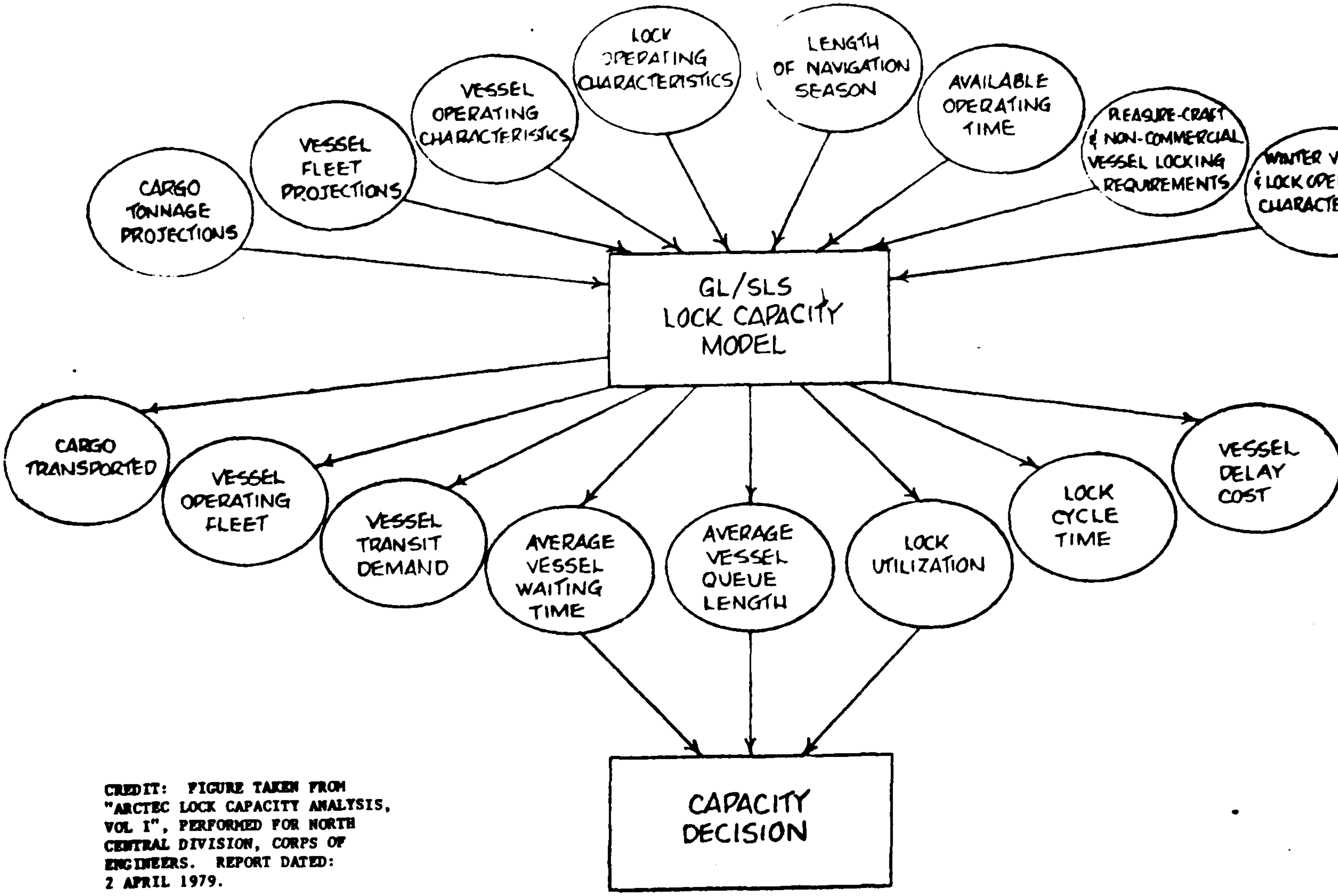
Economic studies and projection of trends in waterborne traffic combined with computer simulation of the existing Welland Canal indicate that unless some structural improvements of the Welland Canal are made before 1990, traffic desiring to traverse the entire Great Lakes system will be constrained by the limited capacity of the existing canal. Not only will there be too many vessels to handle, but if the trend towards construction of larger vessels in excess of 730 feet continues, traffic will be further constrained as many vessels will be too large to pass through the existing Welland Canal. If this occurs, the Great Lakes region of the United States and Canada will lose a significant amount of future waterborne commerce, requiring the use of more costly means of distributing bulk and general cargo commodities. The potential economic loss for the United States would extend to the United States Great Lakes tributary area, representing 36 percent of the nation's population and affecting all or portions of 19 states.

(2) Sabin Lock Model (April 1975) was developed by North Central Division - ADP Center using techniques and concepts developed in earlier simulation studies conducted by PTTSC. This model requires projections of future traffic and fleet data to estimate the capacity of parallel locks in the St. Mary's River. The purpose of the model is to provide a simulation capability needed for the analysis of future delays at the Soo Locks and to compare the impacts of proposed structural and non-structural changes to the locks. Design of the Sabin Lock Model was based upon its eventual incorporation into a larger GL/SLS system capacity model. Although the Soo Locks consist of a set of four parallel locks, the model structure is flexible enough to address sub-systems of a series of locks (i.e., Welland Canal and locks in the St. Lawrence River).

(3) The Winter Rate Study for Great Lakes-St. Lawrence Seaway System - Arctec, Inc., December 1975, was a study of the effects of extended transit time for ships navigating the GL/SLS system during the winter season. The effect on annual required freight rates of extending the length of navigation season, varying the severity of winter conditions and forecasting alternative future vessel fleets was also made. A computer model of the GL/SLS system was developed to simulate the movement of ships and cargo within the system and to/from overseas ports.

The computer simulation model compiles statistics for various classes of ships operating on each major origin/destination/commodity flow route and uses this information along with vessel operating costs to derive the annual required freight rates for each route. The water simulation model was composed of the following modules: transit time generation model, ship processing model, and freight rate model. Portions of the transit time generation model may be able to contribute to development of a future GL/SLS system capacity model. The simulation model, as presently developed by Arctec, Inc., calculates practical capacity of existing locks and canals in the system.

(4) Great Lakes/St. Lawrence Seaway Lock Capacity Analysis -Arctec, Inc., April 1979, was a study to develop a planning tool to determine if or when in time, the Soo, Welland, and Seaway lock systems can be expected to reach capacity as a function of forecasted traffic, vessel and fleet characteristics, lock characteristics, and length of the navigation season. Their work analyzed the steady-state lock operations and vessel-lock interaction for a given set of input variables which describe the GL/SLS system. Output from their model can be used to determine whether or not a capacity condition has occurred based upon a set of prescribed capacity criteria such as average vessel waiting time, average vessel queue length, and degree of lock utilization. This attempt at developing a lock capacity model will play an important role in measuring potential capacity throughput at the three critical nodes within the system. A brief description of their model is presented below. A conceptual overview of the model is shown in Figure C-2.



CREDIT: FIGURE TAKEN FROM "ARCTEC LOCK CAPACITY ANALYSIS, VOL I", PERFORMED FOR NORTH CENTRAL DIVISION, CORPS OF ENGINEERS. REPORT DATED: 2 APRIL 1979.

FIGURE C-2. OVERVIEW OF GL/SLS LOCK CAPACITY MODEL

The constraining elements in the GL-SLS navigation system are locks at the Soo, Welland Canal, and St. Lawrence Seaway. As the annual traffic handled at these three points rises over the project planning period, vessels will begin to experience longer waiting times and longer vessel queves as the practical capacity of a lock system is reached. Development of the GL/SLS Lock Capacity Model is based upon the following assumptions:

Vessels

(1) All ships in the fleet are represented by specific ship classes.

(2) All ships will attempt to maintain their maximum capable speed at all times except where speed limits exist.

(3) A ship's maximum speed capability is determined by analyzing the ship's thrust capability versus its resistance characteristics in open water and ice.

(4) No accidents involving ships are assumed to occur in the system and no time delays due to accidents are considered.

(5) All lakers are assumed to lay up at the end of the navigation season, while all ocean-going ships are assumed to operate elsewhere.

(6) All ships are treated on an equal basis.

(7) All ships will operate only during daylight hours in areas where nighttime navigation is prohibited.

(8) All ships are assumed to carry a full cargo.

(9) All ships carry only one cargo at a time.

(10) Lakers are phased out or retired from the fleet based on a 75-year useful life.

(11) When additional ships are needed because the cargo demand is greater than the fleet transporting capacity, largest ships are built first.

(12) When the cargo demand is less than the fleet transporting capacity, the smallest ships are deleted first.

Locks

(1) Each lock can be described as a single-server with a simple waiting line queue.

(2) Vessels are processed on a first-come first-served basis.

(3) Lock service time distribution is characterized by its mean and standard deviation.

(4) Vessel arrival rate follows a Poisson distribution.

(5) Vessels are locked through in a manner which minimizes the lock's utilization (maximizes its capacity). If queues exist on both sides of the lock, the lock will alternate in processing upbound and downbound vessels. If a queue exists on one side of the lock and the time of arrival of a vessel at the other side of the lock is less than the turnback time of the lock, the lock will wait to process the arriving vessel. Otherwise, it will turn back to process the next vessel in the queue.

(6) Only one vessel at a time is processed by a lock.

(7) The capacity of each lock system is determined by the constraining lock and the distance between locks does not prohibit the Poisson distribution of vessel arrivals.

(8) At the Soo, vessels arriving are sorted by their use of the lock and form independent queues for each lock. In sorting vessels to each lock, vessels are assigned in a manner which minimizes the system's utilization (maximizes its capacity) within prescribed vessel-lock constraints. As queues start forming, vessels are dispatched to the waiting space provided at each lock in such a manner that no other vessel is blocked from entering an idle lock.

Cargo

(note: These cargo assumptions were required to assess the impacts of extended season activities by Detroit District.)

(1) The total annual tonnage for ore and coal, which are considered to be stockpiled commodities, is assumed to be distributed based on the fleet cargo transiting capability and, as a result, "normal season tonnage" can be shifted to the extended navigation season period.

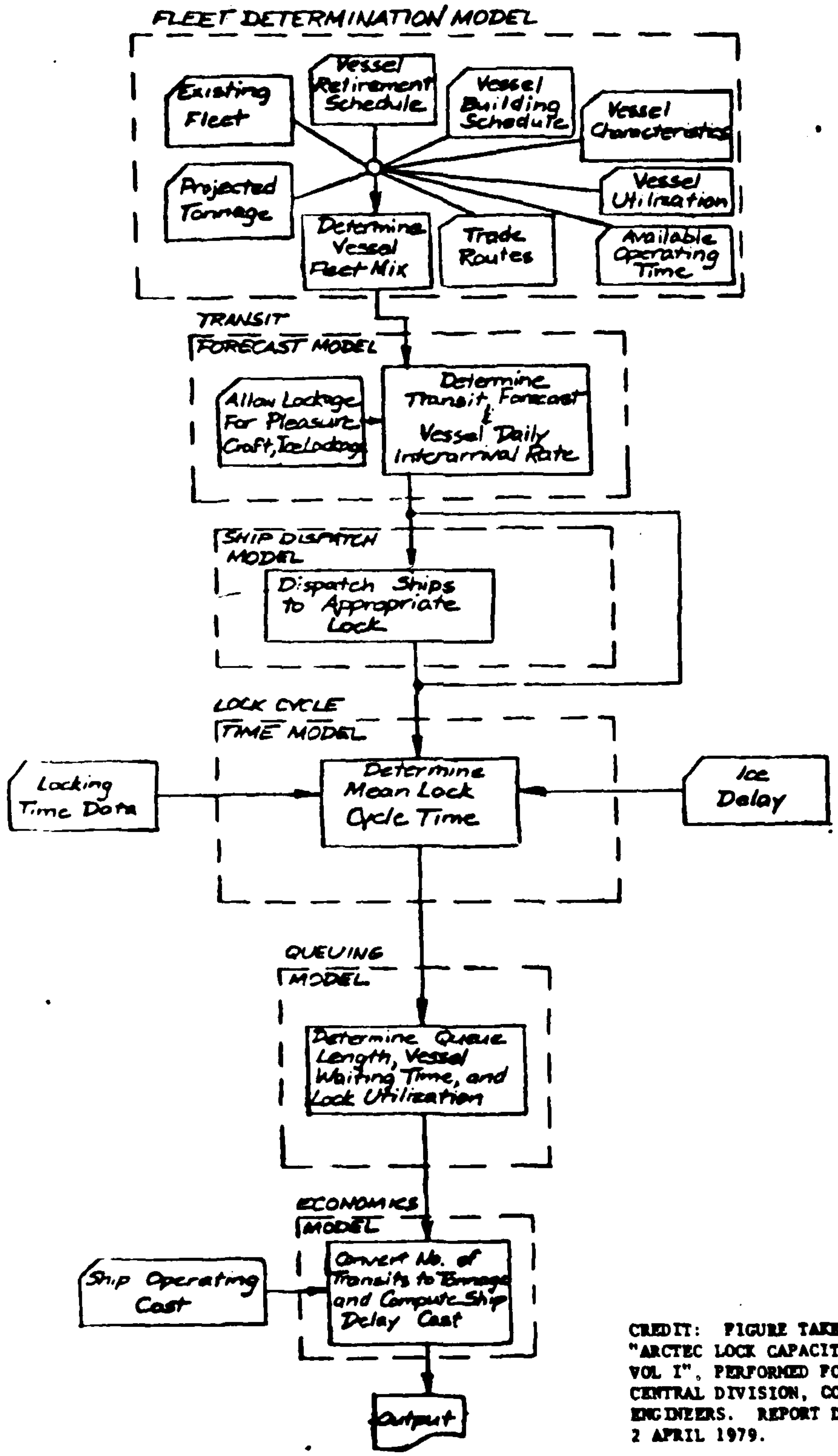
(2) Grain and general cargo are not considered stockpiled commodities and their "normal season tonnage" cannot be shifted to the extended navigation season period. Extended navigation season grain and general cargo tonnages are assumed to be evenly distributed during the extended navigation season.

(3) Stone and other bulk are assumed to be independent of season extension with their entire tonnage demand transported during the normal season.

The lock capacity model is composed of six component parts that process the input variables shown in the conceptual diagram in Figure C-3. Each component is briefly described below.

Fleet Determination Model determines the required fleet mix for a given lock system needed to carry the projected cargo tonnage demand by commodity as a function of the existing fleet, vessel retirement or phase-out schedule, vessel building schedule, available operating time, specific trade routes and vessel characteristics. When the annual cargo tonnage demand is greater than

Figure C-3. Conceptual Block Diagram for Lock Capacity Model



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the transport capacity of the remaining fleet, ships are added to the fleet in accordance with the vessel shipbuilding schedule which can limit the number of additional ships of any vessel class. Ships are added to the fleet under the assumption that the largest vessels are added first with smaller vessels added later if required. If the transport capacity of the remaining fleet is greater than the cargo tonnage demand, vessels are deleted from the fleet with the smallest vessels being deleted first until the transport capacity equals the cargo demand.

Transit Forecast Model converts the vessel fleet generated by the Fleet Determination Model and the annual cargo demand projections into a vessel transit forecast demand (vessel arrivals) by vessel class, direction and commodity that will arrive at the particular lock system on a daily basis as a function of vessel characteristics and vessel utilization.

Ship Dispatch Model is used only for the Soo Lock system where a decision must be made as to which of the four individual locks a particular vessel will be assigned to and use based on vessel-lock limitations and relative lock utilization and vessel waiting time.

Lock Cycle Time Model calculates the mean lock cycle time as a function of the transit forecast of vessels by class, direction, lock turnback characteristics, and level of traffic.

Lock Queuing Model determines average vessel waiting time, average vessel queue length and lock utilization based on the vessel transit forecast, mean lock cycle time, available lock operating time, weather delays, lock malfunction delays, required pleasure craft and noncommercial lockages and ice delays.

Economic Model converts average vessel waiting time delays into delay costs (operating and capital) incurred by each vessel. Delay costs are calculated by multiplying the average queue waiting time per vessel by the vessel cost per hour. Ship costs per hour include variable operating costs such as fuels, wages and benefits, subsistenance and supplies, insurance, maintenance and repair, winter layups, and overhead charges. Capital costs (fixed annual charges) are based on a required return on initial investment.

Other Federal Agencies

A systems analysis of the problems and factors which adversely affect or halt navigation on the St. Lawrence River between Montreal, Quebec, and Lake Ontario was conducted by the St. Lawrence Seaway Development Corporation. The results of this multi-agency study was published as the St. Lawrence Seaway System Plan for All-Year Navigation (SPAN) in 1975. Their analytical approach included development of a mathematical simulation model of seaway operations which would identify constraints to winter navigation. Since the model is capable of keeping track of each ship as it passes through the Seaway, statistics such as time spent waiting for locks, waiting for visibility to improve, waiting for high winds to subside, waiting at anchor due to nightfall and being stuck in ice is developed. The model also provides information on Seaway facilities such as lockage times, amount of time a lock is idle in a given period, and the length of downbound/upbound queues at each lock as well as throughput for these facilities and each subreach in the Seaway.

This model did not formally address the problem of defining the capacity limits of the existing St. Lawrence River locks and channels under normal or extended season operations. However, the lock processing routines in this model may provide a useful basis for capacity studies required for future feasibility studies.

GREAT LAKES FLEET CHARACTERISTICS

The Great Lakes Fleet has been characterized by fewer and larger vessels; deeper draft requirements in harbors and channels, and greater emphasis upon automated handling. The Lakes region pioneered in vessel automation with the first self-unloading vessels and the first giant dockside equipment for continuous automated handling of grain, limestone, coal, cement, and iron ore. The Great Lakes Fleet is composed of five major vessel types: dry-bulk carriers, self-unloaders, tankers, crane vessels, and general cargo carriers. In 1976, the fleet consisted of 174 U.S. vessels and 152 Canadian vessels.

Dry bulk carriers and self-unloaders are the most important vessel type in terms of tonnage and numbers. These vessels are primarily involved in the iron ore, limestone, and grain trades with some also carrying coal. Self-unloaders are basically an adaptation of the dry bulk vessel except that a self-contained unloading system is built into the vessel's hull and deck structure. This concept has become popular with fleet operators since it has a rapid port turnaround time and the vessel is not restricted to serving only those docks that have shore-side unloading capability. Dock operators also benefit because the use of this vessel minimizes the capital invested at the dock.

Special requirements to service this vessel type consist of a large stockpiling area large enough to contain the volume unloaded within reach of the vessel's unloading boom.

The U.S. Fleet operates principally on Lakes Superior, Michigan, Huron, and Erie and was not as severely affected by the opening of the St. Lawrence Seaway in 1959 as was the Canadian Fleet.

The Canadian Fleet, which operated principally through the Seaway, was severely affected as numerous pre-Seaway canallers were scrapped. Trends in the composition of the U.S. Fleet have primarily reflected increases in channel widths and depths and harbor depths, larger lock sizes at the Sault Ste. Marie, and the increased pelletization of iron ore.

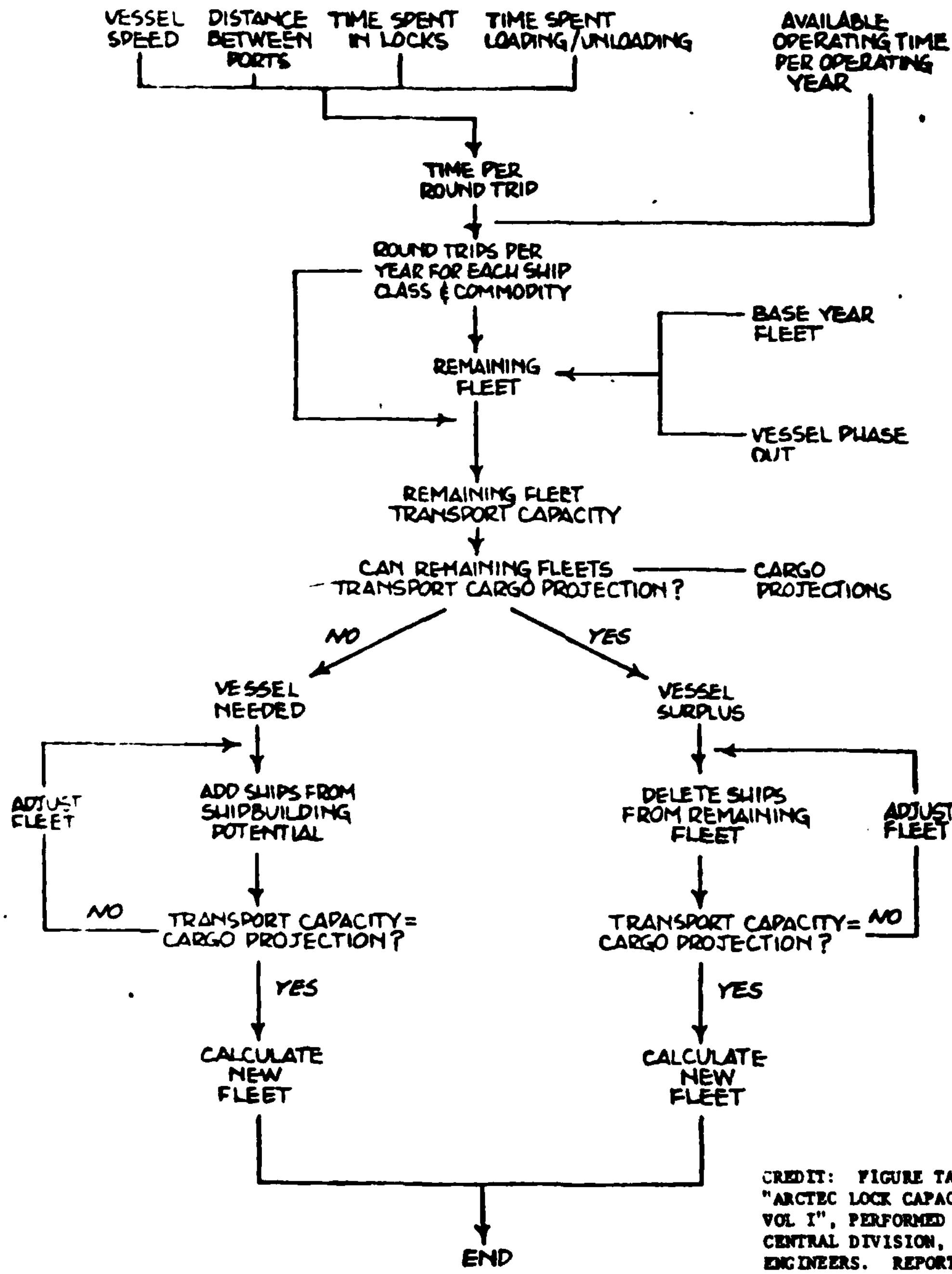
Prior to 1959, much traffic to and from the lower St. Lawrence ports had to be transshipped to smaller vessels (canallers) of about 250-foot length. These smaller vessels dominated the composition of the Canadian Fleet prior to 1959. Upper lakes traffic consisted of movements by medium-sized lakers, mostly in the 400 to 600-foot range. Upon completion of the improvements in the St. Lawrence River, the canallers were quickly phased out of operation, with the exception of commodities. Governmental subsidies provided by the Canadian Government produced a large-scale new-ship-building program to take full advantage of the larger locks in the St. Lawrence River. These new vessels participate primarily in movements of grain (downbound) and iron ore (upbound) through the Seaway.

Fleet Mix Projections.

Future fleet characteristics (number of vessels within each length classification, average carrying capacity by vessel class, and average speeds by class) are required for estimating lock capacity. The fleet determination subroutine of the Lock Capacity Model used the cargo forecasts as input and calculated the required fleet composition to carry the tonnage. A list of the vessel related study assumptions were summarized on pages C-19 and C-21. A schematic diagram of the variables considered in developing the required fleet to carry the forecasted traffic is shown in Figure C-4. A summary of vessel characteristics by class assumed to prevail over the most probable future is shown in Table C-13.

Estimates of System Capacity.

The Arctec, Inc. Lock Capacity Model predictions are the basis for the discussion of capacity. Documentation of their findings were published in a two volume set. Portions of volume one were abstracted for this portion of the Plan of Study. Estimates of future traffic considered in the capacity assessment are presented in Table C-14. These traffic forecasts were supplied to the Contractor for their preliminary capacity analysis and report. Traffic forecasts in Table C-14 may not agree with earlier estimates of future traffic since commodity growth rates and other system model components may reflect changes or improvements after this date of initial preparation.



CREDIT: FIGURE TAKEN FROM "ARCTEC LOCK CAPACITY ANALYSIS, VOL I", PERFORMED FOR NORTH CENTRAL DIVISION, CORPS OF ENGINEERS. REPORT DATED: 2 APRIL 1979.

FIGURE C-4. CONCEPT DIAGRAM OF FLEET FORECAST MODEL

Table C-13 - Vessel Characteristics for Welland Canal and St. Lawrence River

Class Number	Length in Feet	Mean Vessel Speed (mph)	Maximum Carrying Capacity 2/	Vessel Utilization (%) 5/	Locking Time Up (Minutes)	Locking Time Down (Minutes)	Vessel Costs Operating ($/hr)	Vessel Costs Fixed ($/hr)
3 1/	-	-	-	-	-	-	-	
4	0-599	12.6	10,165	70	39	35	373	287
5 3/	600-699	13.3	22,470	70	39	35	396	356
6 4/	400-699	14.6	16,050	70	47	45	254	238
7	700-749	14.5	28,890	70	48	47	435	438

1/ Consists of various pleasure craft, noncommercial vessels and required ice lockages.
2/ Short tons.
3/ Class 5 vessels include Class 5 Lakers (600-649 feet) and Class 6 Lakers (649-699 feet).
4/ This class includes all ocean-going vessels.
5/ Validation computer runs for Welland and St. Lawrence Seaway were based upon a ship utilization factor of 70 percent; ship utilization of 1.0 indicates that the minimum possible number of ballast transits are assigned, whereas ship utilization 0.0 indicates one ballast transit for every loaded transit. All ship transits in the model are either carrying a full load of cargo or are in ballast.

Table C-14 - Summary of Projected Traffic Flows - Unconstrained GL/SLS System

	Projected Flow in Thousands of Short Tons					
	1980	1990	2000	2010	2020	2030
I. Welland Canal						
Soo/St. Clair/Welland/SLS	22,758	27,114	31,327	34,992	38,839	42,752
Soo/St. Clair/Welland	8,286	9,279	11,000	12,433	14,128	16,142
St. Clair/Welland/SLS	17,232	22,436	29,428	38,176	48,654	60,720
St. Clair/Welland	2,072	2,674	3,342	4,061	4,880	5,683
Welland/SLS	13,525	17,560	22,213	26,685	35,334	45,956
Welland	14,291	17,558	20,793	23,559	25,960	28,640
Total Welland Canal	78,164	96,621	118,103	139,906	167,795	199,893
II. St. Lawrence Seaway						
Soo/St. Clair/Welland/SLS	22,758	27,114	31,327	34,992	38,839	42,752
St. Clair/Welland/SLS	17,232	22,436	29,428	38,176	48,654	60,720
Welland/SLS	13,525	17,560	22,213	26,685	35,334	45,956
SLS	8,075	10,850	14,897	18,309	22,313	27,246
Total St. Lawrence Seaway	61,590	77,960	97,865	118,162	145,140	176,674

1/ Computer forecast was prepared on 6/25/79 and assumes a 9-month navigation season for upper four lakes and 8-month season for Lake Ontario and St. Lawrence River.

The Lock Capacity Model was validated using historical lock operating data and vessel information obtained in 1976 at three locations (Soo Locks, Welland, and St. Lawrence River) within the GL/SLS System. In validating the capacity model, the capacity criterion used was to compare model predictions based on transporting the historical level of (1976) tonnage with actual conditions observed at these nodes for number of average daily transits by month and distribution of vessel arrivals by vessel class (i.e., lockage mix). The validity of the relationship between the actual and predicted vessel waiting times and vessel queue lengths at these locks and the relationship between loaded vessel transits to total vessel transits could not be calibrated to 1976 conditions since this data was not available.

Provision has also been provided within the model for a sensitivity test in terms of the number of large bulk carriers that may be built as a result of a future capital or shipbuilding capacity shortage. A range of shipbuilding responses applies only to lakers since salties (ocean-going vessels) are assumed to exist in sufficient quantity in the world that a shortage of investment capital would not restrict their usage within the Great Lakes.

Capacity Criteria.

For purposes of this study, the following criteria were developed to assist in defining when capacity was reached for each lock system. The following items were used as a basis for capacity determination:

(1) Lock Utilization - Percent of the total available time in each period that the lock is being utilized.

(2) Average Vessel Waiting Time - The average time a vessel can expect to wait at the lock for service; within a given period, however, some ships will wait longer while others will wait less.

(3) Average Vessel Queue Length - Average number of ships waiting for service; some vessels will experience longer or shorter lines as they wait for locks.

All three criteria are interdependent; when lock utilization is high, vessels can expect to experience longer lines and longer waiting times. In order to illustrate the impact of each criteria upon capacity, four sets of capacity criterion were used which ranged from "mild" to "severe" capacity conditions. Although the selection of a particular set of criteria can shift the timing of capacity, capacity criterion 3 was used in the initial analysis.

Table C-15 - Capacity Criterion

	Lock Utilization (%)	Average Vessel Waiting Time (hrs)	Average Vessel Queue Length (Ships)
1	70	1.5	1
2	80	2.5	2
3	87.5	4	3
4	90	6	4

Welland Canal Lock System.

The most constraining element within this 27-mile long, eight lock navigation system is Lock No. 7. This lock has a longer cycle time and is just above Locks 4, 5, and 6 which are twinned flight locks. Also, numerous lift bridges for land traffic and narrow channels are also considered to be bottlenecks to vessel movements.

A validation computer run for 1976 was performed for the Welland Canal. There was close agreement between the model predictions and actual conditions experienced at the Welland Canal for the number of average daily transits and distribution of vessel arrivals by vessel class.

A summary of the capacity analysis for the Welland Canal for a range of capacity criterion is shown in Table C-16.

Estimates of capacity for the Welland Canal range between 69.1 and 75.5 million short tons. The traffic forecasts used in developing the most probable future for this particular subsystem strongly impact upon the date capacity is reached. Due to the large increase in projected annual tonnage (future traffic increases by 20 percent from 1976 to 1980 and 27 percent from 1980 to 1990), the canal is expected to reach capacity within the next few years based upon an eight month navigation season.

Beyond 1990, the rate of increase in annual tonnage demand is expected to drop to approximately 20 percent per decade for the period from 1990 to 2010 and to 14 percent per decade from 2010 to 2040. Another factor influencing capacity is the imbalance in commodity flows. Traffic movements at the Welland are predominantly downbound, with about 1.5 tons transported downbound for every ton transported upbound in 1976. For 1980, the ratio of downbound traffic is projected to increase to about 2.5 tons. Beyond 1980, this ratio is projected to decrease continuously to 2.2 in the year 2000 and 1.5 by 2040.

Extending the navigation season at the Welland increases the annual traffic throughput at the canal but does not significantly shift the timing and capacity.

The major reason for this can be found in the mix of traffic using this facility. Almost 60 percent of the total projected traffic in 1980 consists of grains, other bulk, and general cargo which are shipped almost totally in the normal season. For grain and general cargoes, season extension changes the shippers' perception of the level of service available within the system resulting in additional tonnage to be shipped. This additional traffic offsets the "redistribution" of iron ore and coal into the extended season period resulting in minor gains in annual tonnage throughput by the date capacity is reached.

St. Lawrence Seaway Lock System.

The St. Lawrence Seaway extends about 190 miles from the St. Lambert Lock above Montreal Harbor to Kingston, Ontario. This lock and channel system operates for an eight month navigation season starting in mid-April and ending in mid-December. Commercial navigation is constrained the most by the Beauharnois Locks which are relatively close to each other and provide no waiting area for vessels between the locks. In addition, during peak summer months these locks experience more transits by pleasure craft traveling to and from Montreal than the other locks.

Output from the Lock Capacity Model for this subsystem was also validated using data from the 1976 navigation season. The discrepancy between the predicted values using 1976 traffic levels and the actual (historical) values may be primarily due to the fact that all ship transits in the model are either carrying a full load of cargo or are in ballast. Under real-world conditions, many vessels transit the Seaway with less than a full load.

A summary of the capacity analysis for the St. Lawrence Seaway Lock System for a range of capacity criterion is shown in Table C-17.

Based upon a capacity criteria of 87.5 percent lock utilization, average vessel waiting time of four hours, average vessel queue length of three ships and current levels of vessel utilization, the Seaway is expected to reach capacity in the year 2000 for the current normal navigation season of eight months (15 April - 15 December) at an annual tonnage of 95.0 million short tons.

Table C-16 - Summary of Capacity Analysis for the Welland Canal[3]

Navigation Season	Capacity[1] Criterion	Year Capacity[2] Occurs	Annual Tonnage (short tons)
15 Apr - 15 Dec (8 months)	1	1980-	69,100,000
	2	1980-	72,300,000
	3	1980-	75,500,000
	4	1980-	75,500,000

1/ Capacity criterion is defined as follows:

	Lock Utilization (%)	Mean Vessel Waiting Time (hrs)	Mean Vessel Queue Length (ships)
1	70	1.5	1
2	80	2.5	2
3	87.5	4	3
4	90	6	4

2/ + Indicates slightly beyond the year indicated.
- Indicates slightly before the year indicated.

3/ Current vessel utilization of 70 percent. Tonnage is shown in thousands of short tons.

Table C-17 - Summary of Capacity Analysis for the St. Lawrence Seaway Lock System[3]

Navigation Season	Capacity[1] Criterion	100 Percent	
		Year[2]	Annual Tonnage[3]
15 Apr - 15 Dec (8 months)	1	1995-	82,300
	2	1995+	90,200
	3	2000	95,000
	4	2000+	97,000

1/ Capacity Criterion is defined as follows:

	Lock Utilization (%)	Mean Vessel Waiting Time (hrs)	Mean Vessel Queue Length (ships)
1	70	1.5	1
2	80	2.5	2
3	87.5	4	3
4	90	6	4

2/ + Indicates slightly beyond the year indicated.
- Indicates slightly before the year indicated.

3/ Current vessel utilization of 70 percent. Tonnage is shown in thousands of short tons.

TOLLS

Subsequent to initial construction activity, the 83rd Congress passed Public Law 358 (the Wiley Dondero Act) in 1954 creating the St. Lawrence Seaway Development Corporation as the designated U.S. agency to construct and operate deep-draft navigation works in the International Rapids Section of the St. Lawrence River together with the necessary dredging in the Thousand Islands Section; and to operate and maintain such works in coordination with the St. Lawrence Seaway Authority of Canada. The SLSDC was further authorized and directed to negotiate with Canada an agreement as to the rate of charges or tolls to be levied for the use of the Seaway.

Toll charges assessed at the Welland Canal and St. Lawrence River section for the transit of the Seaway make up part of the total origin-destination transportation costs for commodity movements using a Great Lakes-St. Lawrence Seaway routing. The GL/SLS Traffic Forecast and Route Split Model developed by A.T. Kearney, Inc. for the North Central Division, Corps of Engineers, compares total transportation costs between alternate modes to assign potential traffic between a GL/SLS route or competitive routing option. Changes in costs attributed to larger vessels, longer season or any other component of total transportation cost can result in different projections of modal splits for potential traffic.

The toll schedule negotiated with Canada prior to 1959 was recently revised to provide for increased toll levels to be phased in over a 3-year period beginning in 1978. However, since the phasing-in process will be complete by 1980, the level of toll charges for that year will be used in the analysis. New toll charges by commodity families are illustrated in Table C-18.

BENEFITS

Potential benefits for increasing system capacity at the Welland and St. Lawrence River Locks are measured as the additional tonnage throughput allowed by constructing the improvement multiplied by the existing rate differential in the current Logistics Price File which is a part of the GL/SLS Traffic Forecast Model. Delays to vessels and their cargo (i.e., the opportunity cost of the money invested in both the cargo and vessel for the amount of time it is delayed at the locks) would also be credited to any plan of improvement.

If larger locks were constructed for both subsystems, the water portion of the total transportation rate would likely decrease since large vessels could then operate in the GL/SLS system. Under this scenario, lower rates would increase the competitive position of water carriers resulting in a greater share of the total potential GL/SLS traffic. The product of the increased traffic volume due to lower rates and the base case traffic forecast at the old rates would then comprise the majority of the annual benefits. Again, construction of larger locks would be expected to reduce vessel and carrying costs of cargo and would be credited to any lock replacement program.

Construction of either duplicate or larger locks may also enable season extension activities to proceed to a 12 month basis since the additional locks would allow for the required maintenance. The shipper's perception of the GL/SLS system under a 12 month navigation season would likely induce additional traffic to use the GL/SLS. This additional traffic multiplied by the appropriate rate differential between water and the next best alternate mode would produce benefits that could be credited to a Federal plan of improvement. The length of season assumed to be in effect for purposes of this Plan of Study is nine months on the Upper Lakes (Lakes Superior, Michigan, Huron, and Erie) and eight months for the Lower Lakes (Lake Ontario and St. Lawrence River).

SENSITIVITY STUDIES

Changes to key study variables such as commodity growth rates, capacity criteria, total transportation costs, Federal project interest rate and extent of navigation season extension activities will be accomplished in a separate section. The extent of change for each variable and how this variation may affect annual benefits or costs will be shown in future Corps planning documents. This will allow an indirect measurement of the continued feasibility of the study in light of changes in the most probable future.

Table C-18 - St. Lawrence Seaway Joint Tariff of Tolls

	Per Short Ton[1]		
	1978	1979	1980
Montreal-Lake Ontario Section (full transit)			
Bulk	$ .45	$ .56	$ .62
Containers	.62	.62	.62
Government Aid Cargoes[2]	.37	.37	.37
Grain	.37	.37	.37
General	1.15	1.35	1.50
Vessel charge, per gross registered ton	.07	.07	.07
Welland Canal Section (full transit)			
Bulk	.18	.22	.28
Containers	.28	.28	.28
Government Aid Cargoes[2]	.18	.22	.28
Grain	.18	.22	.28
General	.25	.35	.45
Vessel charge, per gross registered ton	.07	.07	.07
Vessel charge for 8 locks	None	None	None
Combined Sections (full transit)			
Bulk	.68	.78	.90
Containers	.90	.90	.90
Government Aid Cargoes[2]	.55	.59	.65
Grain	.55	.59	.65
General	1.40	1.70	1.95
Vessel charge, per gross registered ton	.14	.14	.14
Vessel charge for 8 locks	None	None	None

1/ These tolls are assessed on a metric ton (1,000 kilogram or 2,204.62 lb.) basis.

2/ Government aid cargo includes cargoes currently classed in both the bulk and general cargoes.

APPENDIX D

MAXIMUM VESSEL SIZE STUDY

APPENDIX D

MAXIMUM VESSEL SIZE STUDY

GENERAL

Presented in this section is a summary of the Maximum Ship Size Study prepared by North Central Division, Corps of Engineers. This study addresses size limitations and benefits and costs of increasing size of vessels for use in the Great Lakes - St. Lawrence Seaway System, on a preliminary basis. Technical appendices referenced in this Summary Report have been omitted from this Plan of Study.

PREFACE

It should be noted that the conclusions contained in this Maximum Ship Size Study will be further refined as the St. Lawrence Seaway Additional Locks Study and the Great Lakes Connecting Channels and Harbors Study progress. Specifically, the conclusions contained herein are largely influenced by the degree to which Canada would share in the benefits and costs of improvements to increase the capacity of the Great Lakes - St. Lawrence Seaway System. Due to funding limitations, only two of the many potential U.S./Canadian cost sharing arrangements were analyzed in this study: (a) If all costs are borne by the United States, and (b) If 25 percent of all costs are borne by Canada. In addition, only potential U.S. benefits accruing from greater Great Lakes - St. Lawrence Seaway System capacity were addressed.

The preparation of Appendix D was based upon the need for initial estimates of maximum size ships that could economically operate within the GL/SLS during the project evaluation period. Evaluation of the operation of these very large vessels and the construction of larger locks to accommodate them over the long term was completed assuming two scenarios: (1) season extension in effect prior to larger locks, and (2) larger locks in place prior to season extension.

Estimates of lock capacity used in Appendix D and the increases in capacity attributed to a longer navigation season were based upon earlier work performed by Penn State University. Tonnage throughput at the locks was also assumed to increase in proportion to the additional time available for lockages. This approach has been superceded by analytical studies completed by Arctec, Inc. in April 1979 during their lock capacity contract work. Assumptions of a proportional relationship between tonnage throughput and length of navigation season will not be used in future economic studies. Other study assumptions used in Appendix D that may also change include cost sharing scenarios and system-wide traffic forecasts. This last item is in response to announced changes to the survey report on season extension and commodity growth rates presently included in the GL/SLS Traffic Forecast Model that is the basic planning tool for Season Extension, Connecting Channels and Harbors, and Additional Locks Feasibility Studies.

It is expected that a greater degree of Canadian cost sharing in system improvements, as well as the inclusion of Canadian benefits in the analysis, could have a substantial impact on the conclusions reached regarding the economically justifiable maximum size vessel. Therefore, the additional scenarios shown below will be evaluated during Stage 2 of the study development for both the St. Lawrence Seaway Additional Locks Study and the Great Lakes Connecting Channels and Harbors Study, in order to determine their impact on the optimum size vessel. It should be noted that these six scenarios will be evaluated for each of the following two assumptions regarding improvements to increase system capacity: (a) If the entire Great Lakes -St. Lawrence Seaway is improved, and (b) If the Upper Great Lakes alone are improved.

ADDITIONAL SCENARIOS TO BE EVALUATED

1. Total U.S. and Canadian benefits versus total U.S. and Canadian costs from increasing system capacity.

2. U.S. benefits alone (including 100 percent U.S. benefits on U.S.-Canadian traffic) versus total U.S. and Canadian costs.

3. Canadian benefits alone (including 100 percent Canadian benefits on U.S.-Canadian traffic) versus total U.S. and Canadian costs.

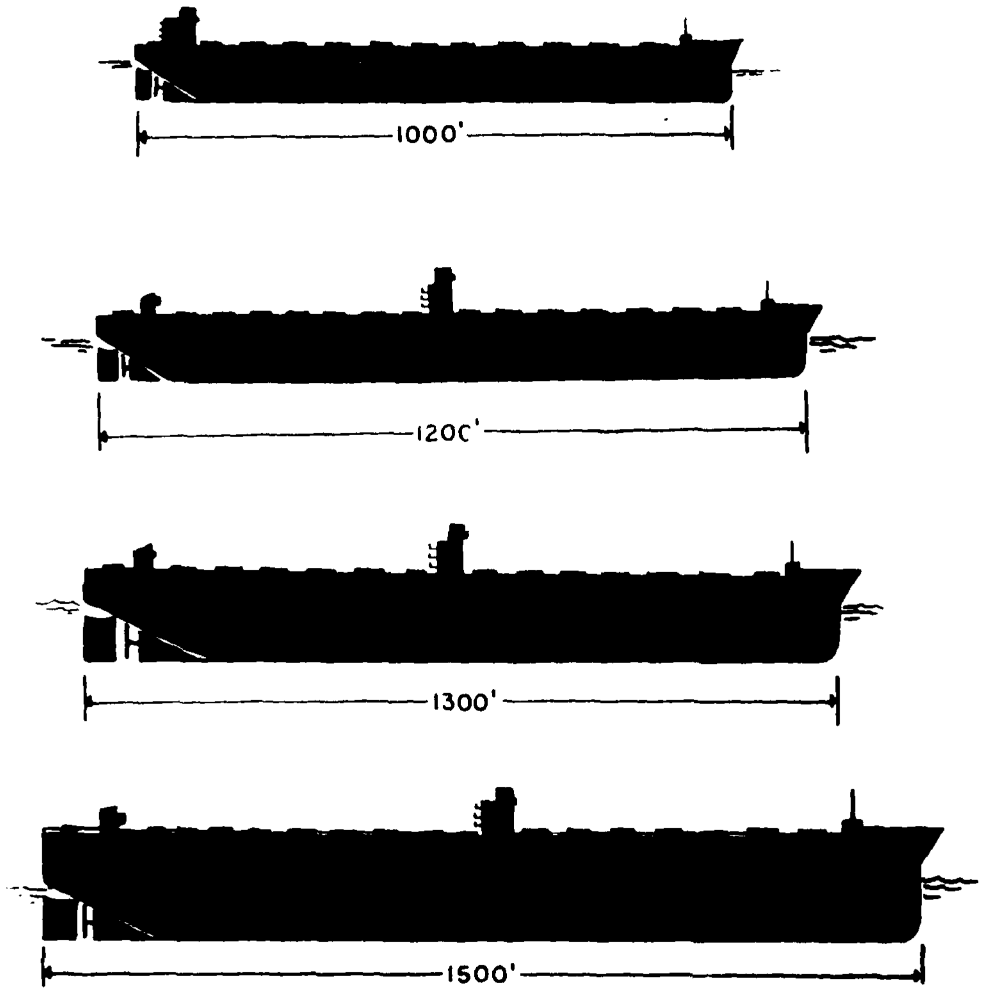
4. Adjust number 2 above such that U.S. benefits comprise only 50 percent of total benefits on U.S.-Canadian traffic.

5. Adjust number 2 above to split costs such that the United States only pays for those improvements within its own territorial boundaries while Canada pays for those improvements within its territorial boundaries.

6. Adjust number 4 above such that the United States only pays for those improvements within its own territorial boundaries, while Canada pays for those improvements within its territorial boundaries.

MAXIMUM SHIP SIZE STUDY

GREAT LAKES ST. LAWRENCE SEAWAY



U.S. ARMY CORPS OF ENGINEERS
NORTH CENTRAL DIVISION

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CONTENTS

SUMMARY AND CONCLUSIONS

The costs and benefits of increasing the capacity of the Great Lakes-St. Lawrence Seaway System by enlarging the maximum allowable size of vessels operating on various portions of the system have been investigated. Economic benefits of three distinct types were considered as arising from larger vessel size:

(1) Increased market share shifted to Great Lakes ports due to improved service and lower transport costs versus alternative transport links.

(2) Lower transport costs resulting in savings on tonnage presently included in the Great Lakes market share of overseas traffic.

(3) Lower transport costs resulting in savings on Great Lakes domestic tonnage.

The influence of vessel size on these benefits has been studied under alternative assumptions regarding the implementation of season extension, namely: (1) With season extension assumed to exist prior to the introduction of larger vessels, and (2) with larger vessels introduced before the implementation of season extension.

The dollar value of these benefits was estimated by establishing the required freight rate (RFR) advantages of conceptual designs of larger vessels, and then applying these advantages to the projected tonnages for various commodities, using projected fleet mixes incorporating vessels of the new maximum size. The composition of these fleet mixes was projected at ten-year intervals over the economic life of the project, using certain simplifying assumptions regarding the replacement of obsolescent vessels.

Projected tonnages reflect the improvement in market share generated by reduced transport costs, as evaluated through changes in the logistics price file.

Costs were estimated for the following components of the system: channel dredging and disposal costs, costs of regulatory structures required to maintain acceptable levels and flows, lock improvements, harbor improvements, bridge and tunnel alterations, aids to navigation, real estate, contingency costs, engineering and design costs, supervision and administration costs, and non-federal first costs.

Costs and benefits were evaluated for scenarios ranging up to vessels of 1500 ft x 175 ft beam for Great Lakes bulk-cargo types, and 1000 ft x 130 ft beam for oceangoing types. Operating drafts were varied from the existing 25.5 ft to a maximum of 36 ft. For each combination of vessel sizes, the corresponding plan of improvements was evaluated for benefits under the alternative assumptions regarding season extension. Costs were assumed to be independent of these assumptions.

Based on the results of this analysis, the following conclusions have been drawn:

(1) If all costs are borne by the United States, and the entire system is improved, the approximate upper limit for the economically justifiable size of Great Lakes bulk carriers is 1200 x 130 ft beam, at a draft of 25.5 ft. The corresponding upper limit for ocean-going vessels serving the St. Lawrence Seaway is 1000 x 130 ft, at the same draft.

(2) If only the upper lakes are improved, the maximum size for Great Lakes vessels should be 1100 x 105 ft, at 25.5 ft draft.

(3) If 25% of costs are borne by Canada, the vessel length and beam specified in (1) above should remain the same, but the maximum economically justifiable vessel draft would increase to 28 ft. Conclusion (2) would remain unchanged in vessel size and draft.

(4) Increased draft is the most significant determinant of economic performance of the vessel itself, but represents the highest cost for system-wide improvements.

(5) The over-all effect of the implementation of season extension is to defer the need for further lock and channel improvement decisions for approximately 13 years, to the year 2008. Thus, there may not be a need for a continuation of capacity studies at this time.

(6) The prior implementation of season extension yields greater benefits on the St. Lawrence Seaway overseas trade, while the introduction of larger vessel sizes before season extension yields greater benefits on the system above the Welland Canal.

(7) Preliminary examination indicates that instituting two-way traffic in the Rock Cut area (West Neebish Channel), would be less costly, faster, and safer for larger vessels than the present system of navigation in one-way channels

on both sides of Neebish Island. This conclusion can also be extended to winter navigation of the present 1000-ft vessels. A detailed study of improvements to the Rock Cut area is suggested.

(8) Further work should include the development of more sophisticated and accurate techniques for sizing channels to accommodate vessels of given dimensions under varying channel and harbor-entrance conditions.

I. INTRODUCTION

A. Purpose

The purpose of this work is to provide information on ship and facility alternatives for use in two Great Lakes St. Lawrence Seaway Navigation System studies being conducted by the Corps of Engineers. The studies are the Great Lakes Connecting Channels and Harbors study at Detroit District and the St. Lawrence Seaway Additional Locks study at Buffalo District. It is intended that these studies establish system parameters of facility size, expected costs and estimated benefits as the basis for any recommendations to Congress for total-system improvements or sub-system improvements at specific ports, in specific channels, or at specific locks. In addition, information is provided concerning the effect upon system capacity under two assumptions: (1) that season extension exists prior to the introduction of larger ship sizes, and (2) that larger ship size exist prior to the establishment of season extension.

B. Scope

The work performed in this study is a screening of vessel and system alternative sizes. Preliminary benefits were established for the operation of fleets containing a range of maximum size vessels. In addition, preliminary costs were established for the facilities necessary to accommodate this traffic. All Connecting Channels and Locks were investigated; however, only the major load-center harbors were included in this screening process. The harbors included account for about 90% of the bulk traffic and 60% of the overseas traffic.

This screening investigation is intended for input to the plan-of-study stage in the two above mentioned studies. Based on this information the Great Lakes Connecting Channels and St. Lawrence Additional Locks studies will concentrate in more detail on the most promising alternatives, in order to: (1) refine benefits; (2) more firmly establish the required facility dimensions; (3) more firmly establish cost estimates through analysis of size-cost vs benefit-reliability tradeoff; and (4) integrate the environmental costs and benefits both tangible and intangible into any plan proposed for recommendation to Congress.

Preliminary engineering estimates of federal capital costs were made for facility improvements for channel and harbor dredging, locks and levels and flow-control works, breakwater removal and construction, and bridge and tunnel construction. Operation and maintenance expenses were estimated from recent experience and real estate costs were estimated as a percentage of federal capital costs.

Costs such as cable crossing and outfall reconstruction were considered to be non-federal costs, and are included in that category as a percentage of federal capital costs.

Benefits, which also should be considered preliminary, are based upon total U.S. traffic, first with season extension assumed to exist before the introduction of larger vessels, and second, with season extension assumed as established after the introduction of larger vessel sizes. It was assumed that larger facilities would not be constructed until the existing system capacity is reached, a date which varies depending on the assumption chosen regarding the sequence of improvements just discussed. The "capacity date" is defined as that point in time at which the least-cost alternative becomes in part or in total more economically attractive than the waterborne modes of transport.

C. Methodology

The primary objective of navigation improvements is to reduce present and future transportation costs. One means of doing this is to provide facilities having greater cargo throughput capacity than the present facilities. The provision for larger vessels in the system may accomplish this objective, as might the introduction of season extension. The determination of the largest vessel which could be used for this purpose would provide a definition of the uppermost limit for improvements.

Using this upper limit as a starting point for the study, and working downward through the engineering and economic analysis of the cost of required navigational facilities, the study establishes the largest maximum ship size that can be justified by comparing these costs to the benefits generated by a fleet containing a proportion of this size vessel. This approach provides a full view of the opportunities for lowering waterborne transportation costs on the Great Lakes-St. Lawrence Seaway and thus greatly reduces the potential for making sub-optimal improvement decisions. This process has been established in two distinct but related parts, one to develop fleet benefits and the other to develop federal costs for accommodating the fleets containing these larger size vessels. Figure I-1 depicts a possible family of curves for fleets containing larger size vessels than in the present fleet.

These conceptual curves display system benefits for a fleet containing a percentage of larger vessels operated at various permissable drafts. These are annualized benefits derived through discounting a fifty-year stream of benefits to a present worth and capitalizing that value.

Conceptual designs of vessels larger than the present maximum size were prepared by the Department of Naval Architecture and Marine Engineering, The University of Michigan, and R.A. Stearn, Inc. The designs were necessary to establish investment and operating costs which are key inputs to the computer simulation model used to develop fleet benefits.

Fleets containing a percentage of these larger vessels were projected for ten-year increments by balancing the projected tonnage against fleet carrying capacity for each increment. Tables I-1 and I-2 display the iron ore, coal, limestone and grain fleet mix projections used in this study. These tables indicate a decreasing percentage of vessels smaller than 731 feet in length and an increasing percentage of larger vessels as time progresses toward the end of the fifty year project life. The NCD computer benefit models were utilized to estimate the future tonnages.

Operation over various trade routes is then simulated at various drafts to develop the fifty-year stream of system benefits, based on required freight rates that yield a 10% return on investment, after tax, to the vessel owner. This benefit stream is then discounted to present value at 6-5/8% interest, annualized, and plotted against system depth to develop the system benefit curves.

To this point, the investigation is unrestrained by costs of federal investment. Observing Figure I-1, it would appear that for a given depth the government should prefer to provide facilities that place the vessel operator on the highest curve, as this would provide the largest savings to the nation over the least cost alternative

FIGURE I-1
HYPOTHETICAL CURVES OF
FLEET BENEFITS

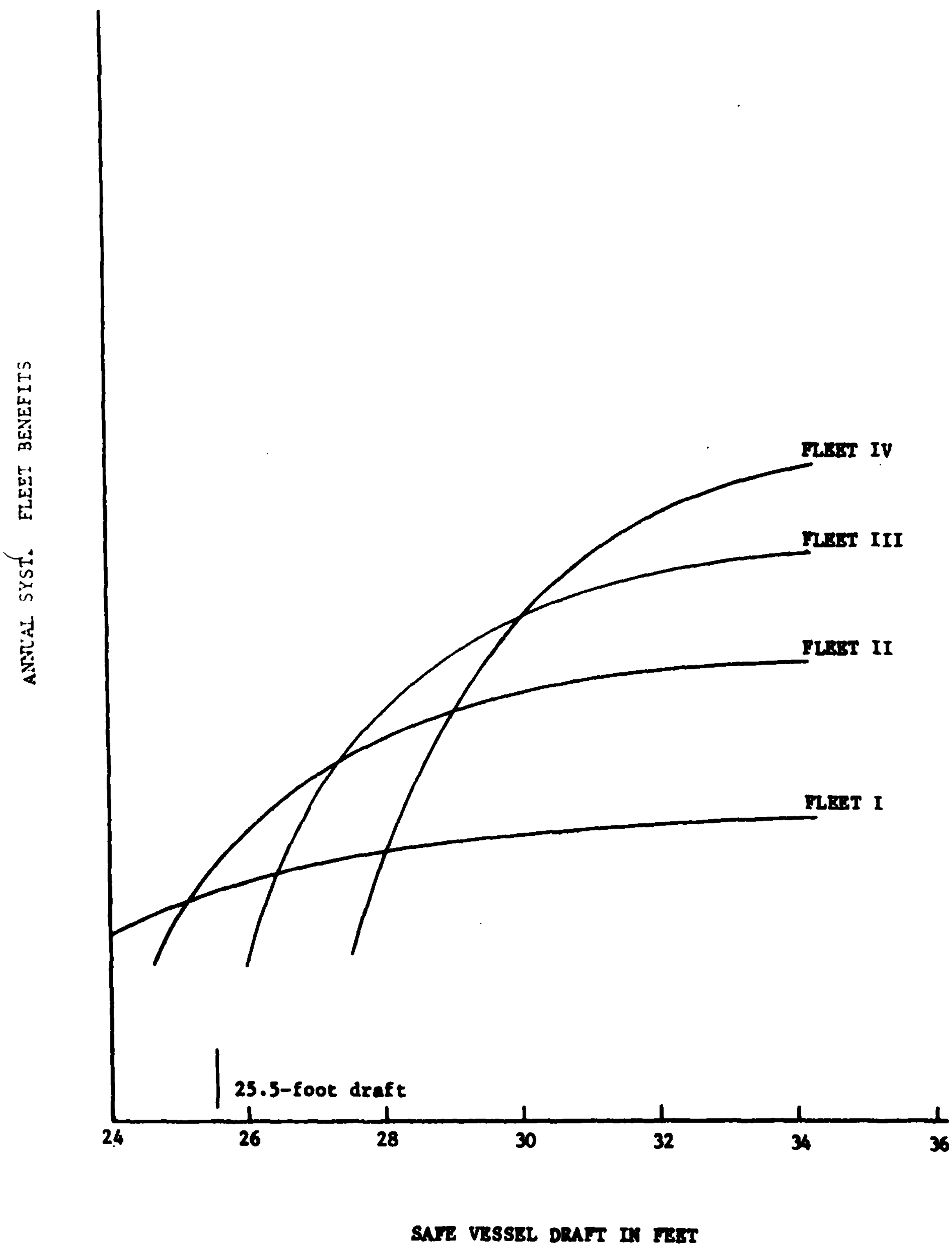


Table I-1

Unconstrained System No Season Extension

TOTAL SHIPS IN IRON ORE, LIMESTONE, COAL, AND GRAIN FLEET

	Number of Ships															
	Base Year		1980		1990 (2)		2000 (2)		2010 (2)		2020 (2)		2030 (2)		2040 (2)	
	25.5'		25.5'		28'	32'/36'	28'	32'/36'	28'	32'/36'	28'	32'/36'	28'	32'/36'	28'	32'/36'
Round trip ton miles 10^6																
Index																
Ship Size Allocation																
Class V 600'-649' x ≤ 75'	51	-	73	-	-	40	-	24	-	18	-	17	-	12	-	12
Class VI 650'-699' x ≤ 75'	22	-	20	-	-	20	-	20	-	12	-	9	-	9	-	9
Class VII 700'-730' x ≤ 75'	47	-	51	-	-	43	-	33	-	25	-	19	-	19	-	19
Class VIII 731'-800' x ≤ 75'	8	-	7	-	-	9	-	12	-	12	-	11	-	11	-	10
Class VIII a 800'-849' x ≤ 75'	4	-	4	-	-	13	-	24	-	28	-	28	-	30	-	30
Class VI w 650'-699' x 78'	2	-	2	-	-	3	-	4	-	4	-	4	-	4	-	4
Class VII w 700'-730' x 78'	2	-	2	-	-	3	-	5	-	6	-	7	-	8	-	8
Class VIII w 731'-849' x 92'	1	-	1	-	-	3	-	3	-	3	-	3	-	3	-	3
Class IX 858' x 105'	1	-	1	-	-	1	-	1	-	1	-	1	-	1	-	1
Class X at LWD & M. S. 1,000' x 105'	5	-	11	-	-	11	-	11	-	11	-	11	-	11	-	11
Total Ships in Historical Size Classes	143	-	172	-	-	146	-	137	-	120	-	110	-	108	-	107
Alternative Maximum Size Ships Required to Carry Annual Ton Miles (1):																
A. 1100 x 105 x 25.5 & 32'/36'	-	-	-	-	15	6	24	17	29	32	37	46	40	57	44	72
B. 1200 x 130 x 25.5 & 32'/36'	-	-	-	-	14	5	19	10	24	23	29	33	33	41	35	52
C. 1300 x 130 x 25.5 & 32'/36'	-	-	-	-	12	5	17	11	19	22	24	32	28	39	30	50
D. 1300 x 175 x 25.5 & 32'/36'	-	-	-	-	9	2	11	7	15	17	18	23	21	29	21	37
E. 1500 x 175 x 25.5 & 32'/36'	-	-	-	-	8	2	10	7	13	14	16	20	18	25	19	32
Grand Total of Ships for Historical Size Classes and Mutually Exclusive Alternative																
A. 1100 x 105 x 25.5 & 32'/36'	143	-	172	-	15	152	24	154	29	152	37	156	40	165	44	179
B. 1200 x 130 x 25.5 & 32'/36'	143	-	172	-	14	151	19	147	24	143	29	143	33	149	35	159
C. 1300 x 130 x 25.5 & 32'/36'	143	-	172	-	12	151	17	148	19	142	24	142	28	147	30	157
D. 1300 x 175 x 25.5 & 32'/36'	143	-	172	-	9	148	11	144	15	137	18	133	21	137	21	144
E. 1500 x 175 x 25.5 & 32'/36'	143	-	172	-	8	148	10	144	13	134	16	130	18	133	19	139

(1) Note each size alternative is mutually exclusive. Therefore, the number of ships for each alternative A, B, C, D & E are each separately added to the ships in the historical size classes.

(2) Number of ships for 32'/36' drafts is assumed to be the same due to routing and operating inefficiencies.

Table I-2

Unconstrained System With Season Extension

TOTAL SHIPS IN IRON ORE, LIMESTONE, COAL, AND GRAIN FLEET

	Base Year		1980		1990 (2)		2000 (2)		2010 (2)		2020 (2)		2030 (2)		2040 (2)	
	Number of Ships															
	25.5'		25.5'		28'	32'/36'	28'	32'/36'	28'	32'/36'	28'	32'/36'	28'	32'/36'	28'	32'/36'
Round trip ton miles 10^6																
Index																
Ship Size Allocation																
Class V 600'-649' x ≤ 75'	51	-	51	-	40	40	24	24	18	18	17	17	12	12	12	12
Class VI 650'-699' x ≤ 75'	22	-	20	-	20	20	20	20	16	12	11	9	9	9	9	9
Class VII 700'-730' x ≤ 75'	47	-	51	-	43	43	33	33	25	25	19	19	19	19	19	19
Class VIII 731'-800' x ≤ 75'	7	-	7	-	9	9	12	12	12	12	12	11	11	11	10	10
Class VIII a 800'-849' x ≤ 75'	4	-	4	-	13	13	24	24	28	28	28	28	30	30	30	30
Class VI w 650'-699' x 78'	2	-	2	-	3	3	4	4	4	4	4	4	4	4	4	4
Class VII w 700'-730' x 78'	2	-	2	-	3	3	5	5	6	6	7	7	8	8	8	8
Class VIII w 731'-849' x 92'	1	-	1	-	3	3	3	3	3	3	3	3	3	3	3	3
Class IX 858' x 105'	1	-	1	-	1	1	1	1	1	1	1	1	1	1	1	1
Class X at LWD & M. S. 1,000' x 105'	5	-	11	-	11	11	11	11	11	11	11	11	11	11	11	11
Total Ships in Historical Size Classes	142	-	150	-	146	146	137	137	124	120	113	110	108	108	107	107
Alternative Maximum Size Ships Required to Carry Annual Ton Miles (1):																
A. 1100 x 105 x 25,5 & 32'/36'	-	-	-	-	2	-	11	2	26	16	43	30	56	43	75	56
B. 1200 x 130 x 25.5 & 32'/36'	-	-	-	-	1	-	9	1	22	4	34	7	47	8	57	11
C. 1300 x 130 x 25.5 & 32'/36'	-	-	-	-	1	-	7	1	18	4	29	6	38	8	47	10
D. 1300 x 175 x 25.5 & 32'/36'	-	-	-	-	1	-	5	1	13	3	21	4	28	6	36	6
E. 1500 x 175 x 25.5 & 32'/36'	-	-	-	-	1	-	5	1	11	3	18	3	25	5	30	6
Grand Total of Ships for Historical Size Classes and Mutually Exclusive Alternative																
A. 1100 x 105 x 25.5 & 32'/36'	142	-	150	-	148	146	148	139	150	136	156	140	164	151	182	163
B. 1200 x 130 x 25.5 & 32'/36'	142	-	150	-	147	146	146	138	146	124	147	117	155	116	164	118
C. 1300 x 130 x 25.5 & 32'/36'	142	-	150	-	147	146	144	138	142	124	142	116	146	116	154	117
D. 1300 x 175 x 25.5 & 32'/36'	142	-	150	-	147	146	142	138	137	123	134	114	136	114	143	113
E. 1500 x 175 x 25.5 & 32'/36'	142	-	150	-	147	146	142	138	135	123	131	113	133	113	137	113

(1) Note each size alternative is mutually exclusive. Therefore, the number of ships for each alternative A, B, C, D & E are each separately added to the ships in the historical size classes.
(2) Number of ships for 32'/36' drafts is assumed to be the same due to routing and operating inefficiencies.

providing the vessel owner is content with freight rates yielding 10% after tax return on investment. However, the introduction of the next step, consideration of federal costs to accommodate this maximum vessel size, may indicate a lesser benefit to the nation than the one derived from accommodating a smaller maximum.

Facilities costs were estimated through establishing concept plan layouts for locks, channels, and harbors that could be expected to be used by the fleets containing the larger vessels. Material quantities are then estimated and costed for each plan layout as varied by depth.

Figure I-2 represents the conceptual system cost including amortized first cost, interest on investment, operation and maintenance and replacement costs of accommodating fleets containing the larger vessels. Such a curve exists for each vessel size, that is for each combination of length and beam, investigated.

Figure I-3 indicates the overlay of Figure I-2 on Figure I-1 to establish the intersection of the annual fleet benefits with annual federal costs of providing facilities to accommodate that fleet. Just as there is a distinct benefit curve for each fleet, there is a distinct cost curve for accommodating that fleet. The intersection points yield total benefit cost ratios of unity, or net present values of zero, giving internal rates of return equal to the specified discounting rate of 6-5/8 percent. However, criteria for selection of projects require that the net present value be maximized, which is simply another way of stating that the incremental benefit-cost ratio must equal one, and the internal rate of return will be greater than the discounting rate of return at 6-5/8 percent.

Considering the simplified case of Figure I-3, the analysis to arrive at the maximum net present value proceeds as follows:

(1) Start with the initial benefit at 25.5 draft, for Fleet I, indicated as point A.

(2) The project cost of deepening to 28 ft draft for Fleet is C', which is greater than the increased benefit A'. Therefore, the net present value is not justified.

(3) However, benefits can be increased to B, by going to Fleet II. This increases the net present value, since the benefit increase AB is greater than the cost

FIGURE I-2
HYPOTHETICAL CURVE OF
FEDERAL SYSTEM COSTS

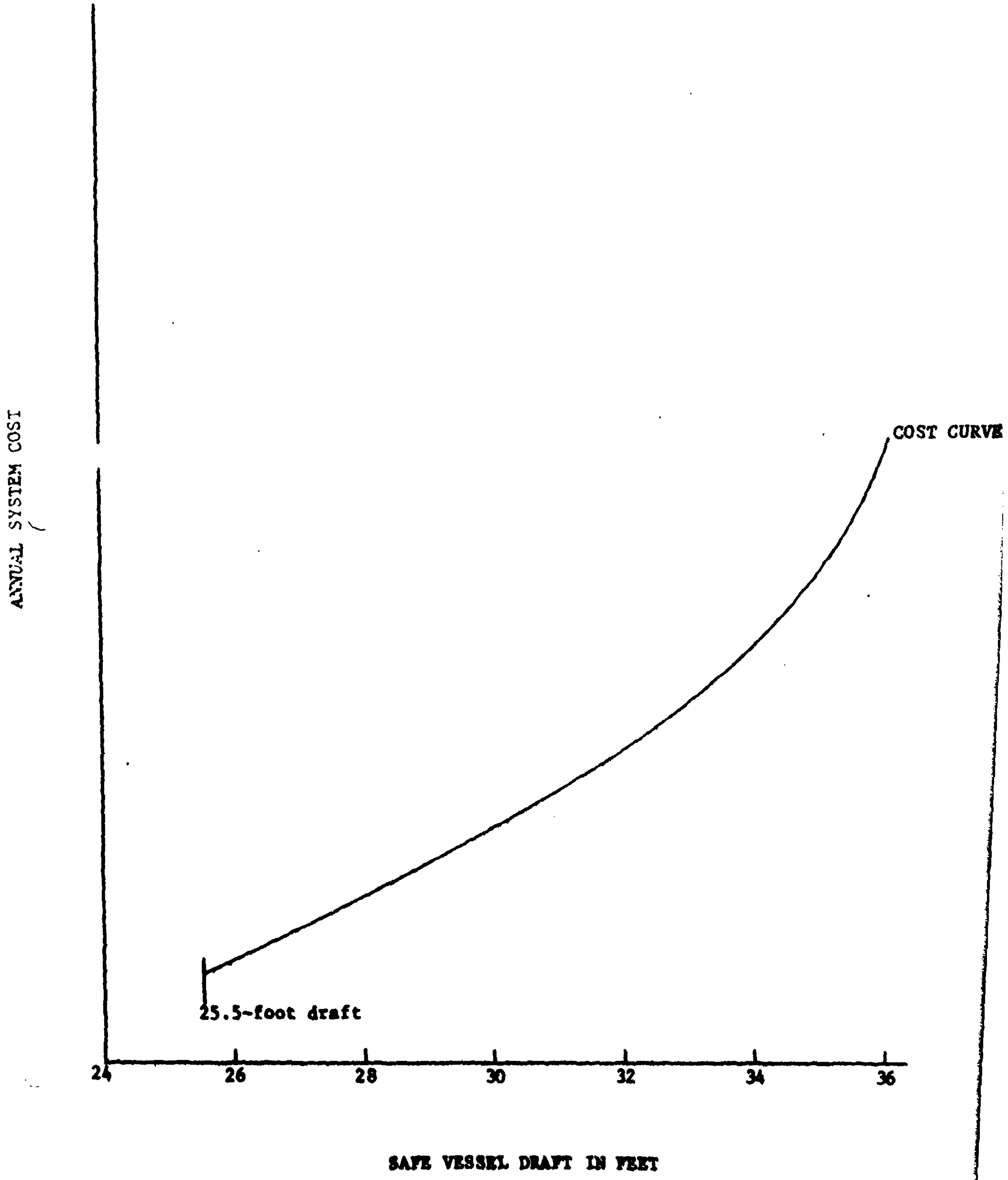
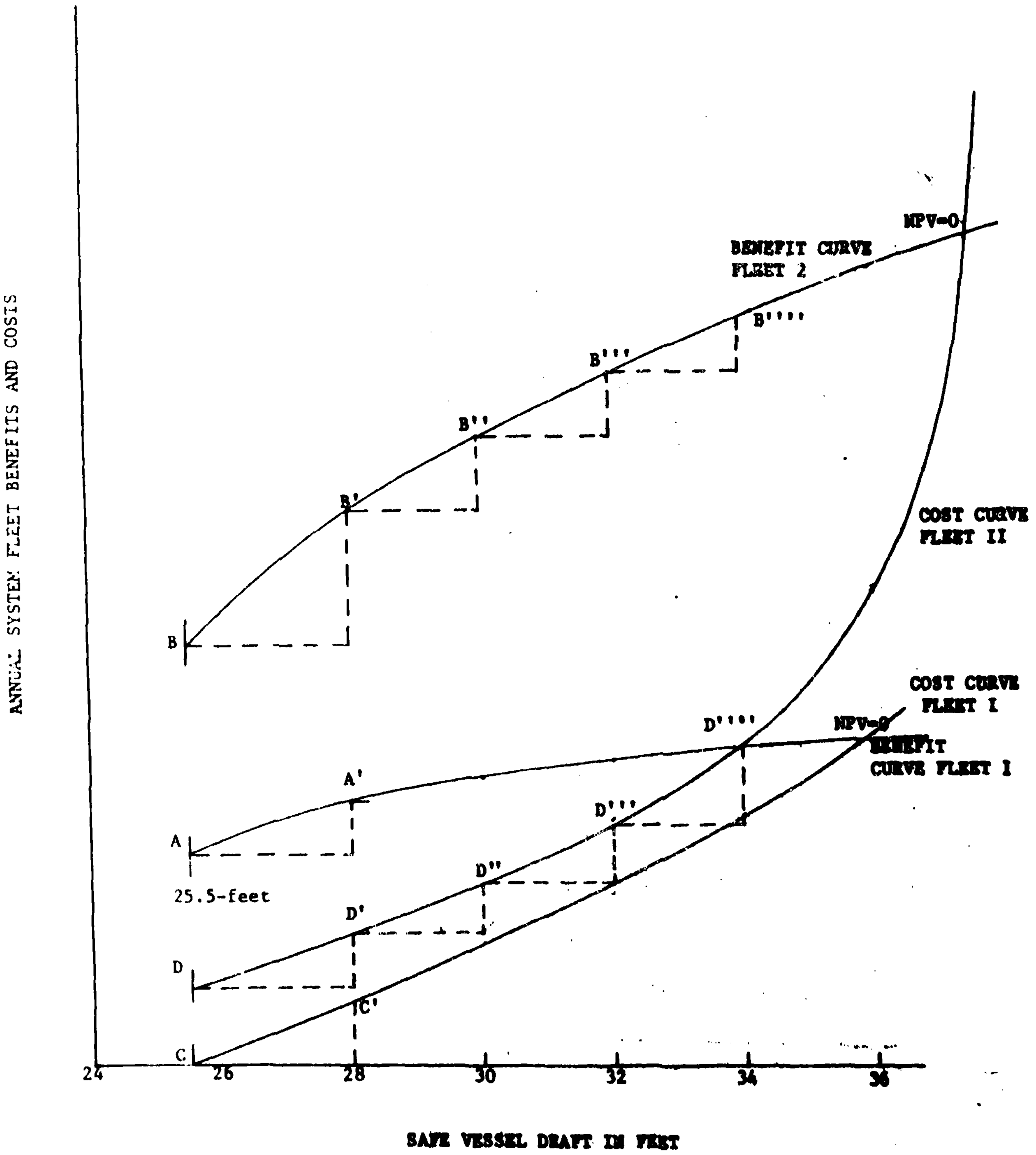


FIGURE I-3



ANNUAL SYSTEM FLEET BENEFITS AND COSTS
BENEFIT CURVE FLEET 2
NPV=0
B
B'
B''
B'''
B''''
COST CURVE FLEET II
COST CURVE FLEET I
NPV=0
BENEFIT CURVE FLEET I
A
A'
D
D'
D''
D'''
D''''
C
C'
25.5-feet
24
26
28
30
32
34
36
SAFE VESSEL DRAFT IN FEET

increase CD. Therefore, the change is recommended.

(4) Deepening to 28 ft for Fleet II further raises benefits to B'. Again, the recommendation is for the improvement, as BB' is greater than DD', and thus the net present value is again increased. Likewise, deepening to 30 ft is recommended.

(5) At 32 ft, D''D''' is about equal to B''B'''. Therefore, the incremental benefit-cost ratio is approximately unity, and the net present value is maximized. Beyond 32 ft draft, the incremental costs of dredging exceed the incremental benefits. The net present value is decreased, and thus the recommendation is to not deepen the system beyond 32 ft.

The analysis just described is performed twice, first with season extension assumed to be in existence, and second, with a larger ship size assumed to occur before season extension. In both cases, the influence of the improvement on the date at which the system reaches capacity is included. The relative worth of each scenario is presented in the form of two curves depicting the annual benefits and costs related to each scenario. The cases presented in the analysis are for an eleven-month shipping season.

II. BENEFITS

A. Vessel Design Considerations

The question of vessel size has been one of the dominant themes in the historical development of naval architecture. Historically, the trend towards larger merchant vessels has taken place in spite of a number of difficult problems in the areas of design and management associated with larger ships. Among the design problems that have arisen in connection with increased size have been structures, ship system complexity, maneuvering, and control. Management concerns have included the problems of finance of extremely large expenditures, both capital and operating, and more recently, the questions of environmental management, and the so-called "management of intangibles," among which may be included the social and regional impacts of the introduction of vessels of unprecendented size.

The underlying benefit responsible for the trend towards larger merchant vessels, in spite of the problems attendent on larger ships, can be broadly identified as the "economic advantages of scale." Briefly, the advantage of scale can be defined as follows: Merchant ships of larger sizes, generally in terms of deadweight, cost less to build and operate, per ton of cargo capacity. Conceptually, this fact is illustrated in Figure II-A-1. As shown in this figure, potential revenue increases proportionately with deadweight, while the various components of cost, both capital and operating, do not increase in direct proportion. Rather, most components of cost increase nonlinearly with vessel size, and the exponent of the increase may be substantially less than unity. Note that in Figure II-A-1, the cost curves show general trends for each individual cost component, and not the relative magnitudes of these components.

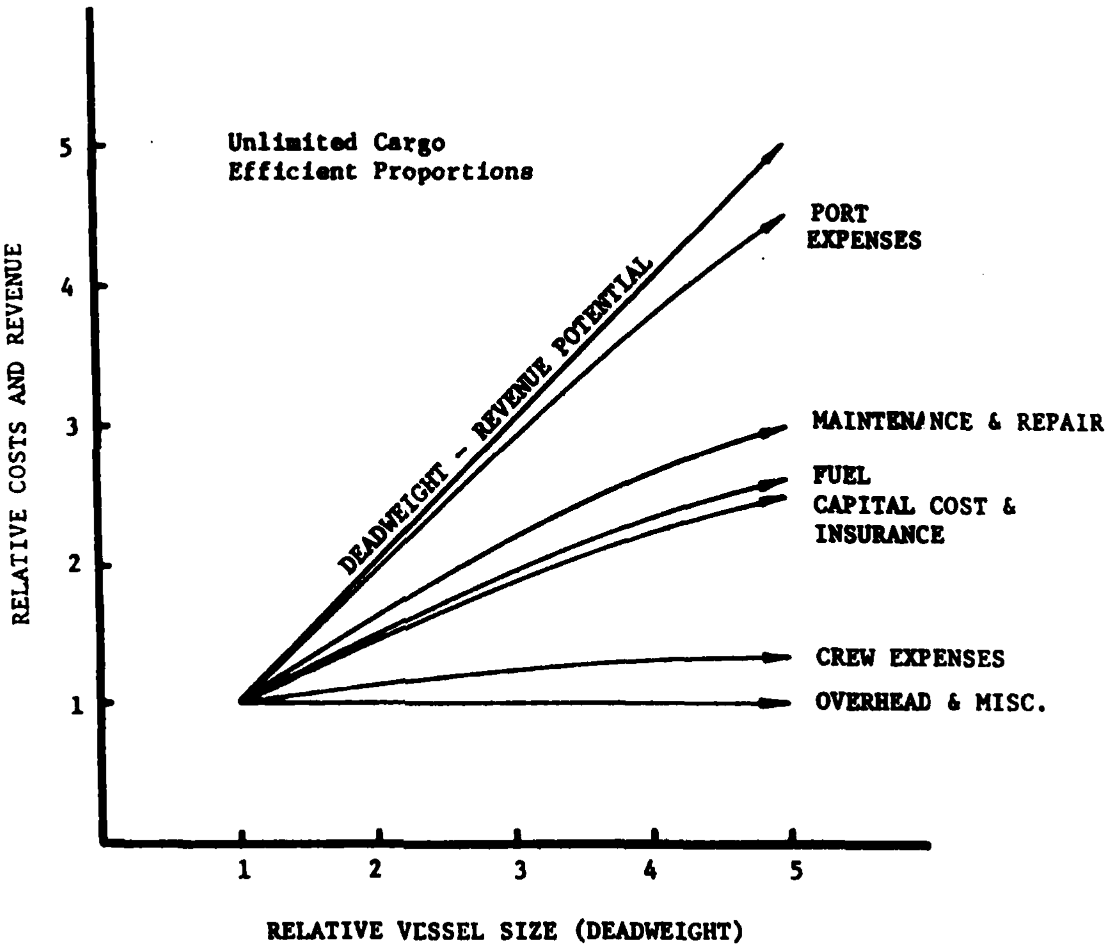
Two factors are required in order to obtain the full magnitude of the advantages of scale:

(1) Unlimited cargo. In order to generate increased revenue in proportion to the increased deadweight, cargo availability must be sufficient to fill the larger vessel.

(2) "Freedom of proportions." In order to realize the ideal cost savings, the vessel must not be forced to deviate

FIGURE II-A-1

Generalized economies of scale for merchant vessels.



widely from the proportions that yield good structural and hydrodynamic efficiency.

Thus, the advantages of scale apply with most force to those types of vessels for which cargo availability is not an over-riding issue, e.g., tankers and bulk carriers, and to vessels whose dimensions are relatively unconstrained by external factors, such as port, channel, and lock facilities. The largest classes of ocean-going tankers exemplify this relatively unconstrained situation, while Great Lakes bulk carriers clearly do not.

Significantly, over the past 20 years, the largest classes of ocean tankers have increased in deadweight by a factor of 10 or more, while the largest classes of Great Lakes bulkers have increased in size by a factor of 2.

In general, the influence of proportions on vessel economics can be summarized as follows:

(1) Increased draft, where feasible, yields significant improvements in vessel economics, as expressed in required freight rates.

(2) Increased beam may produce improvements in vessel economics, up to a point, depending on the other dimensions.

(3) Increased length may produce improvements in vessel economics, given sufficient beam and depth.

Four types of vessels were investigated for the purposes of this study, namely:

(1) Great Lakes bulk carriers suitable for the transport of coal or iron ore on intra-lake or St. Lawrence Seaway voyages.

(2) Ocean-going containerships intended primarily for Seaway services.

(3) Ocean-going bulk carriers intended primarily for Seaway services.

(4) Ocean-going general cargo ships intended primarily for Seaway services.

Principal characteristics of the vessels investigated are given in Tables II-A-1 and II-A-2. Further details of the vessels will be found in Appendix A, Ship Designs.

These concept vessels were economically modeled under alternative assumptions regarding season extension (ranging

TABLE II-A-1. Principal characteristics of Great Lakes bulk-carrier conceptual designs. All dimensions in feet.

Design	Length	Beam	Molded Depth	Operating Drafts			
1	1000	105	56	25.5	28.0	32.0	
2	1000	130	56	"	"	"	
3	1000	175	56	"	"	"	
4	1100	105	56	"	"	"	
5	1100	130	56	"	"	"	
6	1100	175	56	"	"	"	
7	1200	105	60	"	"	"	
8	1200	130	65	"	"	"	
9	1200	130	74	25.5	28.0	32.0	36.0
10	1200	175	65	"	"	"	
11	1200	175	74	25.5	28.0	32.0	36.0
12[a]	1300	130	65	"	"	"	
13[b]	1300	130	69.5	"	"	"	
14[a]	1300	130	74	25.5	28.0	32.0	36.0
15[a]	1300	175	65	"	"	"	
16[b]	1300	175	69.5	"	"	"	
17[a]	1300	175	74	25.5	28.0	32.0	36.0
18[a]	1500	175	74	"	"	"	"

a. Detailed weight estimates, structural calculations, and horsepower estimates for these vessels were performed by R.A. Stearn, Inc.

b. Design data for these vessels was interpolated by R.A. Stearn, Inc. All other vessels were derived from these designs, using weight and cost relationships interpolated by the Department of Naval Architecture and Marine Engineering, University of Michigan.

TABLE II-A-2. Principal characteristics of conceptual designs for St. Lawrence Seaway ocean-going vessels. All dimensions in feet.

Vessel Type	Length	Beam	Molded Depth	Ocean Draft	Seaway Drafts			
Container	730	75	55.0	32.0	25.5	28.0	32.0	
Container	925	105	68.5	34.0	25.5	28.0	32.0	34.0
Bulk carrier	730	75	55.5	35.0	25.5	28.0	32.0	34.0
Bulk carrier	1000	130	70.5	48.0	25.5	28.0	32.0	36.0
Break-bulk	730	75	48.0	32.0	25.5	28.0	32.0	

from 9 to 11-month shipping seasons), and at drafts ranging from 25.5 to 36 feet. For each case, the economic result was expressed as a required freight rate (RFR), which is defined as the freight rate which must be charged to secure a specified 10% return on investment, after a 48% corporate tax. These required freight rates were then used in defining dollar benefits due to reduced transport costs, and in determining the competitive position of the waterborne mode with respect to alternative modes, as described in Section II.C., Economic Benefits. The results of the required freight study are presented in the following section.

The following general conclusions have been reached, based on the required freight rate study described:

(1) Points of diminishing returns are reached on any particular dimensional enlargement, with the exception of draft, within the limits of this study. In particular, at a draft of 25.5 ft, the optimum length for a beam of 105 ft was found to be between 1000 and 1100 ft. At a beam of 130 ft, the optimum length increased to 1200-1300 ft.

(2) Without an increase in system draft, there is little improvement in economic performance to be found in an increase of beam from 130 ft to 175 ft. However, the improvement is greater for 1300 ft vessels than for 1200 ft vessels.

(3) Improvements in vessel economics are relatively slight beyond dimensions of 1200 ft x 130 ft, at drafts between 25.5 ft and 36 ft.

(4) For ocean-going types, improvements due to the advantages of scale will be more applicable to bulk carriers than to container or break-bulk vessels.

B. Required Freight Rate Results

Required freight rates were developed for each of the vessels described in the previous section, on a number of routes. The routes modeled were as follows:

Great Lakes Bulk Carriers: Duluth - Chicago
Two Harbors - Cleveland waterfront
Duluth - Baie Comeau, with backhaul from Sept Isles to Cleveland waterfront

Containerships:	Rotterdam - Montreal - Detroit-Chicago
	Yokohama - Montreal - Detroit - Chicago
	Rotterdam - Montreal - Cleveland-Detroit
Ocean Bulk Carriers:	Chicago - Rotterdam, topping off at Baie Comeau. Empty backhaul.
	Duluth - Yokohama, topping off at Baie Comeau. Empty backhaul.
Break-Bulk Cargo Ship:	Rotterdam - Montreal - Detroit-Chicago
	Yokohama - Montreal - Detroit - Chicago

The results of the required freight rate analysis for Great Lakes bulk carriers are presented graphically in Figure II-B-1 for the representative route Duluth-Chicago. Cross curves of required freight rate versus length and beam are given in Figure II-B-2 for the route Duluth-Chicago at drafts of 25.5 ft and 32 ft. Results for the other routes are quite similar.

These curves show the relative magnitude of the influences of length, beam, and draft on vessel economics. The influence of draft is the most striking, regardless of the other dimensions, while increases in beam or length are found to reach a point of diminishing return, depending on the draft. Similarly, increases in length/beam ratio and beam/draft ratio beyond a certain point are seen to be counterproductive, at least from the standpoint of the required freight rate.

A series of runs was also made to investigate the influence of vessel design speed on required freight rate. This analysis showed that the effect of speed on required freight rate is slight, for speeds ranging between 13.5 and 16.5 statute miles per hour, with an optimum falling between 14.5 and 15 mph. Over the range of speeds investigated, the increase in RFR from the optimum did not exceed 1.3 percent. For this reason, all required freight rate data used in the evaluation of benefits was taken at a speed of 15 mph.

FIGURE II-B-1
Required Freight
Rates for Great
Lakes Vessels

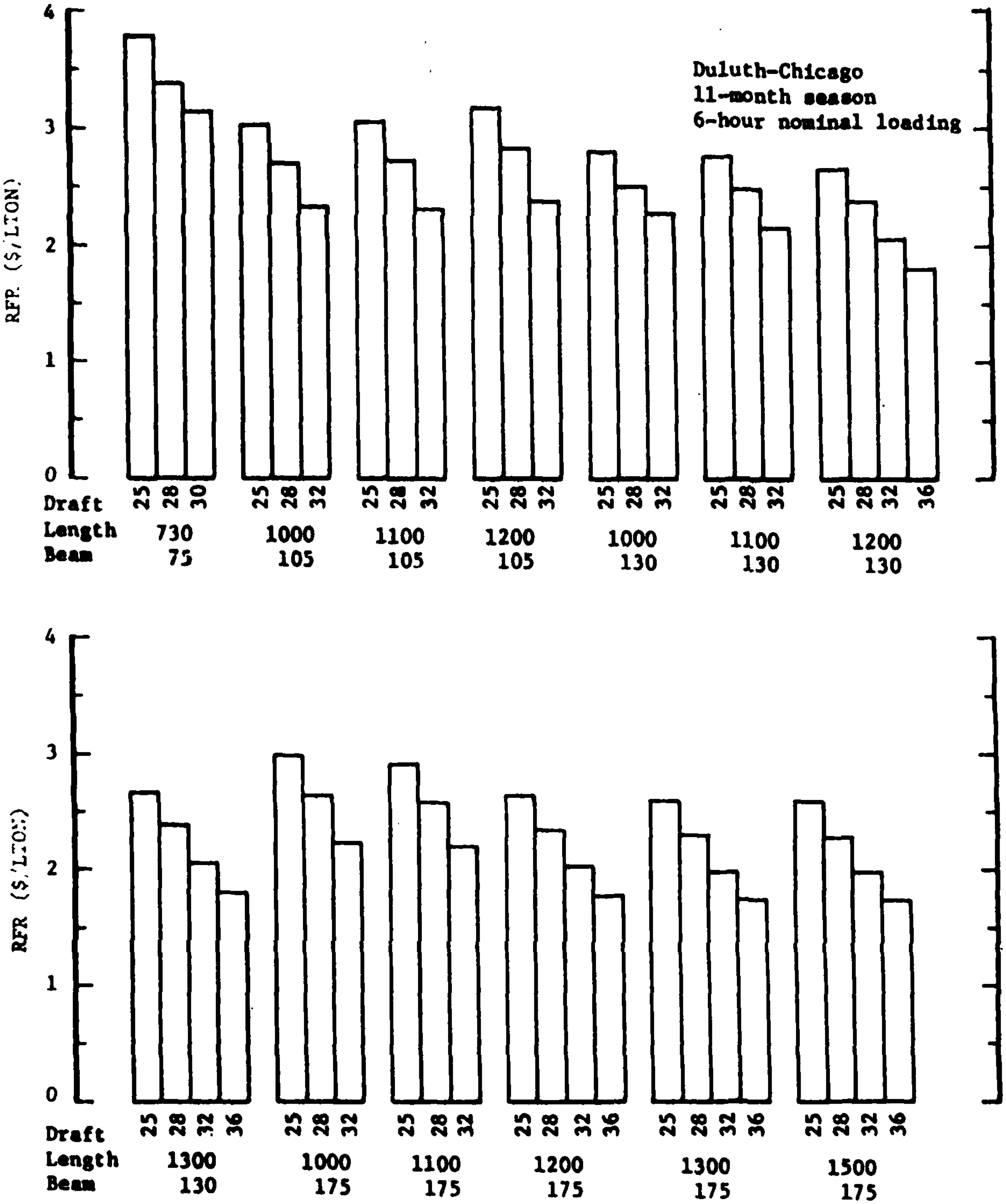
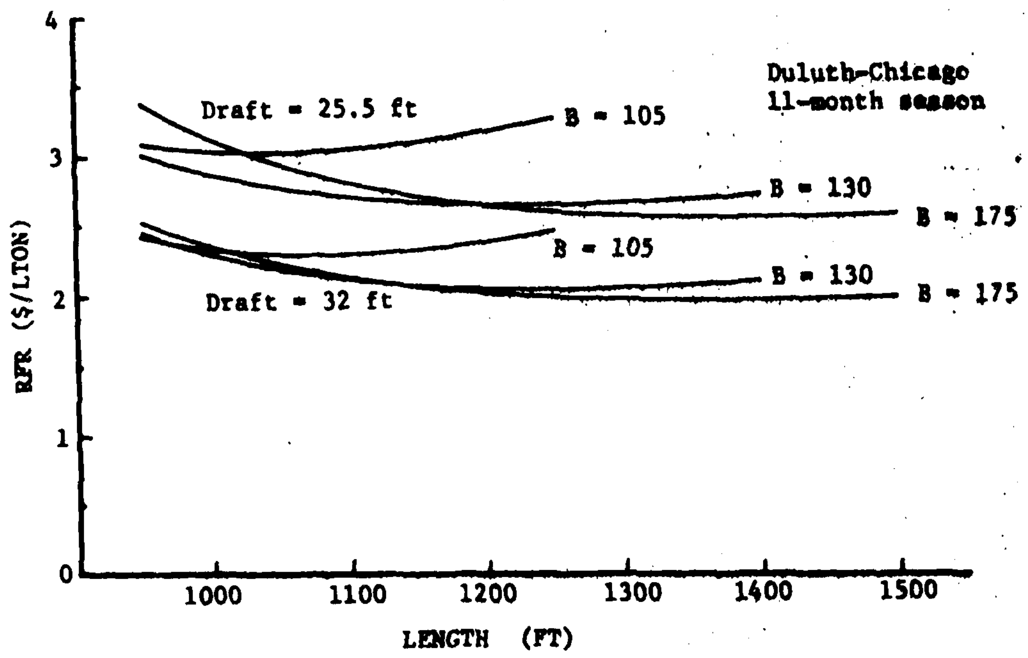


FIGURE II-B-2
Required Freight Rate
versus Length
Beam
Draft



Required freight rate results for ocean-going containerships, bulk carriers, and break-bulk vessels are shown graphically in Figures II-B-3 through II-B-5, respectively.

Further details of the required freight rate analysis, including capital and annual cost breakdowns for the various vessels, tabulations of the actual required freight rates, and sample computer runs, will be found in Appendix A, Ship Designs.

FIGURE II-B-3
Required Freight Rates
Container Cargo
Chicago-Detroit-Montreal
Rotterdam.

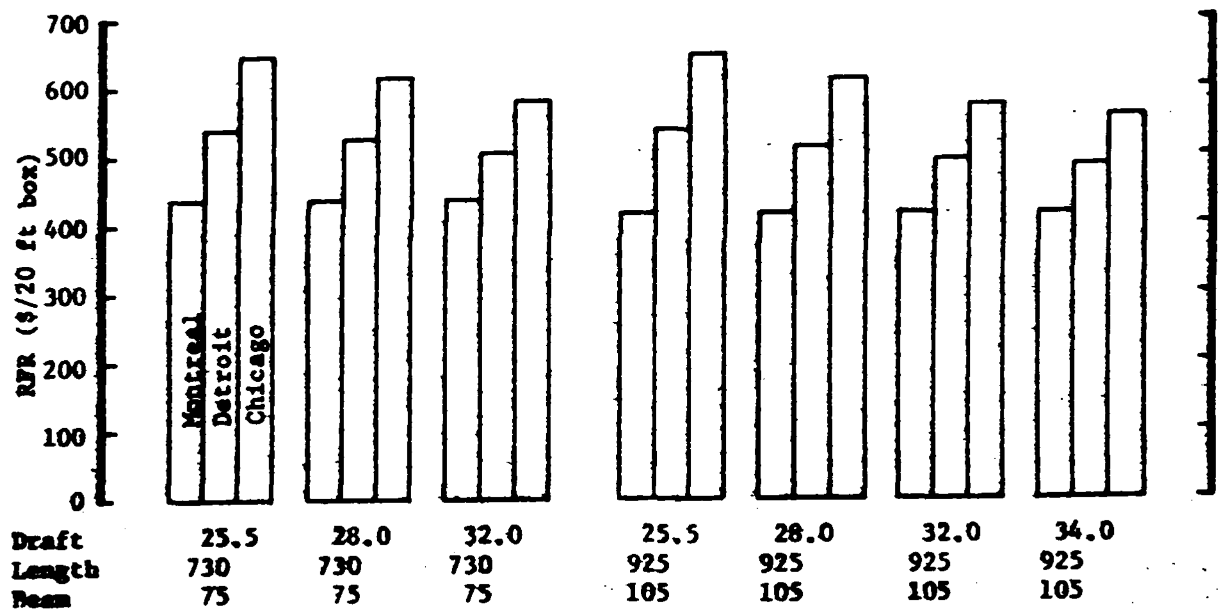


FIGURE II-B-4
Required Freight Rates
Bulk Cargo
Duluth-Rotterdam
Top-off at Baie Comeau
Empty Backhaul

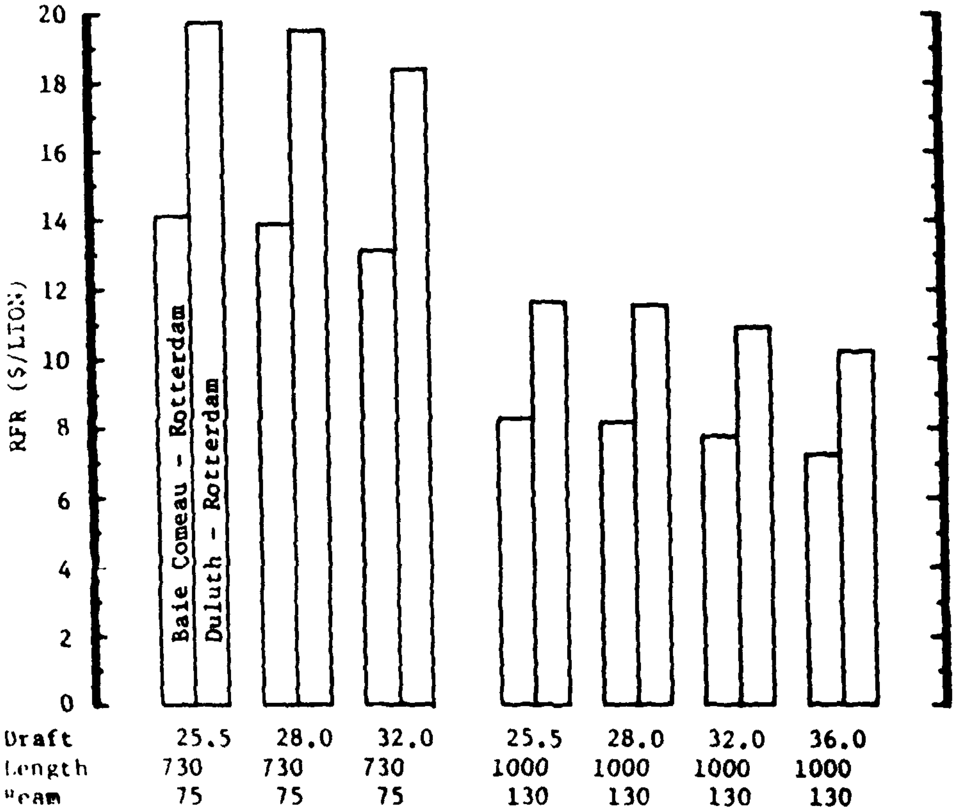
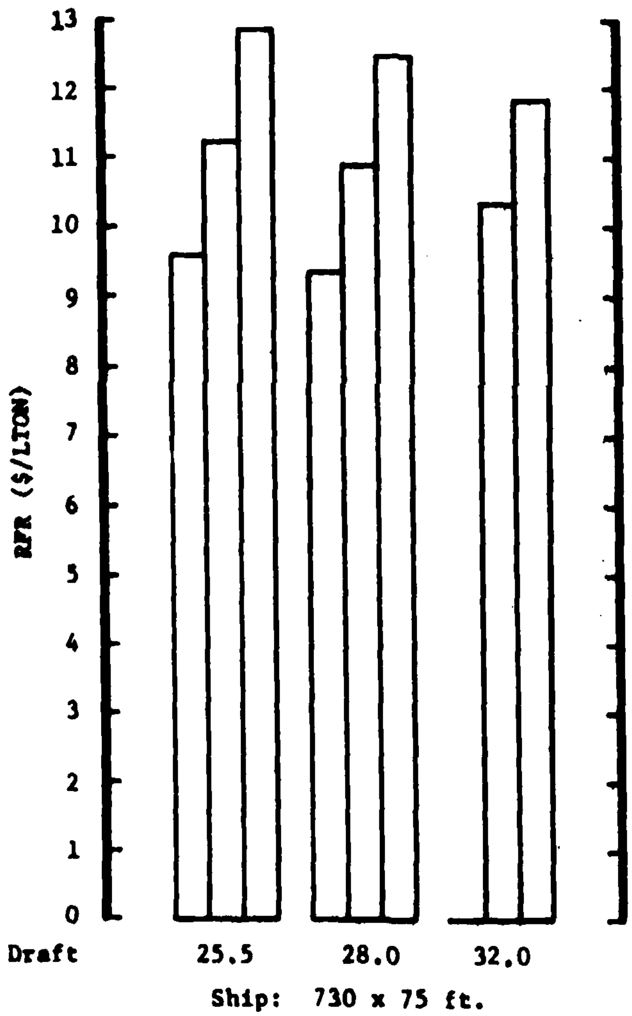


FIGURE II-B-5
Required Freight Rates
Break-Bulk Cargo
Chicago-Detroit-Montreal
Rotterdam.



C. Economic Benefits

The economic benefits of permitting larger maximum vessel sizes on the St. Lawrence Seaway and Great Lakes arise from three major factors. Firstly, an economic benefit would result from the maintenance of or increased market share of traffic induced to the Great Lakes system vs. the alternative coast, because of improved service and lower transportation costs realized by the larger and more efficient vessels. Secondly, the overseas tonnage carried as part of the current base conditions would also benefit from this resulting lower cost basis. Thirdly, the Great Lakes domestic tonnage, which has essentially reached its entire potential share, would benefit through the ability to move this tonnage at a lower cost.

The economic analysis proceeded as follows:

1. Hinterland trade forecasts (cargo projections) and development of Great Lakes -- St. Lawrence Seaway waterborne potential.

2. Application of ship size and depth scenarios to determine potential RFR savings.

3. Results and description of benefit scenarios.

4. Analysis of system-capacity impacts.

These steps are explained in greater detail below.

1. <u>Hinterland trade forecasts and development of waterborne potential</u>.

The forecasts of hinterland trade are associated with forecasts of real economic demand and development, both foreign and domestic. Conceptually, this analysis results in graphical representations of the form of Figure II-C-1. In the figure, the upper curve indicates the total Great Lakes waterborne susceptible traffic, annual tonnage as a function of time. The second curve, labelled "potential tonnage," represents the tonnage that would be captured by the Great Lakes Seaway System under current freight rate savings and service parity with coastal ports. This curve thus represents the system's maximum possible share, the upper bound which can be approached through system improvements such as enlarged vessel size and season extension.

Additional curves below this potential tonnage reflect the capacity of the system, as well as the effects of various improvements on this capacity. The influence of various types of improvements on the capacity date of the system will be discussed further in part 4 of this section.

Real Gross National Product has increased about 3.4% per year from the period 1946 to 1976. The decade 1960-1970 showed a higher rate of about 4.0% a year. Long term trends for the entire period 1890 through 1970 show an average annual increase of real GNP amounting to 3.3%. The A. T. Kearney extrapolation of Data Resources, Inc., Summer 1975, Long Term Forecast shows U.S. Gross National Product forecast ranges from a high rate of 5.3% to 1980, and then tapers off to 4.5% in 1985, 4.0% in 1990, and 3.8% for the period 1990-2040. This forecast was modified downward to reflect the Data Resources Fall 1977 forecast. A 3.3% U.S. GNP growth forecast was used in this work, with income elasticities of unity. These assumptions result in commodity growth rates of about 3.3%. The historical and projected trends in GNP are shown in Figures II-C-2 and II-C-3. Figures II-C-4 and II-C-5 show the impact on all commodities and general cargo traffic at selected growth rates. Figures II-C-6 through II-C-8 provide a historical display of overseas imports and exports for the years 1965-1976 for the U.S. and Great Lakes.

FIGURE II-C-1
TOTAL GREAT LAKES POTENTIAL GENERAL CARGO FLOW
3.3% TRAFFIC GROWTH - SERVICE EQUALS SEASON EXTENSION,
CONTAINER AVAILABILITY, EQUAL SHIPMENT TIME, AND RELIABILITY

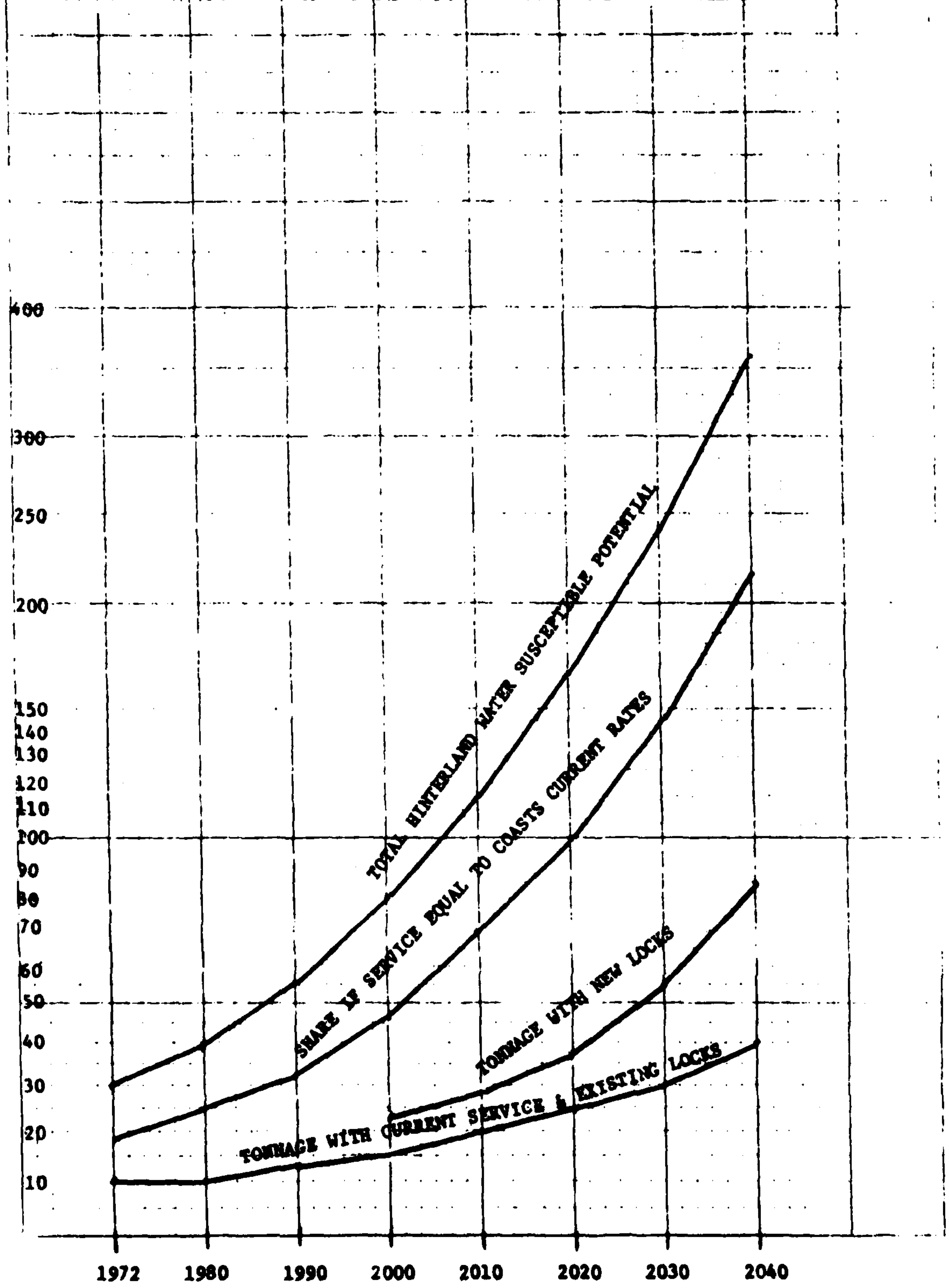
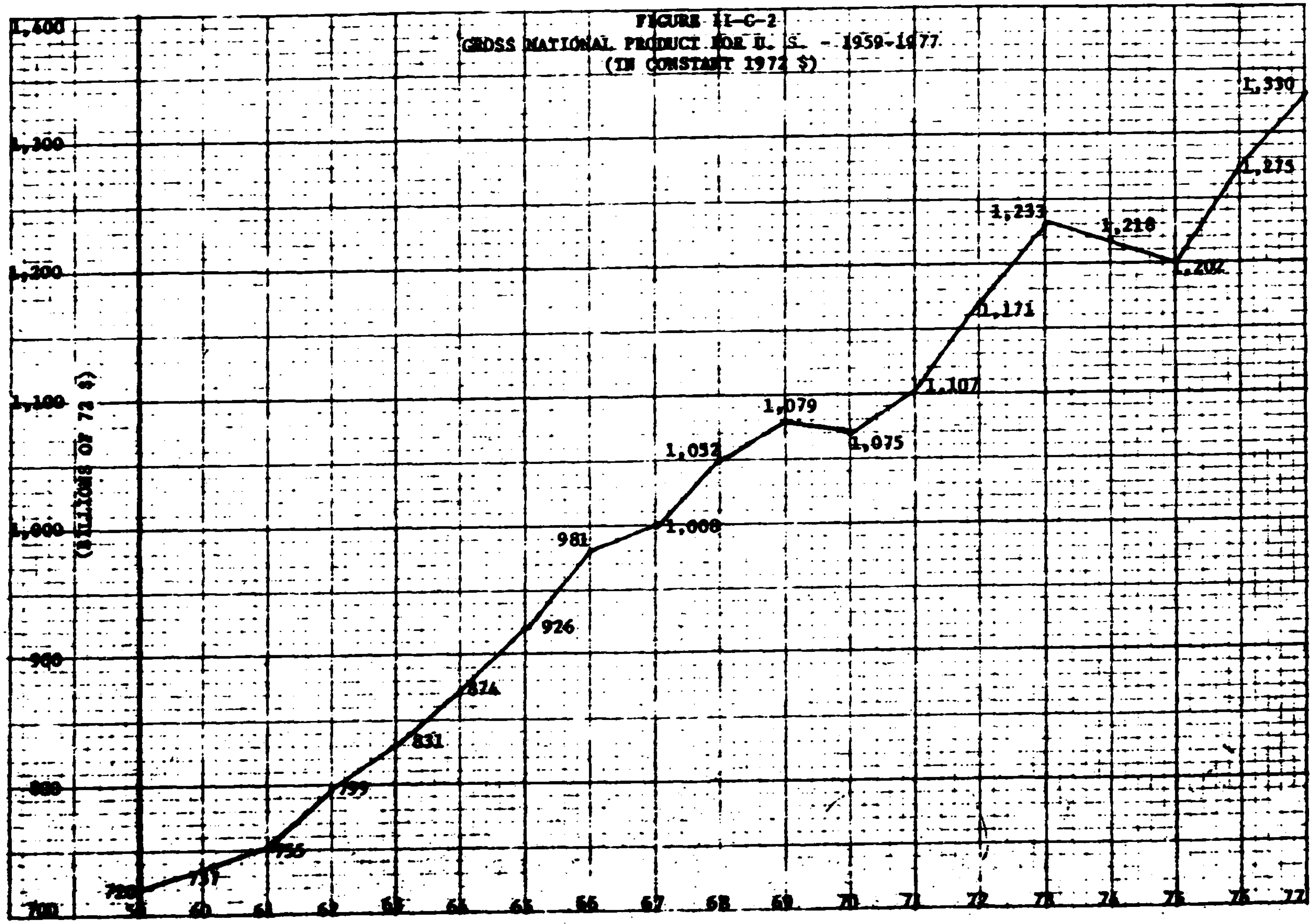


FIGURE II-C-2
GROSS NATIONAL PRODUCT FOR U. S. - 1959-1977
(IN CONSTANT 1972 $)



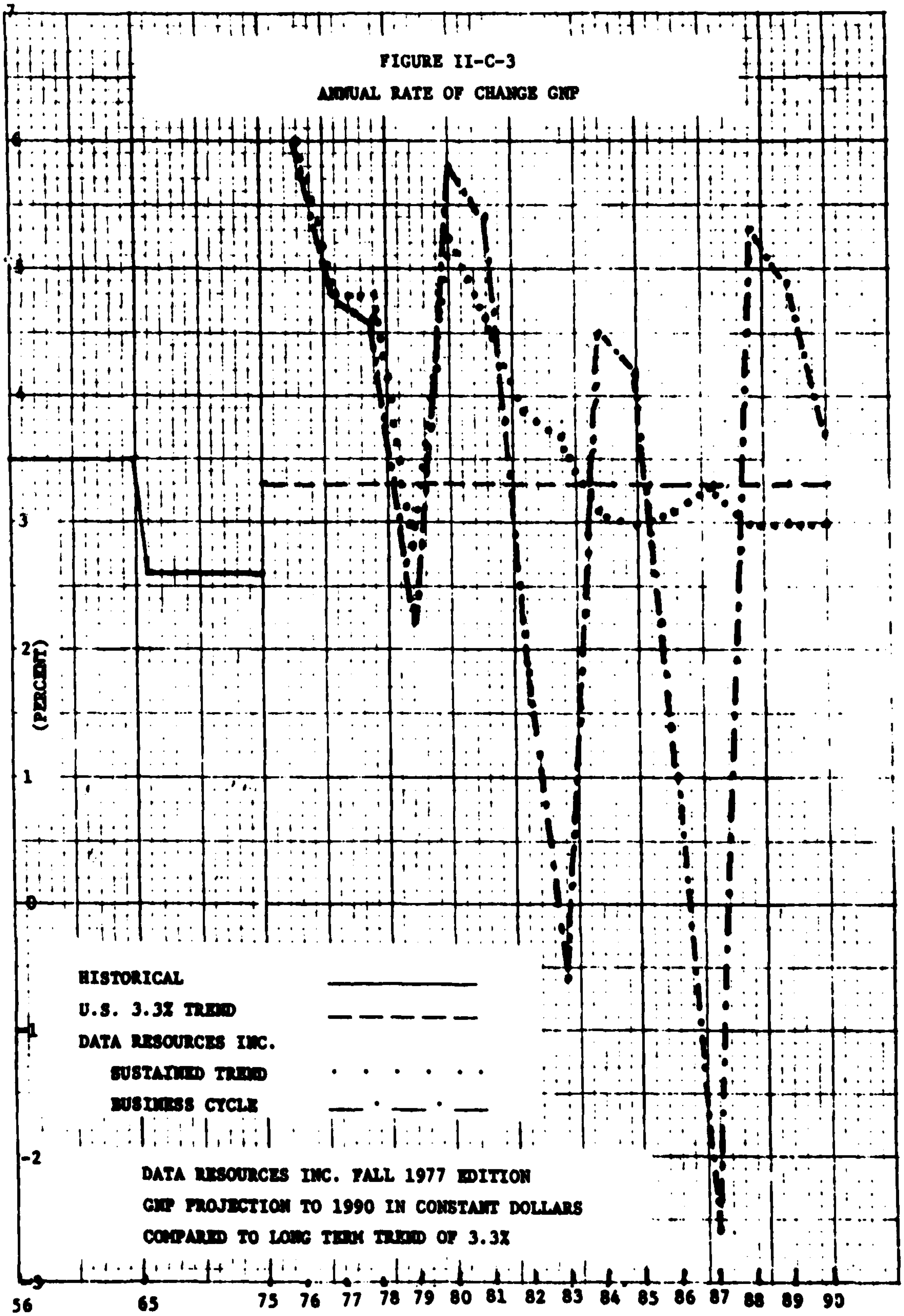
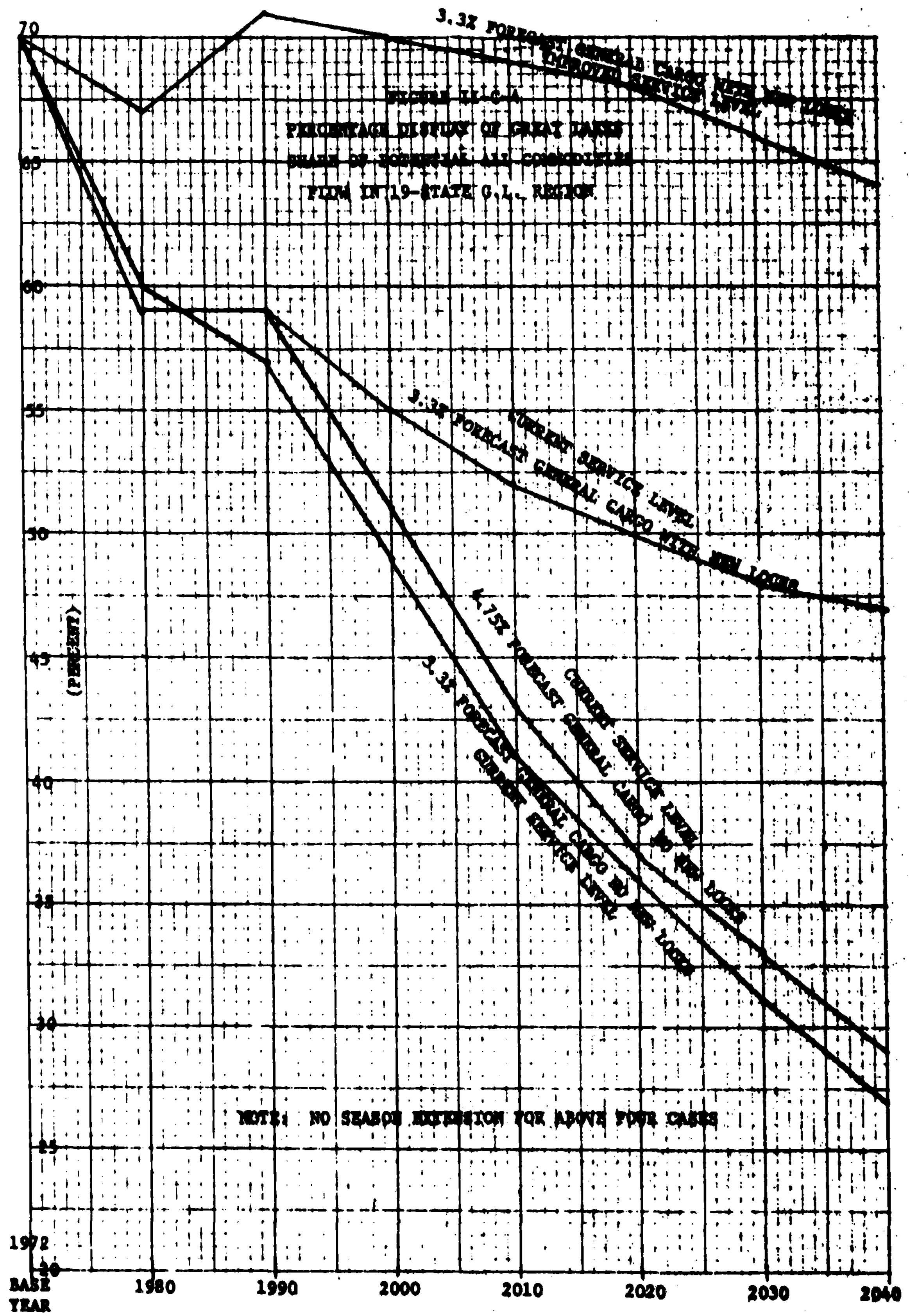


FIGURE II-C-3

ANNUAL RATE OF CHANGE GNP


FLOW IN 19-STATE G.L. REGION
3.3% FORECAST GENERAL CARGO WITH NEW LOCKS
IMPROVED SERVICE LEVEL
3.3% FORECAST GENERAL CARGO WITH NEW LOCKS
CURRENT SERVICE LEVEL
4.75% FORECAST GENERAL CARGO NO NEW LOCKS
CURRENT SERVICE LEVEL
3.3% FORECAST GENERAL CARGO NO NEW LOCKS
CURRENT SERVICE LEVEL
NOTE: NO SEASON EXTENSION FOR ABOVE FOUR CASES
(PERCENT)
70
65
60
55
50
45
40
35
30
25
20
1972
BASE
YEAR
1980
1990
2000
2010
2020
2030
2040

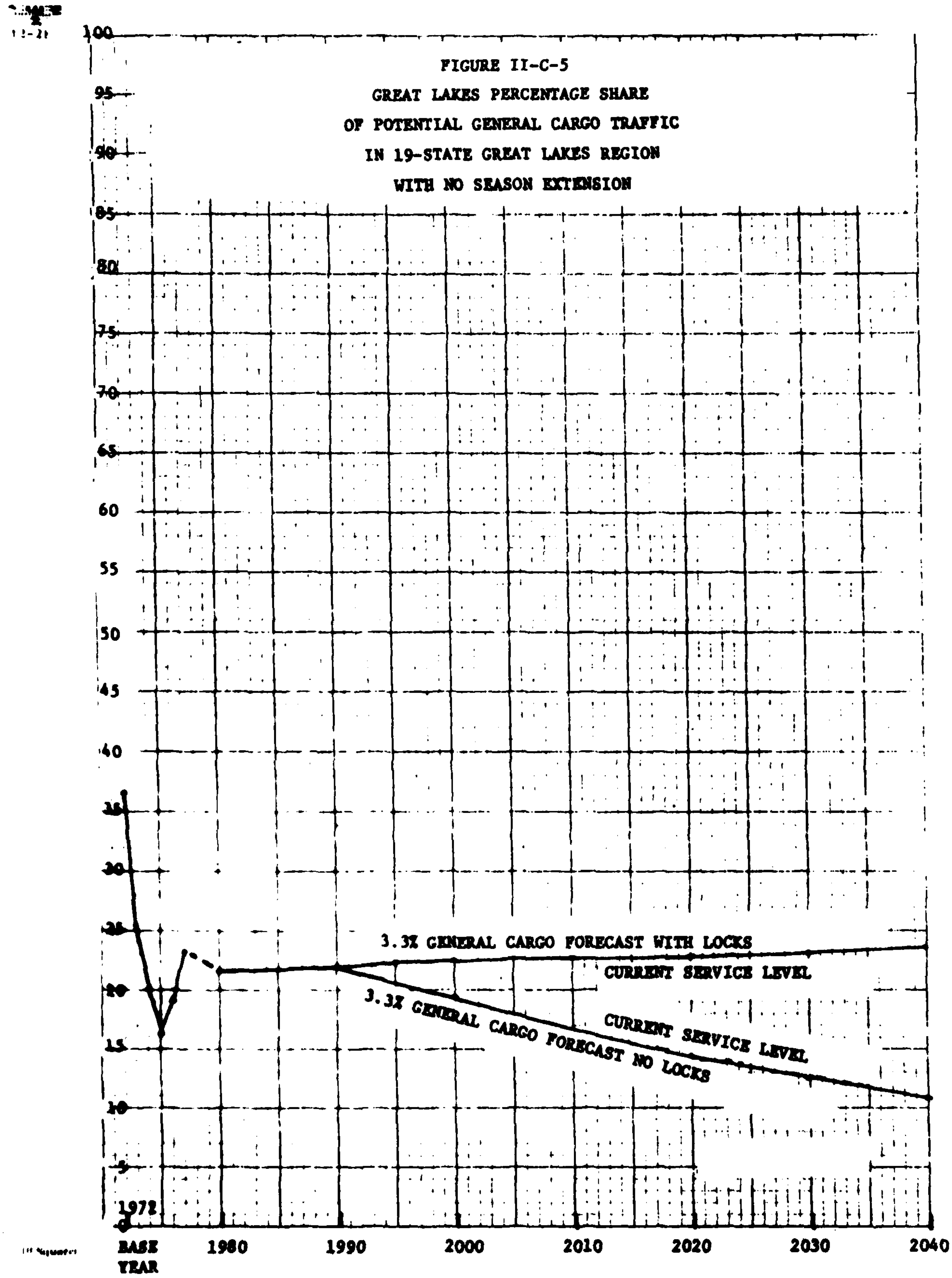
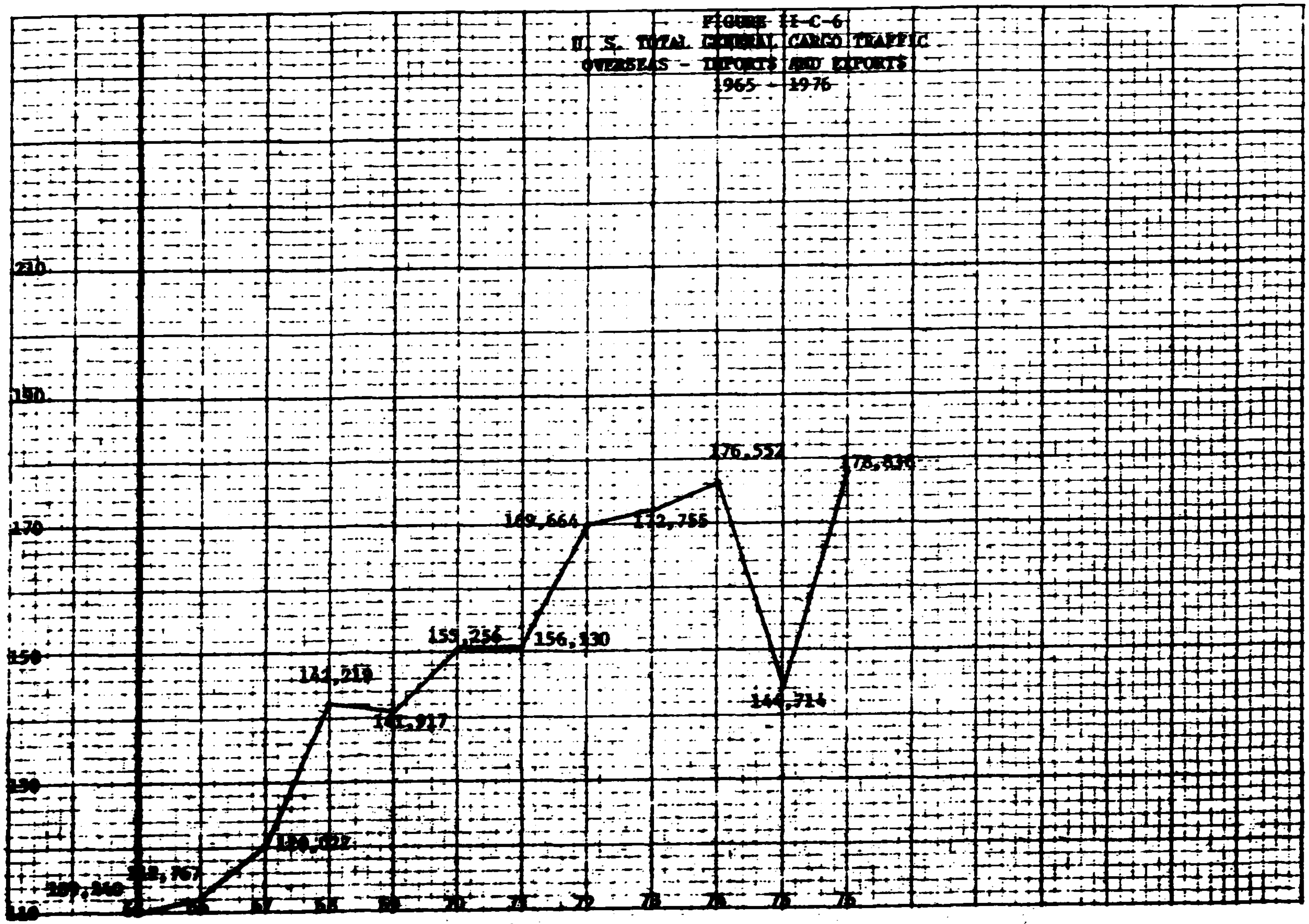


FIGURE II-C-5
GREAT LAKES PERCENTAGE SHARE
OF POTENTIAL GENERAL CARGO TRAFFIC
IN 19-STATE GREAT LAKES REGION
WITH NO SEASON EXTENSION
100
95
90
85
80
75
70
65
60
55
50
45
40
35
30
25
20
15
10
5
0
1972
BASE YEAR
1980
1990
2000
2010
2020
2030
2040
3.3% GENERAL CARGO FORECAST WITH LOCKS
CURRENT SERVICE LEVEL
3.3% GENERAL CARGO FORECAST NO LOCKS
CURRENT SERVICE LEVEL



OVERSEAS - IMPORTS AND EXPORTS
1965 - 1976
210
190
170
150
130
110
169,664
172,755
176,552
155,256
156,130
141,917
144,714
67
70
71
72
73
74
75
76

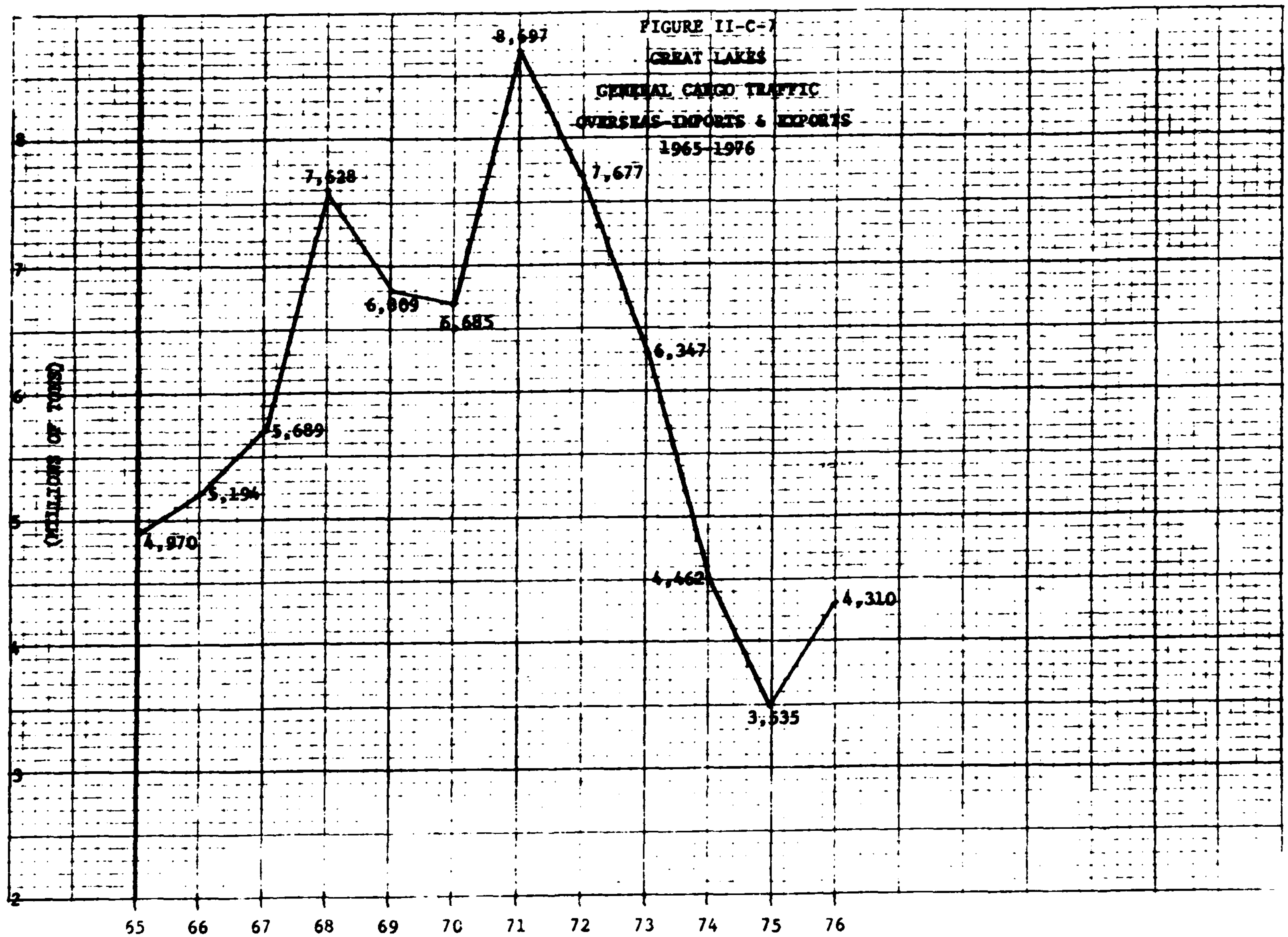
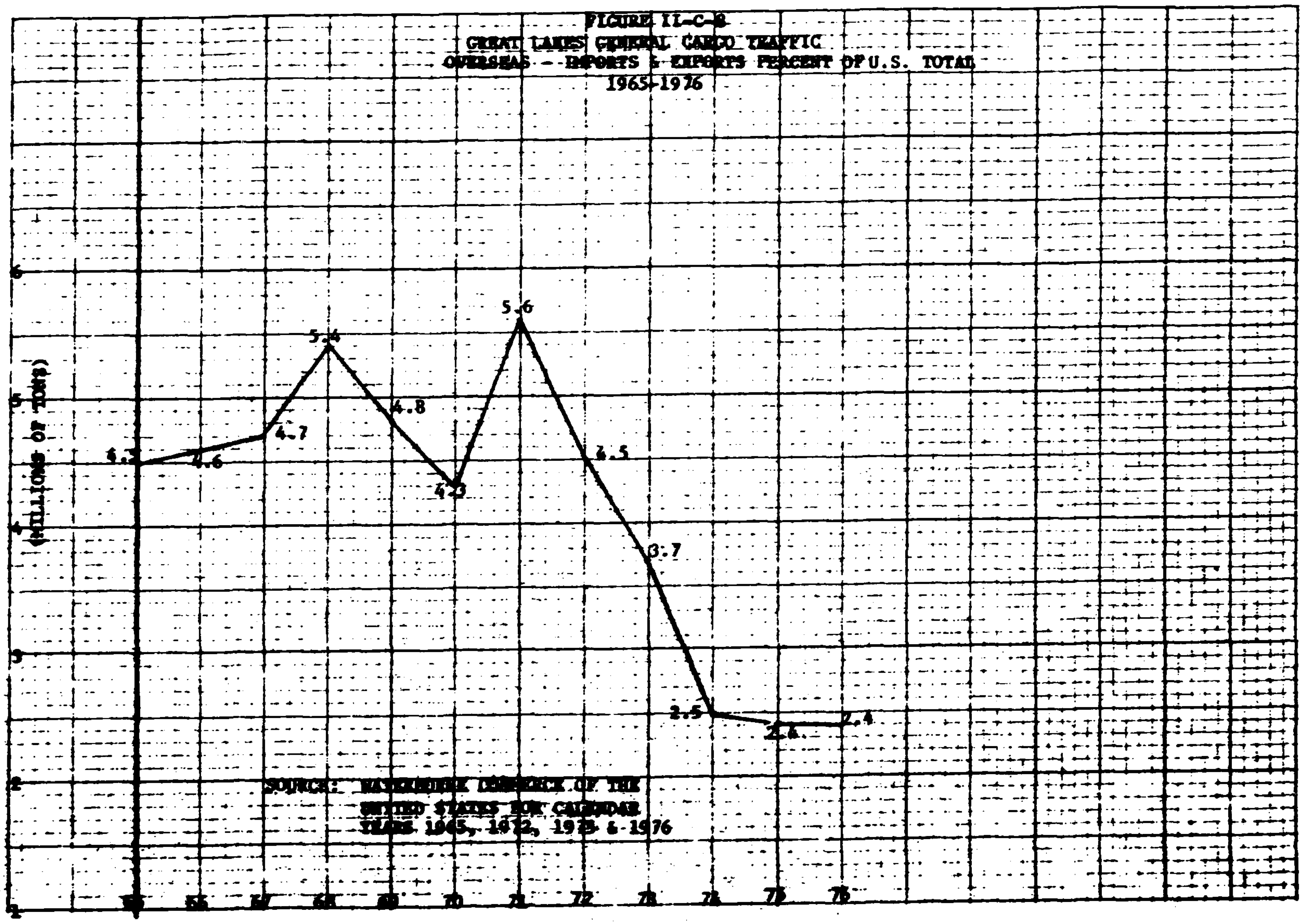


FIGURE II-C-7
GREAT LAKES
GENERAL CARGO TRAFFIC
OVERSEAS-IMPORTS & EXPORTS
1965-1976
(MILLIONS OF TONS)
8,697
7,628
7,677
6,809
6,685
6,347
5,689
5,194
4,970
4,462
4,310
3,535
2
3
4
5
6
7
8
65
66
67
68
69
70
71
72
73
74
75
76

FIGURE II-C-8
GREAT LAKES GENERAL CARGO TRAFFIC
OVERSEAS - - IMPORTS & EXPORTS PERCENT OF U.S. TOTAL
1965-1976



AD-A095 082 CORPS OF ENGINEERS BUFFALO N Y BUFFALO DISTRICT F/G 13/2
ST. LAWRENCE SEAWAY N.Y. FEASIBILITY STUDY FOR ADDITIONAL LOCKS--ETC(U)
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St. Lawrence Seaway total traffic actual 1958-1976 and original tolls committee estimate is shown on Figure II-C-9. The St. Lawrence Seaway general cargo traffic 1959-1977 is shown on Figure II-C-10.

The Great Lakes Traffic Model starts with a standard U.S. and overseas forecast of GNP and the resulting general cargo flows from an income elasticity coefficient for foreign trade. The bulk cargo forecasts were developed from the expert judgment of the U.S. Department of Agriculture and Bureau of Mines. Additional original work was accomplished to further refine the potential for western coal movements. In initial test benefit runs, the A. T. Kearney low forecast of 4.75% was selected for general cargo, and the medium forecast of 2.1% was used for bulk movements. All benefits have been re-calibrated on the basis of a general cargo forecast of around 3.3%. Cargo projections are discussed in greater detail in the Appendix B Section on Fleet Mix Forecasts.

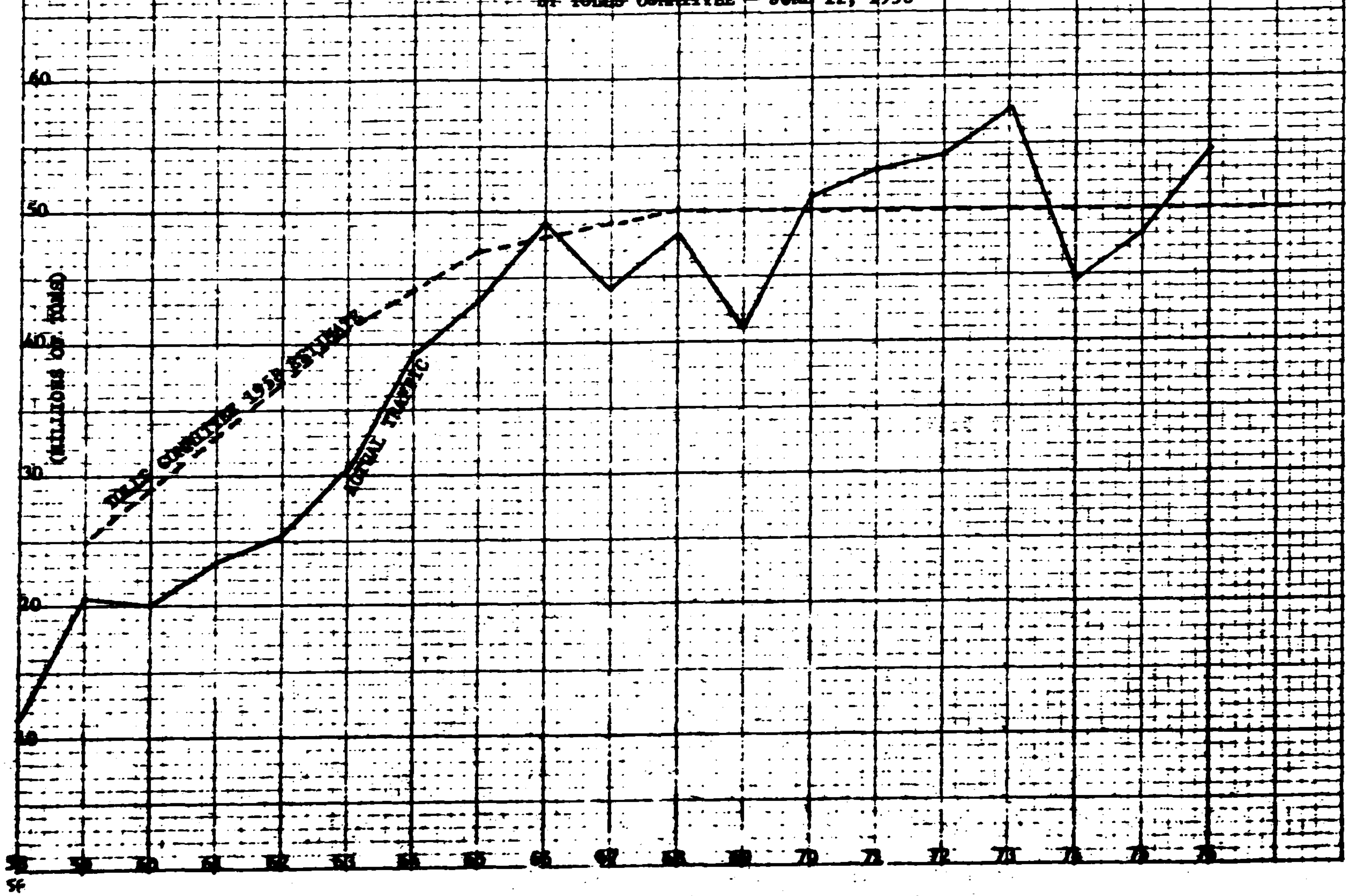
2. Application of ship size and depth scenarios to determine potential RFR savings.

This work was accomplished by applying the Great Lakes Traffic Model to the GNP and commodity forecasts, utilizing required freight rates developed for the larger ship sizes by the Department of Naval Architecture and Marine Engineering, University of Michigan.

The University of Michigan Required Freight Rate Study shows substantial savings resulting from enlarged maximum ship sizes up to 1000 x 130 foot for overseas vessels and 1200 x 130 foot vessels in the domestic trade. Application of these savings to the domestic fleet was applied through the ageing of the current fleet and building new maximum size ships to carry cargo tonnage beyond the capacity of the existing fleet. In 1980 the range of savings from lock size and deepening alternatives was 1% to 14% and this savings range increased to 12% and 24% by 2040 for the domestic laker fleet. The Appendix B Section on Fleet Mix Forecasts contains these ageing tables and RFR indices.

Because of current ocean ship sizes which reflect world conditions and not Great Lakes constraints, and an economic life less than half that of Great Lakes bulk carriers, no ageing process of current fleet is required.

FIGURE II-C-9
ST. LAWRENCE SEAWAY TRAFFIC - ACTUAL & ESTIMATED
BY TOLLS COMMITTEE - JUNE 12, 1958



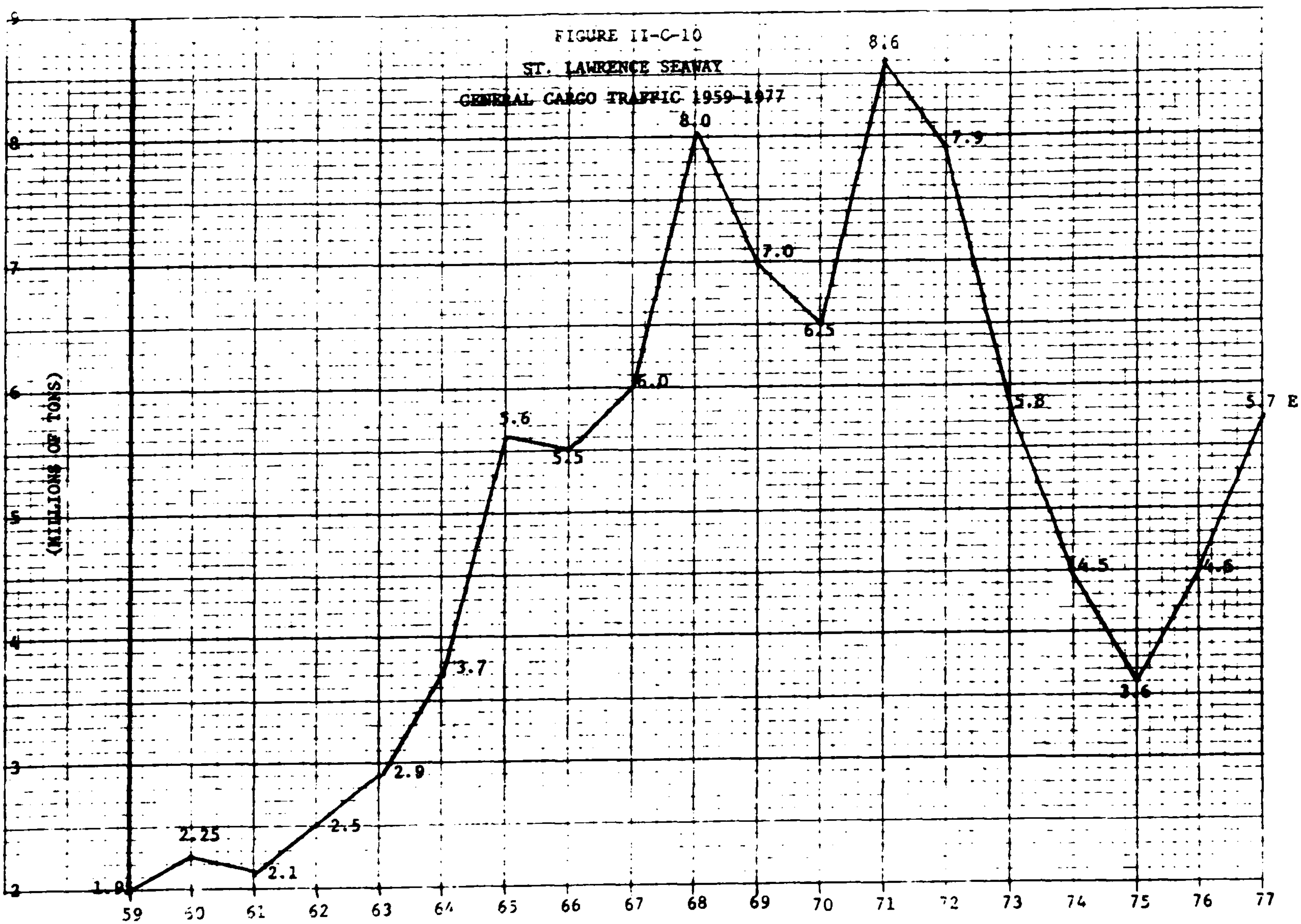


FIGURE II-C-10
ST. LAWRENCE SEAWAY
GENERAL CARGO TRAFFIC 1959-1977
(MILLIONS OF TONS)
2
3
4
5
6
7
8
9
59
60
61
62
63
64
65
66
67
68
69
70
71
72
73
74
75
76
77
1.9
2.25
2.1
2.5
2.9
3.7
5.6
5.5
6.0
8.0
7.0
6.5
8.6
7.9
5.8
4.5
3.6
4.6
5.7 E

The required freight rates for ocean ships were used without the need to age existing ships for changing fleet composition. Ocean ships face both greater physical deterioration in the salt water and greater economic obsolescence because of world wide trends towards ships of large scale. Also, ocean ships using the Great Lakes are built to reflect all trade routes. During the time that locks are being built, ship owners and builders can anticipate the larger size locks for those Great Lakes trade specific ships. On the other hand, the fresh water of the Great Lakes makes possible a long engineering as well as economic life for these ships. For these reasons the existing fleet was aged and the proportion of cargo carried in maximum ship size determined from the need to carry tonnage that the existing fleet cannot handle. The ocean bulk ship would enjoy a savings of 48%, the ocean container ship 14% and the ocean break bulk general cargo ship 8% from the base case for the largest size and depth alternative. See Appendix B for tabular data.

The relative performance of each alternative ship size change RFR was compared with the RFR of the Base Fleet. The percentage differential was weighted by the % of cargo carried by the base fleet ships and the maximum size ships. The resulting Required Freight Rate charges from the base case with improvement is shown for general cargo ships and in ocean ships in Appendix B Tables. For the domestic bulk fleet note that the percentage performance improves with time as the older ships drop out of the fleet. However, the ocean ships immediately respond to the full potential of the larger locks.

The percentage changes in cost basis after fleet mix effects was applied to the water leg of the Logistics Price File. This Logistics Price File is a summary of land leg tariffs, port charges, and water tariffs. The Great Lakes ocean bulk, break bulk and containerized general cargo and domestic bulk tariffs were reduced by the applicable percentage resulting from a lock size and channel deepening alternative. Each improvement alternative was compared to a current baseline case with no improvements to the Great Lakes System.

3. Results and description of benefit scenarios.

The Great Lakes Traffic Model for route splits and associated benefit determination programs were utilized to test ship size and deepening alternatives for normal and year-round navigation. Each data run showed data for Upper Four Lakes, St. Lawrence Seaway and the entire system. The outputs showed average annual total savings and the component parts of induced tonnage savings and savings on base tonnage.

Two basic cases were analyzed to assess the effect upon capacity, the attainment of potential and the effect upon the selection of the maximum ship size. The first case assumes season extension existing before the introduction of larger ships while the second assumes the reverse. A matrix of possible ship sizes, geographic increments, draft, and length of season assumed for analysis could be constructed for the base and reverse condition. Although possible to fill in the entirety of this matrix, as the costs are structured for a detailed incremental analysis would not be productive for initial planning purposes. The detail presented for benefits serves the purpose of screening alternatives prior to study fund expenditure on nonfeasible and grossly negative B/C ratios. As a result, the data shown in Tables II-C-1 through II-C-3 was constructed, filling a portion of the matrix cells. Further incremental analysis is reserved for future pursuit following formats under development by NCD which can be used directly or modified for specific district needs.

In Tables II-C-1 through II-C-3, fifteen cases are used to refer to ship size expansion alternatives. Case 3 refers to ships that can currently use the Poe Lock at Sault Ste. Marie. Enlarged maximum ship size alternative cases 4 thru 9 refer to ships that are incrementally longer and/or wider than the case 3 ships currently utilizing the Poe Lock. The ocean maximum

TABLE II-C-1

BENEFIT SCENARIOS
A-12 28' EXTENDED SEASON
UNCONSTRAINED SEASON EXTENSION IN PLACE FIRST
A-12 28' = 1.00

St. Lawrence Seaway 2010-2060 ($1,000,000)

Alternative	Ship Size Maximum Case		25'	28'	32'	36'
A-1	Ocean 940'x105'		$1,607	$1,720	$1,885	$1,896
	Canada/ St. L. 1000'x105'	Index	.684	.732	.802	.807
A-2	Ocean 1000'x130'		$2,207	$2,350	$2,580	$2,733
	Canada/ St. L. 1000'x105'	Index	.939	1.000	1.098	1.163

Upper Lakes 2010-2060 ($1,000,000)

Alternative	Ship Size Maximum Case		25'	28'	32'	36'
A-3	1100'x105'		$ 234	$ 287	$ 323	$ 323
		Index	.770	.941	1.059	1.059
A-4	1200'x130'		$ 257	$ 305	$ 341	$ 341
		Index	.841	1.000	1.118	1.118
A-5	1300'x130'		$ 257	$ 305	$ 341	$ 341
		Index	.841	1.000	1.118	1.118
A-6	1300'x175'		$ 261	$ 308	$ 341	$ 341
		Index	.857	1.010	1.118	1.118
A-7	1500'x175'		$ 261	$ 308	$ 341	$ 341
		Index	.857	1.010	1.118	1.118
A-8	1000'x130'		$ 244	$ 299	$ 329	$ 354
		Index	.800	.980	1.080	1.160
A-9	1100'x130'		$ 250	$ 305	$ 323	$ 366
		Index	.820	1.000	1.060	1.200

Entire System 2010-2060 ($1,000,000)

Alternative		Ship Size Maximum Case		25'	28'	32'	36'
A-10	U.L.	1100'x105'		$ 345	$ 419	$ 473	$ 473
	Ocean	730'x75'	Index	.130	.158	.178	.178
A-11	U.L.	1100'x105'		$1,853	$2,036	$2,243	$2,254
	Ocean	940'x105'	Index	.698	.767	.845	.849
A-12	U.L.	1200'x130'		$2,451	$2,655	$2,926	$3,069
	Ocean	1000'x130'	Index	.923	1.000	1.102	1.156
A-13	U.L.	1300'x130'		$2,451	$2,655	$2,926	$3,069
	Ocean	1000'x130'	Index	.923	1.000	1.102	1.156
A-14	U.L.	1300'x175'		$2,456	$2,655	$2,926	$3,069
	Ocean	1000'x130'	Index	.925	1.000	1.102	1.156
A-15	U.L.	1500'x175'		$2,456	$2,655	$2,926	$3,069
	Ocean	1000'x130'	Index	.925	1.000	1.102	1.156

LEGEND: U.L. = Upper Lakes; St. L. = St. Lawrence

TABLE II-C-2

BENEFIT SCENARIOS
B-12 28' NORMAL SEASON UNCONSTRAINED
MAXIMUM SHIP IN PLACE FIRST
B 12 - 28' = 1.00

St. Lawrence Seaway 2010-2060 ($1,000,000)

Alternative	Ship Size Maximum Case		25'	28'	32'	36'
B-1	Ocean 940'x105'		$ 748	$ 801	$ 877	$ 883
	Canada/ St. L. 1000'x105'	Index	.684	.732	.802	.807
B-2	Ocean 1000'x130'		$1,027	$1,094	$1,201	$1,272
	Canada/ St. L. 1000'x105'	Index	.939	1.000	1.098	1.163

Upper Lakes 2010-2060 ($1,000,000)

			25'	28'	32'	36'
B-3	1100'x105'		$ 289	$ 353	$ 397	$ 397
		Index	.770	.941	1.059	1.059
B-4	1200'x130'		$ 315	$ 375	$ 419	$ 419
		Index	.841	1.000	1.118	1.118
B-5	1300'x130'		$ 315	$ 375	$ 419	$ 419
		Index	.841	1.000	1.118	1.118
B-6	1300'x175'		$ 321	$ 379	$ 419	$ 419
		Index	.857	1.010	1.118	1.118
B-7	1500'x175'		$ 321	$ 379	$ 419	$ 419
		Index	.857	1.010	1.118	1.118
B-8	1000'x130'		$ 300	$ 367	$ 405	$ 435
		Index	.800	.980	1.108	1.160
B-9	1100'x130'		$ 307	$ 375	$ 397	$ 450
		Index	.820	1.00	1.060	1.200

Entire System 2010-2060 ($1,000,000)

				25'	28'	32'	36'
B-10	U.L.	1100'x105'		$ 191	$ 232	$ 261	$ 261
	Ocean	730'x75'	Index	.130	.158	.178	.178
B-11	U.L.	1100'x105'		$1,025	$1,126	$1,240	$1,246
	Ocean	940'x105'	Index	.698	.767	.845	.849
B-12	U.L.	1200'x130'		$1,355	$1,468	$1,618	$1,697
	Ocean	1000'x130'	Index	.923	1.000	1.102	1.156
B-13	U.L.	1300'x130'		$1,355	$1,468	$1,618	$1,697
	Ocean	1000'x130'	Index	.923	1.000	1.102	1.156
B-14	U.L.	1300'x175'		$1,358	$1,468	$1,618	$1,697
	Ocean	1000'x130'	Index	.925	1.000	1.102	1.156
B-15	U.L.	1500'x175'		$1,358	$1,468	$1,618	$1,697
	Ocean	1000'x130'	Index	.925	1.000	1.102	1.156

LEGEND: U.L. = Upper Lakes; St. L. = St. Lawrence

TABLE II-C-3

BENEFIT SCENARIOS

C-12 28' EXTENDED SEASON UNCONSTRAINED

MAXIMUM SHIP IN PLACE FIRST

C-12 28' = 1.00

St. Lawrence Seaway 2010-2060 ($1,000,000)

Ship Size Alternative Maximum Case		25'	28'	32'	36'
C-1 Ocean 940'x105' Canada/ St. L. 1000'x105'		$ 956	$1,023	$1,121	$1,128
	Index	.684	.732	.802	.807
C-2 Ocean 1000'x130' Canada/ St. L. 1000'x105'		$1,313	$1,398	$1,535	$1,626
	Index	.939	1.000	1.098	1.163

Upper Lakes 2010-2060 ($1,000,000)

C-3 1100'x105'		$ 350	$ 427	$ 481	$ 481
	Index	.770	.941	1.059	1.059
C-4 1200'x130'		$ 382	$ 454	$ 508	$ 508
	Index	.841	1.000	1.118	1.118
C-5 1300'x130'		$ 382	$ 454	$ 508	$ 508
	Index	.841	1.000	1.118	1.118
C-6 1300'x175'		$ 389	$ 459	$ 508	$ 508
	Index	.857	1.010	1.118	1.118
C-7 1500'x175'		$ 389	$ 459	$ 508	$ 508
	Index	.857	1.010	1.118	1.118
C-8 1000'x130'		$ 363	$ 445	$ 490	$ 527
	Index	.800	.980	1.080	1.160
C-9 1100'x130'		$ 372	$ 454	$ 481	$ 545
	Index	.820	1.00	1.060	1.200

Entire System 2010-2060 ($1,000,000)

C-10 U.L. 1100'x105'		$ 241	$ 293	$ 330	$ 330
Ocean 730'x75'	Index	.130	.158	.178	.178
C-11 U.L. 1100'x105'		$1,293	$1,420	$1,565	$1,572
Ocean 940'x105'	Index	.698	.767	.845	.849
C-12 U.L. 1200'x130'		$1,709	$1,852	$2,041	$2,141
Ocean 1000'x130'	Index	.923	1.000	1.102	1.156
C-13 U.L. 1300'x130'		$1,709	$1,852	$2,041	$2,141
Ocean 1000'x130'	Index	.923	1.000	1.102	1.156
C-14 U.L. 1300'x175'		$1,713	$1,852	$2,041	$2,141
Ocean 1000'x130'	Index	.925	1.000	1.102	1.156
C-15 U.L. 1500'x175'		$1,713	$1,852	$2,041	$2,141
Ocean 1000'x130'	Index	.925	1.000	1.102	1.156

LEGEND: U.L. - Upper Lakes; St. L. - St. Lawrence size ship (730' x 75') that can currently use the Welland Canal and St. Lawrence Seaway is shown in Case 10. For purposes of analysis ocean bulk ships are assumed to be either 730' x 75' or 1000' x 130'. Ocean container ships are assumed to be 730' x 75' or 1000' x 105'. The ocean break bulk general cargo ships are assumed to be no larger than 730' x 75'.

These assumptions are based on the expert opinions of naval architects at the University of Michigan with regard to the probable maximum sizes of ocean-going vessel types that could reasonably be expected to transit the St. Lawrence Seaway, given an increased lock size.

A selected combination of five ship size alternatives for domestic ships in the Upper Lakes trade with three ship size alternatives for overseas trade yielded six combinations. These six combinations were then tested for four deepening alternatives - 25.5 feet, 28 feet, 32 feet and 36 feet. The same process was repeated for year-round navigation. The computer run for a given alternative displayed data for the total System and the component parts of the Upper Four Lakes and the St. Lawrence Seaway. The ratio of system benefits is about \$5 - \$9 on the St. Lawrence to \$1 on the Upper Lakes.

The tonnage which is estimated to be part of the baseline market share of the Great Lakes benefits from a lower cost basis. Average annual value for the period 1990-2040 is estimated to be 280 million tons. If Season Extension is in place first instead of maximum ship, the benefits base tonnage is 430 million tons. The tonnage base is split 3 to 1 in favor of the Upper Four Lakes regardless of which improvement program is in place first. See Summary Benefits Table in Appendix B.

Some tonnage moving via unit train to domestic bulk receiving centers, or general cargo moving in rail cars to Coastal ports, is projected to be induced to the Great Lakes-St. Lawrence Seaway System. The additional market penetration of the domestic bulk system is estimated to be about 15%, whereas the St. Lawrence Seaway can be expected to result in a net increase of about 200% for an improvement plan with maximum ship size in place first. See Summary Benefits Table in Appendix B.

The dollar value of the transportation savings to the shipper able to use the additional lock capacity and channel depth available from a larger maximum ship size alternative on the Great Lakes-St. Lawrence Seaway System in the normal season amounts to $1.5 billion. The incremental benefits of building ships larger than 1200' x 130' for the Upper Lakes trade and 1000' x 130' for the overseas bulk and general cargo trade is quite small. The required freight rate values of the alternative ship sizes as determined by the University of Michigan work show no real advantage in operating vessels larger than the case 12 size.

The effect of lowering the required freight rate basis of tonnage currently part of the Great Lakes - St. Lawrence Seaway market share are not expected to be more than $500 million with the shares of the Upper Four Lakes and St. Lawrence Seaway with the larger portion shifting to the St. Lawrence ocean route with larger ship size alternatives. See Appendix B Summary Benefits Tables.

The dollar savings in Appendix B Summary Benefits Tables refer to only the lowering of the rate basis from winter navigation. These estimates of winter rate savings were developed by Arctec, Inc., in a special study for the Corps of Engineers. Higher operating costs during the winter are more than offset by the savings in spreading capital costs over the entire year because of increased ship productivity. Winter rate savings have been sensitized to start at 8-1/2 months. The dollars shown represent the rate reduction applicable to winter traffic using the locks at Sault Ste. Marie from the period 15 December to 31 December.

The winter rate savings for St. Lawrence Seaway traffic was set to start after 8 months and the normal season for the St. Lawrence Seaway was defined as 8 months. The longest season extension was specified as follows:
Starting in 1990 locking facilities will be available on an 11-month basis at Sault Ste. Marie. For the Welland Canal and St. Lawrence Seaway, extended season will start in 1990 and reach a maximum of 11 months because of a need to close the entire non-parallel system for maintenance for one month.

4. Analysis of system capacity impacts.

Lock capacity estimates were defined in terms of tonnage per year. The work of Penn State University in defining lock capacity was the basis of determining the thru-put capacity of the Welland and St. Lawrence Locks. These locks are single, non-parallel facilities. The estimated capacity of the Welland Canal is 100 million tons and the estimated capacity of the St. Lawrence Locks is 110 million tons. There are four parallel locks at Sault Ste. Marie; however, only one lock, the Poe, can handle ships longer than 767 feet and wider than 75 feet. The larger ships using the Poe Lock normally carry iron ore or coal. Therefore, capacity for the Poe Lock was defined as 92.7 million tons of iron ore and 26.9 million tons of coal. The other three locks are sufficiently delay-free that a capacity estimate for overseas grain, general cargo, and other commodities was unnecessary. Season extension increases capacity proportionate to the additional time available for lockages. The Welland-St. Lawrence capacities would be increased by 50 percent by going from an 8-month operation to a 12-month operation. The locks at Sault Ste. Marie have three additional months of use for a 33 percent increase in capacity. Note all benefit runs have assumed a maximum extension of 11 months for the Poe, Welland and St. Lawrence. Restructuring capacity at an upstream lock, such as the Welland, affects traffic on the St. Lawrence Seaway. If upstream locks are constrained, the downstream cargo flow will be reduced, and capacity will not be reached until the year 2020 instead of 2000 under unconstrained conditions.

Figures II-C-11 and II-C-12 indicate the impact on system capacity in terms of the tonnage that can be economically accommodated. Waiting times for lockage develop into queing situations and raise costs so that the least-cost alternative mode is more attractive than the water mode. Figure II-C-11 indicates that with season extension in place the Soo Lock system time at capacity is delayed approximately 13 years to 2008. Figure II-C-12 indicates a similar situation for the Welland Canal and the St. Lawrence Seaway. For the Welland, capacity date appears to be delayed 17 years to 2009 and for the Seaway the point of capacity would be delayed well beyond 2010, to about 2025. The decision concerning need for additional capacity and also the provision for larger ships thus appears delayable to the year 2000 for the Welland Canal and the Soo Locks. For the St. Lawrence, the decision appears deferrable to 2015. Obviously, this raises the question of the need at the present time for system capacity studies such as the Great Lakes Connecting Channels and Harbors, and St. Lawrence Seaway Additional Locks studies. In addition, since the greater share of benefits would arise from additional Seaway traffic, it may not be possible to recommend additional Great Lakes improvements prior to the need to expand Seaway capacity.

One factor, however, that could drastically affect these indications would be the employment of aggressive and effective marketing packages by the Great Lakes ports, thus increasing their share of the waterborne susceptible tonnage. This would move the system closer to its potential at an earlier date, and thus necessitate earlier capacity increases. We are awaiting the availability of the current F. R. Harris, Inc., marketing study, now being conducted for the Maritime Administration in cooperation with the Great Lakes States.

A disconcerting note with regard to marketing is the recent failure of Great Lakes European Lines, which had done some work in the marketing area in its attempt to establish a viable direct container trade.

FIGURE II-C-11

POE LOCK CAPACITY ANALYSIS SUMMARY

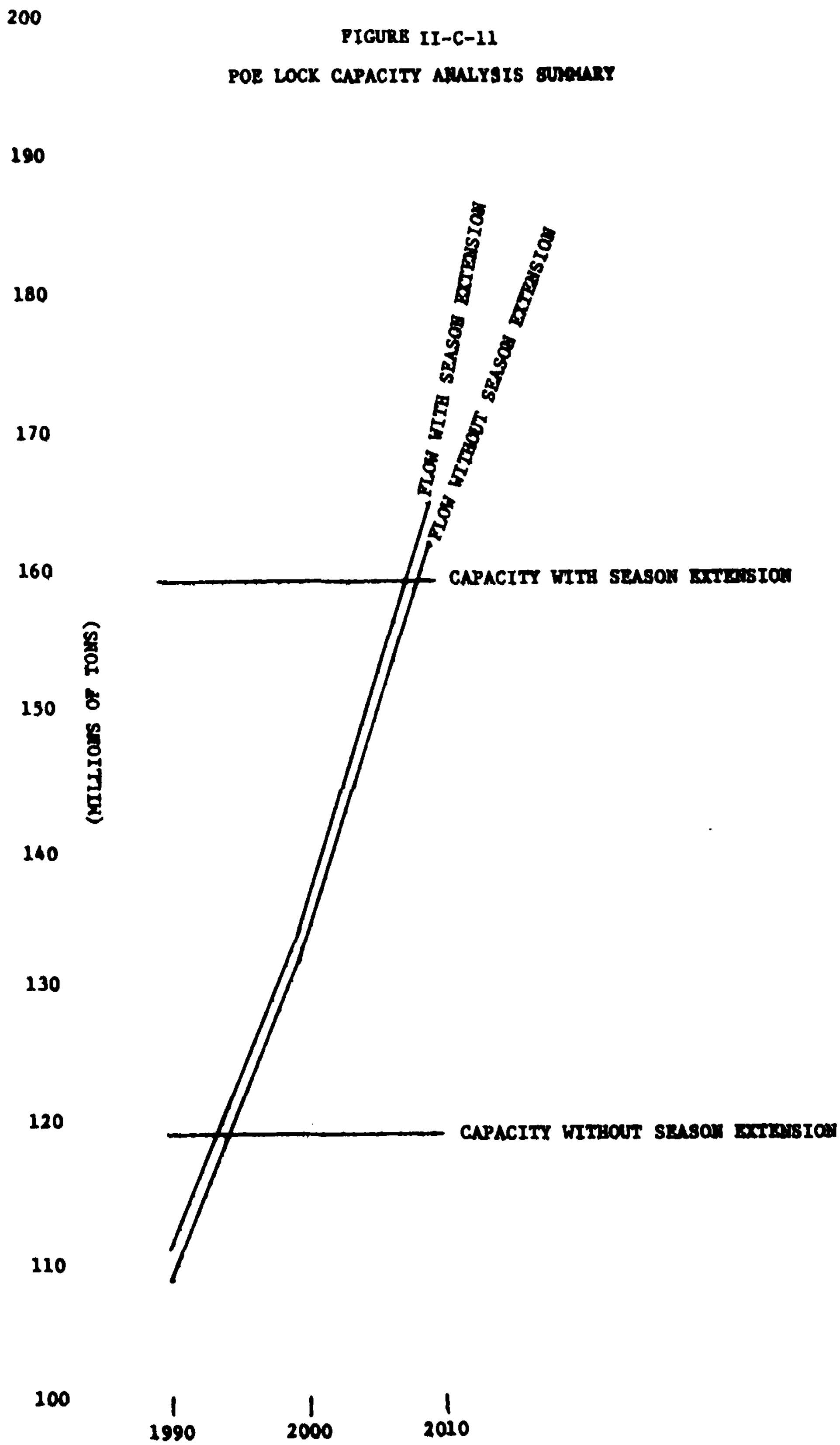
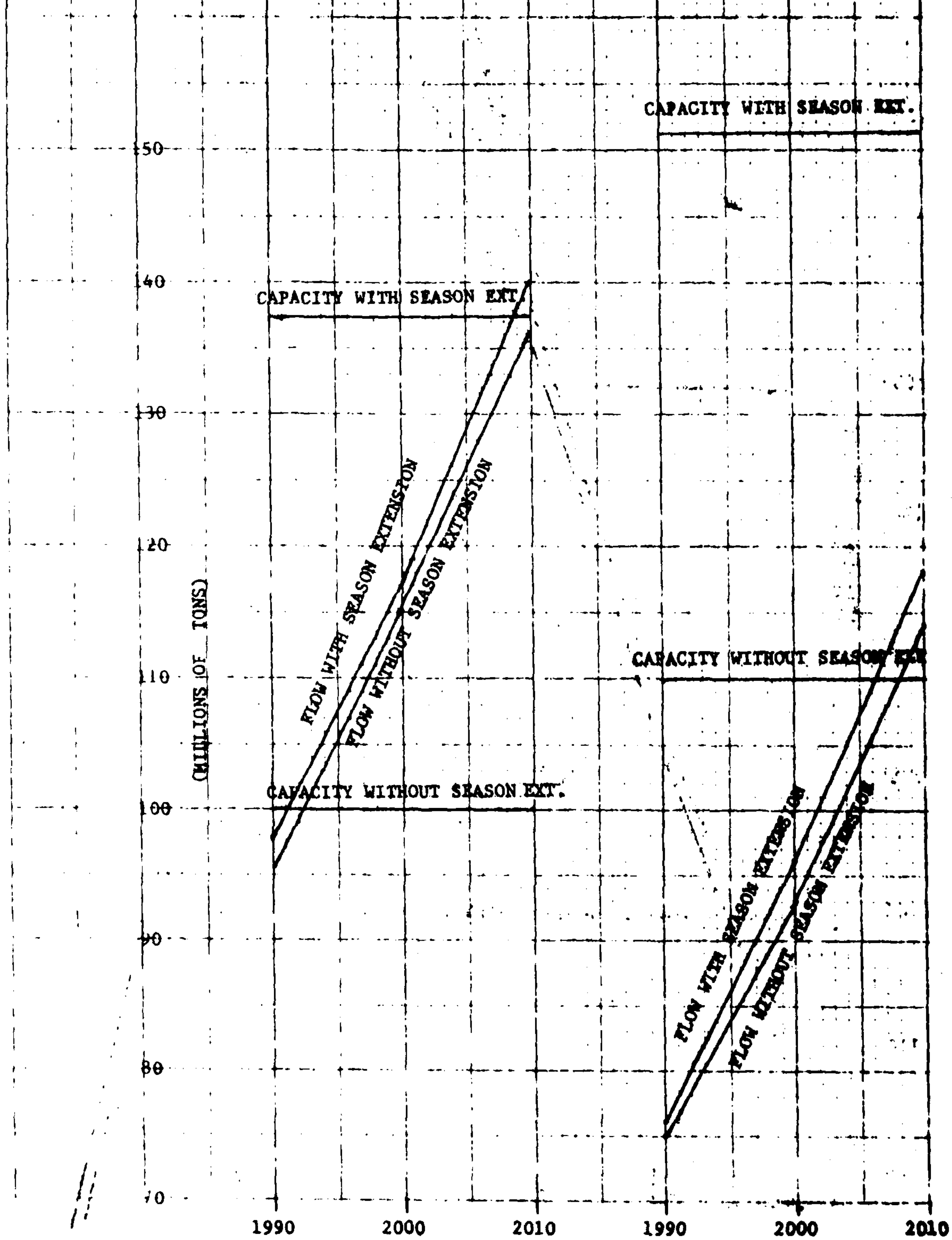


FIGURE II-C-12

WELLAND CANAL & ST. LAWRENCE SEAWAY

LOCK CAPACITY ANALYSIS SUMMARY



III. COSTS

A. Channels

To establish the costs of channel improvements required for various maximum vessel sizes it was necessary to develop a set of criteria relating channel depths and widths to relevant vessel dimensions. This preliminary work was followed by the development of a computer program to translate these criteria into estimated required channel widths and depths for 79 channel reaches, considered in both up and downbound conditions, for each of 28 projected vessels, for a total of 4,424 distinct solutions. Details of the criteria and computer routine may be found in Appendix C, Channel Sizing Criteria.

Channel plan layouts, quantitative estimates of dredged material, and cost estimates for dredging and disposal work involved, were prepared in cooperation with Corps of Engineers personnel at Rock Island District. Channel cross sections were prepared at critical intervals, and the quantities of over-burden and rock were calculated. Appropriate costs, including those of material disposal, were applied to obtain the final dredging cost estimates. Such estimates were prepared for the St. Marys River, Straits of Mackinac, Grays Reef Passage, the St. Clair River-Lake St. Clair-Detroit River system, Pelee Passage, Welland Canal, and for the St. Lawrence River from Lake Ontario to a point just downstream of Montreal. Details of this work will be found in Appendix D, Channel Cost Estimates.

In connection with channel improvements, an investigation was made of the effects on the levels and flows in the connecting channels for various channel dimensions associated with larger maximum vessel sizes. This study was carried out by the North Central Division Water Control Center, with the assistance of the Detroit District Great Lakes Hydraulics and Hydrology Branch. The purpose of the work was to estimate the number, type, size, and approximate cost of compensating structures that would be required to maintain levels and flow velocities at acceptable values in conjunction with the enlarged channels required for ship size increases. Specifically, compensating structures were studied and costed for the St. Marys River, St. Clair-Detroit River system, and for the St. Lawrence River. The details and results of this study are included in Appendix

E, Impact of Larger Vessel Sizes on Levels and Flows.

The estimated total costs of channel dredging are summarized in Table III-A-1 for each maximum vessel size investigated. The costs of dredging and lock structures (following section) are shown in order to provide the reader with a sense of their magnitude and relative importance. These two components of cost are by far the largest costs associated with the improvements. The additional costs associated with compensating structures to maintain levels and flows are summarized in Appendix E.

B. Locks

The analysis of lock improvement costs was carried out at Rock Island District. Details of this analysis are given in Appendix F, Lock Cost Estimates. The estimated initial costs of lock improvements for the entire system, as a function of vessel size and draft, are summarized in Table III-B-1.

C. Harbors

Two separate tasks were undertaken for each of the harbors investigated. First, entrance channel and harbor channel width and depth criteria were formulated, plans were prepared, and cost estimates were made. Second, similar analysis was undertaken for berthing facilities and turning basins. This work was confined primarily to the non-river sections of the harbors, as preliminary analysis indicated that the improvements necessary to allow river transit by vessels of unprecendented size would be uneconomical.

Details of the analysis, development plans for representative harbors, and cost estimate details are included in Appendix G, Harbor Improvement Plans. Representative harbor layouts are shown in Figures III-C-1 through III-C-4. The costs of harbor improvements are included in Channel costs, as the required improvements consist mainly of dredging items.

D. Bridges and Tunnels

Estimates were prepared for bridges and tunnels crossing the connecting channels, the Welland Canal, and the St.

III. COSTS

A. Channels

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D. Bridges and Tunnels

Estimates were prepared for bridges and tunnels crossing the connecting channels, the Welland Canal, and the St.

TABLE III-A-1

DREDGING COSTS (000's)

Ship Size	Draft 25.5'	28'	32'	36'
St. Marys River:				
940x105	0	413,971	836,656	1,150,399
1000x130	789,052	983,092	1,583,110	2,178,714
1100x105	0	413,971	836,656	No Plan
1100x130	789,818	989,129	1,588,395	2,185,014
1200x130	790,561	995,204	1,593,700	2,191,332
1300x130	790,560	995,166	1,593,700	2,191,331
1300x175	1,280,329	1,497,833	2,204,741	2,930,701
1500x175	Not Fully Costed			
Straits of Mackinac:				
940x105	0	3,739	25,078	52,830
1000x130	0	3,739	25,078	52,830
1100x105	0	3,739	25,078	No Plan
1100x130	0	3,739	25,078	52,830
1200x130	0	3,739	25,078	52,830
1300x130	0	3,739	25,078	52,830
1300x175	0	3,739	25,078	54,076
1500x175	Not Fully Costed			
St. Clair-Detroit-Pelee:				
940x105	0	1,148,911	6,310,460	11,103,473
1000x130	1,287,298	1,184,713	6,470,737	11,376,176
1100x105	0	1,148,911	6,310,460	No Plan
1100x130	1,287,298	1,316,347	6,631,015	11,648,879
1200x130	1,287,298	1,462,609	6,791,293	11,921,582
1300x130	1,282,599	1,457,270	6,661,577	11,869,94[illegible]
1300x175	1,800,086	2,031,178	7,648,467	13,019,801
1500x175	Not Fully Costed			

TABLE III-A-1 (Continued)

DREDGING COSTS (000's)

Ship Size	Draft 25.5'	28'	32'	36'
Welland Canal:				
940x105	1,019,028	1,129,971	1,316,267	1,522,449
1000x130	Not Investigated			
1100x105	1,019,028	1,129,971	1,316,267	No Plan
1100x130	Not Investigated			
1200x130	1,228,895	1,372,410	1,596,502	1,846,458
1300x130	1,228,894	1,417,333	1,596,501	1,846,457
1300x175	1,759,763	1,913,939	2,226,153	2,577,086
1500x175	Not Fully Costed			
St. Lawrence Seaway:				
940x105	2,195,149	2,845,329	3,948,163	5,078,035
1000x130	Not Investigated			
1100x105	2,195,149	2,845,329	3,948,163	No Plan
1100x130	Not Investigated			
1200x130	2,874,690	3,639,156	4,941,895	6,355,974
1300x130	2,874,690	3,639,156	4,941,895	6,355,974
1300x175	4,566,138	5,573,732	7,286,357	9,205,413
1500x175	Not Fully Costed			
Harbors:				
940x105	159,773	308,931	549,284	1,034,861
1000x130	316,013	502,950	958,840	1,741,312
1100x105	200,490	647,008	1,158,525	No Plan
1100x130	359,790	564,595	1,041,976	1,903,791
1200x130	410,117	634,348	1,134,404	2,081,804
1300x130	467,935	713,932	1,236,454	2,277,192
1300x175	489,413	768,125	1,370,618	2,496,409
1500x175	Not Fully Costed			

TABLE III-B-1

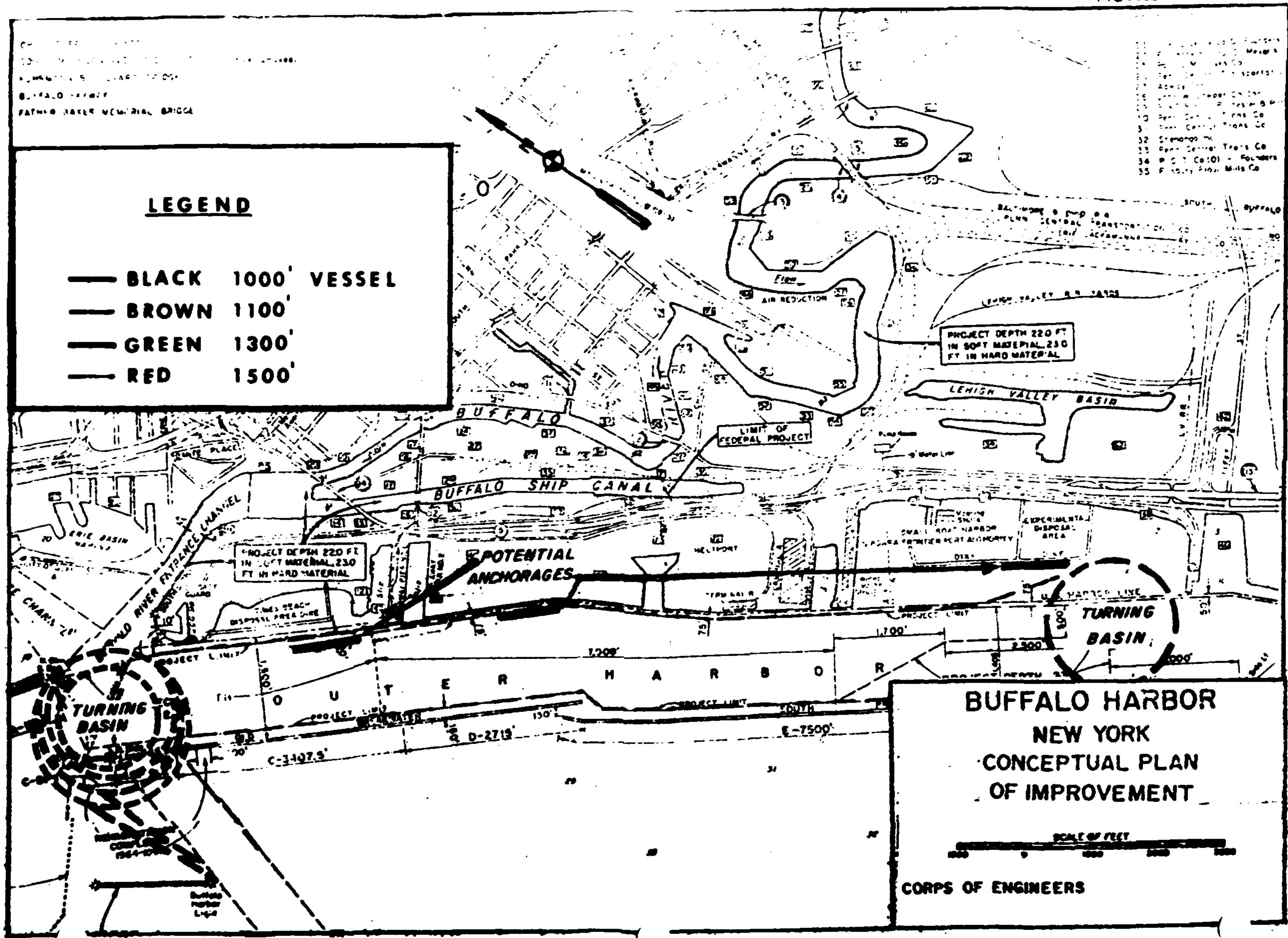
Cost of Lock Structures Entire System (Millions)

Ship Size	Draft 25.5'	28'	32'	36'
940x105	1,004	1,102	1,176	1,324
1000x130	1,112	1,218	1,299	1,459
1100x105	1,125	1,232	1,314	1,549
1100x130	1,223	1,340	1,429	1,605
1200x130	1,335	1,462	1,559	1,751
1300x130	1,418	1,556	1,657	1,862
1300x175	1,626	1,788	1,902	2,101
1500x175	1,783	1,960	2,094	2,342

Upper Lakes System Only (Thousands)

Ship Size	Draft 25.5'	28'	32'	36'
940x105		Not Applicable		
1000x130	64,806	69,190	76,814	89,957
1100x105	67,595	74,377	80,252	94,447
1100x130	71,287	76,109	84,495	98,953
1200x130	77,768	83,028	92,177	107,949
1300x130	78,587	90,660	97,821	114,654
1300x175	91,943	106,176	112,986	134,239
1500x175	105,694	116,065	125,602	146,528

FIGURE III-C-1



U. S. ARMY

CORPS OF ENGINEERS

FIGURE III-2

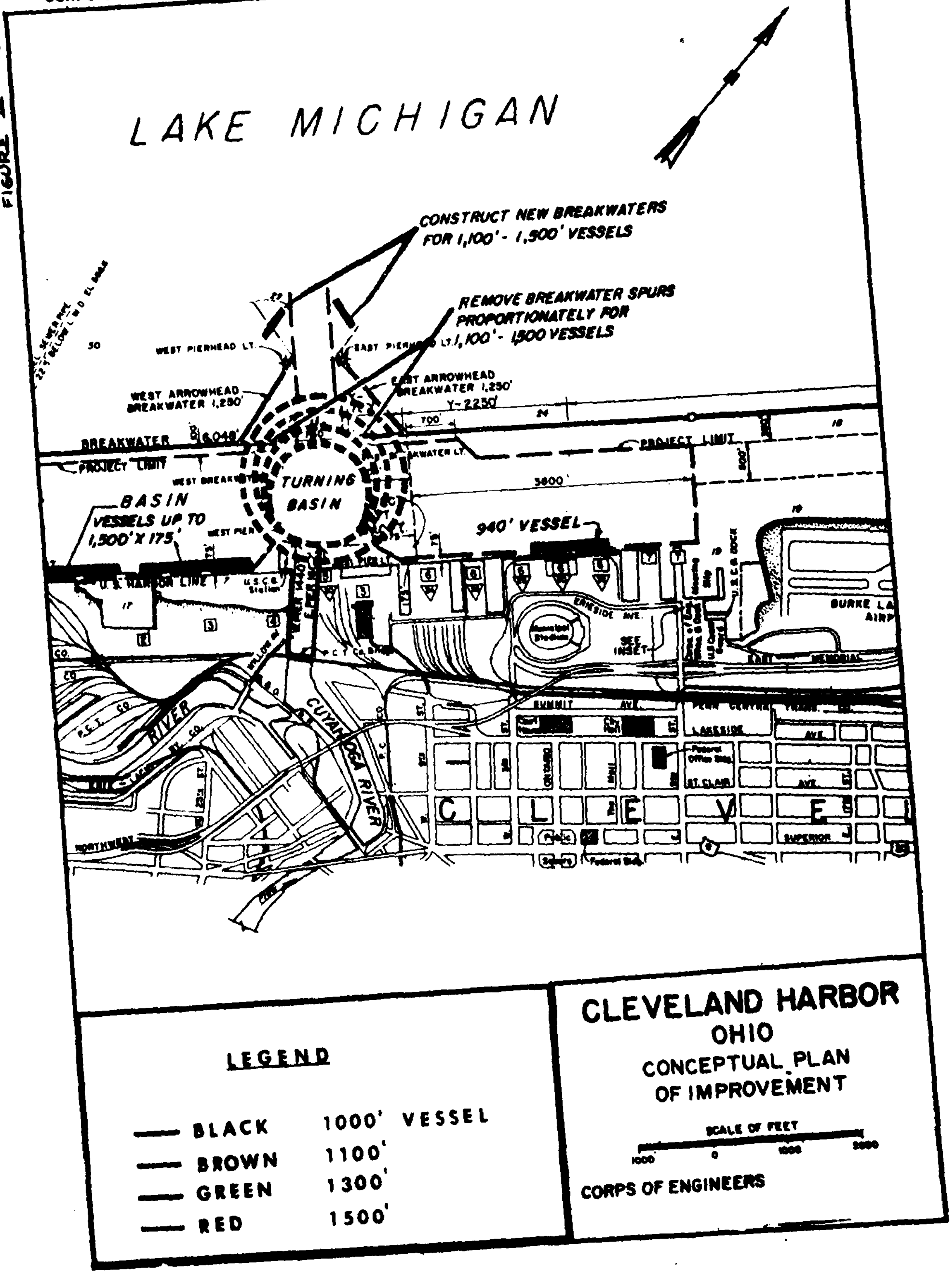
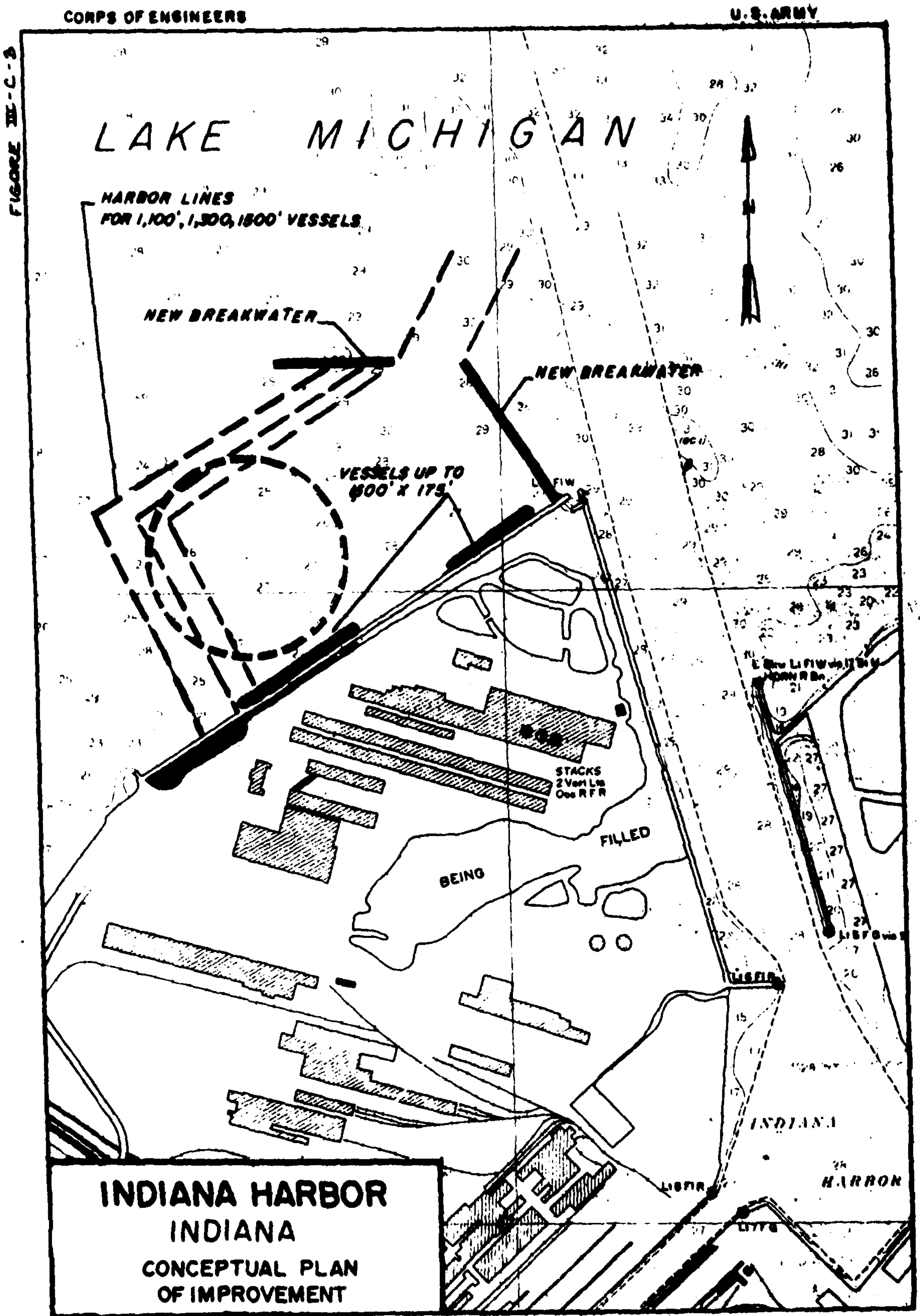
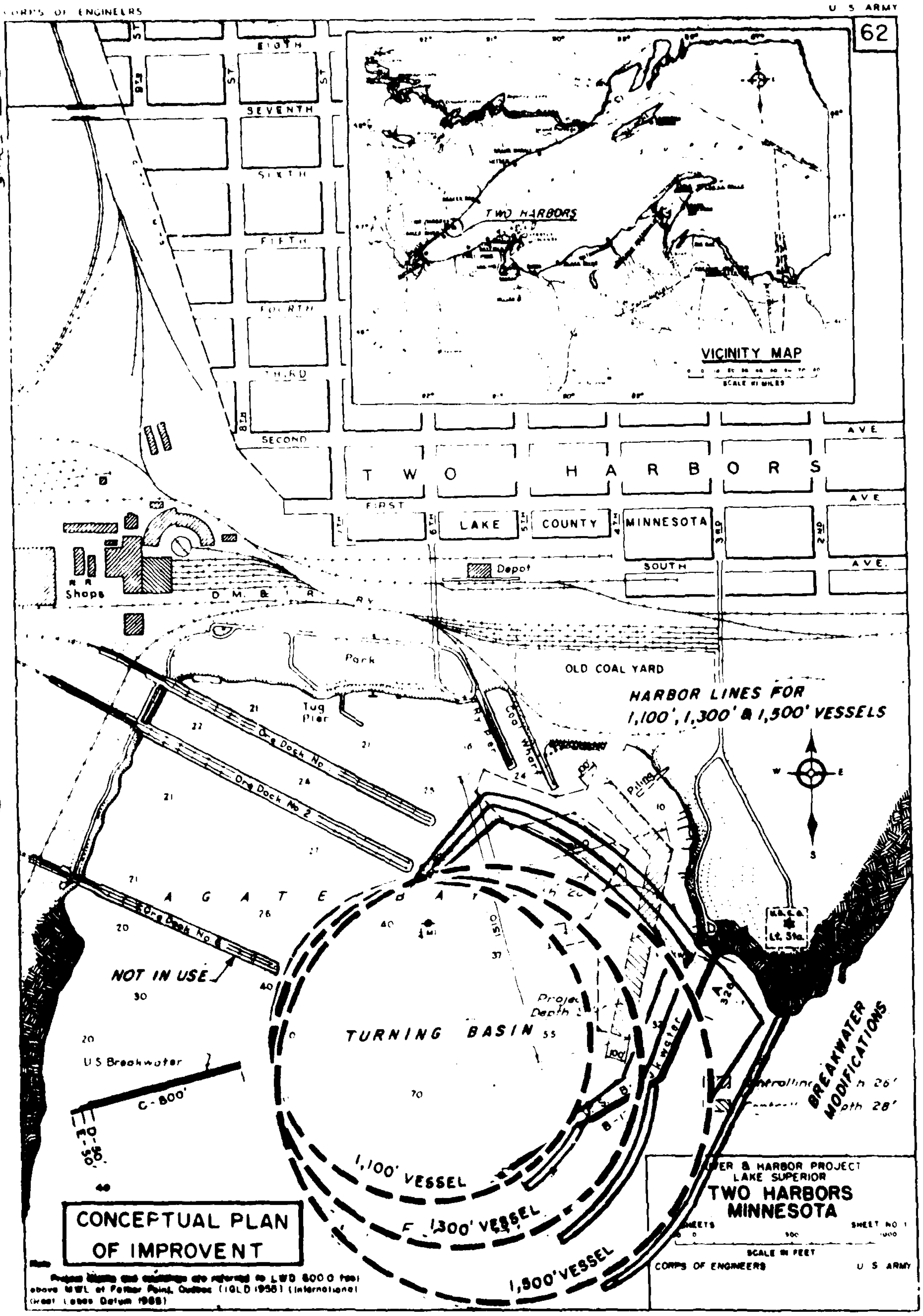


Figure III-C-3




VICINITY MAP
TWO HARBORS
SEVENTH
SIXTH
FIFTH
FOURTH
THIRD
SECOND
FIRST
SOUTH
AVE
T W O H A R B O R S
LAKE COUNTY MINNESOTA
Depot
R R Shops
Park
OLD COAL YARD
Tug Pier
Ore Dock No 2
HARBOR LINES FOR 1,100', 1,300' & 1,500' VESSELS
A G A T E B A Y
NOT IN USE
TURNING BASIN
U S Breakwater
C-800'
1,100' VESSEL
1,300' VESSEL
1,500' VESSEL
BREAKWATER MODIFICATIONS
Lt. Sta.
RIVER & HARBOR PROJECT
LAKE SUPERIOR
TWO HARBORS
MINNESOTA
SCALE IN FEET
CORPS OF ENGINEERS
U S ARMY
CONCEPTUAL PLAN OF IMPROVENT

Lawrence Seaway. Except for the harbor bridge at Duluth, Minnesota, it was unnecessary to provide estimates for harbor bridges and tunnels, since, as previously noted, the vessels under consideration will not be involved in river transits.

E. Aids to Navigation

The costs of improvements to aids to navigation were estimated at 1% of the total federal construction capital costs.

F. Real Estate Estimates

Real estate costs were factored into this analysis in the form of a percentage increase applied to the federal construction capital cost. An increase of 2% was assumed to cover these costs. This simplified approach was used in the absence of more detailed data, in the belief that locals will not in all cases be willing to provide lands, easements, and rights of way as project contributions.

G. Contingency

A 20% contingency cost was applied to the sum of federal construction capital cost, aids to navigation, and real estate costs.

H. Engineering and Design, Supervision and Administration

These cost components were estimated as follows: Engineering and design costs were placed at 5% of the total federal capital costs; supervision and administration costs were estimated at 6% of the total of federal capital plus E & D cost.

J. Non-Federal First Costs

These costs include pipeline and cable relocation costs, plus an additional contingency allowance. Non-federal costs are estimated at 2% of the total federal first cost. Costs for new docks and piers, cargo-handling equipment, etc., are not included in this analysis, as such items are regarded as self-liquidating. Facilities of this nature would be required regardless of the transportation mode selected to handle the projected cargo movements.

K. Investment Costs

Interest on the federal capital cost was calculated at a rate of 6-5/8%, and was assumed to accrue for 5 years. The construction period was estimated at 10 years, with the benefit stream beginning in the sixth year after the commencement of construction.

Table IV-4, in the following section, represents an example of the addition of capital cost items to arrive at Federal Capital Construction cost, while Table IV-5 represents an example of the conversion of Federal Capital Construction cost to investment cost. A separate cost book, which is not a part of this report nor of the appendices, contains the details of each plan investigated.

L. Operating and Maintenance Costs

Volumes and costs for maintenance dredging in recent years were obtained from the Corps of Engineers Annual Reports to provide a basis for comparison. The increase in annual costs expected to arise from the projected new work was assigned to each vessel size cost scenario. Annual costs for work done in Canadian waters was extrapolated from U.S. figures.

IV. SYSTEM SCENARIOS

A. Benefit Scenarios

Three sets of benefit scenarios are presented, differing primarily in the assumed timing of season extension. The development of these benefit scenarios is described above in Section II.E., Economic Benefits. The relevant assumptions regarding season extension are as follows:

(1) Season extension is assumed to exist prior to the introduction of larger maximum vessel sizes (Plans A-1 through A-15).

(2) Larger vessels are assumed to be introduced prior to the institution of season extension, with operations confined to the normal season (Plans B-1 through B-15).

(3) Larger vessels are assumed to be introduced before the implementation of season extension, but allowing for an 11-month operating season once season extension is instituted (Plans C-1 through C-15).

The results of these benefit scenarios for sets A, B, and C are shown as functions of draft in Tables IV-1, IV-2, and IV-3, respectively.

These benefits were developed by operating the Great Lakes Traffic Model for the specific case of the 1200' x 130' x 28' vessel, and applying index factors to that base result to determine benefits for the remaining scenarios. These index factors were derived from previous runs of the model for each vessel-size scenario, using a somewhat higher GNP growth rate than that finally adopted. The index-factor approach was employed to avoid the necessity of rerunning each scenario under the altered GNP growth assumption, an unacceptably expensive process. Past experience has shown that this approach is valid, in that changes in the GNP growth assumption, while producing some shift in the benefit curves, do not alter the shape or relative position of the curves.

B. Cost Scenarios

Only 15 cost plans are presented, as the costs associated with benefit scenario sets A, B, and C are independent of the assumptions regarding the timing of season extension implementation. For this reason, cost plans can be matched with each of the three benefit scenario sets. All discounting and amortization is at an interest rate of 6-5/8%.

C. Plan Descriptions

The 15 system plans are outlined as follows:

Plan 1. This plan allows for 730' x 76', 940' x 105', and 1000' x 105' vessels on the entire GLSLS system. Traffic consists of U.S. to and from Canada, and U.S. to and from overseas ports, using the St. Lawrence Seaway.

Plan 2. This plan allows 730' x 76', 940' x 105', 1000' x 105', and 1000' x 130' vessels to trade on the entire GLSLS system. Traffic consists of U.S. to and from Canada, and U.S. to and from overseas ports, using the St. Lawrence Seaway.

Plan 3. This plan allows 1100' x 105' vessels to operate above the Welland Canal only. Traffic consists of U.S. domestic and U.S. to and from Canada. The Welland Canal and St. Lawrence Seaway remain at present dimensional limitations of 730' x 76'.

Plan 4. This plan allows 1200' x 130' vessels to operate above the Welland Canal only. Traffic consists of U.S. comestic and U.S. to and from Canada. The Welland Canal and St. Lawrence Seaway remain at present dimensional limitations of 730' x 76'.

Plan 5. This plan allows 1300' x 130' vessels to operate above the Welland Canal only. Traffic consists of U.S. domestic and U.S. to and from Canada. The Welland Canal and St. Lawrence Seaway remain at present dimensional restrictions of 730' x 76'.

Plan 6. This plan allows 1300' x 175' vessels to operate above the Welland Canal only. Traffic consists of U.S. domestic and U.S. to and from Canada. The Welland Canal and St. Lawrence Seaway remain at present dimensional limitations of 730' x 76'.

Plan 7. This plan allows 1500' x 175' vessels to operate above the Welland Canal only. Traffic consists of U.S. domestic and U.S. to and from Canada. The Welland Canal and St. Lawrence Seaway remain at present dimensional limitations of 730' x 76'.

Plan 8. This plan allows 1000' x 130' vessels to operate above the Welland Canal only. Traffic consists of U.S. domestic and U.S. to and from Canada. The Welland Canal and St. Lawrence Seaway remain at present dimensional limitations of 730' x 76'.

Plan 9. This plan allows 1100' x 130' vessels to operate above the Welland Canal only. Traffic consists of U.S. domestic and U.S. to and from Canada. The Welland Canal and St. Lawrence Seaway remain at present dimensional limitations of 730' x 76'.

Plan 10. This plan allows 730' x 76' and 1100' x 105' vessels to trade on the system above the Welland, but only 730' x 76' vessels below the Welland. Traffic consists of U.S. domestic, U.S. to and from Canada, and U.S. to and from overseas ports via the St. Lawrence Seaway. The Welland Canal and St. Lawrence Seaway remain at present dimensional limitations of 730' x 76'.

Plan 11. This plan allows 730' x 76', 940' x 105', and 1100' x 105' vessels to trade on the entire GLSLS system. Traffic consists of U.S. domestic, U.S. to and from Canada, and U.S. to and from overseas ports through the Seaway.

Plan 12. This plan allows 730' x 76', 940' x 105', and 1000' x 130' vessels to trade on the entire GLSLS system, with 1200' x 130' vessels operating above the Welland Canal only. Traffic consists of U.S. domestic, U.S. to and from Canada, and U.S. to and from overseas ports through the Seaway.

Plan 13. This plan allows 730' x 76', 940' x 105', and 1000' x 130' vessels to trade on the entire GLSLS system, with 1300' x 130' vessels operating above the Welland Canal only. Traffic consists of U.S. domestic, U.S. to and from Canada, and U.S. to and from overseas ports through the Seaway.

Plan 14. This plan allows 730' x 76', 940' x 105', and 1000' x 130' vessels to trade on the entire GLSLS system, with 1300' x 175' vessels operating above the Welland Canal only. Traffic consists of U.S. domestic, U.S. to and from Canada, and U.S. to and from overseas ports through the Seaway.

Plan 15. This plan allows 730' x 76', 940' x 105', and 1000' x 130' vessels to trade on the entire GLSLS system, with 1500' x 175' vessels operating above the Welland Canal only. Traffic consists of U.S. domestic, U.S. to and from Canada, and U.S. to and from overseas ports through the Seaway.

Fleet mixes containing 1000' x 130' ocean-going types and 1000' or 1100' x 130' Great Lakes vessels were not investigated for the entire system. Inspection of the benefit tables indicates that the benefit of these two sizes is, in all the shallower-draft upper-lakes cases, less than that of the 1200' x 130' vessel, and therefore would be expected to have lower entire-system benefits than system fleets containing the 1200' x 130' Great Lakes vessels.

D. Results

The effect upon system capacity of either the introduction of larger maximum vessel size or the implementation of season extension is to defer the need for further improvement until approximately 2010, as indicated in the tabulated benefits, Tables IV-1, IV-2, and IV-3. Thus, for the introduction of a subsequent improvement, the year 2010 becomes the zero year of a further 50-year investment horizon.

A review of the benefit tables indicates that the largest benefits for the St. Lawrence Seaway occur under scenarios A-1 and A-2, for the upper lakes alone under scenarios C-3 through C-9, and for the total system under scenarios A-10 through A-15. As a result, since costs do not vary among benefit scneario sets A, B, and C, the only meaningful comparisons for screening purposes are those involving the above benefit scenarios. Such comparisons will result in the highest net savings for the selection of maximum vessel size, and will also serve as an indication of the optimum relative timing of larger vessel size and season extension implementation. These benefit-cost matches could be considered as National Economic Development Plans. Further district analysis, taking into account social and environmental consequences, may indicate the selection of other benefit-cost matches as a recommended plan. Economically, however, these benefit-cost matches would be sub-optimal.

TABLE IV-1

BENEFIT SCENARIOS
A-12 28' EXTENDED SEASON
UNCONSTRAINED SEASON EXTENSION IN PLACE FIRST
A-12 28' = 1.00

St. Lawrence Seaway 2010-2060 ($1,000,000)

Alternative	Ship Size Maximum	Case	25'	28'	32'	36'
A-1	Ocean 940'x105'		$1,607	$1,720	$1,885	$1,896
	Canada/ St. L. 1000'x105'	Index	.684	.732	.802	.807
A-2	Ocean 1000'x130'		$2,207	$2,350	$2,580	$2,733
	Canada/ St. L. 1000'x105'	Index	.939	1.000	1.098	1.163

Upper Lakes 2010-2060 ($1,000,000)

A-3	1100'x105'		$ 234	$ 287	$ 323	$ 323
		Index	.770	.941	1.059	1.059
A-4	1200'x130'		$ 257	$ 305	$ 341	$ 341
		Index	.841	1.000	1.118	1.118
A-5	1300'x130'		$ 257	$ 305	$ 341	$ 341
		Index	.841	1.000	1.118	1.118
A-6	1300'x175'		$ 261	$ 308	$ 341	$ 341
		Index	.857	1.010	1.118	1.118
A-7	1500'x175'		$ 261	$ 308	$ 341	$ 341
		Index	.857	1.010	1.118	1.118
A-8	1000'x130'		$ 244	$ 299	$ 329	$ 354
		Index	.800	.980	1.080	1.160
A-9	1100'x130'		$ 250	$ 305	$ 323	$ 366
		Index	.820	1.000	1.060	1.200

Entire System 2010-2060 ($1,000,000)

A-10	U.L. 1100'x105'		$ 345	$ 419	$ 473	$ 473
	Ocean 730'x75'	Index	.130	.158	.178	.178
A-11	U.L. 1100'x105'		$1,853	$2,036	$2,243	$2,254
	Ocean 940'x105'	Index	.698	.767	.845	.849
A-12	U.L. 1200'x130'		$2,451	$2,655	$2,926	$3,069
	Ocean 1000'x130'	Index	.923	1.000	1.102	1.156
A-13	U.L. 1300'x130'		$2,451	$2,655	$2,926	$3,069
	Ocean 1000'x130'	Index	.923	1.000	1.102	1.156
A-14	U.L. 1300'x175'		$2,456	$2,655	$2,926	$3,069
	Ocean 1000'x130'	Index	.925	1.000	1.102	1.156
A-15	U.L. 1500'x175'		$2,456	$2,655	$2,926	$3,069
	Ocean 1000'x130'	Index	.925	1.000	1.102	1.156

LEGEND: U.L. = Upper Lakes; St. L. = St. Lawrence

TABLE IV-2

BENEFIT SCENARIOS
B-12 28' NORMAL SEASON UNCONSTRAINED
MAXIMUM SHIP IN PLACE FIRST
B-12 28' = 1.00

St. Lawrence Seaway 2010-2060 ($1,000,000)

Ship Size Alternative Maximum Case		25'	28'	32'	36'
B-1 Ocean 940'x105' Canada/ St. L. 1000'x105'		$ 748	$ 801	$ 877	$ 883
	Index	.684	.732	.802	.807
B-2 Ocean 1000'x130' Canada/ St. L. 1000'x105'		$1,027	$1,094	$1,201	$1,272
	Index	.939	1.000	1.098	1.163

Upper Lakes 2010-2060 ($1,000,000)

		25'	28'	32'	36'
~~B-3 1100'x105'~~		$ 289	$ 353	$ 397	$ 397
	Index	.770	.941	1.059	1.059
B-4 1200'x130'		$ 315	$ 375	$ 419	$ 419
	Index	.841	1.000	1.118	1.118
~~B-5 1300'x130'~~		~~$ 315~~	~~$ 375~~	~~$ 419~~	~~$ 419~~
	~~Index~~	~~.841~~	~~1.000~~	~~1.118~~	~~1.118~~
~~B-6 1300'x175'~~		~~$ 321~~	~~$ 379~~	~~$ 419~~	~~$ 419~~
	Index	.857	1.010	1.118	1.118
B-7 1500'x175'		$ 321	$ 379	$ 419	$ 419
	Index	.857	1.010	1.118	1.118
B-8 1000'x130'		$ 300	$ 367	$ 405	$ 435
	Index	.800	.980	1.108	1.160
B-9 1100'x130'		$ 307	$ 375	$ 397	$ 450
	Index	.820	1.00	1.060	1.200

Entire System 2010-2060 ($1,000,000)

			25'	28'	32'	36'
B-10 U.L.	1100'x105'		$ 191	$ 232	$ 261	$ 261
Ocean	730'x75'	Index	.130	.158	.178	.178
B-11 U.L.	1100'x105'		$1,025	$1,126	$1,240	$1,246
Ocean	940'x105'	Index	.698	.767	.845	.849
B-12 U.L.	1200'x130'		$1,355	$1,468	$1,618	$1,697
Ocean	1000'x130'	Index	.923	1.000	1.102	1.156
B-13 U.L.	1300'x130'		$1,355	$1,468	$1,618	$1,697
Ocean	1000'x130'	Index	.923	1.000	1.102	1.156
B-14 U.L.	1300'x175'		$1,358	$1,468	$1,618	$1,697
Ocean	1000'x130'	Index	.925	1.000	1.102	1.156
B-15 U.L.	1500'x175'		$1,358	$1,468	$1,618	$1,697
Ocean	1000'x130'	Index	.925	1.000	1.102	1.156

LEGEND: U.L. = Upper Lakes; St. L. = St. Lawrence

TABLE IV-3

BENEFIT SCENARIOS

C-12 28' EXTENDED SEASON UNCONSTRAINED

MAXIMUM SHIP IN PLACE FIRST

C-12 28' = 1.00

St. Lawrence Seaway 2010-2060 ($1,000,000)

Alternative	Ship Size Maximum Case		25'	28'	32'	36'
C-1	Ocean 940'x105'		$ 956	$1,023	$1,121	$1,128
	Canada/ St. L. 1000'x105'	Index	.684	.732	.802	.807
C-2	Ocean 1000'x130'		$1,313	$1,398	$1,535	$1,626
	Canada/ St. L. 1000'x105'	Index	.939	1.000	1.098	1.163

Upper Lakes 2010-2060 ($1,000,000)

			25'	28'	32'	36'
C-3	1100'x105'		$ 350	$ 427	$ 481	$ 481
		Index	.770	.941	1.059	1.059
C-4	1200'x130'		$ 382	$ 454	$ 508	$ 508
		Index	.841	1.000	1.118	1.118
C-5	1300'x130'		$ 382	$ 454	$ 508	$ 508
		Index	.841	1.000	1.118	1.118
C-6	1300'x175'		$ 389	$ 459	$ 508	$ 508
		Index	.857	1.010	1.118	1.118
C-7	1500'x175'		$ 389	$ 459	$ 508	$ 508
		Index	.857	1.010	1.118	1.118
C-8	1000'x130'		$ 363	$ 445	$ 490	$ 527
		Index	.800	.980	1.080	1.160
C-9	1100'x130'		$ 372	$ 454	$ 481	$ 545
		Index	.820	1.00	1.060	1.200

Entire System 2010-2060 ($1,000,000)

				25'	28'	32'	36'
C-10	U.L.	1100'x105'		$ 241	$ 293	$ 330	$ 330
	Ocean	730'x75'	Index	.130	.158	.178	.178
C-11	U.L.	1100'x105'		$1,293	$1,420	$1,565	$1,572
	Ocean	940'x105'	Index	.698	.767	.845	.849
C-12	U.L.	1200'x130'		$1,709	$1,852	$2,041	$2,141
	Ocean	1000'x130'	Index	.923	1.000	1.102	1.156
C-13	U.L.	1300'x130'		$1,709	$1,852	$2,041	$2,141
	Ocean	1000'x130'	Index	.923	1.000	1.102	1.156
C-14	U.L.	1300'x175'		$1,713	$1,852	$2,041	$2,141
	Ocean	1000'x130'	Index	.925	1.000	1.102	1.156
C-15	U.L.	1500'x175'		$1,713	$1,852	$2,041	$2,141
	Ocean	1000'x130'	Index	.925	1.000	1.102	1.156

LEGEND: U.L. - Upper Lakes; St. L. - St. Lawrence

Each plan was analyzed by the method exemplified by Tables IV-4 through IV-9. Specifically applying to Plan 12, Table IV-4 presents the summation of appropriate federal construction capital costs, as well as operating and maintenance costs that would be incurred in various parts of the system to allow the traffic described under Plan 12. The federal construction capital costs were then reduced to investment costs at system drafts ranging from 25.5 ft to 36 ft, as indicated in Tables IV-5 through IV-8. In Table IV-9, the investment costs were annualized and added to the annual operating and maintenance costs to arrive at the total annual expenses at various drafts. (Similar calculations were performed for each of the scenarios, Plans 1 to 15.)

Table IV-10 presents the annual cost and benefit for each plan analyzed, assuming that all costs are borne by the United States. Table IV-11 presents the results of the same analysis under the alternative assumption that 25% of total costs are borne by Canada, with 25% of the benefits accruing to Canada. It should be noted, however, that the benefits reported in this study were not reduced under this assumption, since these figures contain only U.S. benefits.

As described in Section I.C., Methodology, the criterion for selection of a plan for further analysis at the District level is the maximum net saving, that is, the maximum difference between annual benefit and annual cost. The maximum value of the net saving occurs for Plan A-12, which accommodates Seaway-transitting vessels of 1000' x 130' and Great Lakes vessels of 1200' x 130' operating above the Welland Canal only, at a uniform system maximum draft of 25.5 ft. As shown in Table IV-10, either deepening the system to 28 ft draft or enlarging the maximum vessel size in accordance with Plan A-13 results in a lower value of the net saving. This in turn indicates that the incremental benefit-cost ratio of either further incremental improvement is less than unity. On this basis, the Corps would not undertake either of these additional incremental improvements.

A further implication of this analysis is that the introduction of season extension prior to an enlarged maximum ship size is more advantageous when entire-system benefits are considered. This conclusion is reflected by

TABLE IV-4

ADDITION OF PLAN COSTS (1000's)

PLAN A-12 VESSEL SIZE 1200x130

DRAFTS

	25.5'	28'	32'	36'
Seaway & Welland	$5,752,260	$ 6,734,852	$ 8,502,857	$10,392,791
Detroit	713,696	982,773	5,943,650	10,649,144
St. Clair	575,600	718,336	1,163,143	1,628,938
Straits	0	3,739	25,078	52,230
St. Marys	820,419	1,140,322	1,797,967	2,421,371
Harbors (1)	569,890	943,279	1,683,688	3,116,665
Total Federal Capital Construction Cost	$8,479,865	$10,523,301	$19,116,383	$28,261,739

(1) All Harbors

$410,117	$634,348	$1,134,404	$2,081,804
159,773	308,931	549,284	1,034,861
$569,890	$943,279	$1,683,688	$3,116,665

O&M Expenses

$19,431	$ 19,431	$19,431	$19,431
1,057	1,206	1,388	1,605
1,279	1,494	1,733	2,193
265	342	391	439
$22,032	$ 22,473	$22,943	$23,668

TABLE IV-5

ALTERNATIVE PLAN A-12 1200x130x25.5

FEDERAL CONSTRUCTION CAPITAL COST (1000's) (Includes dredging, bridges, tunnels, breakwaters, locks, relocations)	$ 8,479,865
PLUS AIDS TO NAVIGATION 1%	84,799
PLUS REAL ESTATE 2%	169,597
TOTAL:	$ 8,734,261
PLUS CONTINGENCY 20%	1,746,852
TOTAL FEDERAL CAPITAL COST	$10,481,113
PLUS E&D 5% 524,056	11,005,169
PLUS S&A 6% (Sum of FCC & E&D)	660,310
TOTAL FEDERAL FIRST COST	$11,665,479
TOTAL-NON FEDERAL FIRST COST (2% of Federal First Cost)	$ 233,310
TOTAL FIRST COST	$11,898,789
Plus interest prior to beginning Accrual of Benefit Stream 6-5/8% 5 years	$ 3,941,474
TOTAL INVESTMENT COST	$15,840,263

TABLE IV-6

ALTERNATIVE PLAN A-12 1200x130x28

FEDERAL CONSTRUCTION CAPITAL COST (1000's) (Includes dredging, bridges, tunnels, breakwaters, locks, relocations)	$10,523,301
PLUS AIDS TO NAVIGATION 1%	105,233
PLUS REAL ESTATE 2%	210,460
TOTAL:	$10,839,000
PLUS CONTINGENCY 20%	2,167,800
TOTAL FEDERAL CAPITAL COST	$13,006,800
PLUS E&D 5% 650,340	13,657,140
PLUS S&A 6% (Sum of FCC & E&D)	819,428
TOTAL FEDERAL FIRST COST	$14,476,568
TOTAL-NON FEDERAL FIRST COST (2% of Federal First Cost)	$ 289,531
TOTAL FIRST COST	$14,766,099
Plus interest prior to beginning Accrual of Benefit Stream 6-5/8% 5 years	$ 4,891,271
TOTAL INVESTMENT COST	$19,657,370

TABLE IV-7

ALTERNATIVE PLAN A-12 1200x130x32

FEDERAL CONSTRUCTION CAPITAL COST (1000's) (Includes dredging, bridges, tunnels, breakwaters, locks, relocations)	$19,116,383
PLUS AIDS TO NAVIGATION 1%	191,164
PLUS REAL ESTATE 2%	382,328
TOTAL:	$19,689,875
PLUS CONTINGENCY 20%	3,937,975
TOTAL FEDERAL CAPITAL COST	$23,627,850
PLUS E&D 5% 1,181,392	24,809,242
PLUS S&A 6% (Sum of FCC & E&D)	1,488,555
TOTAL FEDERAL FIRST COST	$26,297,797
TOTAL-NON FEDERAL FIRST COST (2% of Federal First Cost)	$ 525,956
TOTAL FIRST COST	$26,823,753
Plus interest prior to beginning Accrual of Benefit Stream 6-5/8% 5 years	$ 8,885,368
TOTAL INVESTMENT COST	$35,709,121

TABLE IV-8

ALTERNATIVE PLAN A-12 1200x130x36

FEDERAL CONSTRUCTION CAPITAL COST (1000's) (Includes dredging, bridges, tunnels, breakwaters, locks, relocations)	$28,261,739
PLUS AIDS TO NAVIGATION 1%	282,617
PLUS REAL ESTATE 2%	565,235
TOTAL:	$29,109,591
PLUS CONTINGENCY 20%	5,821,918
TOTAL FEDERAL CAPITAL COST	$34,931,509
PLUS E&D 5% 1,746,575	36,678,084
PLUS S&A 6% (Sum of FCC & E&D)	2,200,685
TOTAL FEDERAL FIRST COST	$38,878,769
TOTAL-NON FEDERAL FIRST COST (2% of Federal First Cost)	$ 777,575
TOTAL FIRST COST	$39,656,344
Plus interest prior to beginning Accrual of Benefit Stream 6-5/8% 5 years	$13,136,164
TOTAL INVESTMENT COST	$52,792,508

TABLE IV-9

ANNUAL COSTS (1000's)

PLAN A12 1200x130

DRAFTS

	25.5'	28'	32'	36'
Investment Cost	$15,840,263	$19,657,370	$35,709,121	$52,792,508
Interest 0.06625	1,049,417	1,302,301	2,365,729	3,497,504
Amortization 0.002794	44,258	54,923	99,771	147,502
O&M	22,032	22,473	22,943	23,668
ANNUAL COST	$ 1,115,707	$ 1,379,697	$ 2,488,443	$3,668,674

Table IV-10

SUMMARY OF NET SAVINGS (NS)
All Costs borne by United States

		25.5	28	32	36
Plan A-1	Benefit	1,607	1,720	1,885	1,896
	Cost	676	1,118	2,137	2,898
	NS	931	602	- 252	- 1,002
Plan A-2	Benefit	2,207	2,350	2,580	2,733
	Cost	1,071	1,316	2,286	3,312
	NS	1,136	1,034	294	- 579
Plan C-3	Benefit	350	427	481	481
	Cost	35	334	1,141	No Plan
	NS	315	93	-660	-
Plan C-4	Benefit	382	454	508	508
	Cost	334	451	1,301	2,175
	NS	48	3	-793	-1,667
Plan C-5	Benefit	382	454	508	508
	Cost	340	462	1,298	2,194
	NS	42	- 8	- 790	-1,686
Plan C-6	Benefit	389	459	508	508
	Cost	477	612	1,526	2,472
	NS	-88	-153	-1,018	-1,964

Table IV-10 Continued

SUMMARY OF NET SAVINGS (NS)

		25.5	28	32	36
Plan C-7	- Not Costed				
Plan C-8	Benefit	363	445	490	527
	Cost	289	391	1,102	1,699
	NS	74	54	- 612	-1,172
Plan C-9	Benefit	372	454	481	545
	Cost	310	419	1,196	1,992
	NS	62	35	- 715	-1,447
Plan A-10	Benefit	345	419	473	473
	Cost	34	334	1,141	No Plan
	NS	311	85	- 668	-
Plan A-11	Benefit	1,853	2,036	2,243	2,254
	Cost	685	1,120	2,142	2,898
	NS	1,168	916	101	-644
Plan A-12	Benefit	2,451	2,655	2,926	3,069
	Cost	1,116	1,380	2,488	3,669
	NS	1,335	1,275	438	-600
Plan A-13	Benefit	2,451	2,655	2,926	3,069
	Cost	1,123	1,390	2,486	3,688
	NS	1,328	1,265	440	-619

Table IV-10 Continued

SUMMARY OF NET SAVINGS (NS)

		25.5	28	32	36
Plan A-14	Benefit	2,456	2,655	2,926	3,069
	Cost	1,259	1,540	2,713	3,966
	NS	1,197	1,115	213	- 897

Plan A-15 - Not Costed

Table IV-11

SUMMARY OF NET SAVINGS (NS)
25% of Cost Assigned to Canada

		25.5	28	32	36
Plan A-1	Benefit	1,607	1,720	1,885	1,896
	Cost	507	838	1,602	2,173
	NS	1,100	882	283	- 277
Plan A-2	Benefit	2,207	2,350	2,580	2,733
	Cost	803	987	1,714	2,484
	NS	1,404	1,363	866	249
Plan C-3	Benefit	350	427	481	481
	Cost	26	250	855	No Plan
	NS	324	177	- 374	-
Plan C-4	Benefit	382	454	508	508
	Cost	250	338	975	1,631
	NS	132	116	-467	-1,123
Plan A-11	Benefit	1,853	2,036	2,243	2,254
	Cost	513	840	1,606	2,173
	NS	1,340	1,196	637	81
Plan A-12	Benefit	2,451	2,655	2,926	3,069
	Cost	837	1,035	1,866	2,751
	NS	1,614	1,620	1,060	318
Plan A-13	Benefit	2,451	2,655	2,926	3,069
	Cost	842	1,042	1,864	2,766
	NS	1,609	1,613	1,062	303

the fact that the benefits arising under scenarios A-1, A-2, and A-10 through A-15 are greater than the corresponding benefits in the alternative scenario sets B and C. In addition, as noted above, the effect of introducing season extension first is to delay the need for larger vessels to meet capacity requirements.

On the other hand, should a need exist to improve only the system above the Welland Canal, the analysis indicates that larger vessels should be introduced before season extension is implemented, as the benefits presented in scenarios C-3 through C-9 (and B-3 through B-9) are greater than those arising under scenarios A-3 through A-9. For this limited-benefit goal, the net saving is greatest for Plan C-3, which provides for the operation of 1100' x 105' vessels on the upper lakes, at a system draft of 25.5 ft, with the subsequent introduction of season extension. Should season extension not be implemented following the introduction of larger vessels, the benefits would be as displayed in Table IV-2, by Plans B-3 through B-9. The best plan, under these circumstances, would be Plan B-3.

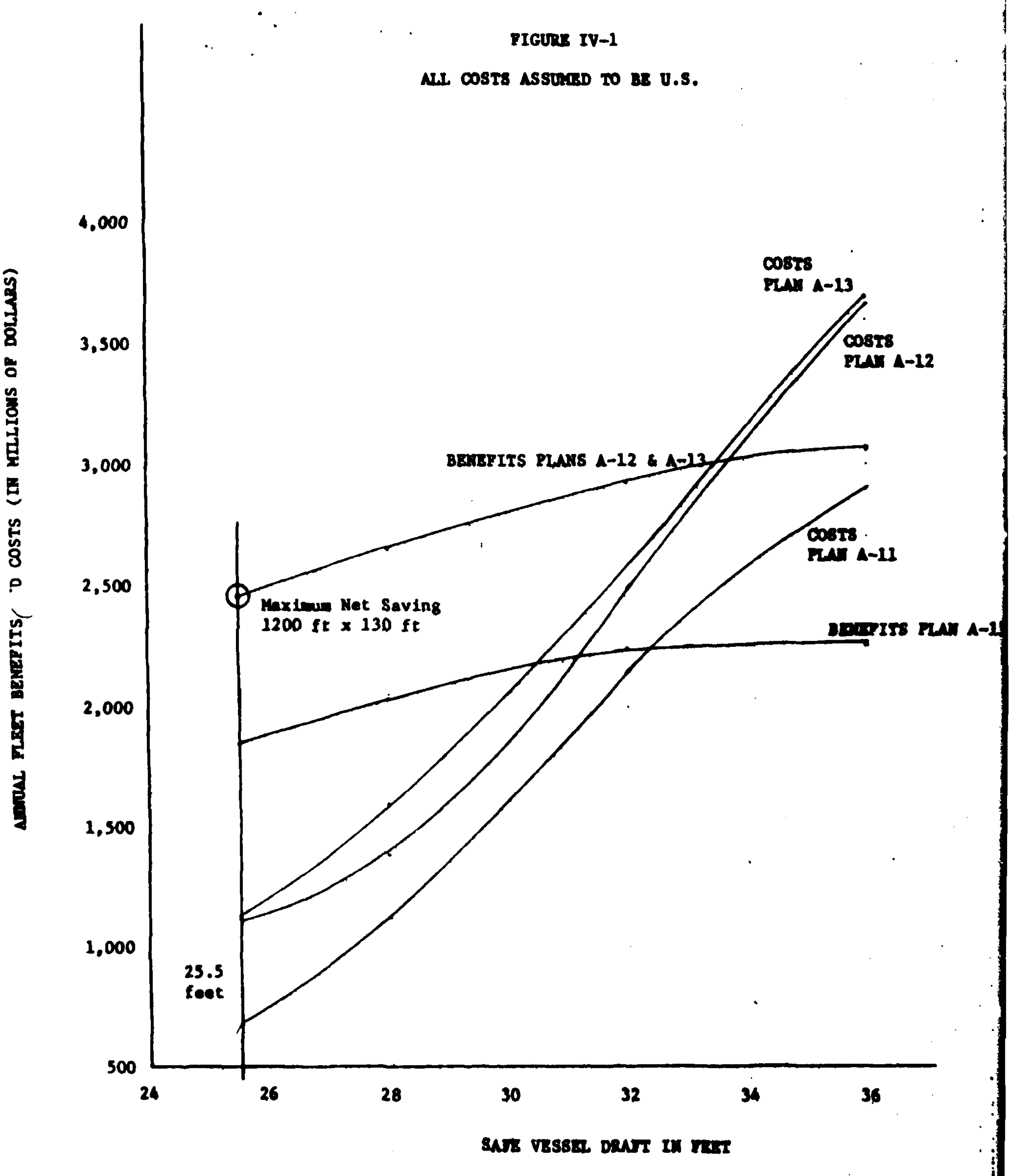
The implementation of the improvements entailed by Plan C-3 would not necessarily delay the need for season extension. *In fact, season* extension would remain desirable for the separate reasons of better vessel capital utilization and stockpiling-cost savings, rather than for reasons of system capacity. Simply stated, for season extension, the capacity increase represents a beneficial aspect, but not the sole reason for implementation, whereas the principal reason for enlarged maximum ship size is a capacity increase to obtain transportation savings on tonnage that would otherwise be required to move on the more costly non-waterborne modes. Figures IV-1 through IV-4 are graphical representations of the above analysis.

With the assumption that 25% of the costs are borne by Canada, Table IV-11 indicates that the entire-system Plan A-12 at 28-ft draft is optimum, while for the upper-lakes only, Plan C-3 at 25.5-ft draft remains the best choice.

Should a need exist to improve the system to accommodate overseas traffic, the optimum plans, without and with Canadian cost sharing, are Plan A-2 at 25.5-ft draft, and Plan A-2 at 28-ft draft, respectively.

FIGURE IV-1

ALL COSTS ASSUMED TO BE U.S.



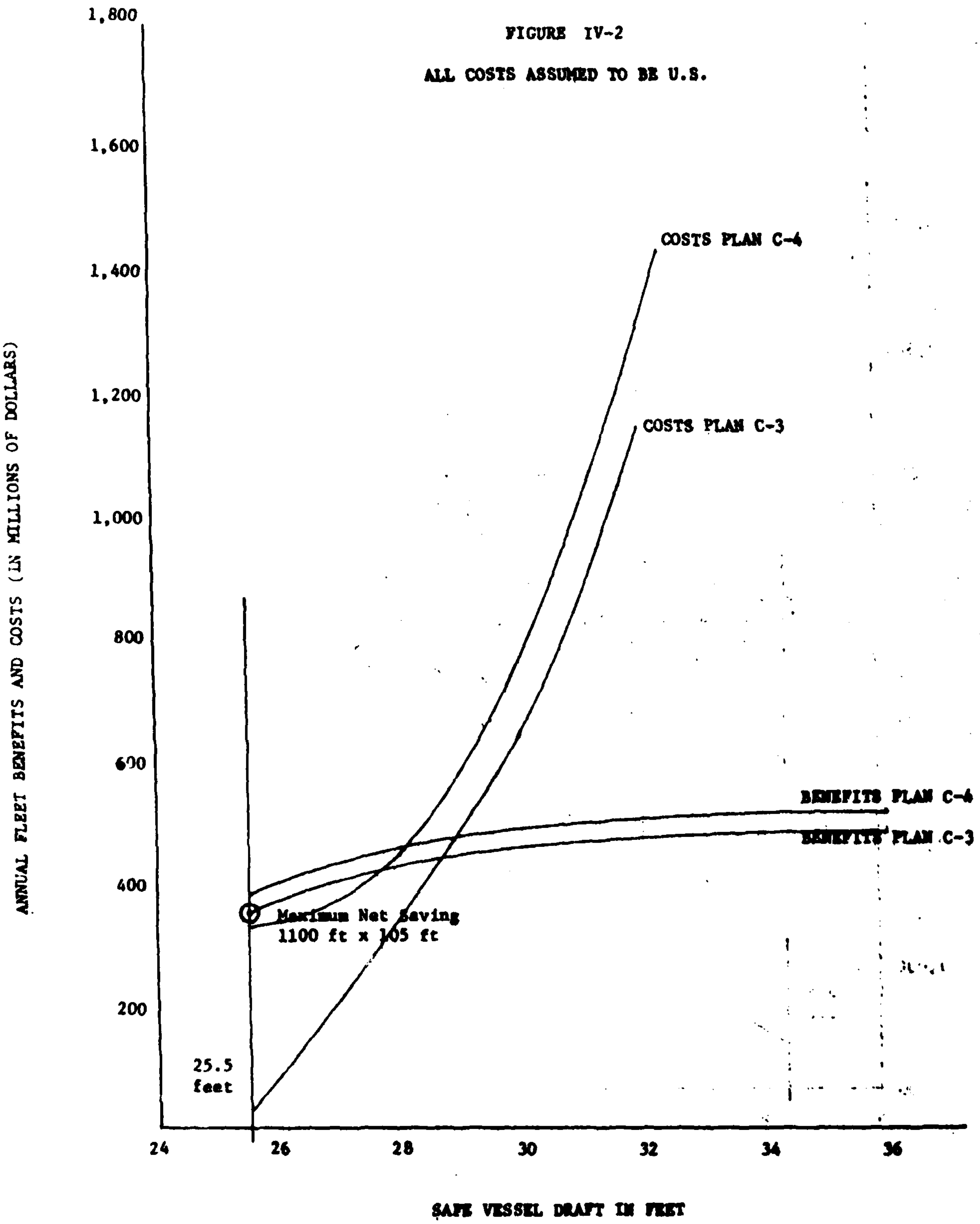


FIGURE IV-2
ALL COSTS ASSUMED TO BE U.S.
ANNUAL FLEET BENEFITS AND COSTS (IN MILLIONS OF DOLLARS)
1,800
1,600
1,400
1,200
1,000
800
600
400
200
COSTS PLAN C-4
COSTS PLAN C-3
BENEFITS PLAN C-4
BENEFITS PLAN C-3
Maximum Net Saving
1100 ft x 105 ft
25.5
feet
24
26
28
30
32
34
36
SAFE VESSEL DRAFT IN FEET

FIGURE IV-3

25% OF COSTS ASSUMED TO BE CANADIAN

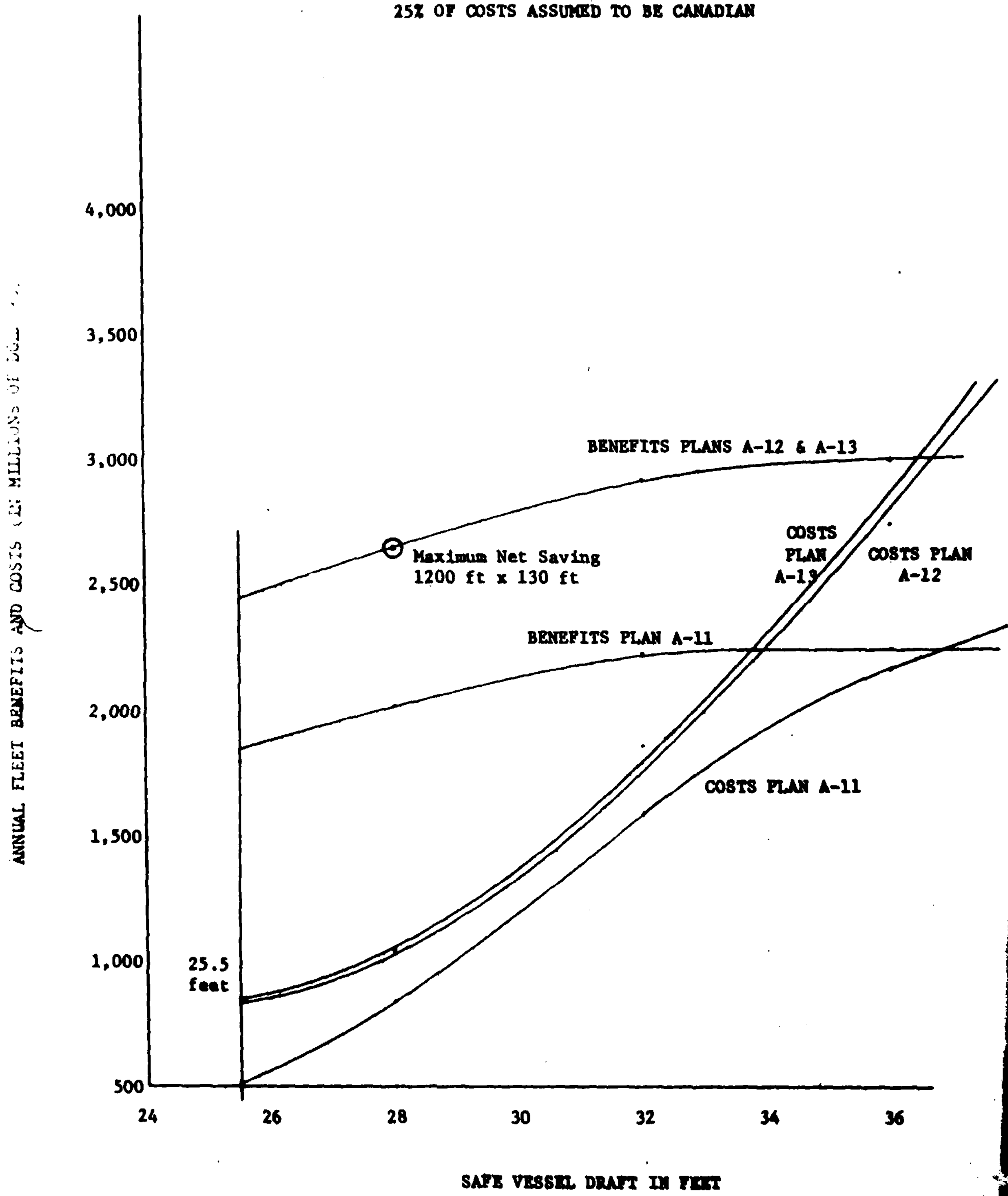
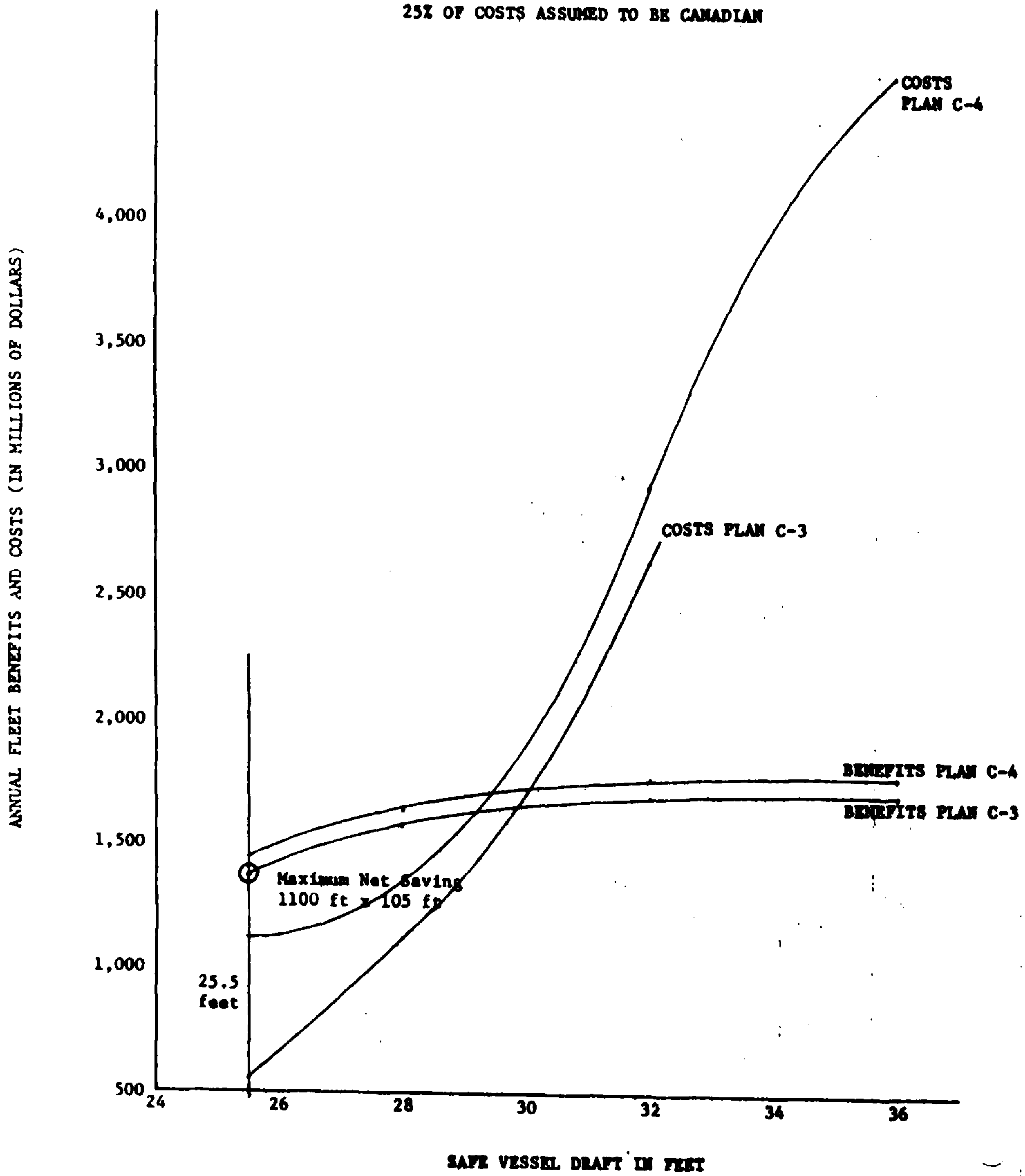


FIGURE IV-4

25% OF COSTS ASSUMED TO BE CANADIAN



In all cases, plans that improve parts of the system, either for upper lakes or for Seaway traffic only, provide smaller annual savings than do entire-system improvement plans. In all cases, however, the rate of return is 6-5/8%, the same as the discounting rate. Based on this finding, and on the fact that so many elements of the system, both at the harbors and in the connecting channels, serve both the intralake and overseas traffics, it could be argued that the GLSLS should be analyzed and improved as a "system," rather than in upper lakes and Seaway increments. The matching of allocated costs and benefits for the elements that are common to both traffics, when incrementalization is strictly applied, is both difficult and somewhat artificial. Such an analysis can be performed to optimize the system by restricting harbor improvements, first, to a set of harbors that cover their own improvement costs plus the fully allocated costs of channel improvement, and then adding further harbors that at least cover their own cost.

The finding that prior season extension on the Seaway, and subsequent season extension on the upper lakes, relative to the introduction of larger vessels, yield maximum benefits, as indicated by the benefit patterns displayed in Tables IV-1 through IV-3, appears to be the result of the time value of money and the shape of the tonnage growth curves. For the Seaway, the implementation of season extension greatly enhances the service factors, improving the market share early in the investment period, while larger vessel size would not have the same magnitude of impact on market share. The discounting technique recognizes the shape of such benefit flows, weighing early benefits with greater worth than later benefits. Thus, the total present value of the benefit stream is greater for plans giving larger early benefit flows than for plans in which the larger benefits occur later. The immediate benefits resulting from an improved market share thus favor the prior implementation of season extension on the Seaway.

On the upper lakes, a consideration of stockpiling requirements, and the design of the vessels involved, results in a pattern of benefits in which large benefits can be generated early in the investment period by transport savings alone, due to the efficiency of the larger vessels. No major impact on market share is achieved by either larger vessels or season extension. Thus, while these benefits do not depend on the prior implementation of season extension, such implementation can be justified for reasons of stockpiling cost savings and improved capital utilization.

V. FUTURE WORK

In view of the results presented here, it appears that future work should concentrate on Plans A-12 and A-13 at drafts up to 32 ft, and Plans C-3 and C-4 at drafts up to 28 ft. These plans provide for Great Lakes bulk carriers in the 1200-1300 ft by 130 ft range, with a maximum ocean-going vessel of 1000 ft x 130 ft, for the entire-system improvements (A-12 and A-13), and for Great Lakes vessels of 1100 ft x 105 ft or 1200 ft x 130 ft for upper lakes improvements only (C-3 and C-4, respectively).

Detailed studies should include refinements of the techniques used to establish channel widths and depths for the larger vessels. There is a need for greater precision in the dredging cost estimates, and these constitute the greatest percentage of the total cost of improvements. It is suggested that channel cross section, material characteristics, and dredging costs should be programmed into the channel sizing model so that the model may be run in an optimization mode.

Future work should include contact with Canadian authorities for the purpose of establishing system size criteria. Presently, a review of Corps Regulations, American Society of Civil Engineers publications, Corps work on a new Panama Canal, and the Texas A&M report entitled "Mathematical Model to Predict the Behavior of Deep-Draft Vessels in Restricted Waterways," include criteria that are basically consistent. However, in comparing this material with Canadian work concerning channel dimensions for St. Lawrence Seaway improvements, it appears that there are large divergences of criteria, with the Canadian dimensions generally smaller. These differences should be resolved.

The state of the art in this critical area of sizing channels with respect to vessel characteristics could be much improved. It is suggested that expertise in ship hydrodynamics should be combined with channel modeling efforts such as those at the Corps Waterways Experiment Station to produce this improvement in the state of the art. It appears that an investment of about $500,000 in such an effort could save as much as $1 billion in investment costs of dredging. Funds could also be well directed towards the development of more productive means of dredging than those in general use at present.

A more detailed analysis should be performed comparing two-way traffic in the Rock Cut area of the St. Marys River with the present system of traffic on both sides of Neebish Island. This is especially important in view of the difficulty anticipated for 1000' vessels transitting Middle Neebish Channel during the extended shipping season. Possible increased benefits would arise through reduced transit times, while costs would be reduced by eliminating maintenance costs for the 10 miles of the present Middle Neebish Channel. Safety of vessel transits would also be improved if the bends of the Middle Neebish Channel could be avoided by traffic. By comparison with improvements to the Rock Cut, straightening of the Middle Neebish Channel could entail the social impact of relocating the community on the east side of Neebish Island.

Real estate costs based on more detailed plans should be prepared, along with more detailed cost estimates for bridge and tunnel relocations.

Lastly, the environmental impacts of system enlargement must be included in the final analysis. These impacts must be quantified to the greatest possible extent so as to establish the shift in the project cost function, and hence, on the maximum vessel size that can actually be proposed.

APPENDIX E

PUBLIC INVOLVEMENT

ST. LAWRENCE SEAWAY - ADDITIONAL LOCKS STUDY

APPENDIX E

PUBLIC INVOLVEMENT

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APPENDIX E

PUBLIC INVOLVEMENT

It is the policy of the Corps of Engineers that civil works projects under its authority be conducted in an atmosphere of public understanding, trust, and mutual cooperation. This is accomplished through actively involving the public in water resources studies by opening and maintaining channels of communication. The process of identifying water resources issues, exploring alternatives, and selecting a feasible and desirable plan requires a continuous two-way communication process between the study planners and identifiable "publics"—defined as any affected or interested non-Corps of Engineers entity. This includes other Federal, regional, State, and local government agencies and officials; public and private organizations; and individuals.

The main goal of a public involvement program is to establish a two-way communication process which will:

- Acquire sufficient information from the broadest practical cross section of concerned citizens, groups, and governmental agencies to identify area problems, issues, needs, priorities, and preferences regarding alternative resource usage, development, and management strategies;

- Inform the public and promote full public understanding of the St. Lawrence Seaway-Additional Locks Study--the study process, progress, implications, and results; and

- Develop a process of interaction and instill in the publics a desire to participate and become involved in the study.

OVERVIEW

Public involvement will be a continuous process throughout all phases of this study. Agencies and groups will be asked to provide information about problems and issues in the region and to suggest alternative solutions. Individuals, and representatives of groups and agencies will also be asked to evaluate those plans and suggest modifications that would make the plans more responsive to area needs. Evaluation of the study process, progress, and results will also be open to public review.

While each stage of study development involves the conduct of common tasks (Figure E-1), the required planning output from each stage is sufficiently different to suggest that both the form of the public involvement program and the definition of relevant publics that should be involved in each stage, may also be different. Thus, the public involvement program for this study was planned on a stage-by-stage basis rather than on the

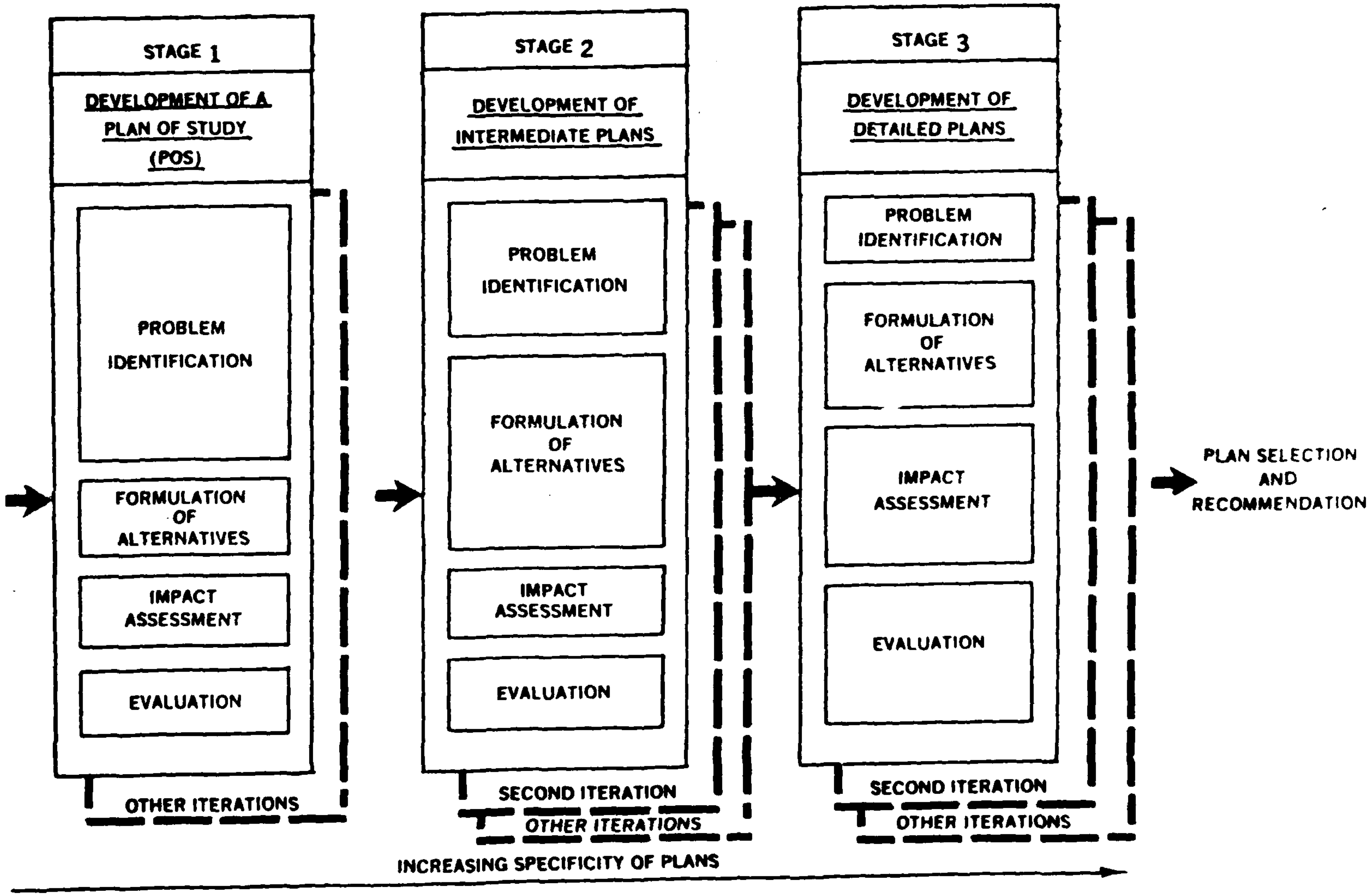


Figure E-1 - Plan Development Stages study as a whole. This utilizes the transition from one stage to the next and the requirement for a reviewable output at the end of each stage, for ending one phase of a public involvement program and beginning the next. The program also recognizes that review of planning accomplishments at the end of each stage is not, by itself, meaningful public involvement, and therefore affords the opportunity for the public to participate during each planning stage. While the general nature of the public involvement program is the same during each planning stage, there will be differences in the forums for involvement and the intensity of interaction with the public as the plan moves through successive stages. This is due to the fact that public interest in a study matures over time, and that different decisions must be made at each stage.

Figure E-2 represents the nature of the relationship between planners and publics during the various planning tasks which are carried on during all stages of the study. The public involvement process calls for open and continual interaction wherein public input is used to guide study activities, and publics are made aware of how their contributions to planning have been used. The process aims to integrate public involvement with all the study activities including the development of factors or issues which must be assessed, and weights and priorities that form the basis for decision making.

Generally, the role of the public in the study is to provide timely information to the planners so that alternative plans will, to the maximum extent possible, respond to public needs and preferences. On the other hand, the planners have the responsibility of providing information to the public, so that those choosing to participate can do so, with a relatively full and complete understanding of the issues, opportunities, and consequences. In regard to the latter, a program for informing and educating the public is an essential component of the public participation process. Its purpose, thus, is to facilitate and support the public involvement effort. Public information and education supports the overall involvement effort by:

- generating public awareness of the study and soliciting participation;

- providing specific information to both the actively participating and non-participating publics;

- announcing and publicizing significant study milestones such as study initiation, planning checkpoints and, of course, the recommendation of a final plan.

THE PUBLIC'S RECOMMENDATIONS FOR INVOLVEMENT

To aid in the development of the public involvement program, public input was solicited at seven workshops which were held along the

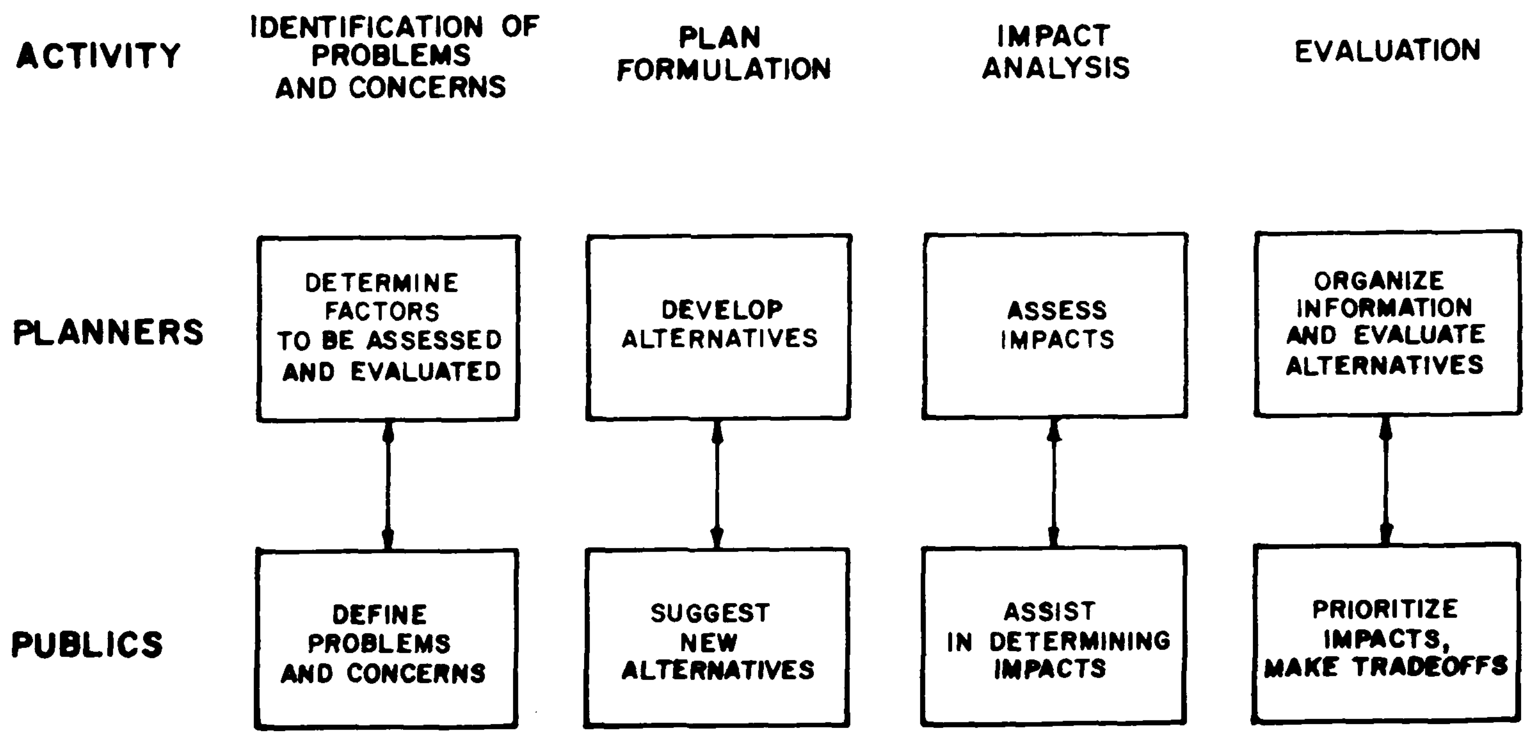


Figure E-2 - Relationship Between Planners and Publics

St. Lawrence and in Buffalo, NY. This input was analyzed by Great Lakes Tomorrow, Inc. (GLT), which was contracted to conduct the workshops. GLT then furnished its recommendations for public involvement based on this analysis. The following recommendations are described in relation to the questions which were asked the public at the workshops. These recommendations were considered, but not necessarily incorporated into the public participation program at this time. This is mostly due to the generality of the program discussed herein, or they were not compatible with the overall conduct of the study.

What should be the criteria used for public involvement-design?

The participants identified the need for issue identification, two-way communication, continuing education and information, and guaranteed public input into the decision process. Continuity of public involvement and a sustained progressive educational effort were requested. A public involvement program should provide access for systemwide and Canadian interests. The process should be clearly defined with a commitment by the Corps to use it. It should define the role of the public, and provide direct access to the decision process, adequate information and education, staff assistance, and have adequate funding.

Who should be involved in the study?

The workshop participants listed many "publics" who they felt should be involved in the study. They emphasized Canadian publics, the St. Regis Mohawk Tribe, riparian and recreational interests, local officials, and planning groups. The Buffalo workshop which had more of a systemwide representation expanded this list to include port authorities, shipping interests, industrial users, water-related utilities, various Federal and State agencies with interests or missions in the Great Lakes, related studies, and the Canadian counterparts to those publics identified. Also identified, but in general terms, were those "publics" that may gain or lose economically, those physically in the path of development, and those publics and communities whose patterns of activity would be changed in some way.

What are the public information needs?

Suggestions regarding information needs range from the availability of full technical documentation to the use of summaries of existing information, completed study phases, and of alternatives. Regular and continuing information using local media was generally stressed. The public needs access to all the information used in making decisions. Materials should be complete, understandable, organized, timely, and present both positive and negative data. New participants should be provided with an orientation package. The objective of a public information mechanism is to educate the involved citizen to "know the territory" so that future involvement can be relevant and productive. Technical documents and study materials should be available at regional, public, and university libraries along the Seaway and at all government repositories within the Great Lakes Basin. Summaries of existing information, completed study phases, and alternatives being presented for evaluation should be sent to governments, planning agencies, and media along the Seaway, to organizations with interests in the study and major media in the Basin, and to members of the public on request after notification. Prior to decision points, meetings, workshops, and hearings, briefing materials should be made available to the public, and briefings should be held for local governments and regional planning groups. The "information" public those agencies and individuals whose interest in the study is not presently acute enough to warrant their active participation, should be informed also, through newsletters, press releases, public service announcements, speaking engagements, and talk shows on local media.

How might public involvement for the SLS-AL program be secured?

Participants indicated a need for multiple channels of communication to afford the maximum opportunity for self-identification and not to use a mailing list as the sole identification of publics. The identification of publics is required so they may, if they wish, be involved in the planning process. A good cross sectional identification is necessary to secure the variations in public concerns. The retention and expansion of public involvement throughout the study will depend on the public's perceived ability to influence the course of the study.

Mechanisms used must provide maximum opportunity for two-way communication such as continuing groups or task forces, the establishment of progressive and continuing education programs, and the active solicitation of public comment. Establishment of task groups composed of publics with technical knowledge or specific interests to examine issues of public policy in connection with the study was as suggested.

Facilitated public workshops should be scheduled to assist in identification and evaluation of alternatives as they are developed. It was recommended that these workshops be conducted by a neutral party with the Corps and task groups providing technical support. Where formal hearings are required before decision points, prior briefing sessions are to be held which are accessible to both local and systemwide publics. The briefings would be designed to inform the public and better prepare them for the hearing, enabling more relevant testimony. Again, a neutral party was recommended to conduct such briefings to encourage analytical rather than proprietary reviews. A process should be established to encourage and respond to comments made by the public reviewing the study documents and that opportunities for evaluation be provided.

Who should conduct the public involvement program?

There was much concern at the workshops that a neutral, third-party presence was important at workshops and other non-formal public participation activities. Co-sponsorship of these meetings was recommended as an added factor in credibility with local interests. The League of Women Voters, Great Lakes Tomorrow, the St. Lawrence Valley Canadian-American Conference Council, and Sea Grant Institutions were suggested as possible sponsors. A Contractor should be used to develop and prepare specialized fact sheets addressing specific policy issues, and briefing documents for the pre-hearing meetings and facilitated workshops. This would incorporate the broadest system viewpoint as an aid to public consideration and discussion. A Contractor would be appropriate to facilitate Canadian involvement if and when this becomes possible. It was recommended that the Corps staff and run task groups, formal hearings, be responsible for feedback to participants, provide media contact, and publish newsletters, study summaries, group materials, and hearing announcements. GLT stated that its reasons for recommending this division of responsibility were based on the Corps in-house capability for public information activities and proximity to the ongoing study efforts. On the other hand, a Contractor or third party would have appropriate skills in relating to the public and a mandate to examine secondary and tertiary impacts and relationships. The third party could also provide an effective balance wheel at meetings and, as long as the study remains a unilateral effort, they might be the only means of achieving Canadian participation.

The workshop participants generally stressed the need for impartiality, independence, and someone with "no axe to grind" to run the public involvement program.

CRITERIA AND OBJECTIVES

The first step in planning or designing a public involvement program is to establish the criteria by which it is to be planned and the objectives which it is to meet.

Criteria

The two criteria which were established for this public involvement program were based on the needs of the two parties in the communication process - the planners and the public. The first criterion is that the program should obtain information from the public which will be useful in meeting study objectives. It should provide the planner with information so that plans which are developed will, to the maximum extent possible, respond to public needs, preferences, and priorities.

The second criterion is that the program satisfy the needs of the public. The public must be kept informed, educated, and up-to-date on the study progress. Individuals need to feel that they are being heard when expressing opinions or voicing concerns about problems.

Objectives

As a basis for planning and designing the public involvement program, a set of specific program objectives or goals was required. These objectives are as follows:

- To identify interested and affected "publics" for both the St. Lawrence River area and systemwide.
- To present information which will assist the public in defining their water resources needs and concerns.
- To provide a structural program which affords the public the opportunity to influence and shape the formulation of planning alternatives and express their preferences in choosing a course of action.
- To provide the planners with definite channels through which information on public goals and priorities, and preferences regarding planning alternatives can be obtained.
- To coordinate study efforts with land and water resource planning of other Federal, State, regional, and local agencies.
- To build public confidence and trust in the planning process and procedures and in the individuals doing the planning.
- To encourage public participation and involvement in the study.
- To resolve conflicts between interest groups by achieving compromise and thus, plans which better satisfy the needs and preferences of a broader base of public interests.
- To develop support for the final plan, and assistance in carrying it out by involving the "publics" in its formulation and selection.
- To develop a program that is flexible and affords opportunities for its evaluation and changes if necessary.

A growing concern about the use and allocation of our nation's natural resources along with the demand of more and more citizens and organizations to participate in resources planning decisions has created an atmosphere in which improved communication between the public and the planner has become increasingly important. Poor communication fosters misunderstanding by both parties which may result in conflict and mistrust.

The basic elements of the communication process are shown in Figure E-3. Essentially what the figure says is, Who says What and How To Whom with what Effect. The mechanism by which the communication actually takes place is determined by the planner and public; by their selection of whom they wish to communicate with, the information content and the format of the communication, the method, and the techniques by which

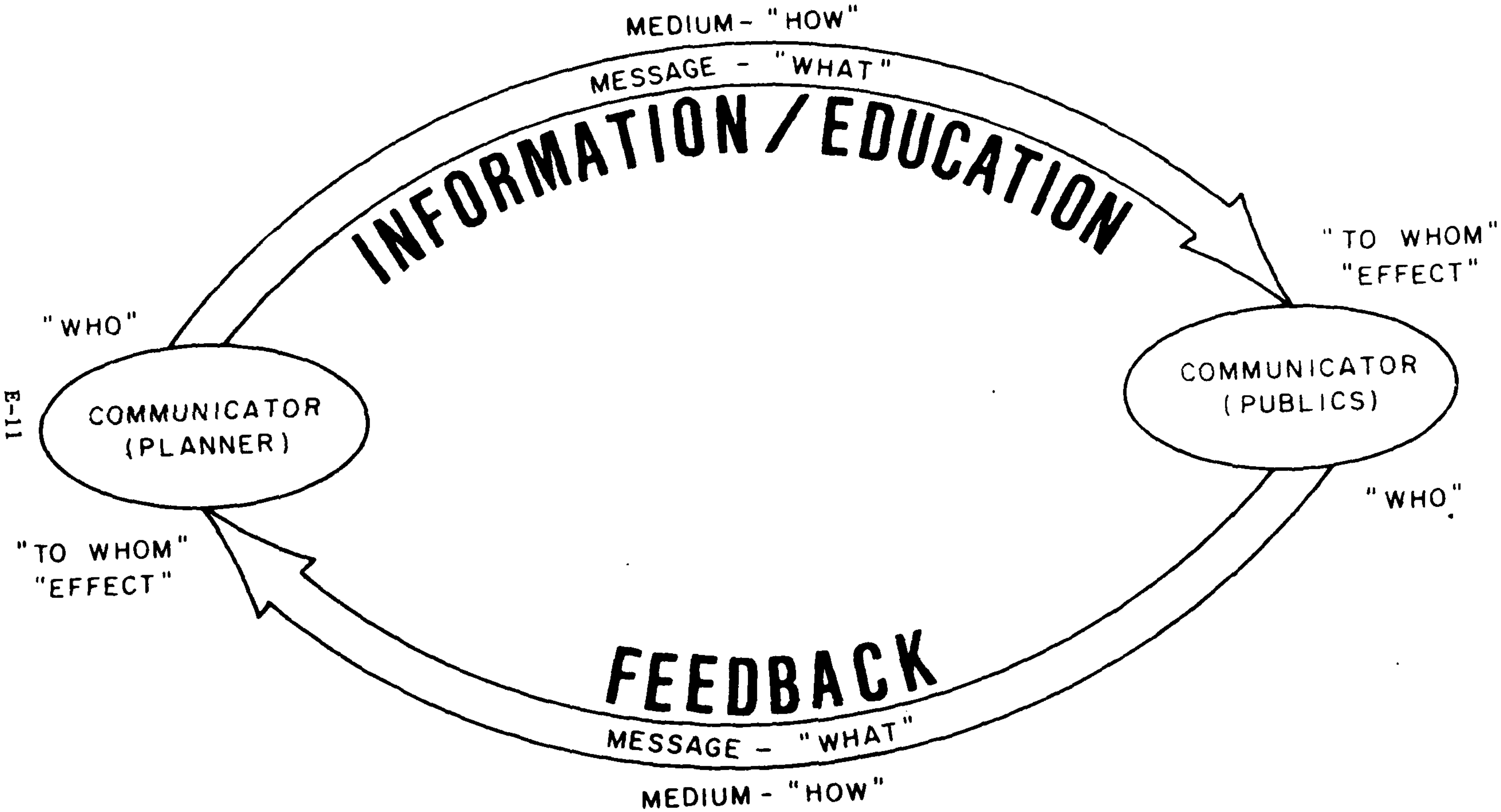


Figure E-3 - Elements of the Communication Process the message will be "transmitted." For the process to be effective, not only does the information, e.g. from the planner to the publics, have to be disseminated, but also the opportunity to complete the loop through feedback from the publics to the planner may be required.

THE PROGRAM

There are basically four tasks which must be accomplished to implement an effective public participation program. These are:

- Identify the Publics. This task establishes the "Who" and "To Whom" elements; mailing lists are developed and updated; and methods are incorporated to further identify additional "publics" as the study progresses.

- Establish Purposes for Communication. This task establishes the "What" or message to be transmitted and the desired "Effect" or purpose of the communication.

- Determine the Channels of Communication. This task determines the "How" or medium through which the communication will take place; establishes a program for diffusing information to and educating of the "publics" and the collection of information or feedback to complete the communication.

- Analysis and Evaluation. This task summarizes and analyzes the feedback to determine its meaning and relative importance, and the relation of the feedback to the desired effect of the communication; evaluates the effectiveness of the communication process; and makes subsequent changes to the public participation program if evaluation shows them advisable.

These five tasks are used in the following discussion to describe the basic program for public participation in the St. Lawrence Seaway-Additional Locks Study. The discussion of each task is arranged to first give a general description of the task, followed by specifics as they relate to this study.

Task 1 - Identify the Publics. This task may be the most elusive aspect of public participation. The public is not a single body but is diffuse. At the same time, it is highly segmented into interest groups, communities, and individuals. There are groups with common goals, ideals, and values. An individual may belong to more than one of these groups from which he draws his information and structures his values. Thus, multiple association allows the opportunity for multiple access to individuals as participants in the planning process. The public consists of those who are identified and wish to participate, those who are identified and do not have an interest in the study, those who are identified and wish only to be kept informed, and those who have not been identified. The "participating" publics will usually consist of agencies and organizations which have responsibilities or interests in the study, are individuals who have participated in like studies in the past, those individuals affected by a problem, and those who may be affected by a possible solution or plan.

The actual identification of the publics is accomplished in three ways: through self-identification by means of correspondence or appearance at public meetings and workshops pertaining to the study; third party identification using a group or individual to identify others who may have an interest in the study; and staff identification which is accomplished by the planner through analysis of agencies and organizations, geographic and demographic analysis, past participation, field interviews, and identification of those to be directly affected.

Because of the short time frame for completing the Plan of Study (Stage 1) and the abstract nature of some of the major concerns, goals, and objectives, it is difficult to achieve effective broad scale participation. Only a small number of people want to commit time to broad issues and concepts. With this in mind, staff efforts to identify publics were first directed to agencies and organizations which, because of their area of responsibility, geographic location, or interest and goals, were thought to have an interest in this study. This was accomplished by researching the study correspondence file, the Buffalo District mailing list, participation lists of other public meetings and conferences, and various planning and environmental directories. These staff efforts were augmented by third party identification through the use of area coordinators in setting up workshops for the study. These area coordinators supplemented the list of publics by further defining individuals, organizations, and agencies which would have an interest in the study. Attendance at workshops, which were conducted by Great Lakes Tomorrow, Inc., for this study, further added to the identification of the public through self-identification. This latter category represented those publics which had not been identified previously, but by their attendance at the workshops via the news media identified themselves as interested in the study and desiring to participate in its planning.

The following is a categorization of the publics by agency, organization, and interest group. Despite restrictions placed upon contact with Canadian publics, they have been identified to a limited extent in this listing in anticipation that the future will see a more tolerant policy by the governments of the United States and Canada regarding participation in this study by the various Canadian publics.

International

International Joint Commission
Great Lakes Fishery Commission

Federal (U.S.)

Members of Congress
Department of Agriculture
  Soil Conservation Service
Department of the Army
  Office, Chief of Engineers
    North Central Division
      Chicago District
      Detroit District
      St. Paul District
    North Atlantic Division
      New York District
Department of Commerce
  Economic Development Administration
  Maritime Administration
  National Oceanic and Atmospheric Administration
    Office of Coastal Zone Management
    Office of Sea Grant
    National Ocean Survey, Lake Survey Center
    National Marine Fisheries Service
Department of Health, Education, and Welfare
  Public Health Service
Department of Housing and Urban Development
Department of Interior
  Bureau of Indian Affairs
  Bureau of Mines
  Bureau of Outdoor Recreation
  Fish and Wildlife Service
  Geological Survey
  National Park Service
Department of State
Department of Transportation
  St. Lawrence Seaway Development Corporation
  U.S. Coast Guard
Water Resources Council
Environmental Protection Agency
Federal Power Commission
Council on Environmental Quality
Advisory Council on Historic Preservation
Federal Energy Administration
St. Regis Mohawk Tribe

Federal (Canada)

Department of the Environment
- Environmental Management Service
- Inland Waters Directorate
- Fisheries and Marine Service

Department of Public Works

Ministry of Transport
- Canadian Coast Guard
- St. Lawrence Seaway Authority

State of Illinois

- Department of Transportation
- State Clearinghouse

State of Indiana

- State Planning Services Agency
- Department of Natural Resources

State of Michigan

- State Clearinghouse
- Department of Natural Resources
- Michigan Sea Grant Program

State of Minnesota

- State Clearinghouse
- Department of Natural Resources

State of New York

- Members of the State Legislature
- State Clearinghouse
- Department of Transportation
- Office of Parks and Recreation
- Department of Commerce
- Department of Environmental Conservation
- St. Lawrence - Eastern Ontario Commission
- Power Authority of the State of New York

State of Ohio

- State Clearinghouse
- Department of Natural Resources

State of Pennsylvania

State Clearinghouse
Department of Natural Resources

State of Wisconsin

State Clearinghouse
Department of Natural Resources

Province of Ontario

Hydro-Electric Power Commission of Ontario
Ministry of the Environment
Ministry of Natural Resources

Province of Quebec

Department of Tourism, Fish and Game
Quebec Hydro-Electric Power Commission

Regional

Great Lakes Basin Commission
Great Lakes Commission
Upper Great Lakes Regional Commission
Black River - St. Lawrence Regional Planning Board
St. Lawrence - Franklin Regional Water Resources Planning Board

County

Jefferson County
  Cooperative Extension Service
St. Lawrence County
  Environmental Management Council
  Cooperative Extension Service

Local (U.S. and Canada)

Towns and Villages along the St. Lawrence River
Property Owners
Interested Public
Universities and Colleges
Libraries

ORGANIZATIONS

Civic (U.S.)

Chamber of Commerce of the USA
Jefferson County Chamber of Commerce
Massena Chamber of Commerce
St. Lawrence County Chamber of Commerce
League of Women Voters

Industry (U.S.)

American Association of Port Authorities
American Bureau of Shipping
American Pilots Association
Association of American Railroads
Council of Lake Erie Ports
Great Lakes - Seaway Users Association
Great Lakes Task Force
Industrial Users Group
International Association of Great Lakes Ports
International Longshoremen's Association
International Shipmaster's Association
Lake Carriers' Association
Lake Erie Marine Trades Association
Lake Freight Association
Lake Pilots Association
Marine Engineers Beneficial Assn.
Masters, Mates, and Pilots
New York State Waterways Assn., Inc.
Seafarers International Union
St. Lawrence Seaway Pilots Association
Upper Great Lakes Pilots, Inc.
U.S. Great Lakes Shipping Association
Water Transport Association
Western Great Lakes Port Association

Industry (Canada)

Corporation of Lower St. Lawrence River Pilots
Corporation of Mid-St. Lawrence River Pilots
Corporation of Professional Great Lakes Pilots
Corporation of St. Lawrence River and Seaway Pilots
Corporation of Upper St. Lawrence Pilots
Dominion Marine Association
Great Lakes Pilotage Authority, Ltd.
Great Lakes Waterways Development Association
Lake Ontario Pilots
Laurentian Pilotage Authority
Montreal Harbor Pilots
Shipping Federation of Canada

Environmental (U.S.)

American Fisheries Society
New York State Conservation Council
American Assn. for Conservation Information
American Committee for International Wildlife Protection, Inc.
American Conservation Assn., Inc.
American Rivers Conservation Council
American Scenic and Historic Preservation Society
Canada-U.S. Environmental Council
Conservation Foundation
Ducks Unlimited, Inc.
Federation of Conservation Clubs
Friends of the Earth
Great Lakes Tomorrow
Intl. Assn. of Fish and Wildlife Agenices
Izaak Walton League of America
Laboratory of Ornithology - Cornell University
Lake Erie Cleanup Committee, Inc.
National Audubon Society
National Campers and Hikers Assoc., Inc.
National Water Resources Assn.
National Watershed Congress
National Waterways Conference, Inc.
National Wildlife Federation
Natural Resources Council of America
Natural Conservancy
New York State Assn. of Conservation Commissions
Northeast Assoc. of Fish and Wildlife Resource Agencies
Outboard Boating Club of America
St. Lawrence Valley Conference Council
Sierra Club
Sport Fishing Institute
United States Tourist Council
Wetlands for Wildlife, Inc.
Wildlife Society

Environmental (Canada)

Canadian Nature Federation
Canadian Parks/Recreation Association
Canadian Wildlife Federation
Conservation Council of Ontario
Ducks, Unlimited (Canada)
Federation of Ontario Naturalists
Fisheries Council of Canada
National & Provincial Parks Association of Canada
Nature Conservancy of Canada
Quebec Wildlife Federation

The above categorization represents those publics who have an interest in the study. Of these only a relatively small number will probably actively participate in the study as was demonstrated at the seven previously mentioned workshops which were held in February 1978. The "participating public" consists of agencies which have a direct responsibility in the study area and a definite interest in the conduct of the study, organizations, and special interest groups whose interests or goals are oriented to the future of the Great Lakes-St. Lawrence River Basin or transportation, and individuals who represent the possible affected public or have a problem and need orientation.

The remaining public, considered as the "information audience," consists of those agencies, organizations, and groups, and individuals whose interest in the study is not presently acute enough to warrant their active participation, and the general or mass public. The latter represents those who have not been identified as having an interest in the study but through information furnished via the media may at sometime during subsequent stages of the study identify themselves as having an interest.

During Stage 2 (Formulation of Preliminary Plans) and Stage 3 (Development of Final Plans) the identification of the publics will continue, along with further definition of those who wish to actively participate. Information programs (discussed under Determining the Channels of Communication) will be utilized to inform and educate all the publics. They will make the "information public" aware of the study, facilitate their self-determination of study interest, and provide awareness of opportunities for involvement. The information program will also prepare the public for review at the end of each stage.

Task 2 - Establish the Purposes for Communication. Every communication has a purpose or an objective, otherwise there wouldn't be a need for the communication. It is therefore necessary to establish the objective or desired effect and the message or "what" that must be communicated to give the desired effect.

There are two basic objectives of communication which coincide with its two-way process; to inform and educate, and to provide reaction and feedback. With each study stage stressing a different task, the public involvement during each will be different. Thus, the specific objectives of the communication process will differ, but can be summarized into four categories. They are:

- To identify needs, issues, and concerns.

- To get ideas and solve problems.

- To review and comment on data and analysis.

- To provide preferences, resolve conflicts and arrive at consensus.

These objectives coincide with the study tasks as shown in Figure E-1. During Stage 1 - Plan of Study, for which this report is the resulting review document, needs, issues, and concerns required identification. This included the identification of problems to be addressed, issues to be considered, alternatives which should be investigated, and possible impacts which must be assessed and evaluated.

During Stage 2 - Formulation of Plans, the focus of the study will be shifted from problem identification to formulation and preliminary testing of alternative solutions. The objectives of the communication process between the study planners and the publics will also shift to that of getting ideas and solutions to solving problems, and to explore their possible impacts. The communication will furnish the public information concerning the possible alternatives and seek feedback as to their impacts. The public must be made aware of various trade-offs and compromises which are implicit in the selection of one alternative over another. The public in turn must express their views as to the adequacy of the range of alternatives, provide suggestions concerning modifications which might improve the desirability of an alternative, and indicate which alternatives are clearly unacceptable.

Stage 3 - Development of Final Plans centers on developing in detail a small number of alternative plans, their assessment, evaluation and modification, and the selection and recommendation of one plan. The focus here shifts from formulation of solutions to that of refinement, assessment, evaluation, and selection. During this stage, the public will be more able to identify with various alternatives because each alternative can be described in very real terms as to how it might specifically affect various interests. As a result, interest heightens and conflicts among interest increases. Thus, the communication objectives for this stage center on review, comment, and analysis with resolution of conflicts and consensus as the ultimate goal. Detailed information concerning the implications of each alternative will be provided to the public. The public must provide information to aid the planner in determining the short and long-term consequences and incidence of effects, suggest mitigative measures and modifications which would increase the acceptability of alternatives, and express preferences with regard to the alternatives under consideration.

Task 3 - Determine Channels of Communication. Information and feedback must be communicated between the planners and publics through some medium in order to accomplish the desired effect or objective of the communication. The selection of the media, or the technique and forum to be used depends on the desired effect or objective of the communication, type of information to be communicated, the publics to which it is to be directed, and the response or feedback that is desired. In determining which technique or forum to use, it is first necessary to analyze the available techniques as to their purpose, characteristics, advantages and disadvantages, ability to meet the various objectives, and effectiveness with various publics. Table E-1 describes various techniques which have been used in water resources studies, along with their advantages and disadvantages. Table E-2 displays the capabilities of these techniques in accomplishing various communication characteristics and the objectives to which they are oriented.

Effective use of the various mass media available today is an important element of a successful public participation program. Mass media are characterized by a large audience which is heterogeneous in nature, i.e. wide representation of publics. Common forms of mass media include radio, television, newspapers, magazines, direct mail, and others. Mass media are generally considered to be one-way communication techniques, from planner to the publics. Two-way communication can be developed via the mass media when used in conjunction with other techniques. Table E-3 summarizes the effectiveness of different types of mass media in reaching various cross section of the public.

It is very difficult to say which technique or media will be used when, with whom, and for what purpose. In general, though, there are some techniques that are best suited for the purposes or objectives of each respective stage. This does not limit the use of other techniques as the need arises, but attempts to establish a minimal program in general terms for the conduct of this study.

During Stage 1 - Development of a Plan of Study, for which this report is the resulting document, the public participation efforts were oriented to obtaining information. Following identification of the publics, consisting mainly of agencies and organized groups, coordination letters were developed informing them of the study. Where direct contact for information was deemed advisable, the agencies and organizations were requested to furnish a representative for purposes of contact. These letters are included in Appendix G - Coordination and Pertinent Correspondence. Personal and telephonic interviews were then conducted to gather and develop an information base for this study. Letters were posted to various planning agencies in the eastern Ontario-St. Lawrence River basin requesting their input in describing problems, needs, and opportunities of associated water and land resources which should be considered in this study in conjunction with commercial navigation. Small meetings with groups also augmented this information gathering and several speaking engagements were also utilized to inform the public of the study. The services of Great Lakes Tomorrow, Inc. (GLT), an international citizens organization dedicated to involving the public in agency decision making in the Great Lakes Basin, were contracted to arrange, conduct, monitor, and evaluate several workshops for the purpose of incorporating public input into this Plan of Study, specifically the

Table E-1 - Communication Techniques

Technique	Description	Advantages	Disadvantages
Public Hearing	Formal and highly structured meeting with a record of the hearing, usually in the form of a verbatim transcript and written statements.	Provides opportunity to be on permanent record as having put forth a certain view. Accepted by the public. Open to all.	Costly, formal rules, little information given out, one-way, requires control and order, does not address specific issues.
Public Meeting	Informal meeting with some structure. Official transcript may or may not result.	Less formal and costly than hearings, open to all, two-way, could supersede the hearing.	Somewhat formal, transcript not required, requires order and control, does not address specific issues.
Informal Small Group Meeting	Small scale public meeting.	May serve several purposes, several forms, oriented to geographic or interest group, two-way.	Somewhat formal, limited public.
General Public Information Meeting	Large scale meeting for furnishing information to the public.	Open to all, two-way, informal, can be structured to address specific issues.	Does not solicit feedback, is not action oriented.
Presentations to Community Organizations	Small, informal meeting with a specific public.	Addresses specific issues, some two-way.	Limited public, not oriented to feedback.
Information and Coordination Seminars	Small, informal meeting for providing information to or coordination with special interest groups and agencies.	Keeps elected officials up-to-date, providing specialized information to interest groups, aids coordination between agencies, advance preparation for workshops, low time budget.	Limited public, little feedback, key officials represent the views of the general public.
Operating Field Offices	Utilizes a field office as a liaison between the agency's main office and the public.	Can serve a planning function as well as public contact, very useful in a controversial study, makes agency more accessible to the public, transcends distance between the planner and publics.	V..., costly, may duplicate some efforts of main office, number of publics contacted is low for the cost, mostly feedback and reaction.
Local Planning Visits	On-site visits by the study team members to local communities and the area.	Good 2-way, addresses specific interests, oriented to getting feedback, good one-on-one contact, informal, advance preparation for workshops, meeting with media.	Is not oriented toward information/education, numbers of public contacted are low.
Planning Brochures and Workbooks	Technical and non-technical brochure for providing alternatives and data, and soliciting feedback from the public.	Oriented towards specific interests and tasks.	Limited distribution, communication is written not oral, little personal contact may require some professional expertise, requires commitment of time by the public.
Informational Brochures and Pamphlets	Brief, written materials for furnishing information to the public.	May be basin-wide or local, can address specific issues or interests, stimulates interest, introduces public to the study, easily understood, wide circulation.	Strictly informational in nature, one-way, not a feedback or reaction mechanism, costly.
Field Trips and Site Visits	Non-professional "show me" trips for groups, local officials, and the media.	Address specific issues and interests, good two-way, can be used as a press conference.	Public informed indirectly through representatives, limited publics, mostly informational, feedback minimal and not representative of all the publics, oriented to identifying problems and other objectives.

Table E-1 - Communication Techniques (Cont'd)

Technique	Description	Advantages	Disadvantages
Public Displays and Model Demonstrations	Manned or automated presentations using various media to provide overview of study issues and alternatives.	Contact with many publics, two-way, solicit comments and feedback, quick appraisal of alternatives.	Is not issue oriented, general overview information, brief.
Materials for Mass Media	Press releases and information materials provided to inform the press, radio and TV media.	Result number of publics contacted is high, informational in nature.	No feedback, general.
Response to Public Inquiries	Telephone or written response to questions directed to the agency.	Address specific issues, personal response, provides agency accountability, supplements list of participating publics.	Numbers of public are low, feedback only, no personal contact, limited objectives.
Letter Requests for Comments	Letters to agencies, organizations, or groups requesting their comments concerning certain issues.	Address specific interests, solicite views and ideas, able to reach specific publics, time efficient.	Limited public, no personal contact, limited two-way, public input through representatives.
Community Interest Advocate or Ombudsman	Agency appointee to serve as a liaison with the community to investigate and resolve community complaints, and make recommendations to the agency.	Addresses specific interests, good two-way, solicits publics' views and comments.	Information furnished in general, objectivity of contact may be questioned by public.
Workshops	Working meetings where public and agency discuss specific issues.	Directed to specific publics, small groups, addresses specific interests, good two-way.	Oriented to feedback, can be costly, numbers of public contacted are low, not oriented to providing information.
Charettes	Highly intense meeting with the express purpose of reaching a decision or resolving a conflict.	Problem solving and decision oriented, addresses specific interests.	Presupposes a certain amount of advance preparation, low public contact, does not furnish information.
Advisory Committee	Appointed group of public representatives which advises the agency.	Useful as a "sounding board" for study proposals, addresses specific issues, good two-way.	May not be representative of all public views, public numbers are low, oriented to soliciting feedback not providing information to publics.
Task Forces	Appointed group which advises the agency relative to a specific problem or area.	Handles specific problems, good two-way, good for handling technical problems.	Short-term, problem specific, dissolved upon solution of problem, few publics contacted, expertise required, oriented for soliciting feedback, not providing information.

Table E-2 - Capabilities of Communication Techniques

Public Participation Techniques	Communication Characteristics: Number of Publics Contacted	Communication Characteristics: Ability to Handle Specific Interest	Communication Characteristics: Degree of 2-Way Communication	Communication Objectives, General: Inform/Educate	Communication Objectives, General: Reaction/Feedback	Communication Objectives, General: Identify needs, issues, concerns	Communication Objectives, Specific: Get ideas/Solve Problems	Communication Objectives, Specific: Review and Comment on Data and Analyses	Communication Objectives, Specific: Provide Preferences Resolve Conflict/ Consensus
Public Forums									
Public Hearings	M	L	L		X	X		X	
Public Meetings	M	L	M	X	X	X		X	
Informal Small Group Meetings	L	M	H	X	X	X	X	X	X
General Public Information Meetings	M	L	M	X					
Presentations to Community Organizations	L	M	M	X	X	X			
Information & Coordination Seminars	L	H	H	X	X			X	
Community Contacts									
Operating Field Offices	L	M	L		X	X	X	X	
Local Planning Visits	L	H	H		X	X		X	
Planning Brochures and Workbooks	L	H	L	X	X		X	X	
Information Brochures and Pamphlets	M	M	L	X					
Field Trips and Site Visits	L	H	H	X		X			
Public Displays	H	L	M	X	X		X	X	
Model Demonstration Projects	M	L	M	X	X			X	X
Material for Mass Media	H	L	L	X					
Response to Public Inquiries	L	H	M	X				X	
Letter Requests for Comments	L	H	L		X		X	X	
Community Interest Advocates	L	H	H				X	X	X
Ombudsman or Representative	L	H	H		X	X	X	X	X
Interactive Group Methods									
Workshops	L	H	H		X	X	X	X	X
Charettes	L	H	H				X	X	X
Advisory Committees	L	H	H		X	X	X	X	
Task Forces	L	H	H			X	X	X	

L = Low

M = Medium

H = High

X = Objectives for which technique is oriented.

Table E-3 - Effectiveness of Various Mass Media

Publics	Media								
	Printed Brochures	Radio Programs and News	TV Programs and News	Newspaper Articles	Magazine Articles	Direct Mail and Newsletters	Motion Picture Film	Slide-Tape Presentation	Telelecture
Individual Citizens	L	H	H	H	L	L	M	M	L
Sportsmen Groups	M	M	M	M	H	H	H	H	M
Conservation-Environment Groups	M	M	M	M	H	H	H	H	M
Farm Organizations	M	M	M	M	H	H	M	M	M
Property Owners and Users	L	H	H	H	L	L	M	M	L
Business-Industrial	L	M	M	M	M	H	M	M	L
Professional Groups and Organizations	L	M	M	M	M	H	M	M	L
Educational Institutions	L	L	L	M	M	H	M	M	M
Service Clubs and Civic Organizations	L	M	M	M	M	L	H	E	M
Labor Unions	L	M	M	M	L	L	M	M	L
State-Local Agencies	M	L	L	L	M	H	H	H	H
State-Local Elected Officials	M	L	L	K	L	H	H	H	H
Federal Agencies	M	L	L	L	L	H	M	M	M
Other Groups and Organizations	M	M	M	M	M	H	H	H	M

H = Highly Effective

M = Moderately Effective

L = Least Effective

identification of public concerns along the St. Lawrence River and possible impacts which must be addressed during the study to enable their assessment. These workshops were conducted at Massena, Ogdensburg, and Alexandria Bay, NY on 20, 21, and 22 February 1978, respectively, and were directed to the general public and local agencies and organizations. To afford maximum opportunity, each location had an afternoon and evening session. A single workshop was conducted at Buffalo, NY on 24 February 1978 and was directed to shipping and other Great Lakes interests. Attachment 1, at the end of this appendix, is a summary of these workshops. In preparation for these workshops, an information brochure was developed to furnish information to the public and prepare them for participation at the workshops. Press releases were also developed. Mass media coverage of the workshops prior to, during and following was adequate. This included newspaper and magazine articles, and radio and television announcements and interviews. Following the workshops, a feedback brochure was prepared by GLT. This feedback was furnished to the workshop participants and included a summary of the workshop results and GLT's recommendations to the Buffalo District concerning public participation for the remainder of the study. A draft Plan of Study document will be provided to select agencies for their review and coordination. It will also be placed in community and university libraries and Federal depositories to enable access and review by the general public. Following a formal review period, a public hearing will be held, whereby public evaluation of the Plan of Study will be possible. Incorporation and/or address of comments and criticism will be incorporated into a final Plan of Study. This report will be placed in libraries for reference by the publics throughout the study. The publics will be notified as to the locations and provided the opportunity to purchase the document at the cost of reproduction. This latter requirement is necessary because of the report's volume and the cost which would be necessary to provide such voluminous document to all the publics which would request it if it were at no charge.

During Stage 2 - Development of Intermediate Plans, review procedures and a public meeting will be provided as during Stage 1. Public involvement during Stage 2 will require more interaction among the various interests as well as between the public and planner. Generally workshops are suited to all three stages, and this will be used extensively. Interviews and small meetings will be utilized to address specific problems or interests. Information meetings will be incorporated to provide a better understanding of the alternatives being considered, and their possible impacts, to educate the public and better prepare them for public hearings and workshops. This will be augmented with presentations at meetings, visits to agencies and organizations, and extensive use of mass media. Correspondence with the public will also be utilized here and of course throughout the study. As in Stage 1, documentation of Stage 2 results will be provided to the public as feedback in the form of a Preliminary Feasibility Report (PFR). The report will not only display alternative plans, their impacts, and the evaluation and selection of the plans warranting detailed planning in Stage 3, but will include a Public Involvement appendix which will explain the role of the public in the decision process to date, evaluate the public involvement process, and develop the public involvement program for Stage 3.

Stage 3 - Development of Final Plans, is concerned with the detailed development of a small number of alternative plans, their assessment, modification and evaluation; leading to one final plan of action which will be recommended to Congress. During this stage, public involvement will be most intensive. Each alternative will be described in very real terms as to how it might specifically affect various interests. Thus, interest in the study rises and conflict among interests increases. It is also during this last stage that the numbers of participants and diversity of interest groups will be the greatest. Information furnished to the public will focus on detailing the nature, magnitude, and incidence of the effects of each alternative plan and to assess and put into perspective the public's evaluation of those effects. The planner will need to know the remaining concerns and issues that have not been fully addressed or completely overlooked, the adequacy of the assessment of the effects, the public's preferences and priorities, and potential compromises and trade-offs. As in Stage 2, interaction among various interests as well as between the public and planner is required. Again, workshops provide the most effective means of effectuating this interaction and will be used throughout Stage 3. Small meetings with representatives of several interests will be utilized to resolve conflicts. Committees may be helpful in assessing effects and evaluating the plans.

Again, documentation will be made available as a means of accounting to the public on how their input into the planning process was used in the final decision making. This documentation in the form of a Draft Final Feasibility Report (DFFR) will address the conduct of the entire study and provide rationale to the selection of a final decision. As with the two previous documents, Plan of Study and Prelimminary Feasibility, the DFFR will afford the public an opportunity to scrutinize the study and to comment on its conduct.

At the end of each stage and following public review of the stage documentation by the public, a public meeting will be conducted to verbally inform the public of how the study is going and to give the public an opportunity to put on official record their reaction to the study efforts.

Task 4 - Analysis and Evaluation - The purpose of the task is to analyze and evaluate public input, and to evaluate the effectiveness of the public involvement program. This latter evaluation will also consist of appropriate changes to the program if the evaluation shows them advisable.

Analysis summarizes and displays the number, content, and nature of public input so that it can be considered in the planning process. It strives to identify public opinion and values, their underlying reasons, and new ideas, information, issues, and resource management alternatives. Basically, analysis describes what the public said, but does not assign any weight or importance to public inputs; this is done in the evaluation phase. To aid in analyzing public input during this study, objectives and decision making questions will be defined prior to the actual effort. Analysis will recognize that all input has value and merit in the decision making arena no matter their source or detail and whether they are opinions or well reasoned arguments. The analysis will be systematic, visible, objective, and traceable permitting effective evaluation of the input and providing a means to support decisions to both the public and agency hierarchy. Input via different channels or media will be summarized independently, i.e. results of workshops will not be combined with personal letters. Each has its own implications. The analysis will be continual throughout the study and not only at times of requested response.

Evaluation of public input is subjective in nature and involves the interpretation of the importance of various kinds of public input. It integrates this input with other factors which are involved in reaching a decision. These include technical, social, economic, environmental, fiscal, political, and legal factors. Analysis simply provides the planner with a description and summary of the public's input. The planner then must evaluate these inputs by weighing them against one another and against the above factors in arriving at a decision. Because evaluation of public input is subjective, i.e., no formula or quantitive method to guide it, there must be guidelines to provide consistency throughout the study. For this study, these guidelines are:

- All public input has value, is desired, and will be considered.

- Varying degrees of importance will be placed on all input. Primary input such as personal letters and interviews will have more importance than secondary input such as form letters and petitions.

- There is a silent public that would derive economic benefit from possible improvements to the St. Lawrence Seaway. Input from certain sources may be given more importance than others based on the number of publics represented.

- Input from publics which may be directly impacted upon will be given more importance than input from publics whose involvement is based upon interest only.

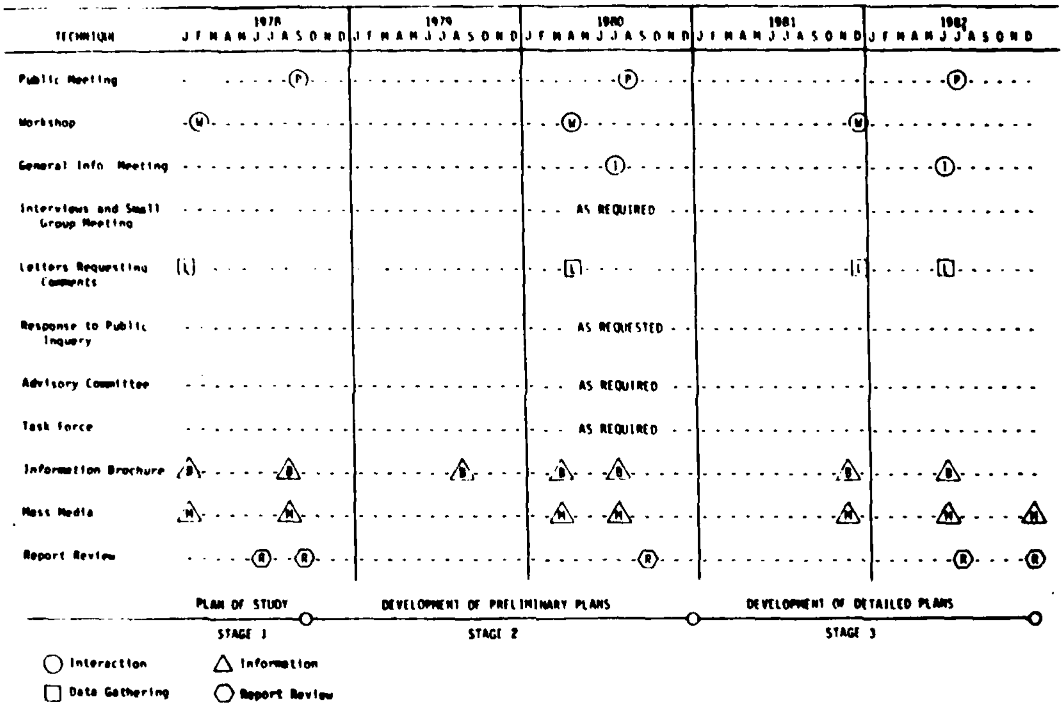
- Reasons and backup to support input adds depth and meaning to the input, but its absence of detail will not detract from the fact that it is an important expression of values.

- Quality and quantity are both important aspects of public input. It is as important to know how people feel about various matters and why they feel that way, as it is to know how many.

- The recommendations or decisions which result from public input will be disclosed throughout the study. This feedback will provide the public the opportunity to react to the decision, which in turn will furnish more valuable public input.

The final step in this task is to evaluate the effectiveness of the public participation program. Actually, this evaluation is a continual process and not a last step and as such is used to evaluate each communication as well as the overall program. As with evaluating the input, this evaluation will also take into account that quantity or numbers of publics participating is not necessarily a measure of a technique's or program's effectiveness. The quality of the participation will also play a part in this evaluation. The results of the interaction will be compared to the objectives which had been set to determine whether or not they had been achieved. The evaluation of the public participation program is not the sole duty of the planner. Although he has his information needs for the study, the public also has needs which must be satisfied. Therefore, efforts will be made throughout the study to utilize the public in evaluating the program. During workshops and other small meetings, time will be set aside to explore the adequacy of the program with the participants. The public meetings which will be conducted at the end of each stage will also be used as a convenient checkpoint with the public concerning the program's adequacy. As a result of this evaluation, certain changes to the public participation program may be warranted. These changes will be incorporated into the program for subsequent stages of the planning process.

FIGURE I-1 - PUBLIC PARTICIPATION SCHEDULE



SUMMARY OF PUBLIC WORKSHOPS CONDUCTED BY GREAT LAKES TOMORROW, INC. FOR THE ST. LAWRENCE SEAWAY-ADDITIONAL LOCKS STUDY - FEBRUARY 1978

On 20, 21, 22, and 24 February 1978 workshops were conducted at Massena, Ogdensburg, Alexandria Bay, and Buffalo, NY, respectively, by Great Lakes Tomorrow, Inc. under contract with the Buffalo District. With the exception of the Buffalo workshop which was single session, the workshops were double sessions, afternoon and evening, for the convenience of the participants. The following is a summary of the interests and concerns which were raised during these workshops.

There was general consensus among most workshop participants that this study should not be done in isolation from other studies relative to Great Lakes transportation. They are unwilling to accept the rationale of separate "Congressional authorization" or "study jurisdictions" as excuses for not integrating the studies. There was strong concern that a way be found to integrate research data, findings, need justification and cost/benefits of such studies. For example, there was particular emphasis on the need to explore the relationships between Extended Season Navigation and the SLS-AL Study.

Participants were also extremely concerned that a means be found to include Canadian governments and citizens in the study process without further delay.

Many workshop participants indicated either implicitly or explicitly that they did not have much confidence that there would really be careful evaluation of <u>whether</u> of not construction or system modification should occur, or that concerns they expressed would necessarily be taken seriously. They assumed that there would be construction. There was much doubt expressed as to whether local or regional impacts would be considered as being very important in determining whether expansion is needed in the national interest.

Local citizens are generally agreed that there were a number of factors which should seriously be considered in arriving at a decision regarding expansion of Seaway capacity. They expressed many concerns about the social, environmental and economic impacts of dredging. "If you will have to dredge, how long does it take? What will be its impact on the summer residents? This a dirt poor county and the esthetics of the area are one of its most important economic assets. Thousands of people are summer residents. More come as tourists. You must determine the impact of four or five years of dredging on the bass and muskie fishing, sailing, boating. We live off summer people. What will be the impact on their property? - about 80% of the riparian owners are seasonal residents and live out-of-state the rest of the year." Alternatively, "This is possibly a big construction project. It might post an economic boom of the local area.

Attachment 1

(The oil spill generated a boom - temporarily - for the local economy.) We recognize that the boom period would be temporary and want to know how much money from it would really stop in the local area? What will the costs be to tourist industry dependent residents? How will the two balance out for the local economy?" They are concerned that local citizens will be responsible for bearing the service and capital costs of the secondary impacts which accompany a boom economy and that additional traffic on the Seaway might destroy the basic economy of the region.

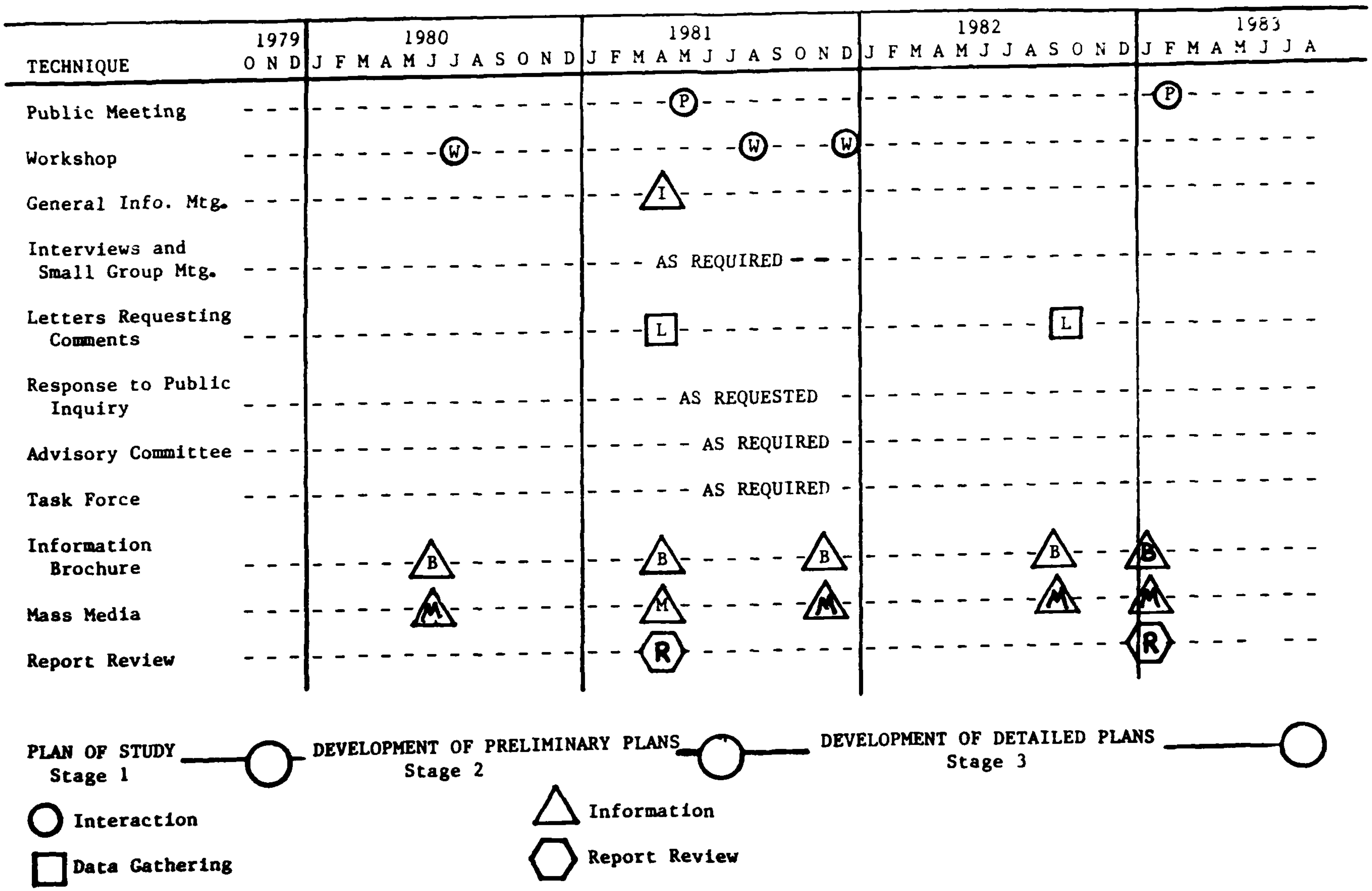
Citizens were also concerned about additional demands that the project might make on energy resources and the general ecosystem of the system. They want to know how ecosystem disruptions will impact on their lifestyle and local economies as well as on the esthetic qualities of the region.

People are worried - they have an extreme anxiety concerning the potential for another oil spill - or spill of other hazardous substances. Captains and pilots are very concerned about increasing barge traffic on the Seaway and believe that it is not possible to provide for safe transport of barge cargoes.

Pilots, both U.S. and Canadian, who attended the workshops and who are responsible for guiding the ships through the Seaway seem to be in agreement that the environmental impacts on the St. Lawrence and social impacts on tourism which will be negative are in direct proportion to the number of ships moving through the system. They believe the present navigation system to be inadequate and poor in certain areas and during bad weather. They are concerned that the system will be designed for the wrong type of ship or that present difficulties and inadequacies will not be corrected and that enlarging the system will then simply compound the present difficulties. They believe fog detectors are placed in the wrong places, bridge lights are left on during fog so they can't see to go under the bridges in proper channels, buoys are pulled up, come loose or are moved. Winds are a hazard in the channel and so are speed limits and certain ship designs. Accidents around the locks, and various groundings should be analyzed before new designs are contemplated. Electronic navigation systems need improving.

Attachment 1 (Cont'd)

FIGURE E-3: PUBLIC PARTICIPATION SCHEDULE



APPENDIX F

PUBLIC CONCERNS

APPENDIX F

PUBLIC CONCERNS

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APPENDIX F

PUBLIC CONCERNS

The first task in the Corps Planning Process is Problem Identification. During development of the Plan of Study this task receives the greatest emphasis as compared to the other three tasks (Figure 1-1). In accomplishing this task, it is necessary to identify public concerns as they relate to issues concerning water and related land resources. These concerns aid in defining the objectives of the study and criteria which will be used to measure the responsiveness of various alternative solutions in meeting the study objectives. These concerns also help to define possible impacts of the various alternative plans in the early stages of the study. This in turn directs subsequent study activities to address these possible impact areas to enable their proper assessment.

A series of seven workshops were conducted at Massena, Ogdensburg, Alexandria Bay, and Buffalo, New York, to identify public concerns as they related to the St. Lawrence Seaway - Additional Locks Study. The following is a categorized summary of those concerns. As part of the studies public involvement program, this summary has been sent to each workshop participant as a feedback. Each of these concerns has been addressed individually and incorporated into the Plan of Study if determined to be applicable.

SUMMARY OF WORKSHOPS

Engineering Concerns.

Construction

1. How will the system be designed to cope with hazardous cargoes?

Response. From a strictly design standpoint, there is little design of the system which would specifically address hazardous cargoes except possibly, channel design. Hazardous cargoes are best controlled by regulations and operational restrictions.

2. What will be the requirements for design of contingencies to deal with groundings and leakage?

Response. Presently, there is a contingency plan in operation for the Great Lakes-St. Lawrence Seaway System, spearheaded by the U.S. and Canadian Coast Guards, which deals with oil and hazardous cargo spills on a regional basis. The St. Lawrence Seaway Development Corp. is presently developing a contingency plan for hazardous cargoes which will be more specifc to the St. Lawrence River area.

These plans will be reviewed and evaluated in conjunction with any modifications to the Seaway which may result from this study.

3. Will the construction of improvements affect the system's ability to accommodate shipping?

Response. Construction may affect shipping, but it will be kept at a minimum. Construction in the channels may reduce speed limits and restrict areas to no passing. Construction around the lock area may reduce entry and exit times. The present system will remain operable at all times. Care will be taken to use construction techniques which will not affect vessels utilizing the system. See Technical Criteria h., Section 4 - Formulating a Plan.

4. Project to year 2000 to determine ship size need. Evaluate potential for other technological changes regarding ship design, other mode changes. Then determine scenario for design of increased system capacity.

Response. This has been done in the Maximum Vessel Size Study (See Appendix D). Conceptual designs were prepared by the Department of Naval Architecture and Marine Engineering of the University of Michigan, and a marine architecture firm. Future fleet projection for various commodities were projected to the year 2040 for an unconstrained system. These will be updated throughout the study. Technology of alternate modes of transportation such as railroads and motor transport, are taken into account in the economic computer model when comparing the cost of that mode with waterborne transportation. These will also be updated throughout the study.

5. Evaluate requirements for natural resources to be used in construction/maintenance and where they will be obtained.

Response. A preliminary materials search will be conducted during the study with the results included in the impact assessment of the various alternatives. See Section 5 - Selecting a Plan, Impact Assessment.

6. How can quality control for any additional construction in the system be guaranteed and monitored?

Response. The objective of this study is to demonstrate the feasibility of possible improvements to the St. Lawrence Seaway. Quality control will be the responsibility of the construction agency. Good quality control is a function of five things; good design, detailed plans and specifications, adequate materials, well-trained inspection, and quality labor. Since this is concerned with the actual construction and does not impact on the feasibility of the improvement, it will not be addressed in this study.

7. What engineering solutions/alternatives should be considered to deal with adverse impacts?

Response. One advantage of an iterative planning process, i.e., performing planning tasks over and over, is that after impacts are identified, mitigation measures are incorporated into subsequent formulation of plans. Every attempt will be made to mitigate damages which would be caused by improvements to the system. Where mitigation is not possible, the monetary value of such damage will be quantified and included as a disbenefit to the project or plan. Non-quantifiable damages along with the monetary damages will be reflected in the impact assessment for use in the evaluation of the plans. Efforts will be made to identify potential areas or sites along the St. Lawrence which may serve in mitigation of environmental damages and possible enhance the environment.

Locks

1. Study alternatives for twinning or enlarging present locks.

Response. The present study authorization specifically directs the Corps of Engineers to investigate the need for enlargement or augmentation of the present locks. Thus, this will be the central thrust of the study along with other needs of commercial navigation.

2. Is there a need, in terms of numbers of transits, to have more than one lock?

Response. See Section 3 - Problems and Needs and Appendix C - Capacity.

3. How large must the locks be?

Response. Refinement of the Maximum Vessel Size Study via additional cost-sharing scenarios will provide the upper limit in respect to vessel size for which improvements to the Seaway are economically justified. This size may decrease upon applying environmental, social, and regional criteria. In essence, lock sizing will be the result of iteratively performing the four basic planning tasks (Figure 1-1).

4. What will be the requirements for the design of locks to mitigate potential for, and impact of, accidents and spills in or near locks?

Response. Accidents in or near locks are usually not as severe as those in channels and open waters, mainly due to the reduced vessel speed, but the potential does exist. The main causes of accidents at locks appear to be cross currents and winds which affect the control of the vessel on approaching the lock; and human error. Cross currents have been remedied at Polly's Gut (downstream of Snell Lock) and at Toussaint Island (upstream of Iroquois Lock). Winds can be compensated for by windbreaks and by providing lock guide walls on both sides of the channel. These will be considered in the design of new locks and any modifications of existing locks. Human error is something that will always exist, but its potential for occurrence can be reduced by continual training of vessel masters and pilots. The U.S. Coast Guard is establishing such a program for the Great Lakes-St. Lawrence Seaway System.

5. Lock design considered in developing alternatives for expansion should concentrate on the many salties using the system rather than on the lakers. (Lakes <u>have</u> twin screws, bow and stern thrusters, are maneuverable and designed for the Great Lakes system. They are fewer in number than the salties. They have trained crews. Consider that perhaps less than 5 percent of current fleet of foreign ships using the system have the capability of the lakers. For example: Naval architects design salties for tugboat assistance using 3-5 tugs to get them alongside docks. They are not designed for shunter tugs or Great Lakes-Seaway locks).

- Review and evaluate foreign locks.
- Review and evaluate optimum ship and lock design for winter navigation not assume Sault St. Marie locks are best design)
- Design locks to accommodate characteristics of foreign ships' facilities across channels.
- Design locks for improving capacity of system AN for safety.

<u>Response</u>. This warrants consideration during design of future locks and channels. Design will consider the operational differences of the many types of vessels using the system and projections of future fleets. With a larger more efficient system, newer more modern salties may be attracted for service on the system. The state-of-the-art for lock design will be researched. This will include foreign lock design practices. Locks will be designed in accordance with various winter navigation scenarios, i.e., normal season, and 9, 10, 11, and 12 month navigation season. Safety will be of prime concern in not only lock design but also in the design of all modifications.

6. Evaluate existing Seaway accident record to determine specific needs for modification of Seaway/lock design.

<u>Response</u>. During the initial phases of Stage 2, problems and needs of the system will be analyzed in more detail. As part of this analysis, historical records of all accidents on the system will be examined to determine the type of accident, place of occurrence, reason

for accident, vessel type, amount of damage, etc. This will help to pinpoint problem areas in the system.

Navigation

1. Determine needs for safety reforms on existing system before expanding it.

- Could the capacity of the existing system be expanded through developing safer and more efficient navigation aids, requiring pilot training?
- Evaluate need and alternatives for improved navigation aids.
  a. Consider permanent navigation aids, including electronic aids to be installed on Seaway and on shipboard. Reconsider the Loran System. Evaluate short-range transponder.
  b. Evaluate shunter tugs and effect of wind on their efficiency and safety.
- What would be the economic and environmental impacts of increased shipping on the Seaway without changing present navigation safety system?

Response. Formulation of alternative plans will be staged. The first stage will be to address the present system to determine what can be done to solve present and future needs. This will, of course, include not only capacity but also safety. Alternatives will include structural lock modifications, all weather navigation aids, shunters, mules, kevels, etc. Since no action serves as the basis of comparison for all alternatives, it too will be analyzed.

2. Reevaluate the impact of ship size and speed limit relationship on the Seaway.

Response. Vessel controllability, which is a function of several things not to mention speed of the vessel relative to the water and channel configuration, will be analyzed to determine adequacy of the present speed limits for existing and future fleets.

3. Evaluate the need for restrictions on shipping hazardous cargoes on the Great Lakes-St. Lawrence Seaway during inclement weather (especially during extended navigation season).

Response. Restrictions on shipping hazardous cargoes on the system is the responsibility of the operation and enforcement agencies which are the St. Lawrence Seaway Development Corp. and U.S. Coast Guard respectively and not within the authority of the Corps. The G.L.-S.L.S. Navigation Season Extension Program is investigating the feasibility of winter navigation. Hazardous cargoes will be addressed in its impact assessment.

4. Examine potential for increase/decrease in navigation safety if vessel sizes are increased.

Response. A modified system may mean more vessels using the system. This, in turn, increases the potential for accidents. A modified system may also mean larger and thus fewer vessels. This, of course, decreases the potential for accidents due to congestion, but may increase the potential due to size. A new system may attract new vessels. Because new vessels have better controllability, the potential for accidents decreases. This impact will be investigated and presented in the impact assessment for each plan.

5. What additional navigation aids will be required?

Response. This will be determined for each alternative plan.

6. Develop performance and design standards for ships. Design ships to ensure navigation safety and efficiency.

Response. Presently such standards are enforced during early April and December when ice conditions are experienced on the system. Such restrictions during normal season may also increase the capacity of the system. This will be investigated particularly in relation to the existing system.

7. Determine and implement requirements for pilot training for navigation on Great Lakes-Seaway System.

Response. The U.S. Coast Guard is initiating such a program. This will be financed by the pilotage fee charged to the vessels using the service.

8. Provide a means for continued input from pilots during the study process.

9. Determine how to place pilots and other system users on Boards or technical teams which evaluate alternatives and determine safety programs, ship and lock design for Seaway use.

Response. The Seaway pilots along with all the other public will be afforded numerous opportunities throughout the study to provide input into its development. Because they are users of the system they will have a unique role along with other selected public to aid in layout and design of alternative plans. This may be accomplished via the formation of a design advisory task force. This will not be limited to design nor pilots, but other publics and used on an as needed basis.

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Lake and River Levels and Flows

1. What levels and flows will be required by various alternatives being considered to expand system capacity?
   - Is the volume of water presently flowing through the Seaway adequate to sustain new locks? To maintain hydropower requirements?

2. Will there be an increased potential for flooding below the locks?

3. What will be the effect on lake levels if proposed diversions at Niagara and Chicago are implemented? How would this impact requirements for modification of channels and harbors?

4. How will level/flow requirements for increasing Seaway capacity affect Lake Ontario?

5. How will required/constant water levels be maintained?
   - Especially downriver.
   - How will water levels relate to requirements for speed limits?
   - How will variation in water levels affect fish spawning in the Seaway/Lake Ontario?

6. What are benefits/disbenefits to be realized from river and lake level regulation?

Response. The impacts of the various alternative plans on the levels and flows of the St. Lawrence and Great Lakes will require careful assessment. These impacts will be investigated, along with possible modifications to the present regulation plan of the St. Lawrence to benefit not only navigation, but also other users such as power, riparian, and environmental. This effort will be coordinated with the ongoing Lake Erie Regulation Study being done by the IJC and the Lake Ontario Shoreline Protection Study which has been authorized by Congress but not funded.

Energy and Power Production

1. How will additional/larger locks impact hydroelectric power production?
   - What will more or larger locks require in additional volumes of water (individual as well as total Seaway demand)?
   - How much hydroelectric power will be lost? How will it be replaced?

Response. This will be investigated in conjunction with levels and flows. Additional locks may or may not mean additional loss of available water for power production. Larger locks may mean larger and fewer vessels, thus fewer lockages. The impact upon power production is quantifiable and its monetary loss or gain will be included in the determination of economic benefits.

2. What will be the effect of expanding Seaway capacity on the potential for siting nuclear plants on the river?
- Study use of thermal affluents from nuclear plants to keep river open and locks operative during extended season navigation. What will be effects of increase radionucleides - cesium, iodine?

Response. The aspect of using thermal effluents for extending season navigation is being investigated by the Navigation Season Extension Program. There does not appear to be any relationship between increased capacity of the Seaway for navigation and the desirability of the Seaway for locating nuclear plants. Therefore, it will not be of concern for this study unless such association is demonstrated during the study.

3. Do a net energy analysis of alternative for expanding the system, including other modes. Include impacts on hydrogeneration and energy requirements for construction and maintenance.
- What are the induced energy effects of the project?

Response. Each alternative plan will be analyzed in regard to its impacts on short and long term energy consumption and hydropower.

ENVIRONMENTAL CONCERNS

Ecological Impacts.

1. What are the impacts of the present navigation on the biological productivity of the St. Lawrence River?

Response. When the present St. Lawrence Seaway was constructed, the National Environmental Policy Act was not in existence (NEPA 1969), Public Law 91-190). No effort was made to do an environmental assessment of the construction and/or operation of the Seaway. Under the present study, the Corps of Engineers in cooperation with the U.S. Fish and Wildlife Service will consider the impacts of present navigation on the ecology of the St. Lawrence River. Using the preliminary report by the USFWS, "St. Lawrence River Ecological Studies: Biological Characteristics, 1976" and the information presently being collected during the Winter Navigation Demonstration Program and the Navigation Season Extension Feasibility Study, a profile of existing conditions on the Seaway will be developed. This information will then be compared against historical information such as the "Biological Survey of the St. Lawrence River Watershed, 1930" and the "Biological Survey of the Oswegatchie and Black River Systems, 1931" (Supplement to 20th and 21st New York State Conservation Dept. Annual Reports respectively) in an attempt to develop a profile of pre-seaway conditions. This information will greatly aid the assessment of future navigation improvements to the St. Lawrence Seaway.

2. What are the impacts of present extended season (December) navigation on the local environment, ice fishing, air quality, public health (from ships' bilges and sewage), water level regulation, local property, etc.?

Response. The impacts of navigation during an extended season (Winter Navigation) is being addressed by the Navigation Season Extension Program under the direction of the Detroit District - Corps of Engineers. This program is considering various study scenarios for an extended season (e.g.: firm up of December shipping; 10 month season; 11 month season; and all-year navigation). This study will require an environmental impact statement which will include the above listed concerns.

3. Will comprehensive baseline data (using a multidisciplinary approach) be obtained to facilitate sound decision making?

Response. This is the main objective of both the National Environmental Policy Act (P.L. 91-190) and this present study. As the existing study schedule indicates, environmental baseline data collection will continue into mid-1980. Should significant data gaps be identified which cannot be filled through consultation with experts in that discipline, the schedule is flexible enough to accommodate the changes. Again, the goal here is quality information for sound decision making.

4. What will be the ecological impacts of temporary population increases during the construction phase of the project?

Response. The environmental assessment for this study will consider the impacts on both the Human Environment and the Natural Environment. The short-term population increase due to the labor force needed for construction of the project represents potential economic impacts to the local community. Its impacts on community cohesion, labor force composition, and employment will also be considered. A temporary population increase also impacts upon the fish, wildlife, and recreational aspects of the natural environment as the construction workers and their families will most probably utilize these resources. The impacts on social and cultural concerns not listed above will also be taken into consideration.

5. What will be the effects of larger or more vessels on the ecology of the St. Lawrence River?

Response. The environmental assessment for the St. Lawrence Additional Lock Study (SLS-AL Study) will attempt to determine the impacts of increased navigation and/or shipping capacity on the ecology of the river. It will first be necessary to develop an ecological profile of the existing Seaway and determine what the impacts of the present level of navigation have been. The next step will be to consider different scenarios such as increased ship size, number of ships, or both, and determine their effects on the physical, chemical, biological, etc...aspects of the Seaway.

6. What will be the cumulative environmental impact of Winter Navigation and twinning or enlarging the locks? (These do not seem to be separable activities).

Response. The maximum capacity of the Seaway would be approached by having multiple locks and all-year navigation. This concern will be one of the study scenarios considered during the environmental assessment.

7. What will be the ecological impacts of various channel improvement activities such as dredging, shoal removal, and construction?

Response. These concerns will be addressed in the SLS-AL Study for each alternative plan considered.

Water Quality.

1. Will water quality deteriorate or improve if there are more or larger commercial vessels using the system?

Response. Determining how much improvement or degradation of water quality due to increased navigation is possible is a major concern of the SLS-AL Study. The environmental assessment will consider all of the variables which impact upon existing water quality of the St. Lawrence River.

2. Will there be increased potential for spills of hazardous cargoes?

Response. At first glance one would say yes to this question. However, the SLS-AL Study will explore alternatives for improved ship design and navigation practices to decrease the potential for toxic and hazardous substance spills.

3. How much siltation and resuspension of sediments will result from increased dredging and increased ship transits, and what will be the effect of resuspending pollutants such as Mirex, PCB's, etc...?

Response. Physical, chemical and biological analyses will be done on samples of sediments from the river. This information will then be correlated with limnological and hydrological data on the river to determine how the construction and operation activities under each alternative plan will impact sediments, resuspension, and redistribution.

4. What other measures will be required to protect water quality as system capacity increases: (As an example, will there be increased water pollution from ships' sewage, bilges, or ballast activities?)

Response. The SLS-AL Study will investigate and evaluate alternatives for improved ship design and navigation practices to alleviate or prevent these problems. The study will consider all possible factors which could affect water quality.

5. What will be the impacts on water quality with respect to recreation, tourism, fish & wildlife, municipal drinking water supplies, etc...?

Response. As previously indicated, the environmental assessment will consider all of the factors which could impact upon existing water quality, including the human and natural environment. Both direct and indirect effects will be looked at for each alternative plan.

Hazardous Substance Spills.

1. Will the potential for more spills of hazardous materials such as oil and chemicals be identified?

Response. Yes, the SLS-AL Study will identify, where possible, the areas for increased potential of such spills.

2. How can we deal more effectively with spills - now and with increased system capacity?

Response. The SLS-AL Study will review and evaluate existing regulations and contingency plans for oil and hazardous cargo spills with the various responsible agencies. This will be done vis-a-vis the various plans of improvement to assess changes necessitated by such alternative plans. There presently exists a Great Lakes Coastal Region Oil and Hazardous Substances Contingency Plan promulgated by the Ninth U.S. Coast Guard District. This is a regional plan which is coordinated with the Canadian Coast Guard plan. Another plan is presently being developed by the St. Lawrence Seaway Development Corp. which will address the St. Lawrence River area specifically.

3. What about efficiency of communication systems in regards to ships' cargoes?

Response. The SLS-AL Study will investigate the existing means for monitoring and tracking hazardous cargoes through the St. Lawrence Seaway system.

Geology.

1. Will the geology of the study area be investigated for strata composition, fault location, and seismic activities? Also, what future plans are there for geological evaluation?

Response. The Plan of Study gives a general survey of these factors. Core samples have been taken in the areas of the proposed twin lock scheme. The final analysis of this effect is scheduled for FY 79. Additional strata composition data using explosive charges and sensitive recording equipment were also collected. Future work will involve review of literature and existing data and correlation of this information with various design schemes. Alternative plans may also necessitate additional explorations and seismic testing.

2. What are the seismic hazards and their potential to damage the locks?

Response. This concern will be included in the environmental and feasibility reports for the SLS-AL Study. The St. Lawrence River valley and in particular the Massena area have a history of seismic activity. This will be of prime concern in formulating and designing various lock schemes.

3. Will an entire Great Lakes geological-geographical system evaluation be made?

Response. The Plan of Study contains a summary of the geological aspects of the Great Lakes-St. Lawrence Seaway System. It is not anticipated that further detail of the geological-geographical aspects will be developed for the entire System as part of the SLS-AL Study. The upper system is addressed more thoroughly in the G. L. Connecting Channels and Harbors Study.

4. What future plans are there for study of other impacts on the geology of the region, such as nuclear plants, waste disposal sites, mineral resource recovery?

Response. These and other considerations in regards to geological impacts will be considered only as they relate to alternative plans of the SLS-AL Study.

Dredging.

1. What will be the impact of dredging to deepen and widen channels on environmental quality?

Response. The environmental assessment will consider and evaluate the impacts of dredging for channel improvements on recreational and commercial fisheries, on turbidity and siltation, on water quality, on aquatic plants, and on other physical, chemical, and biological factors.

2. What will be the impacts of dredge spoil disposal?

Response. The impact of dredge spoil disposal upon the environment will be dependent upon a number of factors. First of these is the quality of the dredge spoil material. This factor will determine the means of disposal available. Second will be the actual amount of material to be disposed of. Some additional factors include: equipment used, method of disposal, impacts on disposal site, time of year or season when dredging and disposal is done, etc... In addition to the environmental statements required under the National Environmental Policy Act of 1969, disposal of dredge or fill material is also covered under Section 404 of the Federal Water Pollution Control Act Amendments of 1972 to the extent that a permit is required for these activities. This means that these activities will receive a double assessment and evaluation.

3. How will the aesthetic quality of the area be maintained during dredging and construction?

Response. Prior to the actual dredging and construction, proper operational methods will be recommended so to minimize any adverse impacts to the aesthetic quality of the region. In most cases, short-term impacts of this nature are unavoidable, however, sound management often can curtail the level of such impacts.

Erosion and Shoreline Impacts.

1. What will be the effects of additional or larger ships on erosion along the project area (Lake Ontario/St. Lawrence River)?

Response. This concern will be addressed in the environmental assessment for the SLS-AL Study. The first steps will be to determine the existing shoreline erosion occurring along the St. Lawrence due to natural causes and existing navigation practices. Two ongoing studies are presently looking at this problem. The first is a study to predict the rate of shore erosion and the amount of structural damage that would occur both with and without Winter Navigation activities. This study is being done by the St.Lawrence-Eastern Ontario Commission under a contract with the St. Lawrence Seaway Development Corporation. The second study involve a monitoring of shoreline erosion along the U.S. portion of the St. Lawrence, St. Clair, St. Mary's, and Detroit Rivers. The study will establish a data-base showing sites of maximum shoreline change, will measure erosion rates, and will monitor and document these factors using low altitude aerial photography. This second study is funded through the Great Lakes-St. Lawrence Seaway Navigation Season Navigation Extension Program, and the work is being done by the U.S. Army Corps of Engineers Cold Region Research and Engineering Laboratory (CRREL). Once these data are collected and made available, the SLS-AL Study will evaluate them as they relate to non-ice conditions and supplement where required. In addition, past studies of vessel generated waves will be analyzed and supplemented. The erosion data and vessel wave data will then be correlated to determine impacts of both more and larger vessels. The SLS-AL Study will attempt to determine the impacts of increased vessels and vessel sizes to the erosion problem.

2. What will be the impacts of shoreline erosion due to increased navigation activities upon critical shoreline areas such as wetlands?

Response. This concern will be addressed in the environmental assessment for the SLS-AL Study. However, this is a difficult assessment to make. As noted in the Plan of Study, wetlands serve multiple functions in nature. One such function is to moderate or dampen the wave energies approaching the shoreline. During major storms much of the emerging vegetation is lost, but the rhizomes or root structures tend to hold the soil in place and act to recolonize the area. Another reason for the difficulty here is that shoreline erosion is only one of many factors which may impact on wetlands and wetland vegetation. It may be difficult to extract the amount of impact due directly to navigation induced shoreline erosion.

3. How does vessel size and speed affect shore erosion and shore structures, and how can such impacts be mitigated or prevented?

Response. The environmental assessment for the SLS-AL Study will endeavor to evaluate all of the factors of shoreline erosion and shore structure integrity in relation to each alternative plan of study, including the factors listed above. See 1 above.

Socio-Economic.

1. What the local economic benefits to the St. Lawrence Valley as opposed to national benefits? (Short term/long term)

2. What will be the impacts of larger ships on smaller ports such as Ogdensburg and Waddington? How can port "specialties" be identified?

3. What new industries and port activities will this mean for the area?

4. How will SLS-AL Study assist in keeping industry in the Basin?
   - Do we get wakes or trade?
   - How do local port authorities relate to expanded capacity on the Seaway?
   - What kind of economic incentives are needed for local ports to provide services to accommodate increased trade?

5. Will promises made regarding long-term benefits to the local economy be fulfilled this time? How accurate were the predictions made regarding costs/benefits to the local/regional economy for the St. Lawrence Seaway?

Response. The long-term economic impact of an expanded Seaway on the region's economy and existing ports and harbors will be addressed in a regional economic study that will also evaluate the region's ability to produce all or a portion of the goods and services required for project construction. An important part of this regional economic study is to point out both the positive and negative impacts of an expanded Seaway and will bring together as much existing data from Regional Planning Board studies as exists at that time. (See Section 6 - Study Management).

6. How can "hidden costs" such as property degradation be identified and included in the cost/benefit analysis?

7. How will increased shipping affect local property owners? Will their property receive additional impacts from ships' wakes? How will questions of "equity" related to property damage or other negative impacts on the "little" people be resolved?

Response. Vessel generated wave studies and the human environmental portion of the environmental assessment document will assist in the evaluation of the social and economic costs for riparian property owners. Economic losses to the area, if they are identified by either of these two studies, will be considered in the benefit evaluation process as negative benefits or project costs if there is an engineering solution that can be implemented. (See Section 6 - Study Management).

8. Study socio-economic and environmental impacts on housing, schools, wages, jobs, tourism. Is there a possibility of Federal economic relief via designation as an impacted area? Will there be jobs, new exporting, new shipping, public housing?

9. What opportunities will be lost due to the project - what are the other national needs relative to the resources of the region?

10. Can expanding the Seaway do something "good" for the region?

11. What will be the construction-phase impacts on the region and its local communities? Will there be overloads, overbuilding, and additional inflation?

12. Examine national benefit vs. local - regional costs of community services, the impact of spills, etc.

13. What will be economic impact of expansion on tourism, natural areas, water quality, fish and wildlife of the region? Will it be deteriorated or improved or changed?

14. What are the advantages and disadvantages of Seaway expansion to northern NY (St. Lawrence Valley-Eastern Lake Ontario)? Preservation vs. development?
- Short term, long term?
- Employment, retaining industry?
- Enhancing growth of the region?
- Impact on competing modes of transportation?

15. What will be the additional demands on local social service systems: police, fire protection, schools, health care, welfare, housing?

16. What will be the effect of enlarging system capacity (during construction and afterwards) on the existing way of life in the North Country?

17. What will be the impacts on institutional framework of the region? Policies need to be developed to deal with impacts.

18. What will be the impact on the entire tax base of the region? (Income, sales, property, credits, incentives, etc.)
- Especially with regard to industrial development.

Response. Identification of near-shore impacts of larger vessels will be aided by the vessel generated wave study and the environmental assessment. Engineering works that are feasible or practical will be considered to mitigate or eliminate any adverse impacts on the local area. Construction costs for these measures would be considered in the estimated first costs of improvement. Intangible economic losses, to the extent that they can be estimated, measured or projected to increase beyond the "without project condition" will be subtracted from the anticipated benefits.

Socio-economic impacts of any proposed improvement in the St. Lawrence River will be aided by the environmental assessment that will address both the human and natural environment. The human environment's ability to sustain short term dislocations attributed to project construction will be evaluated with this information.

19. Will the region be able to supply labor for new industry generated by additional locks?

20. If local labor is utilized for the project, what will be the impact on the local job market?

21. Will the project maximize opportunity of participation in the project by minorities and small businesses?

22. Examine the potential impact of the project on the short and long term job market.

Response. Labor resources in the local area will be measured by using New York State Department of Labor statistics. Labor demand is a function of the recommended plan and cannot accurately be predicted at this time. The assessment of each alternative will include the impact of project construction on the available resources, including labor supply, in the area.

23. Will there be proper payment for land, early payment, proper appraisal, early settlement? Will appraisal be on potential or current use?

24. How and by whom will amount of land needed be determined? Will there be limits on land taking - need to determine minimum amount required?

- (Keep state out of development business)

Response. A major item of work in the future will consist of the preliminary design and cost estimates for various alternatives that will contribute to increased system capacity. The extent of real estate required will be a function of the physical size of the plan (additional vs. larger locks) under consideration. This work item will address the problems of real estate acquisition and prices to be paid to individual property owners.

25. What will be the effect of increase in the numbers and size of vessels on summer season recreational boating, fishing, cottaging, sightseeing, re ships/power dam, camping, swimming, day-use picnics, further development of public camp areas and the tourist industry. (Long and short term)

- How will conflicts with recreational use, boating, bathing and fishing be resolved?

26. What will be the study consideration of summer resident interests?

27. How can the Seaway become more of an attraction to recreation and tourism?

Response. A recreation study item has been identified to address the local concern that any structural improvement may jeopardize the existing recreation resource base. This study will address many of the environmental and economic concerns that must be considered in the formulation, assessment and evaluation of alternatives. The major emphasis of the recreation study will be to evaluate the role of recreation in the area economy and to develop the methodology of measuring the impacts to the area.

28. What are Treaty obligations to St. Regis Indians - how will this project impact them: Culture, lands, economy, land claims?

- How might the Indians impact the project?

Response. Land, easements and rights-of-way required for each plan of improvement will distinguish between property to be acquired from the St. Regis Indians and other property owners. The Corps of Engineers acknowledges the present controversy between the Indians and the SLSDC and recognizes the need to avoid any adverse impact on the Indians and/or their legal property rights or culture.

29. What is the net cost going to be electrical generation by PASNY, Ontario-Hydro, Quebec?

Response. Hydraulic studies that will be scheduled in the future to answer technical concerns regarding the hydraulic impacts of operation of larger locks can be modified to include the quantities of water required for lock operation that would otherwise be used for hydropower production. The economic losses by the power interests will be considered in the overall benefits to cost ratio.

30. What cost-sharing alternatives are being considered for expansion of the U.S.-Canadian system capacity?

31. What is the life expectancy of the Seaway as a whole?

32. What are the economic implications of Canadians having costs for 13 locks vs. U.S., 6 - how to coordinate planning and resolve questions o. equity?

33. Evaluate ways to pass cost of modifications to Seaway on to shipowners (or those who benefit directly). Include in costs: construction, operation, plus land loss, esthetic impacts, recreational, local fishing and guide losses. (Internalize externalities)

34. Who pays and how and how much? How much will be user fees and how much public tax monies?

35. Examine the need for changes in toll rates to absorb costs, and the need to charge for worth and build a fund for replacement, repair of system by its users.

Response. Toll levels were originally established by joint negotiations between the St. Lawrence Seaway Authority (Canada) and St. Lawrence Seaway Development Corporation (United States) in light of the traffic forecasts at that time. Initial tolls were set at a level that would encourage use of the completed Seaway but, at the same time, would generate revenues that could cover first costs, interest and maintenance.

Incremental costs of increasing Seaway capacity will be the basis for estimating the additional tolls and charges required to repay this investment. A separate toll study will be accomplished as a future work item.

36. Do a systems analysis regarding the loss to the country if the project is NOT undertaken.

37. In determination of feasibility, what assumptions are used? What economic interests are considered? How is this information used to determine benefit/disbenefit to the local economy?

38. Find out who is.responsible for projecting economic benefit to the region?

Response. The approach to be taken in the economic evaluation will be an overall systems approach that has been formally documented as the GL/SLS Traffic Forecast Model. This computer model utilizes system-wide traffic forecast and transportation rate differentials to measure the additional economic benefits that are produced by system or sub-system navigation improvements in the Great Lakes.

All study assumptions and use of this traffic model will be included in the report. Additional descriptive information on the model can be obtained by contacting the Buffalo District, Corps of Engineers.

Regional impacts or benefits are not a part of national transportation savings which are presently defined as National Economic Development (NED) benefits and used in the economic justification of the project. Secondary or regional benefits will be displayed in the planning documents if they can be measured or forecasted during the project evaluation period. In the event that secondary benefits are not tangible, a qualitative measure of their significance will be included in the impact assessment and considered in the evaluation of each alternative plan.

39. What are the long range implications of changes in the amounts and types of nonrenewable resource cargoes being transported or projected for transport through the Great Lakes-St. Lawrence Seaway? When will this traffic peak? When will levels of specific items drop?

- How will a major change or loss of a nonrenewable resource cargo be projected (Ex.: What are implications of a drop in amount of iron ore, or coal, being transported on the system? What are the implications for system expansion?)

40. What will be the impact of expanding the Seaway on energy problems? Will there be increasing energy industry traffic, more oil spills, need for storage and port facilities?

Response. The Great Lakes/St. Lawrence Seaway Traffic Forecast Model will be used to forecast future traffic levels for each major segment of the system. Waterborne transport of specific nonrenewable resources (coal, iron ore, petroleum) can be quantified by decade or by major origin-destination components. All forecast assumptions will be displayed and references to secondary sources of information will be documented in the Economic Appendix. Forecast assumptions will be specified and/or cited so that the affected publics may be fully informed on the most probable future under existing conditions.

The national energy policy prevailing at the time of economic evaluation may require a change in the system-wide assumptions in terms of specific commodities (i.e., fossil fuels, petroleum, etc.) that contribute to the aggregate level of traffic.

41. Evaluate the potential of the maritime subsidy program with respect to construction and operations of an expanded system.

Response. The maritime subsidy program applies to the shipping industry and not Federal water resources projects which receive their funding directly from Congress. Thus, improvements to the system would not be eligible for such subsidies.

System-Wide.

Planning Coordination

1. How to integrate public and private plannning which might impact the SLS-AL and Great Lakes Connecting Channels Studies?

2. Will there be a master plan for the St. Lawrence Seaway that will integrate all issues/uses?

3. How will you integrate fragmented planning, including Canadian planning, into this study?

Response. Both studies have ident fied the many planning agencies on the GL/SLS system. Through meetings and coordination with these agencies, it will be possible to exchange ideas and coordinate planning efforts so as to maximize objectives and goals in the best interest of local, regional, and national citizenry.

The St. Lawrence-Eastern Ontario Commission is in the process of developing a comprehensive resources development program for the lands and waters along the St. Lawrence River and Eastern Lake Ontario. Their initial step has been the development of goals and objectives for this program. These have been published in Coastal Resources - Goals and Objectives, dated July 1976. The Black River-St. Lawrence Regional Planning Board has a larger geographical area and is also oriented towards comprehensive and coordinated planning. The SLS-AL Study will not develop a master plan for the St. Lawrence area since this is the responsible area of the above agencies and their Canadian counterparts. The SLS-AL Study will coordinate and integrate its plans with those of SLEOC and BRSLRPB in an effort to make its national goals and objectives compatible with those of the above agencies.

An initial effort to do this has been the incorporation of local goals and objectives into study objectives and criteria for the SLS-AL Study.

4. Do an information search to identify previous studies applicable to the St. Lawrence Seaway. Integrate them and fill in necessary information gaps with this study.

Response. A cursory search has been accomplished during the development of this Plan of Study (Appendix J). This has enabled some general study areas to be identified. Prior to accomplishing individual study efforts, a more detailed search will be completed to refine information gaps. The ultimate goal will be to fill all necessary gaps with information which will enable proper and adequate formulation of alternative plans and the assessment of their impacts and ultimately the selection of the "best" plan.

5. How will economic and environmental studies mandated for this project be integrated with ongoing and future studies so everything won't continue to be piecemeal? Will you use EPOS from Winter Navigation for data?

Response. The SLS-AL and GLCCH studies are being closely coordinated together and with other ongoing studies, such as the G. L. Navigation Season Extension Program. The EPOS of this latter study is being used to define the studies which will be performed under that program and those which will need to be accomplished under the SLS-AL Study. Coordination with other agencies throughout the GL/SLS basin will integrate studies in other areas such as economic and social.

6. What are the impacts of a lack of systematic approach to the cumulative effects of additional locks, upper lakes connecting channels and harbor modifications, vessel size increase, change in lake levels, extended navigation seasons and the Lake Erie-Lake Ontario water studies?

- How will these studies be officially coordinated?
- How will a coordinated Plan of Study between Detroit and COE regarding the SLS-AL, Connecting Channels, and Winter Navigation Studies be accomplished?
- If the locks are doubled or the system capacity is expanded, will the potential for winter navigation be enhanced or decreased?

Response. The SLS-AL and GLCCH studies are being coordinated by the Buffalo and Detroit Districts respectively and the North Central Division office in Chicago. This is done through periodic checkpoint meetings and exchange of data and study results. Vessel size is incorporated in both studies through the Maximum Vessel Size Study which is the "building block" for both studies. Study schedules have been coordinated through Stage 2. At that time, the need for parallel schedules will be evaluated. Until the results of the Winter Navigation Program are known, both studies will be assuming various scenarios for season extension. The environmental studies of the WNP are being closely coordinated with both studies. The synergistic effects of additional locks on the need for winter navigation have not been analyzed. Without additional locks, navigation below Lake Erie is limited to eleven months at the most. Additional locks will allow for year-round navigation. Whether this one additional month would provide substantial benefits for winter navigation is not known. This will be analyzed and displayed in the impact assessment.

U.S./Canadian Coordination

1. Determine how to formally involve Canadian interests. Evaluate most effective means to accomplish same.

Response. A request for Canadian coordination for the SLS-AL and GLCCH studies was transmitted to the U.S. State Department and Canadian Ministry of External Affairs under diplomatic procedures. The Canadian Marine Transportation Administration under the Ministry of Transport has been designated to represent the Canadian government in coordinating the SLS-AL Study. The Canadian Coast Guard has been designated for the GLCCH study. Procedures will subsequently be established.

2. How can cooperation with Canada be established at Federal, provincial, State level? How can red tape be eliminated? How can the economic, social, environmental effects of SLS-AL on other side of the border be determined?
- Conduct joint Canadian/U.S. studies of environmental, social and institutional effects of present Seaway and of expansion alternatives.
- What will be impact on Canadian/U.S. labor relations?

Response. Cooperation with Canada is being established on an informal basis. Unfortunately, diplomatic protocol has limited it initially to only one Federal agency. Procedures will be established in the near future. Efforts will be made to get provincial views and input also. Impacts on the Canadian environment, economy, and social structure will be assessed and used in plan evaluation, though it will not be weighted as much as the U.S. impacts since this stage of the study is to recommend to Congress a plan which is in the best interest of the U.S. and to serve as the basis for a joint study with Canada. Since both U.S. and Canadian sections of the Seaway will require improvement, there should be no impact upon U.S./Canadian labor relations.

3. What will be expansion sites and locations in both Canada and the United States?

Response. This is the purpose of the study along with their feasibility; economically, environmentally, and socially.

4. Should the U.S. proceed with the study without agreement that Canada will engaged in the entire study on a parallel basis? How should this question be proposed to Congress?

Response. The study will be conducted under two-step authorization procedures. The final report will reflect that degree of investigation necessary to establish the feasibility, desirability, and U.S.

interest in further development of the Seaway. If development is found to meet the above criteria, it will be recommended to Congress that detailed investigations necessary to meet the criteria for authorization of construction be authorized. It will be during this latter stage that a joint study with Canada will be necessary to finalize plans and provide the necessary detail for construction.

5. Look at pilot situation--are there enough Canadian pilots to meet present and future traffic needs? Can United States/Canadian differences be resolved?

Response. This has been addressed in this report (Section 3 - Problems asnd Needs and Section 4 - Formulating a Plan). Pilotage is the responsibility of the various agencies mentioned therein and therefore its problems and solutions are not within the authority nor the scope of this study.

6. What might be impact on system if Quebec becomes independent?

Response. The answer to this is not known, and because it is hypothetical and a very sensitive political issue, it will not be addressed by this study directly other than its possible address in the final recommendations to Congress.

System-wide Transportation Alternatives

1. Examine Seaway shipping projections in light of shift of industry from the Northeast.
- Intermodal aspects - if these are considered, how will projections be affected?
- Validate projections.
- Examine efficiency of competing modes.

Response. These will all be subject of detailed economic studies throughout the study. (Section 4 - Formulating a Plan).

2. Could capacity/efficiency be improved by other methods than expanding the locks:
- More pilots.
- Faster lockage.
- Improved navigation aids (electronic and visual - visibility enhancement, radar systems).
- Management of traffic on seaway.
- Traffic control.
- Evaluate increasing the lake levels.
- Is there a way ice booms can be used without damage to shore or impact on power production?

- Optimization of Great Lakes Fleet use.
- Elimination of recreational lockages or charge user fees to all recreational users, or build small locks for recreational craft.
- Change in governmental structures, regualtions such as repealing Jones Act provisions restricting cargoes originating in U.S. ports to U.S. Flagships, or changes in I.C.C. regulations.

3. Are there land transportation alternatives - railroad, trucking or a combination that is as feasible as additional locks?

Response. The SLS-AL Study will investigate all problems attending navigation on the Seaway and the alternative plans for their solution. (See Section 4 - Formulating a Plan). Because some solutions, e.g. pilotage and I.C.C. regulations, are not within the purview of the Corps, to make recomemndations to Congress, they will not be considered in this study.

4. What will be the effect (benefits/disbenefits) on the total transportation system in the Northeast, including:
- Other modes, intermodal options (rail, trucking)?
- Traffic?
- Costs?
- Development of off-loading facilities, coal and materials storage capacities?
- Changes in future energy costs - allocation and demand?
- On East Coast ports?

Response. These all are very difficult to evaluate. Projected cargoes diverted by an improved Seaway will be identified. The impact of this diversion will be addressed to the extent that it can be quantified. Where it cannot be identified, such impact will be subjective.

5. What is the relationship between St. Lawrence Additional Locks Study and N.Y. State Barge Canal (All American Ship Canal) Study:
- Use a cost/benefit ratio to evaluate.

6. Are there alternative routes for navigation to present system? (All American, all Canadian?)

Response. The Barge Canal study is being conducted by the New York District, Corps of Engineers. Because an improved Barge Canal may divert traffic from the Seaway and vice versa, these two studies are being coordinated especially in terms of economic projections.

7. Regional transportation impacts: What will be impacts on other modes? Will increases in local commercial tonnage affect tourism?

Response. This will be the subject of a regional economic study. (Section 6 - Study Management)

8. How will it address the impacts of not constructing additional locks - on economy, energy and Canadians?

Response. "No Action" serves as the base case from which to measure impacts of alternative plans. As such, it will be assessed and displayed as an alternative action for possible recommendation as the selected plan.

9. What is the ecological benefit to the national interest of locks vs. railroads, trucks, with volume carried (on basis of 80 million population and products moving through Great Lakes trade area).

Response. The Corps is restricted to investigating waterborne transportation. Other modes will be considered only in regards to impacts on them by improvements to the Seaway. Under "No Action" future traffic over and above the present capacity of the Seaway will be forced to use a more expensive mode of transportation. In this regard, the environmental and economic impacts will be addressed and quantified where possible.

Public Participation

1. Can a process be devised for more public input, between study phases, and appropriate for the project. Need input prior to having the work for a given phase of the project being accomplished. Determine where "decision" points are and provide for adequate input by affected parties before contracts are let to a Contractor, and money invested.

2. Need to reach publics (local) and involve.

3. How can you get information to public in an organized fashion on a continuing basis?

4. Broader public representation in study - need for mechanism for involvement of publics (and agencies) on an early and continuing basis.

Response. See Section 6 - Study Management and Appendix E - Public Involvement.

REVIEW OF OTHER PUBLIC INVOLVEMENT EFFORTS

There have been at least a dozen program in the last three years (1975-1977) designed to systematically involve the public in issue identification and planning within the Great Lakes Basin. A number of these have had workshop formats to encourage the direct participation of all who attended, while others depended on public reviews of printed draft materials. The proceedings, summaries, or reports of eleven such programs were obtained and reviewed for their relationship to commercial navigation and its implications for the St. Lawrence Seaway and in the Great Lakes system. Several other known programs were not reviewed, either because reports were unobtainable or because they had not yet been published. Several other publications, providing background for public concerns were also reviewed.

The results of previous public involvement programs, whether identified as issues, problems or individual concerns, represent a resource of some value to the proposed Additional Locks Study. The people involved ranged from experts representing all facets of the transportation industry to the citizen generalist who may represent a resource of some value to the proposed Additional Locks Study. The people involved ranged from experts reprsenting all facets of the transportation industry to the citizen generalist who may represent a value system critical to planning guidance and implementation.

These concerns have also been categorically summarized. They have been referenced to their respective source publication. A bibliography of these publications follows the summary. Unlike the concerns expressed at the workshops, these concerns were not responded to individually but were analyzed and used in the development of this Plan of Study.

Engineering Factors.

Engineering factors relate to the feasibility of various management alternatives and their physical impacts. The focus will include, not only the area of construction but also upstream facilities affected by a need to conform - locks, channels, ports and harbors, and non-navigational uses. Problem areas with a physical relationship also include levels and flows, navigation and safety, various vessel criteria and power and energy considerations.

Design - Construction

- Improvement of Corps planning and project development time frame. (Shortening the usual 17 years) (2)

- Should the N.Y. State Barge Canal be developed as an expanded Great Lakes - Atlantic Ocean connecting waterway? (3)

- Examine feasibility of a deep draft canal from Lake Erie to the Hudson River. (2)

- Examine potential procedures for deepening the Great Lakes - Seaway system another 10 feet, recognizing the environmental and economic problems and the problem of increased flows. (2)

- The biggest problem with the system is draft. It is the cheapest commodity from the shipbuilding standpoint whether using the existing fleet or in new construction. (7)

- The major cost of vessel size increases would be that of dredging connecting channels and harbors and finding places to put immense quantities of dredged materials at an affordable price. (7)

Locks

- Study the advisability of further improvements to channels and locks related to present and future deep draft navigation. (9)

- Locks for larger ships will require more than changes in size. A way must be found to handle safely the additional water passing through the locks. (7)

- Examine alternatives to existing lock systems, both hardware and operations including winter navigation. (2)

- Examine improved facilities (both ship and shore) and operating procedures for moving ships past dams or rapids. Include alternatives to locks and winter operations. (2)

- Expedite a feasibility study of additional locks on the St. Lawrence Seaway to determine data requirements, timing and possible alternatives for movement of commodities to and from the Great Lakes Region. Problem - A Federal policy is required on Canadian participation. (2)

Ports and Harbors

- Do we need to maintain all commercial harbors in the Great Lakes as deep draft harbors? If so, what draft? What are the implications of regional ports for capacity planning? What are the political and economic realities that need to be examined?

- The costs of accommodating larger ships will include modification of ports and harbors, modification of bridges, particularly on the St. Lawrence, lock modification and additional locks, relocation of tunnels and pipelines, and additional aids to navigation. (7)

- Can port productivity be improved for cargo handling, particularly in adverse winter weather conditions? (2)

- How would larger vessels affect river ports, port survival and consolidation, and facilities for transfer of cargo to site? (7)

- There is a consensus that there are too many marginal ports on the Great Lakes. (4)

- Promote facilities for offshore delivery of oil and other liquids. (9)

Levels and Flows

- What will be the effect of overall system changes on lake levels? (7)

- If dredging is done to increase channel depths, compensating works must be installed to maintain the existing profile and keep flow velocity safe for navigation. Effects on other interests must be evaluated, including hydroelectric power, shoreline damage and recreation. (7)

- Provide for equitable regulation of Lake and River water levels so as to minimize total adverse impacts of fluctuation in supply conditions, taking into account costs to power, navigation, shoreline development and the natural resource base. (1)

- Regulate lake levels to maintain larger and more reliable channel and harbor depths, to permit larger tonnages. (2)

- Resolve conflicting goals of artificially high water for draft and shoreline erosion consequences. (9)

- The issue of regulation of lake levels to reduce shore erosion and aid commercial navigation needs to be studied in relation to existing shoreline problems. This is particularly true of area downstream from Lake Ontario on the St. Lawrence. (9)

- Assess the means and the impacts for a major deepening (10 feet) of the channels in the Great Lakes and the Seaway. The problem of slowing water flow through deepened channels needs to be considered. (2)

- A lake level regulation study of the Lake Ontario-St. Lawrence River subsystem with N.Y. State and local representation to develop impoved methods of regulating the subsystem and obtain data on high and low water level conditions for use in management of shoreline areas. (9)

Navigation - Communications

- Develop a plan for vessel communications and traffic management which would provide better scheduling of tugs, pilots, berths and port services, safer navigation in ports and waterways, increased safety on the open lakes and increased lock utilization through scheduling of vessel arrivals. (2)

- Navigation should include concerns for ship size, design and oil spill problems in both winter and summer navigation. (9)

- Need for an operational short-range all-weather radio navigational system adequate for operation in restricted waterway. Elimination of delays caused by weather can increase effective capacity of system. Canadian cooperation is essential. (2)

- Optimize the tug system on the Great Lakes to assist ocean carriers. (2)

- Identify problems of vessel maneuverability, including that under various ice conditions, related to channel size, navigation aids and conditions. (2)

- Determine ice-breaking and ice-management requirements for the Seaway. (2)

- Need a reliable ice breakup and formation forecast system with improved weather forecasting for earlier opening of the St. Lawrence Seaway. (2)

- Identify vessel criteria for independent operation in various ice conditions. This should ease regulation and limit the amount of icebreaker assistance. (2)

- Upgrade U.S.C.G. capacity for ice-breaking. (2)

- Examine multi-barge linkage systems. (2)

- Will larger vessels (particularly those carrying hazardous cargoes) require special precautions that may decrease efficiency of other vessels shutting down the entire system? (7)

- Need for evaluating air cushion vehicles for winter ice-breaking and rescue functions. (2)

- Continue the Great Lakes-St. Lawrence Seaway Navigation Season Extension Study, which includes a feasibility study and a Demonstration Project, until the technical, economic, and environmental feasibility, or lack thereof, of season extension, has been determined for all parts of the system, and investigate related programs having significant impacts on navigation. (9)

Vessel Size - Other Criteria

- Vessels beyond maximum size now allowed would require changes to all elements of the Great Lakes-St. Lawrence Seaway - locks, channels and harbors. (7)

- What are the costs and benefits of no change in vessel size? (7)

- What other types of vessels are proposed for either bulk or general cargo? What is the largest size ship that is economically feasible within the system? What criteria are to be used? What support facilities are needed? Can expansion of locks, channels and harbors be justified? Do we need to plan for larger vessels transiting the Seaway? (2)

- There is a need for optimization of ship characteristics for Great Lakes/overseas trade, which would acknowledge limitations of St. Lawrence Seaway locks and identify routes, commodities and volumes for ocean service. (2)

- Are smaller vessels or integrated barge tows feasible alternatives to larger vessel size? What are the tradeoffs between vessels better adapted to the current system, traffic control improvements and better service, compared to larger vessels and the required system modifications? (7)

- Determine optimal vessel size which can transmit existing locks. (2)

- The relationship of increased vessel size to plans to extend the navigation season needs to be determined as well as the interface with other medial and containerization. (7)

- Need to examine whether all future vessels will be 1,000 feet or larger. Will we need to build and maintain a smaller vessel fleet? (2)

- Develop analysis of next generation of Great Lakes ships - the need for dredging, shore effects, the impact on lock size, economic visibility of bulk carriers. (2)

- Need for compartmentalization of bulk carriers for safety. (2)

- The safety implications of larger ships need to be examined in relation to accident potential, particularly channel passage, the increased danger of grounding and damage in winter operations, the danger to shore personnel at the water's edge, and the potential for larger tanks and more hazardous cargoes, i.e., liquefied natural gas. (7)

- What are the energy requirements of larger vessel size, not only in terms of vessel operation, but related to new construction throughout the system, port changes, dredging, the use of non-renewable resources, regionalization related to transfer costs and the waste of in-place facilities? (7)

Power - Energy Considerations

- Fuel availability will be a continuing problem in transportation and will affect future choice of modes. (3)

- An examination of total energy use in the implementation and maintenance of the program was suggested. This included not only direct but induced usage. (8)

- Need for study on alternate fuels to assure future shipping on the Great Lakes. (2)

- Need for data to compare energy efficiency of Great Lakes shipping vs. land modes - unit fuel consumption. (2)

- Emphasis must be placed on energy conservation in transportation. (3)

- There is a need for detailed studies of the operation of existing hydroelectric plants in the St. Lawrence Basin and for alternative regulation patterns. (9)

Environmental Factors.

Environmental quality, as a national objective in water resources development, needs to be considered in a systematic way so that trade-offs of environmental consequences can be made explicit. In keeping with the less quantifiable nature of the category, many of the concerns are general in nature. Specific problems of the St. Lawrence River area, water quality, spills and hazardous materials, dredging, erosion, sedimentation and shoreline impacts are also listed.

General

- Environmental and energy considerations are seen to be contrary to economic efficiency. (4)

- There was expressed concern that those promoting winter navigation had no regard for the environment and no concern for future generations. An understanding of these concerns, their nature, their bases and their intensity is essential for communication. (6)

- Environmental constraints will increase transportation construction, operation and maintenance costs. (3)

- There is a lack of information on the environmental and social impacts of proposed shifts in transportation modes and policies. (3)

- A comparison of potential environmental hazard from increased stockpiling, cargo transfer, stack emissions, bottom scour, and the attendant construction and new industry in the coastal zone associated with increase vessel size, needs to be made as a total package against current conditions. Total environmental cost including modifications to the system needs to be identified. (7)

- There is a lack of explicit consideration of environmental and energy factors in investment decisions and policies. (3)

- Support efforts to improve Seaway consistent with maintenance of environmental quality. (1)

- An examination was asked of increased air and noise pollution, new pollutant hazards, additional vessel wastes and other impacts associated with winter vessel movement. (8)

- The impact of bubblers, heat transfer, ice-breaking and the disruption of the winter thermocline and its impact on aquatic systems needs to be considered. This also pertains to ice-breaking and vessel movement in wintering areas. (8)

- There was some concern expressed that winter navigation was challenging nature rather than cooperating and co-existing. Such attitudes may relate to social values of areas affected by the program. (6)

- How should the environmental, economic and social objectives and impacts be balanced in a regional transportation policy and plan? (3)

St. Lawrence River Area

- Ecological baseline data for existing conditions do not exist and must be undertaken to allow determination of short and long term environmental impacts. Data base should be built on identified available information and extended to fill gaps. (8)

- High flood damage areas exist along the St. Lawrence and high water levels have accelerated shoreline erosion. Resulting sedimentation has damaged spawning habitat of important sport species. (9)

- The St. Lawrence River Area has a number of large areas posing critical environmental concern. They are water-oriented recreation areas of at least regional concern and include the Thousand Islands, the St. Lawrence River Islands and other smaller groups. There are five rivers, tributary to the St. Lawrence, designated as wild or scenic and others designated as recreational. (9)

- In the St. Lawrence, there are problems associated with toxic wastes from industry, including mercury. The river does not meet IJC water quality objectives and there are water quality limited segments. (9)

- There are unsatisfactory conditions in a number of estuaries and embayments along the river shoreline. These include turbidity, excessive coliform counts and nuisance growths of aquatic plants. (9)

- The St. Lawrence River has wetlands significant for fish and wildlife habitat and the entire south shore is a primary waterfowl use area for nesting and migration. (9)

- There are bank erosion problems along the lower reach of the St. Lawrence. Although the plan of control operates to modify lake level fluctuations, problems associated with high water are not prevented. Peak levels have been reduced by Seaway channel improvements. (9)

- There is inadequate baseline data on the use of the shoreline and analysis of degradation and change can only be estimated. (9)

- Give priority in research on life cycles, food chains and optimum habitat requirements of the area's aquatic and animal species in the St. Lawrence River since little base information is presently available. (11)

- Out of basin diversion, particularly in the Black River Basin area could be a major concern in a longer time frame. (9)

- Inadequate land use planning and control has resulted in continuing developmental pressure on agricultural lands and environmental area. (9)

- Year-round large-scale commercial navigation of the St. Lawrence Seaway poses a number of concerns related to adverse environmental effects. (9)

- Large-scale steam electric development along the St. Lawrence causes concerns for water quality, fish habitats, the fishing industry, recreation and tourism. (9)

- Preservation of valuable wetlands required. Substantial wetlands reduction is occurring with one of the reasons being the artificial lowering of Lake Ontario water levels caused by the St. Lawrence Seaway Development and Power project water management plan. Valuable river wetlands are also being threatened by encroaching development. (9)

- The impact of winter navigation on wetlands concerns damage to shore vegetation, flooding and sudden water level changes. Particular concern is voiced for water level changes in Lake Ontario and the St. Lawrence due to ice control structures. (8)

<u>Water Quality</u>

- How will increased vessel size affect the Great Lakes as a fresh water resource? (7)

- Maintain water quality to the extent required for continued productivity of aquatic biological resources. (1)

- Provide for equitable application of water quality standards to all developments affecting coastal water quality, public and private, U.S. and Canadian. (1)

- The impact of winter navigation on water quality, including the effect of resuspension of toxic materials and nutrients must be examined. (8)

- Enforce regulations governing treatment and discharge of sewage and other waste waters from commercial and recreational vessels. (1)

- Establish and enforce a "no dumping" policy of bilgewater and sewage by commercial and pleasure craft. (9)

- Assess need for Seaway facilities for vessel wastes. (2)

- Identify and quantify impact of shipping operations on water quality of ports and harbors. (2)

- Identification of marine sanitation devices to prevent overboard discharged waste and for solid waste disposal systems for Great Lakes vessels. Other waste equipment would include oil and fresh water separators and stack controls for the 50% of the Great Lakes commercial fleet that is coal-fired. (2)

Spills - Hazardous Materials

- Heavy waterway traffic of hazardous materials presents a pollution danger. (3)

- A policy is required on transportation of hazardous products; not only ship construction guidelines, but reporting on types of cargoes and destinations. (9)

- There is a potential for a major oil spill in the St. Lawrence River with widespread severe impact. The extended navigation season will increase the potential. (9)

- Study the increased potential for oil and toxic material spills, the remedial procedures available and the long-term effects in a fresh water environment. (8)

- Changes in regulations, safety requirements, contingency plans and a redefinition of hazardous and toxic materials are necessary. Materials not considered hazardous in terms of a few hundred gallons may assume another character when thousands of tons are considered. (7)

- The need for expansion of emergency capabilities of the U.S.C.G. and other agencies for spill detection and control. (8)

- Ensure availability of specialized equipment and personnel adequate to provide rapid and effective containment and clean-up of a spill of oil or other toxic substance that would endanger the area's aquatic resources. (1)

Dredging

- Aquatic systems, habitats and food supply will all be affected by the dredging necessary for removal of sediments, channel modification, harbor modification, and ship transit. (1)

- Dredge spoil disposal presents water quality problems. (3)

- Dredging required to maintain commercial and recreational navigation depths causes disruption of aquatic environments. As long as erosion and sedimentation are continued, dredging will be required. (9)

- Dredging, resuspension of toxic materials, dredge disposal in open water, and turbidity, all will adversely affect productivity of the fish population. (7)

- An analysis of problems associated with dredging and with season extension was requested, based on increased flows, disposal of dredged materials and habitat destruction, the effect of resuspension of bottom sediments and turbidity. (8)

- Study the disposal of dredge material from maintenance and new construction including the economic, environmental and institutional impacts. (2)

- Provide for disposal of materials from maintenance dredging in an ecologically satifactory manner. (9)

- Develop priorities for dredging-disposal. (2)

Erosion - Sedimentation - Shoreline Impacts

- Increased vessel size in confined areas will increase erosion, sediment transport and turbidity. Maintenance dredging will have to be increased. (7)

- Determine impact of navigation and navigational facilities on shore damage, erosion and flooding and measures to mitigate adverse effects. (2)

- The second effect is that of shore erosion from moving ice flows and damage to shore structures from pack ice or ice packing. (6)

- Provide for use and management of shorelands and tributary uplands in ways that reflect the normal processes of change affecting shoreline natural resources (such as marsh eutrophication and shoreline erosion) and that entail minimum interference with those natural processes. (1)

- Studies should determine impacts of ice control measures and vessel movement on shore erosion, sedimentary impacts, and property damage. (8)

- The impact of larger ship size on mammals, water fowl and shore birds requires definition of impact areas, potential for spills, erosion and wetland damage. The data is not available. (7)

- The public feels that there should be an examination of the hazards of winter shipping to the shore owner due to channel maintenance, and a mitigation process. (9)

Socio-Economic Factors.

The social concerns expressed in previous public forums have necessarily addressed economic issues as one of the principal activities of people. Government activities and group interactions, especially those related to perceived inequities in cost/benefit distribution form a significant part of the public concerns. Transportation elements recognize limitations in the currently available economic data needed to support projections of increased capacity needs. economic constraints and data limitations, employment, community interaction, and industry and cost/benefit factors are sub-categories used.

Economic Constraints - Data Limitations

- It is difficult to measure existing system capacity to allow comparison and analysis of the economic benefit and rate structure for the various modes. (3)

- There is a lack of basic localized commodity traffic flow data. (3)

- Identify general cargo flows between Great Lakes ports as a base for possible Sea-Truck system. (2)

- Develop a marketing and operating profile of the competition to the Great Lakes marine transportation system to understand limiting factors to Seaway growth. Determine origin/destination of cargoes. Do research and develop data bank of origin/destination for foreign trade. A basic necessity for planning. (2)

- How will increased vessel size and system capacity relate to the balance of payments, export trade, the limitation of competition, and capital for alternative development? (7)

- The small volumes available from each of the diverse lake ports is a major barrier to the use of merchant vessels. (2)

- What is the relationship of industry to vessel size, particularly the steel industry which has overcapacity problems? Will commodity overcapacity result? Will system changes encourage more steel imports? (7)

- What will be the effect of the decline in steel purchases by the auto industry on the entire concept? (7)

- Review and analyze capital requirements for vessel financing to replace, modify and expand Great Lakes shipping services. (2)

- States need to examine their role and policy for capital funding and subsidy for all transportation modes. (3)

- There is no single inclusive funding source for transportation, either regionally or nationally. Funding sources are fragmented and single mode oriented as well. (4)

- No incentives exist to increase the productivity of water transport without capital investment. (3)

- Study should consider alternative modes of transportation are not available for many industries. (5)

- How do modal capacity limitations and under-utilization of transport facilities in the region affect economic growth? (3)

- The extent to which waterways in the region should be improved to benefit from economies of larger vessels is not well defined.

- Optimize vessel size, cargo facilities, and port dimensions relative to volume of commodity movement. (2)

- Other economic advantages such as the avoidance of lost business should be considered. (5)

Jobs - Equipment

- Disappointment with an earlier large-scale project that had held out promise of employment and economic benefit that had never developed. (5)

- Winter navigation was seen as reducing employment through diversion of freight from other modes and the use of fewer, larger vessels. Further loss is seen in the disruption of winter recreation and the permanent damage to fish and wildlife which attract the summer recreationist as well. (6)

- What will be the effects of increased vessel size on employment in terms of automation of ships and ports, a trend to regional ports, migration from affected areas and the general region, and the construction of ships and port facilities? (7)

- What will be the effects of vessel size on national, regional and local employment, related to construction, total number of vessels used, capital diversion from other investment, and potential new business for the Great Lakes region? (7)

- Does increased vessel size and resultant system changes have anything to do with the general economic well-being of the people of the region?

- How will port consolidation affect recreation in the region? Can this compensate for effects of regionalization on smaller ports? What other mitigation can be done? (7)

- The change from seasonal to year-round employment was seen as disrupting existing family units and placing a strain on social welfare services. (6)

Community - Interaction

- There is a need to identify the socio-economic effects of season extension - who gains, what are the impacts, what are the outputs, how they are measured. (9)

- Who will benefit from increased vessel size and resulting system modifications? Who will pay the costs - user charges, intermodal costs, port and industry costs and the cost to non-transportation interests? (7)

- The validity of cost-benefit calculations are challenged as being biased and not comprehensive, as making questionable assumptions, using selective inclusion and exclusion of costs including those of environmental, social and energy aspects and the impacts on other transportation modes. (6)

- Highly significant was the "us against them" relationship perceived with winter navigation related agencies. This was strongly voiced by Seaway related residents. The question of "us paying cash but they get the benefits" was also expressed. (6)

- Confusion and misinformation about the organization and activities of winter navigation must be considered representative of a wide lack of understanding. (6)

- Finally, the implied impacts, the "us against them" syndrome could result in alienation of the community. The lack of trust in authority can be increased by a perception of government and industry ignoring their interests. (6)

- The lack of any mechanism for resolution of claims resulting from damage to shore structures and property was of more concern in areas close to winter navigation activities. (6)

- Occupational groups directly affected by winter navigation would include vessel, port and lock personnel and pilots. The effects range from individual safety and comfort, cold weather risk to the impact of change from seasonal to year-round employment on the family. (6)

- Winter navigation is seen as eroding the local power base by changes in funding and the agencies controlling those funds. (6)

- Can water transportation in general and larger vessels in particular, improve social well-being and the quality of life in the Basin? (7)

- How will larger vessels affect recreation, crews and their families, the use of ice in winter, the use of shoreline by owners? (7)

Industry and Cost-Benefit

- One group advocated waterway user charges for further transportation improvements. The U.S. is the only major country in the world that does not charge for use of navigable channels and harbors. (4)

- If the Great Lakes - St. Lawrence Seaway winter navigation season extension is proven to be viable, there needs to be a resolution of the problem of payment - whether user charges or subsidy. (3)

- The concept and issue of user fees to finance the entire cost of development and maintenance of navigational facilities should be examined. Such fees should be determined through the consideration of Federal subsidies to other transportation modes, the relative energy needs, and the local and regional economic impacts. (9)

- Develop a Great Lakes - Seaway industry position on waterway user charges and identify impacts on ports, shipping and waterborne trade in system and the ability to maintain and improve the system. (2)

- The equity of the probable distribution of costs and benefits was questioned. Industry was seen as reaping benefits with local residents and the taxpayer paying the costs. There was question that industrial savings would ever reach the consumer, concern that the taxpayer should not subsidize industry and that local areas (recreational interests) should not bear negative impacts with few, if any, positive returns. (6)

- Season extension is seen as the most cost effective single measure for insuring vitality of Great Lakes shipping - a high priority in the Seaway section. (2)

- What are the impacts on the national economy of increasing the capacity of the system; to private industry relocating to accommodate larger vessels? (7)

- What will be the impact of larger ships on industrial competition in the region; the competitive advantage of domestic firms; the competitive advantage of Great Lakes' cities relative to other regions of the country? (7)

- Increases in vessel size will require vast amounts of capital. Are there better places to spend that money in terms of total benefits to the region and the nation? (7)

- The seasonal decline in regional economic activity due to suspension of shipping in the winter should be examined. (9)

- Industrial users urged a restudy of the whole system so commerce could be continued with no constraints. (5)

- The Seaway Development Corporation believed that the national security, the balance of payments, and other economic benefits had not been considered. (5)

- Will larger vessels increase the general and containerized cargo capacity of the lakes, improve the Great Lakes' share of the transportation market, and foster mid-continent development and international trade? (7)

The Great Lakes-St. Lawrence Seaway as a System.

The Great Lakes-St. Lawrence Seaway is generally called a system. For purposes of commercial navigation, is it one system or two? Do we need system uniformity or does the St. Lawrence Seaway serve different interests, cargoes and functions than the Great Lakes? In the virtual absence of transportation policy, planning, or objectives within the region, it seems unlikely that these questions can be answered with any assurance. Concerns related to the "System" are categorized as policy and planning, system relationships, institutions, industry coordination, and U.S. - Canadian coordination.

Policy and Planning

- There is no national transportation plan or policy. (4)

- There is no national transportation plan and therefore no identification of national policy for the region and for different modes. (4)

- There is no national transportation policy to coordinate state and regional transportation policy, guide the relationships of individual modes and intermodal decisions, and mediate trade-offs among transportation uses and demands. (3)

- At the Federal level, responsibility, funding, and policy are fragmented among many agencies and authorities. Transportation in Congress is addressed by several different committees depending on mode. The modal split is institutionalized in the Federal structure. (4)

- A system is needed to identify transportation priorities, both at the national and regional level. (3)

- Do a systems analysis of transportation in the Great Lakes region including all modes as a basis for transportation policy development at state, region and national levels. There is no national transportation policy nor centralized policy-making body. There is no regional policy and states have only a weak commitment to common interests of the region. (2)

- There is a need for a better definition of the objectives of transportation in the Great Lakes. There is no regional transportation policy that relates the unique characteristics of the region to national policy. (3)

- Can commitment be obtained from local, State and Federal governmental units within the region for a Great Lakes regional transportation policy? (3)

- State governments are better suited to initiating planning and coordination. There is a need for multimodal origin/destination information which is non-existent. Even within a given mode - interstate origin/destination statistics are a rarity. (4)

- There is no comprehensive multimodal planning at the State level. Is this the right level for this planning? (3)

- Policy must be developed to address the problem of under-utilization of all modes of transportation. (3)

- Maximum use is not being made of the existing system. (3)

- Decisions are port-oriented or State-oriented or functionally-oriented rather than transportation-oriented. (4)

- What is the social responsibility of planners and policy-makers? What are tradeoffs between industry welfare and local welfare? At what level will they be identified - analyzed - adjudicated? How can economic and environmental tradeoffs be translated into policy? (7)

- Inject port and navigation considerations into Great Lakes Coastal Zone management programs. (2)

System Relationships

- Are there alternatives to increased capacity of the Great Lakes-Seaway system? What are the impacts of these alternatives? Can the existing system's capacity be increased at less expense? (7)

- Will larger vessels bring more salties to the lakes? Will they encourage more container traffic on the lakes? (7)

- An increase in vessel size will not remove the problem of the seasonal nature of Great Lakes traffic. Larger vessels are not likely to cause any great diversion of traffic from existing modes to the Great Lakes and Seaway. (7)

- The point of optimal size is not a quality of the vessel itself, but of the system, including the physical and social environment. Looking at the ship alone does not tell use whether we should build them. (7)

- How are the other uses of the Great Lakes affected by increased vessel size and system enlargement? (7)

- The advantages of increased vessel size depend on the availability of unlimited cargo and the freedom to choose an efficient set of proportions for the vessel. Are there limits to the available cargo in the useful time frame? For how large a fleet is there unlimited cargo? (7)

- Future studies should be combined with other studies such as winter navigation. (5)

- Studies of additional locks, season extension, lake levels, connecting channels are obviously related to vessel size. How will the studies be integrated? How can adequate interdisciplinary coordination and a systems integration be achieved? (7)

- How does increased size and capacity on the Great Lakes relate to U.S. priorities for investment in other capital short areas? (7)

- The question of whether the upper and lower lakes can be separated for analysis needs to be examined. (7)

- Use analysis to maximize system capacity. Study may prove less favorable to shipping interests. (2)

- Identify reasons for decline in Great Lakes' export grain trade. (2)

- There are no standards to measure costs and benefits of alternative outcomes of the transportation system. (3)

- The question of whether season extension will result in system expansion, increased demand on other resources, weather microchanges, and long-term cumulative effects should be assessed. (8)

- Analysis of transportation problems with available techniques is not possible. (3)

- Create an information base of foreign and domestic commodity flows in the region to provide planning data which is not presently existent.

Institutions

- What kind of institutional framework should be set up to plan and coordinate multimodal transportation systems on a regional basis in the Great Lakes? How can fragmentation of transportation functions and responsibilities be reduced? (3)

- There is no credible regional transportation organization for cooperative transportation planning. (3)

- The fragmented concept of transportation by all interests is seen as an ever present barrier. The interests of various transportation related groups are frequently in conflict. The system is considered in terms of individual components, based on narrow self-interest. The problem is compounded by the regulatory and institutional structure. (4)

- Consolidation of the principal regulatory agencies would assist in the development of a multimodal orientation.

- Local governments, planning agencies and port authorities feel restricted by state government in their capability to act. However, port authorities were seen as able to develop port marking programs and provide a communication link among shippers, operators, and government. (4)

- Inject port and navigation considerations into Great Lakes Coastal Zone management programs. (2)

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- Transportation operators see themselves as constrained by regulatory agencies in the actions they can taken to improve multimodal transportation. They feel that its promotion may not be profitable. Nevertheless, the need for improved communication among modes and government was acknowledged. (4)

- Transportation users felt they have little influence on the regional transportion system, that company protest actions would not benefit the region, and that the market mechanism does not register their dissatisfaction. (4)

- The fragmented approach to transportation is fostered and perpetuated by a regulatory and institutional structure that relates primarily to single modes. Regulations prohibit vertical integration in transportation companies. (4)

- Develop institutional, economic and financial data to provide overview and planning base for Great Lakes ports. (2)

- Coordinate a regional approach to transportation and commerce problems through the Great Lakes Commission. (2)

- Regulation should encourage intermodal transportation planning and the planning and regulatory sectors should be combined. (3)

- The difficulty of knowing where the real hang-ups are in the system should be addressed by the formulation of regional comprehensive transportation planning agencies. (4)

- Resolve inequities in rail rates benefiting East Coast ports. (2)

- Resolve inequitable barge rate structures benefiting Gulf ports. (2)

- Whose jurisdiction would regional ports be under? (7)

Industry Coordination

- There is no comprehensive long-range planning in the industry and one mode does not understand the problems of the others. Planning, where it occurs at all, is restricted along modal, geographic and short time lines, and perpetuates fragmented approaches. (4)

- There is a lack of communication among elements of the industry and among the industry, government, planners, business and labor that are affected by transportation decisions. The breakdown is generated by self-interest but it has major consequences. (4)

- There is no perception of multimodal effects, the regional interest as opposed to local, the public interest as opposed to the carrier interest, and the direct and indirect impact on parties, regions and modes other than those obviously affected. (4)

- Planning is impeded by local interests and local government units which preserve duplicative and inefficient competition in the system. It is a waste of resources for every little port to envision itself as a great salt water terminus. (4)

- Modal interchange does not exist to the extent needed to facilitate movement of goods. (3)

- It is impossible to provide an adequate modal interface for every port. The desire of lake ports to be international tends to weaken surface modes. (4)

- Efficient regional transportation hubs do not really exist for passenger and freight movement. (3)

- Should regional ports be designated on the Great Lakes, thereby eliminating small ports? (3)

- There is a need for consolidation of load centers and a more realistic role for marginal ports. (4)

- Develop a comprehensive plan for improving multimodal feeder service to Great Lakes port terminals. (2)

- There is a need for better information about transport availability. The best decisions on mode and routing cannot be made because of inadequate information. (4)

- The impact of winter navigation on competing modes, primarily rail, is seen as decreasing value and subsequent deterioration of these other modes. (6)

- We may have reached the end of our ability to increase the use of various modes with ease. We face complex problems of justification and explanation in just advancing the use of the present system without even thinking about new systems or changes in them. The problem of coordination is upon us and we can't do more without new ways of talking among various systems of transportation and looking at the impacts they make on the quality of life. (3)

- Examine the potential of feeder services to aggregate cargoes in strategic port locations. (2)

U.S. - Canadian Coordination

- Can a decision for increased vessel size and attendant system changes be undertaken without Canadian participation? To what extent? Is there international agreement on vessel size? (7)

- It was suggested that the good will of Canada was essential for continued open overseas trade and to keep our other international waterways, such as the Panama Canal, open to traffic. (5)

- Identify and assess U.S./Canadian policy effects on the system and approach both governments to clarify issues and address questions of policy. Pilotage, Seaway operation, water quality and fishing are identified. (2)

- Cooperation with Canada for any plan considered was urged by the Pilot's Association. This view was supported by the Ohio Department of Natural Resources. (5)

- Can consistent Canadian and U.S. transportation policies for the corridor between the Great Lakes and the East Coast be developed? Consistent intermodal plans? (3)

- Expand season extension program to Lower Great Lakes and the St. Lawrence Seaway. Coordinate with Canadian government and private interest. (2)

- Identify existing flows from region to region served by water transportation, U.S. and Canadian. (2)

- Identify overseas cargo diverted from U.S. to Canadian ports. (2)

- Insure an adequate number of qualified, registered Great Lakes - St. Lawrence Seaway pilots. (2)

The St. Lawrence Region.

Particular concerns about the Eastern Lake Ontario - St. Lawrence River area have been expressed by citizens and planning agencies of the region. The St. Lawrence recreation area extends from the Lake to St. Regis, NY., constitutes a major economic activity and is therefore a subject of some concern. Related environmental concerns for the region are found under that category.

- Recreation will be mainstay of area's economy for some time. (1)

- Protection of scenic value of natural areas as a significant ingredient of the recreation environment. (1)

- Provide for extending the length of the effective recreation season, to make fuller use of facilities, increase the area's share of the recreation market and enhance local employment and related economic benefits. (1)

- Effects on recreation are caused by weakening of the ice cover by ice-breaking and by increased shoreline erosion and damage to shore structure. (6)

- There are four principal areas on the St. Lawrence that are used for "on ice" activities that might be affected by winter navigation. (6)

- Cross channel pedestrian and vehicle traffic by year-round residents in the international section of the St. Lawrence may be disrupted through maintenance of vessel tracks. (6)

- Provide for control and limitation of public access to critical natural resource areas on the shoreline to prevent avoidable damage to fragile plant communities, loss of highly erodible soils and disturbance of seasonally critical wildlife habitat such as shorebird wintering areas. (1)

- All planning and development should be predicated on the basis of conserving and minimizing use of other non-renewable resources imported from outside the Region, including conservation of imported energy and emphasis on small scale and community-sized applications in order to minimize potential damage to the coastal environment. (1)

- Provide for continuing planning coordination for Coastal Zone resources by local, regional and state agencies. (1)

- Give high priority for coastal sites to recreational facilities serving the public. (1)

- Year-round navigation must be objectively and thoroughly assessed to determine if it is consistent with maintenance of essential environmental qualities of the River and Lake. (1)

- Need for interagency cooperation to allow "one-stop" permit procedures for coastal development. (1)

PREVIOUS PUBLIC INVOLVEMENT EFFORTS - PUBLICATIONS

1. Coastal Resources - Goals and Objectives, St. Lawrence-Eastern Ontario Commission, Watertown, NY. July, 1976.

2. U.S. Great Lakes - Seaway Port Development and Shipper Conference, Final Report of Working Panels. 31 August 1976.

3. Transportation in the Great Lakes Region, Workshop Summary Proceedings, Great Lakes Basin Commission. 19-20 November 1975.

4. Toward More Effective and Efficient Multi-modal Transportation in the Great Lakes Region, Great Lakes Basin Commission. 20-21 October 1976.

5. Lake Erie - Lake Ontario Waterway, NY, Review of Reports, Corps of Engineers, Buffalo District. October 1973.

6. The Social Aspects of Winter Navigation (Draft), Social Effects Work Group - Great Lakes Basin Commission. 4 November 1977.

7. Vessel Size Seminar, Initial Draft Restuls, Great Lakes Basin Commission. 1-2 November 1977.

8. Winter Navigation Workshops Report, Great Lakes Tomorrow. October, 1977.

9. Problem Identification - Great Lakes Region, 1975 National Water Assessment, Great Lakes Basin Commission. August, 1976.

10. State - Regional Future - Great Lakes Region, 1975 National Water Assessment, Great Lakes Basin Commission. July, 1976.

11. Great Lakes Basin Regional Summary Report for the 1975 National Assessment of Water and Related Resources, Great Lakes Basin Commission. April, 1977.

RELATED PAPERS

12. Public Participation in Great Lakes Water Levels Regulation, Further Findings from the Public Hearings Held by the International Joint Commission in 1973. By A.P. Grima and C. Dufournaud, University of Toronto, 1976.

13. Regulation of Great Lakes Water Levels: The Public Speaks Out (From IJC Hearing Records, 1974). By A.P. Grima and C. Wilson, University of Toronto, 1977.

14. Assessing the Social Effects of Public Works Projects, E.J. Baur, Corps of Engineers, Fort Belvoir, Va., 1973.

APPENDIX G

COORDINATION AND PERTINENT CORRESPONDENCE

PERTINENT CORRESPONDENCE

The following correspondence represents communications which were deemed important from a coordination standpoint. The letters from agencies and organizations were in response to initial coordination letters inviting them to participate in the Additional Locks Study and requesting a designated representative for purposes of contact. Other correspondence not covered by the above was deemed important to the development of the Plan of Study and therefore also included.

The correspondence is arranged in chronological order for easier reference and is cross referenced by Table G-1 which is a listing by agency or organization with the subject of the correspondence.

Table G-1 - Pertinent Correspondence by Agency and Organization

Agency	Subject	Date
International		
Great Lakes Fishery Commission	Participation, Canadian Coordination	21 Jul 1977
Federal		
Corps of Engineers		
Office of the Chief of Engineers (DAEN-CWP-C)	To the State Dept. Re: Canadian Coordination	23 Nov 1977
North Central Division (NCDPD-EC)	Status of Economic Models	27 Oct 1977
Buffalo District	Initial Coordination Letters	Various dates
Buffalo District	Reply to Great Lakes Fishery Commission (21 Jul 1977)	11 Aug 1977
Environmental Protection Agency	Participation	19 Jul 1977
Fish and Wildlife Service	Planning Aid	12 May 1978
	Planning Aid	8 Jun 1978
Maritime Administration	Participation	2 Aug 1977
St. Lawrence Seaway Development Corporation	Participation	
U.S. Department of the Interior	Archeological Services	5 Jul 1979
Heritage Conservation and Recreation Service		19 Jul 1979 (reply)
State		
Indiana		
State Planning Services Agency	Interest in the Study	30 Aug 1977
Michigan		
Sea Grant Program	Participation	25 Aug 1977
New York		
Department of Commerce	Participation	5 Aug 1977
Department of Environmental Conservation	Participation	25 Jul 1977
Department of Environmental Conservation	Problems and Needs	5 Jan 1978
Department of Transportation	Participation	25 Jul 1977
Department of Transportation	Interest in the Study	16 Sep 1977
Parks and Recreation	Participation	25 Jul 1977
1000 Island State Park & Rec. Comm.	Problems and Needs	6 Jan 1978
Power Authority of the State of New York	Participation, Problems, and Needs	27 Dec 1977
Planning and Development Clearinghouse	A-95 Coordination	8 Sep 1977
Sea Grant Advisory Service	Participation, Visitor Center	8 Aug 1977
State Historic Preservation Officer	Coordination	5 Jul 1979
Wisconsin		
Department of Administration	Interest in the Study	9 Sep 1977
Regional		
Black R. - St. Lawrence Reg. Plan. Bd.	Participation	14 Jul 1977
Black R. - St. Lawrence Reg. Plan. Bd.	Problems and Needs	19 Dec 1977
Great Lakes Basin Commission	Participation	12 Sep 1977
St. Lawrence - E. Ontario Comm.	Participation	14 Jul 1977
St. Lawrence - E. Ontario Comm.	Problems and Needs	23 Dec 1977
St. Lawrence - Franklin Reg. Water Res. Plan. Bd.	Participation	27 Jul 1977
County		
St. Lawrence County Environmental Management Council	Participation	15 Dec 1977

Table G-1 - Pertinent Correspondence by Agency and Organization (Cont'd)

Agency	Subject	Date
Port Authorities		
Council of L. Erie Ports	Interest in the Study	15 Aug 1977
Erie - W. Pa. Port Auth.	Participation	6 Sep 1977
Organizations		
Amer. Fisheries Soc.	Participation	30 Sep 1977
Assoc. of Amer. Railroads	Participation	30 Aug 1977
Chamber of Commerce of the U.S.	Participation	26 Aug 1977
Dominion Marine	Participation	9 Sep 1977
Fed. of St. Lawrence R. Pilots	Participation	7 Sep 1977
Great Lakes Seaway Users Assoc.	Participation	30 Aug 1977
Great Lakes Tomorrow	Participation	27 Sep 1977
Intl. Assoc. of Fish & Wildlife Agencies	Participation	17 Oct 1977
Intl. Ship Masters' Assoc.	Participation	1 Aug 1977
	Problems and Needs	7 Feb 1978
Lab. of Onithology - Cornell Univ.	Participation	13 Sep 1977
Lake Carriers' Assoc.	Participation	1 Aug 1977
	Problems and Needs	7 Apr 1978
Marine Engr. Beneficial Assoc.	Participation	18 Aug 1977
Massena Chamber of Commerce	Participation	23 Sep 1977
Seafarers Intl. Union	Participation	12 Aug 1977
Seaway Pilot	Participation	3 Jan 1977
Wildlife Society	Participation	25 Aug 1977

DEPARTMENT OF THE ARMY
BUFFALO DISTRICT, CORPS OF ENGINEERS
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BUFFALO, NEW YORK 14207

A-1

NCBED-PN

The purpose of this letter is to inform you of the status of two studies by the Corps of Engineers on the Great Lakes-St. Lawrence Seaway System: The Great Lakes Connecting Channels and Harbors Study and the St. Lawrence Seaway-Additional Locks Study. These studies were authorized by the committees on public works of the United States Congress.

The Great Lakes-St. Lawrence Seaway has often been referred to as the fourth seacoast of the United States. The system, which extends from Duluth to Montreal, consists of the Great Lakes, connecting channels, harbors, and the St. Lawrence River. For study purposes, this system has been divided into two subsystems based upon historical traffic patterns, ship sizes and types, and commodities. The first subsystem, known as the Upper Great Lakes, includes Lakes Superior, Michigan, Huron, and Erie and their connecting channels. This subsystem will be addressed by the Great Lakes Connecting Channels and Harbors Study being conducted by Detroit District. The second subsystem includes the Welland Canal, Lake Ontario, and the St. Lawrence River to Montreal. This subsystem will be addressed by the St. Lawrence Seaway-Additional Locks Study being conducted by Buffalo District.

Though the two studies will be conducted by separate districts, they will collectively address the entire Great Lakes-St. Lawrence Seaway

(GL-SLS) system. Close coordination will be maintained between the districts for the duration of the studies. Improvements to each subsystem will be incorporated in the formulation of improvements to the other.

The primary tasks throughout these studies will be to define the problems and needs of the Great Lakes and St. Lawrence areas and to develop alternative solutions that promote the economic development and environmental quality of the nation. To accomplish this, we must have the active participation of the public and interested agencies during all stages of these studies. This will insure that the studies are responsive to public needs and preferences, and are compatible with local, State and Federal responsibilities and programs. We will use a variety of formats such as news releases, newsletters, interviews, questionnaires, committees, workshops, and public meetings, to interact with other agencies and with the general public.

Some preliminary work is being done to establish a good foundation for these studies. An economic systems model has been developed by the North Central Division. This model is an analytical tool which forecasts potential traffic of the GL-SLS system and predicts traffic flow changes which would result from alternative improvement programs on the GL-SLS system. This model is continuously being updated and will be utilized by these and other systems studies. An investigation is underway, as a part of the preliminary work, to predict future vessel sizes and the system improvements required to accommodate these vessels. The vessel size and improvements will then be economically optimized from a total system standpoint, thus narrowing the range of alternatives to be investigated in the respective studies.

The first phase of the St. Lawrence Seaway-Additional Locks study is underway. This is the preparation and coordination of a Plan of Study (POS). Through coordination with the general public and with other agencies, the POS will present a preliminary view of what the overall study will involve and how the study will be carried out. This phase of the study will emphasize problem identification. The problems and needs of the study area and concerns of the public will be analyzed in order to define the planning objectives of the study. These planning objectives will then serve as guidelines for formulation of alternative plans later in the study.

It is anticipated that these two studies will generate much public interest, which may manifest itself as inquiries to local political entities. The above information should be helpful to you in answering any inquiries directed to you. If additional information is required, please feel free to contact me. Any pertinent information or specific comments you may have at this time would be appreciated.

Sincerely yours,

DANIEL D. LUDWIG
Colonel, Corps of Engineers
District Engineer

Letter A-1 sent to the Following:

Honorable Jacob J. Javits
United States Senate
Washington, DC 20510

Honorable Jacob J. Javits
U. S. Senator
Federal Office Bldg.
111 W. Huron Street
Buffalo, NY 14202

Honorable Daniel P. Moynihan
United States Senate
Washington, DC 20510

Honorable Daniel P. Moynihan
United States Senator
Federal Office Bldg.
111 W. Huron Street
Buffalo, NY 14202

Honorable Robert C. McEwen
House of Representatives
Washington, DC 20515

Honorable Robert C. McEwen
Representative in Congress
307 Federal Building
Watertown, NY 13601

Honorable William F. Walsh
House of Representatives
Washington, DC 20515

Honorable William F. Walsh
Representative in Congress
303 Federal Bldg.
Syracuse, NY 13202

Honorable Frank Horton
House of Representatives
Washington DC 20515

Honorable Frank Horton
Representative in Congress
107 Federal Bldg.
Rochester, NY 14614

Honorable Barber B. Conable, Jr.
House of Representatives
Washington, DC 20515

Honorable Barber B. Conable, Jr.
Representative in Congress
311 Federal Building
100 State Street
Rochester, NY 14614

Honorable John J. LaFalce
House of Representatives
Washington, DC 20515

Honorable John J. LaFalce
Representative in Congress
618 Federal Bldg.
111 W. Huron Street
Buffalo, NY 14202

Honorable Henry J. Nowak
House of Representatives
Washington, DC 20515

Honoable Henry J. Nowak
Representative in Congress
212 Federal Courthouse Bldg.
68 Court Street
Buffalo, NY 14202

Honorable Jack F. Kemp
House of Representatives
Washington, DC 20515

Honorable Jack F. Kemp
Representative in Congress
1101 Federal Bldg.
111 W. Huron Street
Buffalo, NY 14202

Honorable Stanley N. Lundine
House of Representatives
Washington, DC 20515

Honorable Stanley N. Lundine
Representative in Congress
Federal Bldg, Room 122
P.O. Box 1044, Third Street
Jamestown, NY 14701

Honorable Ronald B. Stafford
43rd Senate District
Senate Chamber, The Capital
Albany, NY 12224

Honorable H. Douglas Barclay
45th Senate District
Senate Chamber, The Capitol
Albany, NY 12224

Honorable David O. Martin
112th Assembly District
Assembly Chamber, The Capitol
Albany, NY 12224

Honorable H. Robert Nortz
114th Assembly District
Assembly Chamber, The Capitol
Albany, NY 12224

Honorable Howard M. Metzenbaum
U. S. Senate
Washington, DC 20510

Honorable Howard M. Metzenbaum
U. S. Senator
104 U. S. Customs & Courthouse
Public Square & Superior Avenue
Cleveland, OH 44114

Honorable John Glenn
U. S. Senate
Washington, DC 20510

Honorable John Glenn
U. S. Senator
85 Marconi Blvd.
Columbus, OH 43215

Honorable J. William Stanton
House of Representatives
Washington, DC 20515

Honorable J. William Stanton
Representative in Congress
Painesville, OH 44077

Honorable Charles A. Vanik
House of Representatives
Washington, DC 20515

Honorable Charles A. Vanik
Representative in Congress
Old Federal Bldg., Room 107
210 Superior Avenue
Cleveland, OH 44114

Honorable Louis Stokes
House of Representatives
Washington, DC 20515

Honorable Louis Stokes
Representative in Congress
2947 New Federal Office Building
1240 E. 9th Street
Cleveland, OH 44199

Honorable Mary Rose Oakar
House of Representatives
Washington, DC 20515

Honorable Mary Rose Oakar
Representative in Congress
1892 West 30th Street
Cleveland, OH 44113

Honorable Ronald M. Mottl
House of Representatives
Washington, DC 20515

Honorable Ronald M. Mottl
Representative in Congress
2951 Federal Office Bldg.
1240 E. 9th Street
Cleveland, OH 44113

Honorable Donald J. Pease
House of Representatives
Washington, DC 20515

Honorable Donald J. Pease
Representative in Congress
285 Oak Street
Oberlin, OH 44074

Honorable Delbert L. Latta
House of Representatives
Washington DC 20515

Honorable Delbert L. Latta
Representative in Congress
100 Federal Building
280 South Pain Street
Bowling Green, OH 43402

Honorable Richard Schweiker
U. S. Senate
Washington, DC 20510

Honorable Richard Schweiker
U. S. Senator
U. S. Courthouse, Room 4048
Ninth & Chestnut Street
Philadelphia, PA 19107

Honorable H. John Heinz
U. S. Senate
Washington, DC 20510

Honorable H. John Heinz
U. S. Senator
2031 Federal Building
Pittsburgh, PA 15222

Honorable Marc L. Marks
House of Representatives
Washington, DC 20515

Honorable Marc L. Marks
Representative in Congress
1775 McDowell
Sharon, PA 16146

Great Lakes Fishery Commission
P.O. Box 640
1451 Green Road
Ann Arbor, MI 48105

Honorable Henry P. Smith III
Chairman, U. S. Section
International Joint Commission
1717 H. Street NW, Room 203
Washington, DC 20440

Mr. Karl Janietz
EUR/CAN
Department of State
Washington, DC 20520

Letter A-2, dated 6 July 1977, sent to the following:

Chief Executive
County of Jefferson
175 Arsenal Street
Watertown, NY 13601

Chief Executive
County of St. Lawrence
Court House
Canton, NY 13617

Town Supervisor
Town of Massena
Town Hall
Massena, NY 13662

Letter A-2 dated 19 July 1977 sent to the following:

Mayor
Village of Massena
Town Hall
Massena, NY 13662

NOTE: Letter A-2 is the same as A-1 except for the signature block.

DEPARTMENT OF THE ARMY
BUFFALO DISTRICT, CORPS OF ENGINEERS
1776 NIAGARA STREET
BUFFALO, NEW YORK 14207

B-1
NCBED-PN

The purpose of this letter is to inform you of the status of two studies by the Corps of Engineers on the Great Lakes-St. Lawrence Seaway System: The Great Lakes Connecting Channels and Harbors Study and the St. Lawrence Seaway-Additional Locks Study. These studies were authorized by the committees on public works of the United States Congress.

The Great Lakes-St. Lawrence Seaway has often been referred to as the fourth seacoast of the United States. The system, which extends from Duluth to Montreal, consists of the Great Lakes, connecting channels, harbors, and the St. Lawrence River. For study purposes, this system has been divided into two subsystems based upon historical traffic patterns, ship sizes and types, and commodities. The first subsystem, known as the Upper Great Lakes, includes Lakes Superior, Michigan, Huron, and Erie and their connecting channels. This subsystem will be addressed by the Great Lakes Connecting Channels and Harbors Study being conducted by Detroit District. The second subsystem includes the Welland Canal, Lake Ontario, and the St. Lawrence River to Montreal. This subsystem will be addressed by the St. Lawrence Seaway-Additional Locks Study being conducted by Buffalo District.

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If additional information is required, please feel free to contact me. Any pertinent information or specific comments you may have at this time would be appreciated.

Sincerely yours,

Daniel D. Ludwig

DANIEL D. LUDWIG
Colonel, Corps of Engineers
District Engineer

Letter B-1, dated 22 July 1977, sent to the following:

National Harbours Board
Windsor Harbour Commission
Port of Toronto
Toledo-Lucas County Port Authority
Lakehead Harbour Commission
Rochester Monroe County Port Authority
Port Huron Terminal Co.
Port of Oswego Authority
The Oshawa Harbour Commission
Ogdensburg Bridge and Port Authority
Monroe Port Commission
Milwaukee Board of Harbor Commissions
Lorain Port Authority
Kenosha Board of Harbor Commissioners
Hamilton Harbour Commission
The Brown County Board of Harbor Commissioners
Erie-Western Pennsylvania Port Authority
Seaway Port Authority of Duluth
Detroit/Wayne County Port Commission
Cleveland-Cuyahoga County Port Authority
Department of the Port of Chicago
Port of Indiana - Burns Waterway Harbor
Niagara Frontier Transportation Authority
Port Coordinator - County Building #1
Ashtabula Port Authority
The Great Lakes Press / Jacques LesStrang
Mrs. Freeman

Letter B-1 dated 4 August 1977 sent to the following:

American Bureau of Shipping
45 Broad Street
New York, NY 10004

American Pilots Association
2000 K Street NW
Washington, DC 20006

American Association of Port Authorities
1612 K Street NW
Washington, DC 20006

Water Transport Association
Lincoln Bldg. - Suite 2007
60 East 42nd Street
New York, NY 10017

Letter B-2 dated 6 July 1977, sent to the following:

Administrator
Soil Conservation Service
USDA
State Agriculture Bldg.
Washington, DC 20250

Administrator for Coastal Zone Management
NOAA
3300 Whitehaven Street, NW
Washington, DC 20235

Director
Office of Sea Grant
USDC
3300 Whitehaven Street, NW
Washington, DC 20235

Regional Director
National Marine Fisheries Service
USDC
Federal Bldg.
14 Elm Street
Gloucester, MA 01930

Chairman
Council on Environmental Quality
722 Jackson Place, NW
Washington, DC 20006

Regional Administrator
Federal Energy Administration
26 Federal Plaza
New York, NY 10007

Chief, Bureau of Power
Federal Power Commission
Washington, DC 20426

Regional Director
Public Health Service, Region II, DHEW
Federal Bldg.
26 Federal Plaza
New York, NY 10007

Regional Administrator
U.S. HUD
26 Federal Plaza
New York, NY 10007

NOTE: Letter B-2 is the same as letter B-1 except for the signature block.

Regional Director
North Atlantic Region
National Park Service
150 Causeway Street
Boston, MA 02114

District Chief, WRD
U. S. Geological Survey
343 U. S. Post Office and Courthouse
P.O. Box 948
Albany, NY 12201

Chief, Eastern Field Operation Center
Bureau of Mines
U. S. DI
4800 Forbes Avenue
Pittsburgh, PA 15213

Dept. of Transportation Coordinator
400 Seventh Street, SW
Washington, DC 20590

Director
Water Resources Council
Suite 800
2120 L Street, NW
Washington, DC 20037

Upper Great Lakes Regional Commission
Room 2093 Commerce Bldg.
14th and E. Streets, NW
Washington, DC 20230

B-2 letter, dated 27 July 1977, was sent to the following:

Office of the Governor, Columbus, OH / State Clearinghouse
Robert W. Teater, Director, Ohio Dept Nat. Res.
State Clearinghouse, Harrisburg, PA
Department of Environmental Resources, Harrisburg, PA
State Clearinghouse, Madison, WI
Department of Natural Resources, Madison, WI
Illinois State Clearinghouse
Department of Transportation, Springfield, IL
Clearinghouse Review Officer, Indianapolis, IN
Department of Natural Resources, Indianapolis, IN
State Clearinghouse, Lansing, MI
Department of Natural Resources, Lansing, MI
State Clearinghouse, St. Paul, MN
Department of Natural Resources, St. Paul, MN
State Clearinghouse, Albany, NY 8/4/77
Advisory Council on Historic Preservation, Washington, DC

DEPARTMENT OF THE ARMY
BUFFALO DISTRICT, CORPS OF ENGINEERS
1776 NIAGARA STREET
BUFFALO, NEW YORK 14207

C-1
NCBED-PN

This is to inform you of a study of the St. Lawrence Seaway which is being conducted by the U.S. Army Corps of Engineers. This study, authorized by the Committee on Public Works of the United States Senate, is considering whether the existing project in United States territory should be modified in any way in view of the present and anticipated volume of commercial traffic utilizing the waterway.

The St. Lawrence Seaway Additional Locks Study will define the problems and needs of the study area and develop alternative solutions that promote the economic development and environmental quality of the nation. To accomplish this, it will be necessary to incorporate public and agency perceptions of problems, needs, alternative solutions and related impacts. This will insure that the study is responsive to public needs and preferences to the maximum extent possible, within the bounds of local, state and Federal programs and authorities. A variety of formats will be used to communicate with the public and interested agencies, such as news releases, fact sheets, interviews, questionnaires, committees, workshops, and public meetings.

I cordially invite you and your agency to participate actively in the St. Lawrence Seaway Additional Locks Study. I would appreciate receiving your reply indicating your agency's willingness to participate, and designating an agency representative or contact if different than yourself. Any pertinent information or specific comments you may have at this time would be appreciated.

Sincerely yours,

DANIEL D. LUDWIG
Colonel, Corps of Engineers
District Engineer

Letter C-1, dated 6 July 1977, sent to the following:

Regional Director
U. S. Fish and Wildlife Service
U. S. Post Office and Courthouse
Boston, MA 02109

Commander
9th Coast Guard District
1240 East 9th Street
Cleveland, OH 44109

David W. Oberlin, Administrator
SLSDC
800 Independence Avenue, SW
Washington, DC 20591

Commissioner
New York State Dept. of Commerce
112 State Street
Albany, NY 12207

Commissioner
New York State Dept. of
Er''.onmental Conservation
50 ..olf Road
Albany, NY 12233

Commissioner
New York State Dept. of Transportation
State Campus
Albany, NY 12226

Commissioner
Office of Parks and Recreation
Agency Bldg. No. 1
Empire State Plaza
Albany, NY 12223

Arthur C. Mengel, Executive Director
BR-SLRPB
Payson Hall
St. Lawrence University
Center, NY 13617

William E. Tyson, Executive Director
SL-EOC
317 Washington Street
Watertown, NY 13601

St. Lawrence-Franklin Regional
Water Resources Planning Board
317 Washington Street
Watertown, NY 13601

Letter C-1, dated 22 July 1977, sent to the following:

Power Authority of the State of New York
Great Lakes Region - Maritime Administration

Letter C-1, dated 8 December 1977, sent to the following:

St. Lawrence Co. Environmental Management Council

Letter C-2, dated 6 July 1977, sent to the following:

State Conservationist
Soil Conservation Service
U. S. Dept. of Agriculture
Room 400, Midtown Plaza
700 E. Water Street
Syracuse, NY 13210

Director
Lake Survey Center
National Ocean Survey, NOAA
630 Federal Bldg. & U. S. Courthouse
Detroit, MI 48226

Director, Eastern Region
Maritime Administration
USDC
26 Federal Plaza
New York, NY 10007

Director
Economic Development Administration Ltr. dtd. 7/25/77
Regional Office
USDC
~~320 Walnut Street~~ 10424 Federal Bldg.
~~Philadelphia, PA 19106~~ 600 Arch St.
Philadelphia, PA 19106

Regional Administrator
Region II, EPA
26 Federal Plaza
New York, NY 10007

Regional Director
Bureau of Outdoor Recreation
USDI
Federal Building
600 Arch Street
Philadelphia, PA 19106

Chairman,
Great Lakes Basin Commission
P.O. Box 999
Ann Arbor, MI 48106

Robert W. Kellum, Chairman
Great Lakes Commission
5104 IST Building
2200 Bonisteel Blvd.
Ann Arbor, MI 48105

NOTE: Letter C-2 is the same as C-1 except for the signature block.

DEPARTMENT OF THE ARMY
BUFFALO DISTRICT, CORPS OF ENGINEERS
1776 NIAGARA STREET
BUFFALO, NEW YORK 14207

D-1
NCBED-PN

This is to inform you of a study of the St. Lawrence Seaway which is being conducted by the U.S. Army Corps of Engineers. This study, authorized by the Committee on Public Works of the United States Senate, is considering whether the existing project in United States territory should be modified in any way in view of the present and anticipated volume of commercial traffic utilizing the waterway.

The St. Lawrence Seaway Additional Locks Study will define the problems and needs of the study area and develop alternative solutions that promote the economic development and environmental quality of the nation. To accomplish this, it will be necessary to incorporate public and agency perceptions of problems, needs, alternative solutions and related impacts. This will insure that the study is responsive to public needs and preferences to the maximum extent possible, within the bounds of local, state and Federal programs and authorities. A variety of formats will be used to communicate with the public and interested agencies, such as news releases, fact sheets, interviews, questionnaires, committees, workshops, and public meetings.

I cordially invite you and your organization to participate actively in the St. Lawrence Seaway Additional Locks Study. I would appreciate receiving your reply indicating your organization's willingness to participate, and designating a representative for purposes of contact. Any pertinent information or specific comments you may have at this time would be appreciated.

Sincerely yours,

DANIEL D. LUDWIG
Colonel, Corps of Engineers
District Engineer

D-1 letter, dated 27 July 1977, was sent to the following:

International Ship Master's Association
Dominion Marine Association
Great Lakes Waterways Development Association
Industrial Users Group
International Longshoremen's Association
Vice Admiral Paul E. Trimble, USCG Retired
Lake Freight Association
Lake Marine Engineers Benevolent Association
The Shipping Federation of Canada
U.S. Great Lakes Shipping Association
Great Lakes Task Force
Western Great Lakes Port Association
Council of Lake Erie Ports
International Association of Great Lakes Ports
Jefferson County Chamber of Commerce
Massena Chamber of Commerce
St. Lawrence County Chamber of Commerce
Richard L. Robbins, Executive Director
St. Lawrence Valley Conference Council

Letter D-1 dated 4 August 1977 sent to the following:

President
Federation of St. Lawrence
River Pilots
300 St. Sacrement St.
Montreal, Quebec, Canada

Great Lakes Seaway Users Association
c/o Export Manager
STA RITE Industries Overseas Corp.
293 Wright Street
Delavan, WI 53115

Upper Great Lakes Pilots, Inc.
Clure Public Marine Terminal
Duluth, MN 55802

St. Lawrence Seaway Pilots Assn.
P.O. Box 274
Cape Vincent, NY 13618

Seafarers International Union
Great Lakes Division
10225 W. Jefferson
River Rouge, MI 48218

Great Lakes & Rivers Dist.
Local 47
Masters, Mates and Pilots
2420 Terminal Tower
Cleveland, OH 44113

Lake Pilots Association
802 Sedgwick Street
P.O. Box 902
Port Huron, MI 40860

International Shipmasters Association
9922 Yorkshire Road
Detroit, MI 48224

D-1 Letter Sent to the Following: AUG 2? 1977

American Association for Conservation Information
American Committee for International Wildlife Protection, Inc.
American Conservation Association, Inc.
American Fisheries Society
American Rivers Conservation Council
American Scenic & Historic Preservation Society
Canada-United States Environmental Council
Chamber of Commerce of the United States of America
The Conservation Foundation
Ducks Unlimited, Inc.
Federation of Conservation Clubs
Friends of the Earth
International Association of Fish and Wildlife Agencies
Izaak Walton League of America, Inc.
Laboratory of Ornithology
Lake Erie Cleanup Committee, Inc.
League of Women Voters of the U.S.
National Audubon Society
National Campers and Hikers Association, Inc.
National Water Resources Assoc.
National Watershed Congress
National Waterways Conference, Inc.
National Wildlife Federation
Natural Resources Council of America
The Nature Conservancy
New York State Conservation Council
N.Y.S. Association of Conservation Commissions, Inc.
Northeast Assoc. of Fish and Wildlife Resource Agencies
Outboard Boating Club of America
Sierra Club
Sport Fishing Institute
United States Tourist Council
Wetlands for Wildlife, Inc.
Wildlife Society
Association of American Railroads
New York State Waterways Association, Inc.

BLACK RIVER-ST. LAWRENCE
REGIONAL PLANNING BOARD

LEWIS JEFFERSON ST. LAWRENCE FRANKLIN counties

R&D Center, St. Lawrence University, Canton, New York 13617 (315)379-5355

July 14, 1977

Col. Daniel D. Ludwig, District Engineer
U.S. Army Corps of Engineers, Buffalo District
1776 Niagara Street
Buffalo, NY 14207

Dear Col. Ludwig:

In response to your request of 6 July 1977, please be advised that the Black River-St. Lawrence Regional Planning Board wishes to participate fully in the St. Lawrence Seaway Additional Locks Study.

I am designating myself as agency representative and contact, but will call on my staff as appropriate to represent me on specific technical, environmental, etc. matters which may arise during the course of the Study.

The Black River-St. Lawrence Regional Planning Board looks forward to participating in this Study in whatever way it can as part of its continuing cooperative and long-standing association with the Corps.

Sincerely,

Arthur C. Mengel
Ex. Secretary

ACM/ps

ST. LAWRENCE-EASTERN ONTARIO COMMISSION

317 WASHINGTON ST., WATERTOWN, N. Y. 13601

PHONE (315) 782-0100

EXTENSION 263-4

CHARLES W. KELLY, Chairman   WILLIAM E. TYSON, Executive Director

July 14, 1977

Col. Daniel D. Ludwig
U.S. Army Corps of Engineers
Buffalo District
1776 Niagara Street
Buffalo, NY 14207

Dear Colonel Ludwig:

Thank you for your recent letter seeking to have a representative of the St. Lawrence-Eastern Ontario Commission participate in the St. Lawrence Seaway Additional Locks Study.

As the agency responsible for producing the Coastal Zone Management Act plan for the lands and waters of the New York State portion of the St. Lawrence River, we are vitally interested in future developmental activities which may impact the area's economy and environment.

Due to the importance of this study, I would be pleased to participate as our agency's representative.

Sincerely,

William E. Tyson

jl

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION II
EDISON, NEW JERSEY 08817

July 19, 1977

Mr. Donald M. Liddell
Acting Deputy District Engineer
Department of the Army
Buffalo District
Corps of Engineers
1776 Niagara Street
Buffalo, New York 14207

Dear Mr. Liddell:

This is in response to your letter to the Regional Administrator dated July 7, 1977, in which you requested the participation of this Agency in the St. Lawrence Seaway Additional Locks Study.

Walter Andrews, Chief, Rochester Programs Support Branch, will be the Region II-Environmental Protection Agency contact for this study. Feel free to contact Mr. Andrews at 716-263-3166.

Sincerely yours,

William Librizzi

William Librizzi
Acting Director
Surveillance & Analysis Division

cc: W. Andrews

Great Lakes Fishery Commission
ESTABLISHED BY CONVENTION BETWEEN CANADA AND THE UNITED STATES TO IMPROVE AND PERPETUATE FISHERY RESOURCES

July 21, 1977

Colonel Daniel D. Ludwig
Corps of Engineers
Department of the Army
Buffalo District
1776 Niagara Street
Buffalo, New York 14207

Dear Colonel Ludwig:

Thank you for your informative letter regarding the status of the Great Lakes Connecting Channels and Harbors Study and the St. Lawrence Seaway-Additional Locks Study. Please keep us informed.

At your invitation, I would like to request additional information on three points:

1. How will fishery interests be involved;

2. What connection will these studies have with the studies being made for extended navigation; and

3. What steps have been taken to involve Canadians at various stages in your work?

Thank you in advance for your attention to these questions.

Sincerely,

Carlos M. Fetterolf, Jr.
Executive Secretary

oad • Ann Arbor, Michigan 48105 • Telephone: (313) 662-3209 / FTS 374 5481

DEPARTMENT OF TRANSPORTATION
ST. LAWRENCE SEAWAY DEVELOPMENT CORPORATION
WASHINGTON, D.C. 20590 MASSENA, NEW YORK 13662

July 21, 1977

Colonel Daniel D. Ludwig, USA
Corps of Engineers
District Engineer, Buffalo
1776 Niagara Street
Buffalo, New York 14207

Dear Colonel Ludwig:

In your letter of July 6 you invited this agency to actively participate in the St. Lawrence Seaway Additional Locks Study. I would like to emphasize the fact that the Seaway Corporation wants to be considered as a full partner in this study and we will be pleased to lend every assistance in this very important project.

The Corporation has been considering undertaking a similar study of this nature on its own because of the condition of Eisenhower Lock. However, it is probably more efficient if the two studies are melded into one and if we work together on this project.

I am designating David C. N. Robb, Director, Office of Comprehensive Planning, as our agency representative. Mr. Robb will, in turn, coordinate with our Engineering Department or Systems and Economic Analysis Office whenever the project involves their area.

Sincerely,

D. W. Oberlin
Administrator

NEW YORK STATE PARKS & RECREATION

July 25, 1977

Colonel Daniel D. Ludwig
District Engineer
Department of the Army
Buffalo District, Corps of Engineers
1776 Niagara Street
Buffalo, New York 14207

Dear Colonel Ludwig:

Commissioner Lehman asked that I express New York State's Office of Parks and Recreation's interest in your study of the St. Lawrence Seaway. As you know, we have been increasingly concerned with the implications of these projects on recreation and the environment of the St. Lawrence area. Projects which could change the risk of oil and other pollutant spills such as expanding the navigational season to include hazardous operations during mid-winter conditions would be our primary concern. We would also be interested in programs that would have an effect on the maintenance of Lake Ontario water levels and other recreational impacts or benefits identified by your study.

Our Central Office staff or Charles Elliott, Regional Administrator for the Thousand Islands State Park and Recreation Commission will be happy to work with the study or to provide data for your use. Unfortunately, our staff time is considerably limited, so we would wait until your staff could specify exactly what work would be needed before we would take any action on this project.

Sincerely,

Ivan P. Vamos
Assistant Commissioner for
Environmental Affairs

IPV/dg

cc: C. Elliott

State of New York
Department of
Environmental Conservation
Albany, New York 12233

Peter A. A. Berle
Commissioner

JUL [illegible] 1977

Dear Colonel Ludwig:

This is in response to your letter of 6 July 1977 advising of the St. Lawrence Seaway Additional Locks Study being conducted by the Corps of Engineers.

We are interested in the study and would like to be kept informed of progress on a continuing basis. Our Department representative will be Mr. John A. Finck, Division of Land Resources and Forest Management, at this address. We will determine the extent of our involvement as further information is received.

I appreciate your invitation for us to participate in the study.

Sincerely,

Peter A.A. Berle

Colonel Daniel D. Ludwig
Department of the Army
Buffalo District
Corps of Engineers
1776 Niagara Street
Buffalo, New York 14207

NEW YORK STATE
DEPARTMENT OF TRANSPORTATION
William C. Hennessy, Commissioner

1220 Washington Avenue, State Campus, Albany, New York 12232

[illegible]

Daniel D. Ludwig
Colonel, Corps of Engrs.
NYS Dept. of the Army
Buffalo District
1776 Niagara St.
Buffalo, NY 14207

Dear Colonel Ludwig:

The New York State Department of Transportation accepts your invitation to participate in the St. Lawrence Seaway Additional Locks Study.

I designate Mr. Gunnar Hall, Associate Transportation Analyst, and Mr. Joseph R. Stellato, Director of Waterways Maintenance, as our representatives for the study. Mr. Hall is a member of our Planning Division and is handling our Upstate Port Study. He can contribute to the study on matters relating to the upstate ports and the St. Lawrence Seaway. Mr. Stellato directs the operation of the Barge Canal System and can contribute on the relation between the St. Lawrence Seaway and the Barge Canal.

Sincerely,

W. C. HENNESSY
Commissioner

New York State Department of Environmental Conservation
Environmental Analysis Unit
317 Washington Street, Fifth Floor
Watertown, New York 13601
315-782-0100, Ext.315

Peter A. A. Berle,
Commissioner

July 27, 1977

Daniel D. Ludwig
Colonel, Corps of Engineers
District Engineer
1776 Niagara Street
Buffalo, New York 14207

Dear Colonel Ludwig:

This is in response to the notice, dated 6 July 1977, over your signature, addressed to St. Lawrence-Franklin Regional Water Resources Planning Board, announcing a forthcoming St. Lawrence Seaway Additional Locks Study.

Department of Environmental Conservation is interested in such a study, and we would welcome the opportunity to incorporate our input into an exchange of ideas.

Please consider me to be the contact for this agency, and recipient of future announcements.

Sincerely yours,

Thomas C. Gorthey
Regional Supervisor of Environmental Analysis
Region 6

TCG:JRD:ds

Grand Lodge
International Ship Masters' Association
of the Great Lakes

Office of the Grand Secretary

ROMAN T. KEENEN
– Grand Secretary –
1550 Union Commerce Bldg.
Cleveland, Ohio 44115

August 1, 1977

Colonel Daniel D. Ludwig
Corps of Engineers
District Engineer
Buffalo District
1776 Niagara Street
Buffalo, New York 14207

Dear Colonel Ludwig:

In response to your letter of July 27, 1977, the International Ship Masters Association of the Great Lakes will be pleased to participate actively in the St. Lawrence Seaway Additional Locks Study.

Captain Harvey MacDermid, Apartment 301, 1990 River Road, Marysville, Michigan 48040, is Chairman of our Navigation and Legislative Committee and he or his representative will be pleased to cooperate with you in this beneficial work.

Our Grand Lodge Treasurer, Captain L. A. Gilbert, R. R. 2, Riverside Drive, Ogdensburg, New York 13669, is quite familiar with the St. Lawrence Seaway and he will be happy to lend whatever assistance he can.

We look forward to working closely with you so that the entire Great Lakes area can be benefitted.

Again our appreciation for your kind invitation to participate.

Respectfully yours,

Roman T. Keenen, Grand Secretary

LAKE CARRIERS' ASSOCIATION

CLEVELAND, OHIO 44113
(216) [illegible] 1107

August 1, 1977

Col. Daniel D. Ludwig
District Engineer
Corps of Engineers, U. S. Army
1776 Niagara Street
Buffalo, New York 14207

Dear Colonel Ludwig:

This Association will be pleased to participate in the St. Lawrence Seaway additional lock study.

Contact will be David L. Buchanan, Vice President, and in his absence I will be available.

Sincerely yours,

Paul E. Trimble
Vice Admiral USCG (Ret.)
President

UNITED STATES DE. ARTMENT OF COMMERC
Maritime Administration
Great Lakes Region
666 Euclid Avenue, Room 576
Cleveland, Ohio 44114

August 2, 1977

Colonel Daniel D. Ludwig
District Engineer
Corps of Engineers
1776 Niagara Street
Buffalo, New York 14207

Dear Colonel Ludwig:

You may include my name on your list of agency contacts for the St. Lawrence Seaway Additional Locks Study. The Maritime Administration will participate to the degree permitted by our resources in the areas of ship operation, ship design, and economic analysis of trade patterns.

Sincerely yours,

George J. Ryan
Great Lakes Region Director

STATE OF NEW YORK
DEPARTMENT OF COMMERCE
99 WASHINGTON AVENUE
ALBANY, N. Y. 12245

JOHN S. DYSON
COMMISSIONER

August 5, 1977

Colonel Daniel D. Ludwig
District Engineer, Buffalo District
U. S. Army Corp. of Engineers
Buffalo, New York 14207

Dear Colonel Ludwig:

We have received your letter of July 6, in which you request our Department's participation in the St. Lawrence Seaway Additional Locks Study.

The New York State Department of Commerce looks forward to being an active contributor to the St. Lawrence study. We are sure that this study will have important impacts on the economy of New York's "second seacoast".

I have designated William Graper, Senior Industrial Consultant, to coordinate our participation in this study. Please send all materials to him at the New York State Job Development Authority, Twin Towers Building, 99 Washington Avenue, Albany, New York 12210.

Sincerely,

John Dyson

John S. Dyson

COOPERATIVE EXTENSION NEW YORK STATE

Cornell University • State University of New York • U.S. Department of Agriculture

SEA GRANT ADVISORY SERVICE

607 Raymond Hall
SUNY at Potsdam
Potsdam, New York 13676

August 8, 1977

Daniel D. Ludwig, Colonel
Corps of Engineers
Department of the Army
1776 Niagara Street
Buffalo, New York 14207

Dear Colonel Ludwig:

I would like to take this opportunity to thank you for extending an invitation to me to participate in the St. Lawrence Seaway Additional Locks Study. I am most willing to participate and I am sure that others will be also.

The issues revolving around the Locks Study and the Extended Navigation Season are complex and I am pleased that you are attempting to envolve St. Lawrence River citizenry. To help you identify potential interested parties, I am enclosing a list of individuals who have been active in St. Lawrence River issues. These people may wish to be kept abreast of progress in the Study.

On November 5, 1977, the St. Lawrence Valley Conference Council will be holding a Conference on Seaway Transportation in Cornwall. We are now in the process of planning for this Conference and we would welcome suggestions from you as to content and speakers. The Conference coordinator is Ron Johnson from the St. Lawrence Parks Commission. He can be reached at St. Lawrence Parks Commission, Morrisburg, Ontario, Canada. Tel: (613) 543-2951.

One idea which I have mentioned to you in your visit to Ogdensburg, last December, was to have the Corps of Engineers investigate the possibility of developing a visitor center, which describes the River and the Seaway as the Corps of Engineers visitor did in Bourne, Massachusetts. This idea seems to be a popular one (as is indicated by the fact that the St. Lawrence Valley Chamber of Commerce passed a motion unanimously endorsing the construction of such a facility) and, if possible, I would like to see this idea considered.

I have had many fine working experiences with the Corps of Engineers and I am looking forward to many more in the future. I have a good working knowledge of the people and their concerns and would be willing to help you gain the type of public participation program you desire.

Keep in toucn.

Very truly yours,

Stephen Brown

Stephen Brown
Sea Grant Extension Specialist

SB:ed

NCBED-PN 11 August 1977

Mr. Carlos M. Fetterolf, Jr.
Executive Secretary
Great Lakes Fishery Commission
1451 Green Road
Ann Arbor, MI 48105

Dear Mr. Fetterolf:

Thank you for your letter of 21 July 1977 requesting additional information on the St. Lawrence Seaway - Additional Locks Study and the Great Lakes Connecting Channels and Harbors Study.

As pointed out in Colonel Ludwig's letter of 6 July 1977, the Connecting Channels Study is being conducted by the Detroit District and will be coordinated with the Buffalo District's Additional Locks Study. Although the reply may be the same for both studies, I am forwarding a copy of your letter on to Colonel Remus, Detroit District Engineer, to give him the opportunity to respond directly concerning the Connecting Channels Study.

As for the St. Lawrence Seaway - Additional Locks Study, I think it is pertinent to first discuss where we are today. Initial work consisted of identifying all agencies, organizations, and publics having a concern or interest and notifying them of the study's initiation. We are now in the first stage of the study process, the development of a Plan of Study. Through workshops, correspondance, interviews, and analysis of existing data, the study objectives will be set and measures will be identified to satisfy the problems and needs of the study area. Through inhouse efforts and inputs by other agencies, existing data will be analyzed to identify data gaps which must be filled to develop alternative plans and assess their impacts on the environment, the national economy, social well-being and regional development. Work items for the remainder of the study will be assigned to agencies and organizations, and appropriate funding identified. Throughout the development of this Plan of Study and subsequent study stages, the views and perceptions of various publics, whether they be agencies, organizations or the general public, will be sought and incorporated. They will also be given the opportunity to input to the study by reviewing vari^us study reports and newsletters. The Draft Plan of Study is scheduled for January 1978.

In light of the above discussion and in reply to your inquiry as to how fishery interests will be involved, I should point out that only preliminary study management plans have been developed to date. Finalization of such plans will require identification of agencies and organizations, their capabilities, and their willingness to actively participate. In relation to fisheries, we have identified the U. S. Fish and Wildlife Service, the National Marine Fisheries Service, and various state natural resource agencies as those agencies concerned with fisheries in the United States. The active involvement of these agencies will be sought in addition to the required coordination with the U.S.F.&W.S. as mandated by the Fish and Wildlife Coordination Act of 1958. As for Canada, the Fisheries and Marine Service of the Department of the Environment on the national level and the Division of Fish and Wildlife of the Ontario Ministry of Natural Resources have been identified as the agencies concerned with Canadian fisheries. The involvement of these Canadian agencies leads me to your third area of concern, that being Canadian involvement in the study.

Coordination with and involvement of Canada in this study will initially be kept on an informal basis requiring exchange of data, information and study results, review of reports, and unofficial attendance at meetings. This will, in part, be accomplished through the St. Lawrence Seaway Development Corporation which already has a cooperative agreement with the St. Lawrence Seaway Authority of Canada. This effort will mainly concern the economic and engineering aspects of the study. Coordination with Canadian agencies concerning fisheries and other environmental factors still remains to be resolved. Your views pertaining to this Canadian coordination and involvement for environmental aspects of the study would be greatly appreciated, in particular the capabilities of your organization to effectuate such coordination. If it is determined that more formal coordination is required during subsequent stages of the study, it will be handled by the State Department through formal negotiations with the Government of Canada.

In regards to the Navigation Season Extension Program, the studies will be very closely aligned especially in respect to that portion of the extension program concerning the St. Lawrence Seaway. As you probably know, the Season Extension Program is about to embark on a very ambitious environmental program. It is hoped that much of the necessary data mad/2245

NCBED-PN
Mr. Carlos M. Fetterolf, Jr.

required for the Additional Locks Study will be made available through these studies, leaving only the site-specific environmental studies to be completed.

I trust the above information meets your needs. As previously mentioned, I would appreciate your views on Canadian coordination and also your capabilities for assistance throughout this study. If I can be of any further assistance, please feel free to call on me.

Sincerely yours,

DONALD M. LIDDELL
Acting Deputy District Engineer

AD-A095 082 CORPS OF ENGINEERS BUFFALO N Y BUFFALO DISTRICT F/G 13/2
ST. LAWRENCE SEAWAY N.Y. FEASIBILITY STUDY FOR ADDITIONAL LOCKS--ETC(U)
NOV 79

UNCLASSIFIED NL

6 OF 7
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A095082

SIU

PAUL HALL
PRESIDENT
FRANK DROZAK
EXECUTIVE VICE-PRESIDENT
JOE DI GIORGIO
SECRETARY-TREASURER
CAL TANNER
VICE-PRESIDENT
EARL SHEPARD
VICE-PRESIDENT
LINDSEY WILLIAMS
VICE-PRESIDENT
PAUL DROZAK
VICE-PRESIDENT

AFFILIATED WITH THE SEAFARERS INTERNATIONAL UNION OF NORTH AMERICA • AFL-CIO

SEAFARERS INTERNATIONAL UNION
ATLANTIC • GULF • LAKES AND INLAND WATERS DISTRICT

675 FOURTH AVENUE • BROOKLYN, NEW YORK 11232 • HYACINTH 9-6600

DETROIT OFFICE
10225 W. JEFFERSON AVENUE
RIVER ROUGE, MICH. 48218

August 12, 1977

Mr. Daniel D. Ludwig, Colonel
Corps of Engineers
Department of the Army
1776 Niagara Street
Buffalo, New York 14207

Dear Sir:

With reference to your letter of August 4th regarding a study of the St. Lawrence Seaway, we would be happy to participate in any information you have regarding the additional study of the St. Lawrence Seaway locks.

Please forward information to us as it progresses.

Very truly yours,

Jack Bluitt

JACK BLUITT
Port Agent
Detroit

JB:th
opeiu#10 afl cio

THE COUNCIL OF LAKE ERIE PORTS

August 15, 1977

Buffalo District, Corps of Engineers
1776 Niagara Street
Buffalo, New York 14207

Attention: Col. Daniel D. Ludwig,
District Engineer

Gentlemen:

This is to acknowledge your inquiry of July 27, concerning a proposed study by the U. S. Army Corps of Engineers, in the matter of the modification of the St. Lawrence Seaway, insofar as it is located in United States territory, to cover present and anticipated volumes of commercial traffic.

The Council of Lake Erie Ports is definitely interested in this project, and would appreciate your placing their name on the mailing list for the receipt of further notices.

Very truly yours,

Arthur W. Todd
Secretary

laj

District 2

Marine Engineers Beneficial Association Associated Maritime Officers

AFL-CIO

933-35 SUMMIT STREET, TOLEDO, OHIO 43604 . (419) 255-3940

MELVIN H. PELFREY
VICE PRESIDENT
GREAT LAKES

August 18, 1977

Colonel Daniel D. Ludwig
Corps of Engineers
Buffalo District
1776 Niagara Street
Buffalo, New York 14207

Dear Colonel Ludwig:

I am in receipt of your letter of July 27, 1977, advising me of the study of the St. Lawrence Seaway which will be conducted by the U.S. Corps of Engineers.

This is to certify that our organization would like to be included in this study, and I personally, would like to be named the Representative. Thank you very much for asking us to be a part of this much-needed study.

Very truly yours,

Mel Pelfrey

Melvin H. Pelfrey
Vice President, Great Lakes

MHP/ck

MICHIGAN SEA GRANT PROGRAM

A cooperative effort of The University of Michigan and Michigan State University

August 25, 1977

Colonel Daniel D. Ludwig
Corps of Engineers
District Engineer
Buffalo District
1776 Niagara Street
Buffalo, New York 14207

Dear Colonel Ludwig:

We are interested in learning more about and participating in activities related to the St. Lawrence Seaway Additional Locks Study.

I will act as the contact person for the Michigan Sea Grant Program on this subject.

Looking forward to future correspondence.

Sincerely,

Dr. Erwin Seibel
Assistant Director

ES:cc

The University of Michigan, 2200 Bonisteel Boulevard
Ann Arbor, Michigan 48109, Phone (313) 763-1437

Michigan State University, Dept. of Fisheries and Wildlife
East Lansing, Michigan 48824, Phone (517) 353-0647

STATE UNIVERSITY OF NEW YORK
COLLEGE OF ENVIRONMENTAL SCIENCE AND FORESTRY

SYRACUSE CAMPUS
SYRACUSE, NEW YORK 13210

SCHOOL OF BIOLOGY, CHEMISTRY AND ECOLOGY

SYRACUSE CAMPUS

Schools of
• Biology, Chemistry & Ecology
• Continuing Education
• Environmental and Resource Engineering
• Environmental and Resource Management
• Landscape Architecture
Applied Forestry Research Institute
Empire State Paper Research Institute
Institute of Environmental Program Affairs
State University Polymer Research Center
U.S. Forest Service Cooperative Research Unit

CRANBERRY LAKE CAMPUS
Charles Lathrop Pack Demonstration Forest
Cranberry Lake Biological Station

NEWCOMB CAMPUS
Archer & Anna Huntington Wildlife Forest
Adirondack Ecological Center

TULLY CAMPUS
Heiberg Memorial Forest
Genetic Field Station

WANAKENA CAMPUS
Forest Technician Program

WARRENSBURG CAMPUS
Charles Lathrop Pack Demonstration Forest
Summer Field Program

August 25, 1977

Colonel Daniel D. Ludwig
District Engineer
Buffalo District, Corps of Engineers
Department of the Army
1776 Niagara Street
Buffalo, New York 14207

Dear Colonel Ludwig:

Thank you for your letter of August 22nd in which you invite the Wildlife Society to participate in the St. Lawrence Seaway Additional Locks Study.

I have forwarded a copy of your letter and mine to Dr. James Applegate, who is currently chairman of the Northeast Section of The Wildlife Scoiety. We include both states and neighboring Canadian provinces within our section and should be able to provide helpful input to this study. Dr. Applegate, as chief officer of our Northeast Section, would certainly appreciate receiving any additional information on this project in the way of background material. His address is:

Dr. James E. Applegate
Dey Road
Cranbury, New Jersey 08512

Sincerely,

R E Chambers

Robert E. Chambers
Associate Professor
Department of Forest Zoology

REC:rtp
cc:
Dr. J. Applegate
Dr. F. Evenden
Mr. S. Free

ADVANCING VOLUNTARY LEADERSHIP IN A CHANGING WORLD

Chamber of Commerce of the United States
HUMAN AND COMMUNITY RESOURCES GROUP
202 659-6170
1615 H STREET, N.W.
WASHINGTON, D.C.

August 26, 1977

Colonel Daniel D. Ludwig
Corps of Engineers
District Engineer
Department of the Army
Buffalo District
1776 Niagara Street
Buffalo, New York 14207

Dear Colonel Ludwig:

Thank you for informing the National Chamber of the study you are conducting of the Saint Lawrence Seaway, and we appreciate your invitation to participate actively in it.

While we have a definite interest in the Seaway, I feel that we are not in a position to qualify technically for direct participation in the study. But, I hope you will keep me apprised of the progress you make in conducting it.

In reviewing your letter, the thought occurred to me that you will probably be working closely with the Saint Lawrence Seaway Development Corporation and officials at the U. S. Department of Transportation.

Again, thank you for communicating with us on the study, and I look forward to your progress reports.

Sincerely,

Robert M. Hawk

Robert M. Hawk
Director
Transportation and Communications

ASSOCIATION OF
AMERICAN RAILROADS
AMERICAN RAILROADS BUILDING WASHINGTON, D. C. 20036

JOHN MURRAY
Vice President
Assistant to President

August 30, 1977

Colonel Daniel D. Ludwig
District Engineer
Buffalo District
Corps of Engineers
1776 Niagara Street
Buffalo, New York 14207

Dear Colonel Ludwig:

Thanks for your invitation to participate actively in the St. Lawrence Seaway Additional Locks Study.

The AAR is certainly willing to participate in the Study. Please consider me as the AAR contact.

Sincerely,

John Murray

JEM/mc

State Planning Services
Agency

Lieutenant Governor
ROBERT D. ORR
Director

143 West Market Street
Indianapolis Indiana 46204
(317) 633-4346

State of Indiana

August 30, 1977

Mr. Donald M. Liddell
Acting Deputy District Engineer
Department of the Army
Buffalo District, Corps of Engineers
1776 Niagara Street
Buffalo, New York 14207

Dear Mr. Liddell:

The State Clearinghouse Review Officer has brought to our attention your letter of July 27, 1977 referring to the Corps of Engineers studies of the Great Lakes-St. Lawrence Seaway System. We commend the Corps for undertaking these important studies and we wish to express our keen interest in following these studies, especially the Great Lakes Connecting Channels and Harbors Study.

As the responsible Coastal Zone Management agency in Indiana, we respectfully request to be placed on your mailing list to receive background information and any documents pertaining to the progress and results of the Great Lakes Connecting Channels and Harbors Study. If this request should be directed to the Detroit District Office, we would deeply appreciate your forwarding our request to the appropriate party in that office.

Thank you for your consideration and if we can assist in this endeavor please let us know.

Sincerely,

T. "TED" PANTAZIS
Executive Director

TTP/pa

cc: Roland J. Mross, State Budget Agency

Rexnord

August 30, 1977

Process Machinery Division
PO Box 383
Milwaukee WI

Department of the Army
Buffalo District Corps of Engineers
1776 Niagara Street
Buffalo, New York 14207

ATTN: Daniel D. Ludwig
Colonel, Corps of Engineers
District Engineer

REF: St. Lawrence Seaway Study
D-1
NCBED-PN

Dear S r:

Your letter of August 4, 1977 addressed to Great Lakes Seaway Users Association has been turned over to me for reply.

As you know, the Great Lakes Seaway Users Association is an international shippers group formed for and dedicated to the support of the Great Lakes system.

The outline of the study as presented in your letter indicates that this wil be an . -depth study and could be a monumental task. We look forward to active participation in this study in any way we can be of assistance.

Please address all future correspondence to me and I will pass the information on to our organization as required.

Very truly yours,

R.L. Vest, Supervisor
International Transportation

Secretary - Great Lakes Seaway Users Association

Nordberg

Cable Address

— Erie —
WESTERN PENNSYLVANIA
PORT AUTHORITY

PENNSYLVANIA'S GATEWAY TO THE SEAWAY

ROOM 507 MUNICIPAL BLDG ERIE PA 16501 • PHONE [illegible]
After 4:30 P.M. [illegible]

September 6, 1977

Colonel Daniel D. Ludwig
District Engineer
Buffalo District, Corps of Engineers
1776 Niagara Street
Buffalo, New York

re: Ongoing studies GL-SLS System by Corps

Dear Sir:

The Chairman of the Erie - Western Pennsylvania Port Authority has appointed the undersigned and Admiral Denys Knoll, (Ret) as liaison with your office in connection with studies being made by the Corps of Engineers on the Great Lakes - St. Lawrence Seaway System, as indicated in your letter of July 22, 1977 to the Authority.

As further identification let me say that I am a member of the Great Lakes Commission, as well as serving with Admiral Knoll in the capacity of Co-chairman of the Authority's Advisory Board.

In reviewing your July letter we would respond by saying that acting with the Port Authority, we will be happy to be of assistance in the program.

All of us realize the problems facing the areas in question and recognize further the need for a cooperative effort to see that the goals are met.

Admiral Knoll and I will appreciate your sending us any material presently available and an outline of whatever plans you may have in which the Port Authority, I am sure, will be willing to participate.

Awaiting the pleasure of hearing further from you, I am,

Sincerely yours,

Joseph C Martin

Joseph C. Martin ph
Chairman, Advisory Committee
Erie - Western Pennsylvania Port Authority

JCM/ph
Enclosure: I am enclosing copy of Great Lakes Commission letter of July 21, 1977 re: New York State Barge Canal System which was directed to Col. Hunter in New York. Your comments on this program would be appreciated. JCM

THE SHIPPING FEDERATION OF CANADA
LA FEDERATION MARITIME DU CANADA

300 ST SACREMENT, SUITE 326, MONTREAL, CANADA H2Y 1X4
TELEPHONE (514) 849-2325 • TELEX 01-20668 • CABLE SHIPFED MONTREAL

File: W - 1

September 6, 1977

D.D. Ludwig
Colonel, Corps of Engineers
District Engineer
Department of the Army
1776 Niagara Street
Buffalo, New York 14207
U.S.A.

Dear Sir:

Thank you for your letter dated July 27th advising of a study of the St. Lawrence Seaway which is being conducted by the United States Army, Corps of Engineers, to consider whether the existing project in United States territory should be modified in view of the present and anticipated volume of commercial traffic utilizing the waterway.

This organization would like to be considered an "interested agency" and we look forward to receiving pertinent information concerning the study as it becomes available.

Yours very truly,

J.A. Crichton
PRESIDENT

JAC/cr

FÉDÉRATION DES PILOTES DU SAINT-LAURENT FEDERATION OF THE ST.LAWRENCE RIVER PILOTS

300 RUE ST-SACREMENT, SUITE 212, MONTRÉAL 125 · TÉL.: 849 1329

Three Rivers, September 7th 1977

Colonel Daniel D.Ludwig,
Department of the Army,
Corps of Engineers,
1776 Niagara Street,
Buffalo, New York 14207
USA

Dear Sir,

I read with interest your letter indicating a study was being undertaken on the future needs of the St-Lawrence Seaway. I wish to express our willingness to participate in whatever way you may find our contribution helpful. As President I will be at your disposal whenever needed and if I am unable to attend I will be pleased to delegate someone to represent us.

Regards,

Charles Pouliot

Charles Pouliot,
President.

N.B.: Please note our new address:
1683 rue Royale, suite 4,
Trois-Rivières, P.Québec
G9A 4K2

NEW YORK STATE PLANNING AND DEVELOPMENT CLEARINGHOUSE

Division of the Budget/ State Capitol/ Albany, New York 12224 / (518) 474-1605

September 8, 1977

Donald M. Liddell
Acting Deputy District Engineer
Buffalo District Corps of Engineers
1776 Niagara St.
Buffalo, N.Y. 14207

Re: Direct Federal Development
Project: [illegible]
U.S. Army Corps of Engineers
Studies Great Lakes St. Lawrence
Seaway System
(re: B-2 NCBED-PN)

Dear Mr. Liddell:

Notification of the above indicated project has been sent to state agencies for review via the A-95 State Clearinghouse system. The agencies were requested to inform us if they identified any problems or conflicts regarding the project vis-a-vis their plans and programs and to submit any comments they might have. The agencies were provided 30 days (the usual review period under Part I of Circular A-95).

The end of the 30-day period has passed and we have received no statements identifying problems or making objection to the proposed project. Comments received, if any, are attached for your information.

We want to thank you for submitting this notification in accordance with Part II of Circular A-95.

Sincerely,

Thomas J. McDonald
State Clearinghouse
Administrator

Att.

DOMINION MARINE ASSOCIATION

SUITE 703
350 SPARKS STREET
OTTAWA, ONTARIO
CANADA K1R 7S8

Rear Admiral R. W. TIMBRELL, RCN (Rtd)
President
Tel. (613) 232-3539

Your Ref: D-1
NCBED-PN

September 9, 1977

Colonel Daniel D. Ludwig,
District Engineer,
Corps of Engineers, Buffalo District,
1776 Niagara Street,
Buffalo, New York 14207

Dear Colonel Ludwig:

I have your letter of July 27 (to which my secretary replied in my absence) inviting this Association to participate in the St. *Lawrence Seaway Additional Locks Study being conducted by the U.S.* Army Corps of Engineers.

We will be pleased to participate in this study and would appreciate all communications in connection with the study being addressed to my attention.

Yours very truly,

(Rear Admiral R.W. Timbrell)
President

MEMBER FIRMS

TONNAGE IN EXCESS OF 3,000,000 CAPITAL INVESTMENT IN EXCESS OF $

STATE OF WISCONSIN

Martin J. Schreiber
Governor

DEPARTMENT OF ADMINISTRATION

John Torphy
Secretary

OFFICE OF STATE PLANNING AND ENERGY
One West Wilson Street
Madison, Wisconsin 53702
(608) 266-3382

September 9, 1977

Mr. Donald M. Liddell
Acting Deputy District Engineer
Buffalo District Corps. of Engineers
1776 Niagara Street
Buffalo, New York 14207

Dear Mr. Liddell:

I recently received your letter of July 27th on the two Corps' studies on the Great Lakes-St. Lawrence Seaway System.

Unfortunately, the letter was not very specific as to the purpose of the studies or the means of coordination between federal, state and local governments. We have since learned from other sources as to the extent of the study and the scheduling of the completion of the reports. It is still unclear however, as to the means to be used to coordinate the study effort with the effected states and local governments.

We are aware at the present time that the transportation committee of the Great Lakes Basin Commission is addressing the same issue area. The workshops scheduled by the transportation committee, particularly the November 1-2 workshop in Cleveland, appear to be relevant to the studies of the Great Lakes-St. Lawrence Seaway System. We are aware that a Corps representative is a member of this transportation committee. We would suggest however, that the transportation committee become the more formal mechanism for coordination between this study, the affected states, and other federal agencies. The expertise available on the transportation committee could provide a valuable input to the Corps studies. It would seem appropriate to formally recognize this expertise as a principal input to your efforts.

Thank you for making us aware of the studies and for providing us the opportunity to provide you with our suggestions.

Sincerely,

Garrett A. Nielsen

Garrett A. Nielsen
State A-95 Coordinator
Wisconsin State Clearinghouse

cc: Al Miller, Program Manager
Wisconsin Coastal Management Program

:kf-9/100844

Great
Lakes
Basin
Commission

Frederick O. Rouse
[illegible]

3475 Plymouth Road
Post Office Box [illegible]
Ann Arbor, Michigan [illegible]
313/763-3590 FTS [illegible]

September 12, 1977

Donald M. Liddell
Acting Deputy District Engineer
Department of the Army
Buffalo District, Corps of Engineers
1776 Niagara Street
Buffalo, New York 14207

Dear ~~Mr. Liddell:~~ Don

In response to your July 6 letter concerning the St. Lawrence Seaway Additional Locks Study, I will serve as the Great Lakes Basin Commission representative on the study.

Thank you for the opportunity to participate in this activity.

Sincerely yours,

Leonard

Leonard T. Crook
Executive Director

LABORATORY OF ORNITHOLOGY • CORNELL UNIVERSITY
159 SAPSUCKER WOODS ROAD
ITHACA, NEW YORK 14853 • 607-256-5056

September 13, 1977

Colonel Daniel D. Ludwig
Department of the Army
Corps of Engineers
1776 Niagara Street
Buffalo, NY 14207

Dear Colonel Ludwig:

Thank you for your invitation to participate in the St. Lawrence Seaway Additional Locks Study. The Laboratory of Ornithology would like to participate and contribute to your study in any way we can.

We would like to receive any news releases, fact sheets, or questionnaires which you circulate. Also, please advise us of scheduled interviews, committee meetings, workshops, or public meetings associated with this project.

Sincerely,

Charles R. Smith

Charles R. Smith
Assistant Director
Public Education
DRS/jew-s

NEW YORK STATE
DEPARTMENT OF TRANSPORTATION
William C. Hennessy, Commissioner

1220 Washington Avenue, State Campus, Albany, New York 12232

September 16, 1977

Mr. Donald M. Liddell
Acting Deputy District Engineer
Department of the Army
Buffalo District, Corp of Engineers
1776 Niagara Street
Buffalo, NY 14207

Re: Great Lakes/St. Lawrence Seaway
Studies, PNRS #17979

Dear Mr. Liddell:

The NY State Clearinghouse has recently provided us a copy of your letter to them of August 4, 1977 concerning the referenced subject. I would like to take this opportunity to express the Department of Transportation's interest in the conduct and results of both the Upper Great Lakes and St. Lawrence Seaway Studies. I would also like to remind you of the number of other major studies related to yours: the Lake Erie-Hudson River Ship Canal proposal, and the Barge Canal Rehabilitation proposal, among others.

This Department's interest in your study stems from a number of diverse responsibilities. We own, operate, and maintain the State's Barge Canal System, with major terminii at Troy (Hudson River), Buffalo (Lake Erie), Oswego (Lake Ontario), and Whitehall (Lake Champlain and the St. Lawrence River via the Richelieu River). Our Statewide Planning Section has undertaken a study of the major upstate ports (Albany, Buffalo, Rochester, Oswego, and Ogdensburg). Through the various transportation authorities, bridge and port authorities, and metropolitan planning organizations, we participate in the development and promotion of water-related transportation facilities. Numerous State, local, and international highways, with which we are directly or indirectly involved, cross the canal and seaway systems.

Most of our activities in the foregoing areas are undertaken or overseen on a day-to-day basis in our Regional Offices. Therefore, I have attached a list of our Regional Directors who may be affected by your studies. Please feel free to contact their offices on a staff-to-staff basis for inquiries relating to limited geographic areas. I have also listed relevant contact points in the Main Office for your information. For those aspects of your study requiring a coordinated, Statewide, or formal Departmental response, please address inquiries or reports to Commissioner of Transportation, W. C. Hennessy, Room 507, 1220 Washington Avenue, State Campus, Albany, NY 12232 for appropriate dissemination within the Department.

Please let us know of any support we can provide in this very important study. We look forward to working with you and your staff.

Very truly yours,

H. B. Clarkson

H. B. CLARKSON, Director
Project Development Bureau

HBC/JHB/dc

ATTACHMENT

D. H. Ketchum (Includes Erie & Niagara Counties)
Regional Director
Region #5
Buffalo State Office Building
125 Main Street
Buffalo, NY 14203

A. J. Kopczynski (Includes Orleans & Monroe Counties)
Regional Director
Region #4
1530 Jefferson Road
Rochester, NY 14623

J. M. Powers (Includes Wayne, Cayuga & Oswego Counties)
Region #3
333 East Washington Street
Syracuse, NY 13202

C. J. Lyman (Includes Jefferson & St. Lawrence Counties)
Regional Director
Region #7
Watertown State Office Building
317 Washington Street
Watertown, NY 13601

G. F. Young (In relation to Upstate Ports Study & Barge Canal Study)
State Planning & Research Section
Room 212
Department of Transportation, #4
1220 Washington Avenue
State Campus
Albany, NY 12232

J. M. Stellato (In relation to operation & maintenance of Barge Canal System)
Waterways Maintenance Sub-division
Room 216
Department of Transportation, #5
1220 Washington Avenue
State Campus
Albany, NY 12232

HBC/JHB/dc
9/16/77

MASSENA Chamber of Commerce, Inc.

NIAGARA MOHAWK BUILDING
AREA CODE 315 769 - 3525
P. O. BOX 387 - MASSENA, N. Y. 13662

September 23, 1977

Daniel D. Ludwig, Colonel
Corps of Engineers
District Engineer
Buffalo District
1776 Niagara Street
Buffalo, New York 14207

Dear Colonel Ludwig:

As a Chamber of Commerce we are naturally interested in any projects along the St. Lawrence River. We are especially interested in any project that effects the locks in the area of Massena, New York. You can be sure that we fully support the activities of the Corps of Engineers that may result in expansion of the present lock system.

We in the Chamber, will certainly participate actively in any way to support the St. Lawrence Seaway additional lock study, and will be available to assist in disseminating information concerning the study, or in any other ma manner possible.

A letter to us, or a telephone call, will bring a quick response to your needs.

Sincerely,

Robert J. Hammill Jr.

Robert J. Hammill, Jr.
President

RJH/pp

GREAT LAKES TOMORROW

53 West Jackson Blvd. Chicago, Illinois 60604 (312) 427-5121

An International Organization to Improve Citizen Participation in Great Lakes Decisions

September 27, 1977

Col. Daniel D. Ludwig, District Engineer
Buffalo District, Corps of Engineers
1776 Niagara Street
Buffalo, New York 14207

Dear Col. Ludwig:

Thank you for your letter of July 27th addressed to Richard Robbins, regarding the St. Lawrence Seaway Additional Locks Study. Through some mis-hap in our Chicago office we have neglected an immediate reply and for this we apologize.

Please be assured that we are actively interested in this and all other issues bearing on the future of the Great Lakes. Members our organization are now involved in many related issues including the winter navigation study, lake levels, vessel sizes and other ongoing analyses. We view the Great Lakes and the Seaway as a system that is inseparable and therefore our continuing concern.

For the time being, please consider me as the contact for this program, although another member of our Board of Directors may represent us at specific meetings or workshops. My address is: Box 735, Hiram, Ohio 44234.

Sincerely yours,

Mimi Becker

Mimi Becker
President

American Fisheries Society

ORGANIZED 1870 | INCORPORATED 1910

McGill University
Department of Biology
1205 McGregor Avenue
Montreal, Canada H3A 1B1

September 30, 1977

Daniel D. Ludwig
Department of the Army
Buffalo District
Corps of Engineers
1776 Niagara Street
Buffalo, New York 14207
U.S.A.

Dear Mr. Ludwig:

This letter is in response to yours of 22 August 1977 directed to the American Fisheries Society. Your letter has been forwarded to me by Mr. Carl R. Sullivan, Executive Director of the parent society. I apologize for the delay in responding, but I have been out of my office for a little over one month, and am just now getting caught up on my correspondence.

The purpose of this letter is to express the interest of the North-Eastern Division, American Fisheries Society to participate in the St. Lawrence Seaway Lock Study. I am presently making inquiries within our division as to the most appropriate representative and will provide a name at the very earliest possible date. In the meantime may I suggest that any pertinent information be directed to my office.

Sincerely yours,

William C. Leggett
President, North-Eastern Division
American Fisheries Society

WCL/sb

cc: Mr. Carl R. Sullivan
Executive Director, American Fisheries Society
5410 Grosvenor Lane
Bethesda, Maryland 20014

International Association of Fish and Wildlife Agencies

I.A.F.W.A.

(ORGANIZED JULY 20, 1902)

October 17, 1977

Colonel Daniel D. Ludwig,
District Engineer
Buffalo District, Corps of Engineers
1776 Niagara Street
Buffalo, NY 14207

Dear Colonel Ludwig:

We appreciate the invitation contained in your letter of August 22 to participate in the St. Lawrence Seaway Additional Locks Study. Unfortunately, it will be impossible for any one from the headquarters office of the Association to become involved. However, the interests of the Association will be reflected by the active participation of the New York Department of Environmental Conservation, particularly the Division of Fish and Wildlife, under Director Herbert E. Doig.

Sincerely yours,

John S. Gottschalk,
Executive Vice President

CC: Herbert E. Doig

DEPARTMENT OF THE ARMY
NORTH CENTRAL DIVISION, CORPS OF ENGINEERS
536 SOUTH CLARK STREET
CHICAGO, ILLINOIS 60605

NCDPD-EC 27 [illegible] 1977

SUBJECT: Great Lakes/St. Lawrence Seaway Studies - Status of Economic Studies

District Engineer, Buffalo

1. Reference your letters, NCBED-PN, dated 17 October 1977 and 21 October 1977, subject as above, the response on status and documentation for six economic models is contained below.

2. All six models are currently up and running on the GE 400 used by the NCD-ADP Center, except the Arctec Winter Rate Model which is on the Lawrence Berkley Lab (LBL) system. Please note that all changes to models have only related to the execution of programs to save computer time charges.

3. The identification and description of the models follows. The Plan of Study for the Great Lakes-St. Lawrence Seaway Navigation Systems Study of July 1975 was implemented around the cornerstone of the Great Lakes Traffic Model (#1) as developed by A. T. Kearney. Other models are Arctec Winter Rate Model (#2), Penn State Lock Capacity Model (#3), Sabin Lock Model (#4), Logistics Price File Normal Season Least Cost Rate Model (#5), and the Port Split Model (#6).

4. The status of these models is that all are on line for use on the GE 400 except the Arctec Model which is on the LBL system. The transfer of all relevant G.L. models on this common Lawrence Berkley Lab System will be accomplished in early 1978. This is viewed as the most cost effective solution for both Division and District users. Confusion as to status probably arose because of this process of transfer.

5. The applicability to the system of components such as Sabin Lock Model for Welland studies is very high. The Sabin Lock Model was derived from the Penn State Welland Canal and St. Lawrence Models. Therefore, this model can be transferred back to a single line of locks from the four parallel lock system at Sault Ste. Marie.

NCDPD-EC
SUBJECT: Great Lakes/St. Lawrence Seaway Studies - Status of Economic Studies

6. Study documentation and users manual are available as follows. For the Great Lakes Traffic Model (#1) study documentation and users manual have been furnished district offices. Several training sessions have been held for district personnel. The Arctec Winter Rate Model (#2) and the Penn State Lock Capacity Model (#3) were documented by contractor reports previously furnished Buffalo District. The documentation for the Sabin Lock Model is available upon request of either NCD-ADP or NCDPD-EC. The contractor, Booz, Allen & Hamilton, is finalizing documentation on the Logistics Price File Normal Season Least Cost Rate Model (#5). The Port Split Model (#6) is in the process of development. Initial methodology papers have been previously provided to district economists. Documentation for this model which is being initially utilized for the Season Extension Program will be completed in Spring 1978. A users manual is available for the large complicated models such as the A. T. Kearney Model, but the documentation data base is sufficient for the other models mentioned above.

7. My staff and I will assist you in accomplishing our common goal of building district capability for dynamic model use and assumption testing. The investment of manpower and funds by both Division and District offices has been large. I congratulate you for your interest in getting greater return on this investment from your shift from the mode of model output users to the mode of dynamic assumption testing.

FOR THE DIVISION ENGINEER:

Edwin V. Weiss

EDWIN V. WEISS
Chief, Planning Division

Copy furnished:
DE, Detroit

DAEN-CWP-C   23 NOV 1977

Mr. Karl K. Jonietz
Environmental Officer
Office of Canadian Affairs
Department of State
Washington, D. C. 20520

Dear Karl:

In the interest of having your Department fully informed and in general agreement with our planned informal contacts with Canadian agencies I have provided a draft letter about our studies of additional locks on the St. Lawrence Seaway and on Great Lakes connecting channels and harbors for your review and for its coordination with the Department of External Affairs.

We are prepared to modify the draft letter, as agreed between your office and External Affairs, prior to its use in initial contact to the planned recipients in Canada. Both District Engineers are anxious to proceed with the contacts early in Fiscal Year 1978 so not to delay their study progress.

Sincerely yours,

2 Incl (dupl)
1. Draft Letter
2. List of Recipients

TILFORD C. CREEL
Colonel, Corps of Engineers
Assistant Director of Civil Works,
Upper Mississippi Basin & Great Lakes

CF:
NCD
Detroit Dist
Buffalo Dist

U. S. Army Engineer Division North Central

D R A F T

Dear Sir:

The United States Army Corps of Engineers has been directed by the Senate of the United States to undertake a study to determine whether the existing seaway development of the St. Lawrence River in United States territory should be modified in any way at the present time. Particular reference is to be given to the existing locks and their possible enlargement or augmentation in view of the needs of the present and anticipated commerce utilizing the waterway. This study will be referred to as the St. Lawrence Seaway - Additional Locks Study and has been assigned to the Buffalo District Engineer.

The Corps of Engineers was also directed by the Senate of the United States to review existing and future conditions to determine whether further improvements in the Great Lakes Connecting Channels and Harbors in United States territory in the interest of deep-draft commerce should be undertaken. This study will be referred to as the Great Lakes Connecting Channels and Harbors Study and has been assigned to the Detroit District Engineer.

Because of the international nature of the Great Lakes and St. Lawrence Seaway and the interrelationship of both United States and Canadian developments on Lakes and their connecting channels and outlet river, and at harbors, it is necessary that any study thereof be coordinated and optimized from a total system standpoint. With this in mind the respective District Engineer in full cooperation with United States navigation interests is moving with new emphasis on the above directed studies.

Each study will investigate various alternative plans of potential navigation developments for the Great Lakes and St. Lawrence River, both in U. S. and

Canadian waters, in conjunction with existing Corps study directives, will include a look at the Welland Canal and an alternate route in the United States from Lake Erie to Lake Ontario. Through close coordination and interaction with personnel involved in the two studies, and through an iterative planning process, a truly optimized navigation plan for the development of the Great Lakes - St. Lawrence Seaway System will be formulated for presentation to the United States Congress.

I cordially invite you and your agency to participate in these United States studies. Your individual representative or agency participation would be an informal basis and limited to an exchange of data and information, attendance on an informal basis at meetings and workshops, and review of United States study findings and draft reports. I would suggest that because of the close coordination that presently exists between the St. Lawrence Seaway Authority and the St. Lawrence Seaway Development Corporation, these agencies could serve as intermediaries to effectuate Canadian/United States involvement in each study.

The U.S. Department of State has reviewed and discussed the content of this letter with the Canadian Department of External Affairs. External Affairs has no objection to the Corps seeking information from Canadian interests. Again I would like to extend my invitation to you and your agency to participate with the Buffalo District Engineer in the St. Lawrence Seaway - Additional Locks Study and the Detroit District Engineer in the Great Lakes Connecting Channels and Harbor Study. Both District Engineers as well as myself will appreciate your views and comments.

Sincerely yours,

List of Recipients

Brigadier General Moore
Division Engineer
North Central Division

Director
Environmental Management Service
Department of the Environment
Ottawa, Ontario K1A 0H3

President
St. Lawrence Seaway Authority
Place de Ville
Ottawa, Ontario K1R 5A3

Director
Ontario Ministry of the Environment
135 St. Clair Ave., W.
Toronto, Ontario M4V 1P5

Director
Ontario Ministry of Natural Resources
Whitney Block, Queen's Park
Toronto, Ontario M7A 1W3

Director
Fisheries and Marine Service
Department of the Environment
Ottawa, Ontario K1A 0H3

Canadian Coast Guard
Department of Transportation
Hunter Building
Ottawa, Ontario

Director
Hydro-Electric Power Commission
of Ontario
620 University Avenue
Toronto, Ontario M5G 1X6

Director
Quebec-Hydro Electric Power
Commission
75 Dorchester Boulevard West
Montreal, Quebec H2Z 1A4

Mr. George Rejhon
Counsellor (Environment)
Embassy of Canada
1746 Massachusetts Ave., N. W.
Washington, D. C. 20036

Director
Ministry of Transport
Place de Ville
Ottawa, Ontario K1A 0N5

Director
Department of Public Works
Sir Charles Tupper Building
Ottawa, Ontario K1A 0M2

ST. LAWRENCE COUNTY

ENVIRONMENTAL MANAGEMENT COUNCIL

126 Clarkson Hall Potsdam, New York 13676

Phone (315) 265-3750

December 15, 1977

Colonel Daniel D. Ludwig
District Engineer
Buffalo District
Corps of Engineers
1776 Niagara Street
Buffalo, NY 14207

Dear Colonel Ludwig:

In regard to your letter of December 8, please be advised that we would like to participate in the St. Lawrence Seaway Additional Locks Study. Please address further correspondence to:

Ms. Anne Forsyth
Executive Secretary
St. Lawrence County Environmental Management Council
State University College
Potsdam, NY 13676

Sincerely,

Margaret Johanning

Margaret Johanning

MJ/nal

BLACK RIVER–ST. LAWRENCE
REGIONAL PLANNING BOARD

LEWIS JEFFERSON ST LAWRENCE FRANKLIN COUNTIES

R&D Center, St. Lawrence University, Canton, New York 13617 (315)379-5355

December 19, 1977

Colonel Daniel D. Ludwig, District Engineer
Buffalo District, Corps of Engineers
1776 Niagara Street
Buffalo, New York 14207

Dear Colonel Ludwig:

The Regional Planning Board is happy to assist you in identifying the needs, problems, and opportunities of the water and related land resources of the St. Lawrence River Valley.

While many needs, problems, and opportunities can be easily identified by those concerned with this Region, it must be stressed that there my be many others. However, the absence of comprehensive baseline data on natural, economic, and social systems extant in the Valley forces us to recommend that no new program of navigation improvements should proceed without having conducted and evaluated such studies as would yield this comprehensive data.

The Board's resolution #139, passed 20 October 1976, although directed specifically at the extension of the navigation season, is applicable in more general ways. The text follows:

"WHEREAS the several possible methods for extending the navigation season on the St. Lawrence are unknown as to their effects upon the natural, social, and economic systems which operate upon the river and;

"WHEREAS basic data upon which decisions may be founded regarding these possible effects are to a large extent not available;

"THEREFORE the Black River-St. Lawrence Regional Planning Board considers that a program of studies similar in magnitude to that proposed "Ecological Studies for Navigation Season Extension on the St. Lawrence River, 1976," by the U.S. Fish and Wildlife Service should be carried out before actions are taken to lengthen the Seaway navigation season. The Board further recommends that these studies consider St. Lawrence River in its Regional setting."

The Regional Planning Board stands ready to participate fully in developing the Plan of Study for the St. Lawrence Seaway. The Board has developed data on many of the general areas of consideration. It has also produced a regional land use plan, and Jefferson and St. Lawrence Counties have also produced land use plans. The Board is presently involved in working with the State of New York on developing a 208 Water Quality Management plan and a Coastal Zone Management plan.

We look forward to working with the Corps on this project.

Sincerely,

Arthur C. Mengel
Executive Secretary

ACM/gic

ST. LAWRENCE-EASTERN ONTARIO COMMISSION
317 WASHINGTON ST., WATERTOWN, N. Y. 13601
PHONE (315) 782 0100
EXTENSION 2634

CHARLES W. KELLY, Chairman   WILLIAM E. TYSON, Executive Director

December 23, 1977

Colonel Daniel D. Ludwig
District Engineer
US Army Corps of Engineers
Buffalo District
1776 Niagara Street
Buffalo, NY 14207

Dear Colonel Ludwig:

With regards to the Plan of Study for the St. Lawrence Seaway - Additional Locks Study, the Commission has several concerns. A portion of these concerns are being addressed by efforts undertaken due to season extension activities.

The major concerns are:

Recreation - What will be the impact of additional traffic on recreational boating? In order to address this, projections of size, number and time of the year additional commercial traffic will transit the Seaway are needed.

Water Quality - What will be the change in likelihood of a spill of oil or other hazardous material occurring as the number of ships using the Seaway increases? In conjunction with this is the question of changes in policies and procedures regarding the clean-up of spills that emphasizes prevention more than clean-up.

Shore Erosion - What will be the impact of additional traffic on those river areas where active erosion is currently occurring?

Regarding erosion the Commission has recently completed a study for the St. Lawrence Seaway Development Corporation entitled "Evaluation of Shore Structures and Shore Erodibility: St. Lawrence River, New York State" as part of the efforts related to extension of the navigation season. This report identifies areas of active erosion along the Seaway and develops a soil erodibility potential factor for the entire shoreline. This factor is based upon soil type, slope and vegetative cover. The report is currently being printed. I will forward a copy to Mr. Vogt when it becomes available.

Refinement of the first year's work and continued monitoring of shore profiles is currently underway under an additional grant from the SLSDC. This work will continue through June 1978.

Colonel Daniel D. Ludwig
Page Two
December 23, 1977

Based upon our knowledge of the area it is felt that summer recreation is currently and is expected to continue to be one of the mainstays of the economy of the area bordering the Seaway. This recreation is water oriented with over 85 percent of the seasonal property owners and over 48 percent of transients (campers, vacationers, etc.) reporting, in a Commission survey, that they boated. Thus the identification of impacts of additional commercial vessels are felt to be required.

Hopefully these comments will be useful in your efforts. If I or my staff can be of assistance, please contact me.

Sincerely,

William E. Tyson
Executive Director

ab

POWER AUTHORITY OF THE STATE OF NEW YORK
10 COLUMBUS CIRCLE   NEW YORK, N. Y. 10019
(212) 397-6200

December 27, 1977

Colonel Daniel Ludwig
Buffalo District, Corps of Engineers
1776 Niagara Street
Buffalo, New York 14207

Dear Colonel Ludwig:

I regret the delay in answering your letter of July 22, 1977 relative to the study of additional locks in the U.S. section of the St. Lawrence River. Apparently we never received the letter.

The Authority has a vital interest in your study and welcomes the opportunity to participate. Robert Conner, Resident Manager of the Moses Power Dam is designated the Authority's contact for the studies.

It seems likely that additional locks on the Seaway system in the International Section of the St. Lawrence will increase water usage through the navigation facilities with a concomitant reduction of water available for power generation. This could adversely affect the Authority's ability to meet its firm power contractual commitments.

The Moses Power Dam has a rated capacity of 812,000 kW and during 1976, produced 7,513,000,000 kWhrs of low cost energy which flowed to three large industrial plants at Massena as well as to 19 municipal and cooperative systems, the State of Vermont, the Plattsburgh Air Force Base, and two New York State private utilities.

Additional hydroelectric development in the International Section of the St. Lawrence does not appear economically feasible; the St. Lawrence Power Project develops nearly 90% of the available head between Lake Ontario and the International Boundary. Thus, it is vital that additional navigation facilities minimize water usage so as to cause the smallest possible reduction in power generation.

Please contact Mr. Conner as you require additional information.

Very truly yours,

George T. Berry

George T. Berry
General Manager

SEAWAY PILOT, INC.
POST OFFICE BOX 274
CAPE VINCENT, NEW YORK 13618

3 January 1978

Col. Daniel D. Ludwig
District Engineer
U.S. Army Engineer District
1776 Niagara Street
Buffalo,New York 14207

Dear Col. Ludwig,

Due to a very busy year, and a change of command in this office, your letters of 4 Aug 77 and 7 Dec 77 are being answered now.

We are willing to participate in the St. Lawrence Seaway Additional locks study, and have some ideas that would make vessel transit not only quicker, but safer, regardless of weather conditions.

I have no knowledge of the inclusive dates of this study,but until the first of April most of our members are widely scattered and not at home, however, once some dates are known, either myself here at Clayton, N.Y. or Captain Richard Paytosh in Massena, N.Y. will make ourselves available to meet with you or your team.

I was elected president of our group at our last meeting, and as such will be operating out of my office here in Clayton, rather than Cape Vincent.

Hoping to be of further assistance, I remain,

Sincerely yours,

Philip C. Barnes

Philip C. Barnes, President
St.Lawrence Seaway Pilots Assoc.

North Shore Drive
Clayton, N.Y. 13624

Tel: 315-686-3728

New York State Department of Environmental Conservation
50 Wolf Road, Albany, New York 12233

Peter A. A. Berle,
Commissioner

January 5, 1978

Colonel Daniel D. Ludwig
Corps of Engineers, District Engineer
Buffalo District
Department of the Army
1776 Niagara Street
Buffalo, New York 14207

Dear Colonel Ludwig:

I write in connection with your letter of December 12, 1977 concerning the Corps of Engineers' Additional Locks Study of the St. Lawrence Seaway. We appreciate your request for assistance in the development of a plan of study.

There are a multiplicity of ongoing investigations which could affect the St. Lawrence River area. As you know, these include the Corps of Engineers' Winter Navigation Season Extension Study, the IJC Board Study on Lake Erie Regulation, and the IJC Board Study of Diversions and Consumptive uses in the Great Lakes Basin. We are concerned with any potential duplication in these studies. Therefore, there is a need for close coordination and continuity of effort.

We realize that the Additional Locks Study is necessary to determine the need for locks to meet increase seaway vessel transit capacity and to address winter navigation season extension requirements. However, the study should include a thorough assessment of environmental effects, both of direct and indirect consequence. Many of these effects could have major environmental significance.

We recommend that the plan of study for the Additional Locks Study consider the elements of the environmental plan of study developed in connection with the Winter Navigation Study. Also, the following environmental impact assessments should be identified as plan of study problems and needs, requiring complete study plan evaluation.

1. Effects of dredging, disposal, and spoils on water quality and turbidity;

2. Effects of vessel traffic and other navigation activities on shorelines, and subsequently on fish and wildlife habitats;

3. Effects of turbidity resulting from vessel traffic and navigation activity on aquatic faunal communities;

4. Effects of shore and deepwater erosion on aquatic floral and faunal communities;

5. Effects of water level changes on the aquatic and terrestrial habitats;

6. Effects of navigation on deepwater habitats;

7. Effects of vessel traffic on unique benthic habitats,

8. Effects of vessel tracks and ice suppressors on terrestrial wildlife and waterfowl migration and their utilization of navigation routes;

9. Effects of vessel traffic on fish utilization of navigation channels;

10. Effects of noise resulting from vessel traffic through ice on the aquatic fauna;

11. Effects of winter traffic on behavioral patterns of fish;

12. Effects on recreational user patterns: e.g., winter ice fishing;

13. Effects of oil and toxic substance vessel spills; and

14. The determination of any significant habitat in the area which require inventory and investigation.

Sincerely,

J. A. Finck

John A. Finck
New York State DEC
Representative on St. Lawrence
Seaway-Additional Locks Study

THOUSAND ISLANDS STATE PARK & RECREATION COMMISSION Keewaydin State Park, Alexandria Bay, New York 13607 315 482-2593

Harvey P. Branche, Commission Chairman
Charles J. Elliott, Regional Administrator

January 6, 1978

Mr. Daniel D. Ludwig, PE
Colonel, Corps of Engineers
District Engineer
Department of the Army
1776 Niagara Street
Buffalo, New York 14207

Dear Sir:

Thank you for the opportunity to participate in the study plan for additional locks for the St. Lawrence Seaway. I am extremely interested in the future plans of the St. Lawrence Valley. I have discussed this matter with Ivan Vamos and his shop is better equipped to furnish you with facts and figures on use data and projections. My input will be more descriptive with opinions.

The St. Lawrence Valley is a sparsely populated area. It is an area where the majority of patrons travel great distances to recreate and stay for periods of time ranging from a weekend camping experience to months in cottages or summer homes. The main attraction to the area is the scenic beauty of the river shoreline and uncrowded land area. The main recreation for those who use the area is camping, swimming, boating and fishing. Our main concerns are the maintenance of water quality, the integrity of the shoreline, the water level of Lake Ontario and fish and wildlife resources.

Since the recreationist comes from afar, tourism has become the major industry along the river. The impact on communities which depend upon the economic support from recreation must be considered. The seaway has not proved economically beneficial to the St. Lawrence River area. The area residents look at the maintenance of recreation as much more important than seaway traffic and must be assured that any change in the seaway use will not destroy the attraction to the area.

Winter recreation is growing along the St. Lawrence Valley. The present increase is small in numbers now but high in percentage. The main reason is that local communities are becoming interested in attracting tourists for longer seasons and we are opening more of our parks for winter use. We have excellent climate and facilities for ice fishing, snowmobiling and cross country skiing. In the fall, we have waterfowl hunting. In the spring, we have excellent fishing.

I worked with the U.S. Department of Interior on the recreation portion for the F.Y. 1976, "Demonstration Program Studies for Navigation Season Extension on the St. Lawrence River." Study requirements in order to provide information that will enable proper evaluation of recreational impact due to seaway changes, were carefully thought out. I believe these studies must be done before any major construction on the river is started. The studies we requested are important no matter what type of development is planned.

We found there was not enough base information to properly evaluate a change that would occur if any new development was proposed. Recently, we have discovered that seemingly unconnected programs result in disastrous consequences to the recreation industry years later. The lack of information is because recreation is the economy of the area and facilities are owned and operated by many private, as well as public concerns.

Instead of making fragmented studies, which many times overlap and most often do not wholly answer the questions, I feel we should make an all inclusive study where any future programs could be easily plugged in with little additional cost.

The 1976 study was never completed and I would like to see the Corps continue in this direction. If you do not have a copy of our findings, I would be very happy to supply you with one.

You now have a visitor center at the locks which is a great recreation attraction. I would like to see a facility added to this visitor center which would describe the river, its history and the seaway.

Specific problems that come to mind are the shore erosin in the Lake St. Lawrence area and the wave action on our floating breakwall at the entrance to Keewaydin Marina. There is the potential damage of oil spills or toxic materials from ship accidents. Some changes of erosin patterns may result requiring beach replenishment or shore protection work in our parks.

There will be increased demands for camping and boating in the future. The major increase will be in the Alexandria Bay area and will be provided for at Wellesley Island State Park and private sites. We also have properties at Jacques Cartier and Robert Moses State Parks available for future expansion.

Studies show a continued interest and expansion for boating facilities. There is an increased demand for sailing vessels in the Clayton-Cape Vincent area. This increase will call for changes in our harbor facilities.

The St. Lawrence River is one of the few large bodies of water which has space left for boats 30 ft. and larger. Right now, we lack overnight mooring space or places for boaters to go once they leave their home dock. We now have land on Croil Island, Gallop Island, Cedar Island, Mary Island, Rock Island and Grindstone Island that would provide for existing and future needs.

Department of the Army
Corps of Engineers
January 6, 1978
Page Three

For your use, I am enclosing a copy of the Thousand Islands State Park and Recreation Commission park facilities acreage and attendance charts. I have marked in red the parks that are along the St. Lawrence River. I am also enclosing a map of the region that will show you the location of the parks.

Please advise me if I can be of further assistance.

Yours very truly,

Charles J. Elliott
Regional Administrator
for Parks and Recreation

CJE/ss

Enclosures

cc: Ivan Vamos

CAPT L. A. GILBERT
— Grand Treasurer —
Riverside Drive
Ogdensburg, N. Y. 13669

Grand Lodge
International Ship Masters' Association
of the Great Lakes

Office of the Grand Treasurer

February 7, 1978

Daniel D. Ludwig, P.E.
Colonel, Corps of Engineers
District Engineer
Buffalo District, Corps of Engineers
1776 Niagara Street
Buffalo, New York 14207

Dear Colonel Ludwig:

Thank you for your letter of December 9th. I must apologize for not answering it sooner.

Your letter was of such scope and magnitude that I felt I would sound out the views of the men in the Marine industry before answering.

Mr. Frank A. Augsbury, Jr. of Ogdensburg was most helpful with his background and knowledge of the Marine industry. We came up with the following thoughts for the future Seaway:

1. A realistic toll structure on the Seaway which would encourage additional tonnage movements of all types of cargo throughout the system in the Atlantic Ocean through the Great Lakes both now and in the future.
2. An extended season for winter navigation in order to accommodate vessels for Seaway transit on a $10 million a year schedule.
3. An accommodation with Great Lakes pilots in both the United States and Canada so that undue delays, our lack of pilots, and other contributing factors do not augur against vessel companies' use of the Seaway.
4. Eventually, construction of new locks throughout the Seaway system which would accommodate vessels 1,000 feet long similar to the Poe Lock at Sault Ste. Marie.
5. Broadening of the Welland Canal for two way traffic throughout the entire system at the Welland.
6. Aids to navigation throughout the Seaway system which would avoid dangerous areas such as in the Brockville Narrows, the Alexandria Bay international section, Detroit River, and St. Mary's River.

Enclosed is a copy of an article from the Montreal Gazette dated October 27, 1977 entitled "Shipper urges deepening of St. Lawrence River".

Also, I am enclosing a copy of an article from the Wall Street Journal dated November 7, 1977 entitled "LTV and Lukes Plan to Merge, but Getting Approval of Antitrust Division, Lenders Will Be Delicate Task".

I hope these recommendations will be of some help and value to you in your future planning. Please feel free to contact me at any time for any assistance you may need.

Very truly yours,

L A Gilbert

L. A. Gilbert

Enclosures

LAKE CARRIERS' ASSOCIATION
ROCKEFELLER BUILDING
CLEVELAND, OHIO 44113
(216) 621 1107

April 7, 1978

Colonel Daniel D. Ludwig
District Engineer
U. S. Army Corps of Engineers
1776 Niagara Street
Buffalo, N. Y. 14207

Subject: St. Lawrence Seaway Study

Dear Colonel Ludwig:

We endorse the proposal to twin the Seaway locks. Presumably the twinned locks would be sized in relation to the optimum vessel size concluded from the harbors and connecting channel study being separately undertaken.

That sizing will not only provide the insurance of a second means of transit, but will increase capacity of the system, permit larger vessels to transit, including the new and larger vessels built and being built to make up the U. S. lake fleet.

Such twinning will have favorable economic as well as national defense implications, providing better access to Quebec and Labrador ore.

Along with the study on twinning we recommend continued efforts to improve productivity with the present facilities to which operations will be restricted for the many inevitable years before twinning can be achieved, such as:

(1) Extend the length of the tie-up walls so vessels can be secured to the lock wall and ready to proceed immediately when the lock opens rather than having to hold in channels in varying weather and current conditions.

(2) Straighten channels where appropriate to minimize maneuvering and speed flow of traffic.

(3) Continue efforts to extend Seaway navigation season.

(4) Continue efforts to provide precise navigation capability.

(5) Bring toll procedures to the attention of the National Transportation Policy Study Commission with a view towards integration into national policy that may evolve from its study and recommendations.

Sincerely,

Paul E. Trimble

Paul E. Trimble
Vice Admiral USCG (Ret.)
President

UNITED STATES
DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
100 Grange Place
Room 202
Cortland, New York 13045

May 12, 1978

Colonel Daniel D. Ludwig
District Engineer
Buffalo District, Corps of Engineers
1776 Niagara Street
Buffalo, New York 14207

Dear Colonel Ludwig:

This letter is to aid you in your planning for the feasibility study of Additional Locks and Other Navigation Improvements in the St. Lawrence Seaway, New York. This study was authorized by the resolution on June 15, 1966 of the Committee on Public Works of the United States Senate. This letter is provided to assist you in the feasibility study and is not the report of the Fish and Wildlife Service under the authority of Section 2 (b) of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et seq.).

Past correspondence from this office provided you with input for the development of the Plan of Study in the form of a letter dated November 19, 1976. At that time we expressed our concern regarding the need for comprehensive river-wide studies on the St. Lawrence River in order to accurately assess the environmental impacts of the project.

Since then, an extensive environmental planning effort has been performed as a part of the Great Lakes-St. Lawrence Seaway Navigation Season Extension Program to develop an Environmental Plan of Study for the entire Great Lakes system of which the St. Lawrence River portion is directly relevant to the Additional Locks and Other Navigation Improvements Study. The goal of the Environmental Plan of Study as directed by the Winter Navigation Board has been to develop a program of investigations which will determine the potential effects of proposed navigation season extension. The planning effort for the Lake Ontario-St. Lawrence River sub-basin was carried out by an Environmental Planning Team comprised of professionals from several federal, state, and regional agencies.

The efforts of this team have provided significant progress toward the development of a detailed program of investigations, including a series of baseline data studies. These baseline studies are listed in the March 1978, Interim Environmental Plan of Study submitted to the Winter Navigation Board. These studies will be analyzed in an ongoing process to insure that the individual study components will satisfy the needs of the Additional Locks and Other Navigation Improvements Feasibility Study. It should be noted that these studies are not as much a part of the Winter Navigation effort or the Additional Locks effort as they are a requirement for any major modification in the St. Lawrence River environment. This requirement will continue until the baseline data and other investigations, necessary to provide the required information for all initial planning studies, are acquired and analyzed and used to prepare impact assessments. These assessments, by federal water resource development planning standards, should be done before feasibility determinations and recommendations for construction are sent to Congress.

The Additional Locks and Other Navigation Improvements Study is no exception. Major federal actions being considered as a part of the study include the following:

1. Dredging of the present 27 foot navigation channel to 36 feet would occur. This would involve over 10 miles of channel in more than 30 reaches throughout the St. Lawrence River.

2. Concurrently, disposal of the resulting dredged material would be necessary. At least 10 million cubic yards would be involved.

3. Construction of new locks would be undertaken. This would involve the removal and disposal of millions of cubic yards of material from more than 1000 acres of existing forests, fields, wetlands, and river area.

   There are two alternative proposals under consideration. The first proposal is to build two twin locks of an expanded size parallel to and to the south of the Eisenhower and Snell Locks. This alternative includes modification of the channel between the locks, increasing its width by cutting and dredging along the southern edge of the Wiley Dondero Canal. Over 10 million cubic yards of material would require dredging and disposal.

   The second proposal is to construct a new canal parallel to and north of the Grass River. It would join the existing canal west of the Eisenhower Lock and east of the Snell Lock. The canal would contain one or two new locks. Over 30 million cubic yards of material would require dredging and disposal for this alternative.

4. An increase in the size of ships is contemplated which would necessitate channel widening. This would involve excavation along 20 miles of the river in over 22 reaches from Cape Vincent, New York to the Canadian Border.

5. All these actions would serve to provide for an increase in the navigational capacity and use of the St. Lawrence River, which has a history of navigation disasters. An example is the 300,000 gallon oil spill of 1976.

A variety of other federal planning efforts are in progress on the St. Lawrence River. Active studies include this effort, the Navigation Season Extension Study, the Maximum Vessel Size Study, and the Lake Erie Water Levels Regulation Study which is also addressing the St. Lawrence River. These efforts are often confused and at times it is difficult to separate the elements of one from the others. Because of the complexities of each study, it is also difficult to know how the studies are related.

Table 1 lists several major federal actions being considered by the various studies. Two common threads seem to run through all the efforts listed. Each deals with the Great Lakes and each is related in some way to navigation. Overlap is apparent both in what is being studied and what plans are being considered. One additional study conducted by the North Central Division Office of the Corps of Engineers in Chicago is often cited by each of the others as providing the basic economic information considered in each study. This study, The Great Lakes-St. Lawrence River Navigation Systems Study, may be useful in relating the efforts and in helping to explain the apparent duplication of efforts. This data and the results of this study should be released in a report for review by other agencies and the public to help clarify matters.

As has been discussed, the magnitude of the federal actions being contemplated is great enough to warrant detailed environmental studies and impact assessments in advance of feasibility decision-making by construction agencies. Although the winter navigation effort is presently working on the environmental studies, all the other study efforts should be vigilant to support timely and well-funded studies, thereby avoiding further possible study delays. Continuity in the baseline environmental studies is also extremely important and a break in environmental sampling programs during any one year could result in another year's delay.

The remainder of this letter contains a summary of the ecological resources of the St. Lawrence River, a discussion of the potential environmental impacts of the two lock alignment alternatives, some future study considerations, and our comments on the Preliminary Draft Plan of Study, January 1978, forwarded to us by Mr. Liddell's letter of February 9, 1978.

TABLE 1 - Major Federal Actions Being Considered for the St. Lawrence River by More than One Ongoing Planning Effort

Major Federal Actions Being Considered for the St. Lawrence River	St. Lawrence River Ongoing Planning Efforts: Additional Locks Study	Water Levels Regulation Study	Navigation Season Extension Study	Maximum Vessel-Size Study
Water Levels and Flow Changes	X	X	X	X
River Dredging	X	X	X	X
Dredge Disposal	X	X	X	X
New Lock Construction	X		X	X
Existing Lock Improvement	X		X	
Fixed Navigation Aids	X		X	
Ice Control Structures		X	X	
Increased Ship Size	X		X	X
Increased Navigation	X		X	X
Shoreline Alterations	X	X	X	X

(X) - Action to be considered

The Ecological Resources of the St. Lawrence River

The St. Lawrence River may be described as vast, unique, and complex with regard to its ecosystem. Its length is over 600 miles, making it the longest east-west river on the North American continent. The 125 miles of river which lie in the United States provide significantly diverse habitats to support a large and interdependent array of fish and wildlife.

Despite the critical importance of this biotic system, biological data on the area are lacking. In the past, sporadic studies were undertaken on various aspects of the system. These were limited in scope, however, and only provide preliminary taxonomic reference. In 1976, preliminary studies were initiated by a team of scientists to gather data and to lay a foundation for important future ecological studies. Much more information is needed, though, to begin an understanding of the river's complex biotic system.

A multitude of physical, chemical and biological components interact to produce the biotic system of the river. In addition to identification of the components, a thorough understanding of the interrelationship between constituents is essential. In a system so large and diverse, a change affecting one component may have a magnifying effect on numerous other constituents. This may be illustrated by a discussion of the terrestrial-riverine and aquatic biotic components of the river system.

Terrestrial-Riverine Components

The terrestrial-riverine components of the system are dependent upon the vegetation of the area. Plants are the primary producers in the complex food webs, without which wildlife could not exist. In addition to providing food, plants also furnish essential habitat for cover and nesting. It is the distribution and composition of plant communities which largely influences the distribution of wildlife.

Vegetation along the St. Lawrence River may be broadly broken into three categories: upland, wetland, and deepwater. Delineation is difficult due to the continuum aspect of environmental factors and species composition.

According to studies by Geis and Luscomb (1972), successional fields comprised 22% of the shoreline area in Jefferson and St. Lawrence Counties. Forests, though usually disturbed, comprised 10% of the area in Jefferson County and 23% in St. Lawrence County. Plant communities considered much more fragile occurred on rock outcrops and wetlands, in 13.2% and 40% of the area, respectively.

Recent studies have been conducted in the area in relation to plant community composition (Geis and Kee, 1976; Geis et al, 1976), however, less data exist on the effects on communities of changes in environmental factors. Gilman (1976) noted that water regime was the most important factor regulating the occurrence of wetland communities along Lake Ontario. Other factors, including siltation, water quality, wave action and turbidity, have not been thoroughly addressed.

Some habitats, such as wetlands, may be more productive than others. Distribution and composition of vegetation should be correlated with productivity and corresponding value to wildlife.

Insects have been, perhaps, the most ignored aspect of study along the river. Only preliminary data from a study by Kurczewski et al (1976), exist for the river system. This was largely a taxonomic survey. Information regarding the effects of environmental change (e.g. changing vegetational composition, water level, temperature, siltation) on insect populations is lacking. Results of these changes should also be addressed in relation to the role of insects in food webs.

Little information also exists concerning the reptiles and amphibians of the St. Lawrence. A taxonomic survey by Alexander (1976) identified 22 species as present. An additional 12 species, not observed during the limited study, were also deemed likely to occur.

Due to reptile and amphibian dependence on the water-land interface, environmental modifications of the river could have drastic effects on herptile populations. Effects of disruptive changes such as pollution, dredging and filling, and water level fluctuations cannot be predicted with present data. Distribution of herptile populations should also be known to enable identification of habitat vital to continuance of this component of the food web.

The avian population of the St. Lawrence River is diverse. Over 260 species are present, with numbers rising during migration and decreasing during breeding and winter seasons (Maxwell and Smith, 1976).

The St. Lawrence River provides a path for a large number of migrants whose distributions vary from South America to the Arctic. Environmental modifications which would disrupt this migratory path could have far-reaching effects on the avian populations of the hemisphere.

The shoals and islands of the river provide vital nesting areas for gulls and terns. This group is so closely tied to the river that any changes in the environment due to development may have severe effects on some species.

There is great diversity among the mammals of the river region. Herbivores, insectivores, carnivores, and omnivores are all present. For discussion purposes, an arbitrary categorization into two subgroups, small mammals and large mammals, has been made.

Small mammals, including chiropterans (bats), insectivores (moles and shrews), and smaller rodents (mice and voles), are essential to the food web yet little data exist to designate the most productive areas for these populations. Some geographical and vegetational areas of the St. Lawrence River may be of more importance in the production of small mammals, hence, these areas may be of greater importance in the maintenance of the food web. Environmental manipulations affecting these highly productive areas could have farther-reaching biotic effects than changes in other less productive areas.

A recent survey of the large mammals of the river revealed that of the 34 species of mammals listed for the northeastern region of the United States, 10 have been extirpated or occur rarely in the St. Lawrence River region. Only six of the 34 are considered abundant throughout the region (VanDruff and Wright, 1976). Taxonomic surveys exist, but ecological data from the area are lacking. Despite their importance to regional trappers, there is limited quantitative regional data on the furbearers.

A majority of the large mammal populations depend upon or prefer river or wetland habitats. Species include white-tail deer, coyote, red fox, striped skunk, snowshoe hare, cottontail rabbit, woodchuck and the various furbearers including muskrat, mink, beaver, otter, and raccoon. Degradation of the river and wetlands could change these populations either by direct habitat reduction or indirect reduction of viable food populations. Analysis of the effects of environmental manipulation of the river could not be accomplished on the basis of available information concerning species distribution and habitat utilization.

The Endangered Species Act of 1973, Public Law 93-205, as amended, lists the following species as endangered which are found in the St. Lawrence-Eastern Ontario region:

1) Bald eagle (Haliaeetus leucocephalus)
2) American peregrine falcon (Falco peregrinus)
3) Indiana bat (Myotis sodalis)

New York State has also published a list of protected plant species (Section 193.3, Environmental Conservation Law Section 9-1503). Inventories of the aquatic and emergent plant species in the study area are not available.

Plans derived from studies of the natural resources of the region should consider the maintenance of rare and endangered species as one of the priorities. As a first step the area should be inventoried to see which endangered, threatened, or rare species are present.

Aquatic Components

Primary producers in the aquatic ecosystem are phytoplankton, periphyton, and aquatic macrophytes. These form the basis for the remainder of the complex food web. Modification in the primary producer populations, in terms of distribution and abundance, have a resulting system-wide effect on higher trophic levels. The dynamics of this system-wide ecology cannot be overemphasized.

Preliminary limnological studies of the river were conducted by Mills and Forney (1976). Phytoplankton was found to be most diverse and abundant closer to the river's origin at Lake Ontario. Lowest biomass was observed under ice cover and during mid to late summer, while depth distribution of productivity was determined by available light. One hundred algal forms were noted.

A seasonal change in the abundance of secondary producers, zooplankton, was observed by Mills and Forney (1977). Eighty percent of the winter population consisted of cyclopods. Rotifers predominated from ice-out to early June. Cyclopoid copepods then became most abundant, while in July, cladocerans were predominant. It is not known how this seasonal fluctuation is related to the feeding ecology of fish. Questions such as how a modified environment would affect primary and secondary producers and how these results would affect fish populations do not have answers at this time.

Since fish are dependent upon the primary and secondary producers of the river, it follows that an understanding of the feeding ecology of fish is necessary to relate limnological distribution to fish distribution. Rate of growth and the ultimate size of fish, also, is dependent upon fish diet (Ringler, 1976). Limited research has been done in this area.

The mortality rate is high for larval fish. Modifications of the environment could significantly alter fish populations if susceptible larval populations were disturbed. Distribution of larval fish populations in the river is not known. Preliminary study by Werner (1976) did report, however, that in the open river, alewife comprised almost 94% of larval fish catch. Studies are required to understand the role of larval fish in the ecosystem.

Species composition of adult fish in the St. Lawrence River has been documented due to the fisheries' recreational and economic value (Werner and Ford, 1972; Mills and Forney, 1976). The effects of environmental manipulation on fish populations, however, has not been studied. A statement from New York State Department of Environmental Conservation (1976) exemplifies this:

> "The fisheries resources of the St. Lawrence River have been subject to a number of serious stresses in the last 50 years...Surprisingly, the fish stocks of the river have never been studied properly and the significance of these past and any future environmental stresses is unknown."

The system-wide ecology of the St. Lawrence River is complex in its entirety. The consequences of any environmental change in the river are variable since the components of the ecosystem are likewise variable in distribution, abundance, and in roles in the food web. The functional roles of the components are as important to the ecosystem as the individual components themselves.

Discussion of the ecological value of the St. Lawrence River is not complete without mention of the recreational opportunities that are thereby generated. It is the natural setting and the quality of the environment which attracts tourists and sport enthusiasts to the river. Although studies have not been conducted to determine user-days or regional economic impact of recreation, it is estimated that the river provides millions of recreation days annually (Fish and Wildlife Service, 1976 - Ecological Studies for Navigation Season Extension). The recreational aspect of the river supports 12 state parks, numerous resorts and a multitude of hotel-motels, camping facilities and seasonal homes.

Studies of fishing and hunting use along the river are also unavailable. In a state-wide pilot study by Brown (1976), however, there were 596,000 angler days on the river in 1973. The St. Lawrence River ranks first of all New York State waterways for total harvest of largemouth bass, northern pike, and muskellunge. It ranks second for smallmouth bass, panfish, and bullheads.

The economic impact of fisheries is substantial. During 1973, anglers in the river region spent an estimated $4.9 million in fishing and related expenditures, $2.0 million in related travel expenditure, and an additional $5.0 million in the purchase of major equipment (Brown, 1976).

Total use by hunters and trappers of the area is not known. New York State Department of Environmental Conservation waterfowl checks for 1973 showed 4,378 hunters harvested 3,816 waterfowl in the Wilson Hill, Perch River Wildlife Management Area and other State lands along the river.

With increases in pollution and decreases in fish and wildlife habitat, recreational value and its associated economic value could suffer as recreational and related economic values are closely tied to the ecological and environmental quality and character of the river. Changes which affect biological aspects of the river are relayed to the dependent recreational and economic aspects.

The majority of vegetation within the area of the additional locks portion of the study is composed of disturbed communities. Successional fields (ranging from grassland to shrubland) and agricultural lands comprise most of the area. Deciduous forests and wetlands are present to a lesser extent.

Potential Environmental Impacts of Additional Locks

The twin locks proposal would largely involve removal or disturbance of successional fields. A cattail (*Typha*) dominated wetland, located east of the Eisenhower Lock, would also be disrupted. Similarly the deciduous forest areas interspersed along the length of the channel would be removed or disturbed. Portions of the river bottom would be disturbed by dredging. A detailed description of the fish and wildlife of the site is not available.

The new lock and channel proposal would largely involve destruction of agricultural land and successional fields. In addition, deciduous forest east of Robinson Creek would be removed and portions of the Grass River, Robinson Creek, and the St. Lawrence River would be dredged. Biological data concerning this proposed construction area are lacking.

Our Fish and Wildlife Coordination Act report will be prepared later in the planning process at which time we will provide our formal recommendations. At this time, however, the Fish and Wildlife Service favors the twin locks alternative as opposed to the new lock and canal alternative. This alternative would require much less dredging and spoil disposal.

Additionally, the area which would be impacted by the twin locks alternative is already in navigation use and seems to avoid alteration of more valuable areas. It also avoids alteration of the channel of the Grass River which would involve increased downstream effects.

This suggestion should be used to aid you in your planning and not construed as our acceptance of additional lock construction and associated operational elements.

Future Study Considerations

Site considerations in the Wiley Dondero Canal area are important. The Winter Navigation study effort did not specifically address the site studies that will be needed for this area or downstream areas. A biological survey of the locks area and an aquatic study of the downstream river section will be needed. International coordination on the aquatic study will be needed. Habitat mapping and preliminary field work should begin as soon as possible, probably this summer, to generate information which could guide planning and development of detailed cost estimates. We suggest a meeting to discuss future study plans.

Questions relating to the effects of increasing navigation on the system have also been raised as a part of this study and others. Answers to these questions require information on the effects of present navigation and would benefit from information on the original effects of navigation in the St. Lawrence River. Unfortunately, little information of the effects of the Seaway construction and resulting operations, some of which is similar to what is now being considered, has ever been developed. Detailed biological information is scarce at present for the area and no attempt to develop a pre-Seaway environmental profile has ever been undertaken. An assessment of the effects of increasing navigation will depend on knowledge of the effects of present navigation and will benefit from historical trends.

The following are our comments on Appendix A, Natural Environment, from the Preliminary Draft Plan of Study. We shall address comments on the entire report in future correspondence.

General Comments

A large portion of the Preliminary Draft Plan of Study is devoted to Appendix A, Natural Environment. However, the data from the St. Lawrence River Ecological Study: Biological Characteristics, 1976. U.S.F.W.S., which is often cited, is preliminary. It is designed as a first phase of information which is required for more detailed phases of systemwide analysis. As an example, species are listed but information concerning their distribution, abundance, and habitat requirements is not mentioned. The preliminary nature of the initial biological studies of 1976 was addressed in the Service's letter of February 1, 1977 transmitting the study reports. The letter stated,

> "The need for comprehensive, multi-year studies and the tools to carry out such a task have been described. As is discussed, the information presented is preliminary and the data and findings of these reports are not sufficient to be used as end products either for description of the St. Lawrence River setting, impact assess-

ments, or impact statements for the navigation season extension effort. Aside from the knowledge and findings derived, the effort has been an important and necessary step in the right direction for future studies."

Future efforts involving a systemwide plan of study such as that developed by the Lake Ontario-St. Lawrence River Environmental Planning Team, would provide an approach to necessary project evaluation. It is this goal which should be strived for, an end product which provides description and can easily be translated into an environmental assessment.

Specific Comments

Specific comments are as follows:

Page 26-Vegetation: The discussion of wetland values should be followed by a discussion of physical parameters which affect wetlands (e.g. water level fluctuation, siltation, wave actions, etc.) since the value of the wetland is highly dependent upon such physical parameters.

Pages 63-73-Fishery Resources: The importance of system dynamics should be stressed in this discussion. Analysis of the aquatic food web is necessary for developing an understanding of this ecosystem and how it could be impacted by future modifications.

Page 74-Amphibians and Reptiles: Again, mention of the food web should be made. Distribution and abundance of species is importance in understanding the system. The vulnerability of these biotic components to environmental modifications should also be addressed.

Page 74-Birds: Similar to the preceding comments, distribution and abundance of species should be included along with breeding bird analysis. The St. Lawrence River is highly important to migratory birds and nesting colonies of water birds. The sensitivity of certain avian populations, such as the bald eagle and other raptors to environmental manipulations should be thoroughly explored.

Page 87-Mammals: As with the preceding comments, population dynamics should be included for mammals. Factors such as distribution, abundance, feeding ecology, population movement, and others should all be addressed. Those habitats most valuable to productivity should be ascertained.

Page 89-90-Rare and Endangered Species: The Southern Bald Eagle should now read Bald Eagle according to the February 14, 1978 Federal Register.

Protected plants of New York State should be listed using scientific nomenclature, in addition to common names, to prevent confusion.

An additional comment is that all biotic components of the river system should be addressed in the discussion of the natural environment since all biotic components have the potential to be affected by any environmental modifications. One important component not discussed in this section is the invertebrates. Ongoing studies should be of use in this regard and in general for this section of the report.

We appreciate the opportunity to participate in the planning process and we anticipate a series of future planning aid letters to assist you in this effort.

Sincerely,

John T. Hickey

for Paul P. Hamilton
Field Supervisor

UNITED STATES
DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
100 Grange Place
Room 202
Cortland, New York 13045

June 8, 1978

Colonel Daniel D. Ludwig
District Engineer
Buffalo District, Corps of Engineers
1776 Niagara Street
Buffalo, New York 14207

Dear Colonel Ludwig:

This letter supplements our Planning Aid Letter of May 12, 1978 regarding the feasibility study of Additional Locks and other Navigational Improvements in the St. Lawrence Seaway, New York. In that letter we indicated that the required environmental feasibility studies were being analyzed in an ongoing process to insure that the individual study components would satisfy the needs of your study effort. We are now at the point in this process where we can provide you with a list of the studies which should be included in the Plan of Study and undertaken as part of the total feasibility effort. These study needs have been coordinated with the chairman of the Lake Ontario-St. Lawrence River Environmental Planning Team, the New York State Department of Environmental Conservation, Region 6, Watertown, New York, and with the scientific advisor to the team.

Specific information on the list of studies that follows is available in documents of the Lake Ontario-St. Lawrence River Environmental Planning Team. Cost estimates for the various study components have also been provided as a part of the Lake Ontario-St. Lawrence River planning effort, but were made for both the Lake and River. Cost estimates specific to the River will be developed.

The following environmental investigations should be undertaken:

1. Baseline data collection in the St. Lawrence River; physical characteristics. Duration: 3 years
2. Baseline biological studies along the St. Lawrence River; use of the St. Lawrence River habitats by resident and migratory birds. Duration: 3 years
3. Baseline biological studies along the St. Lawrence River; food chain contribution of the riverine reptiles and amphibians. Duration: 3 years

4. Baseline biological studies along the St. Lawrence River; significance of aquatic insects as food chain components. Duration: 3 years
5. Baseline biological studies at validation sites along the St. Lawrence River; distribution and abundance of benthic invertebrates. Duration: 3 years
6. Baseline biological studies along the St. Lawrence River; the movement and significance of detritus and associated organisms within the river system. Duration: 3 years
7. Baseline biological studies along the St. Lawrence River; characterization of fish stocks and movement throughout the river system. Duration: 3 years
8. Baseline biological studies along the St. Lawrence River; determination of fish feeding ecology. Duration: 3 years
9. Baseline biological studies along the St. Lawrence River; distribution, abundance, and habitat relationships of larval fish. Duration: 3 years
10. Baseline biological studies along the St. Lawrence River; determination of primary and secondary production. Duration: 3 years
11. Baseline biological studies at validation sites along the St. Lawrence River; determination of physical and chemical properties. Duration: 3 years
12. Baseline biological studies at validation sites along the St. Lawrence River; productivity and environmental relationships of aquatic macrophytes in the littoral and wetland habitats. Duration: 3 years
13. Mapping of St. Lawrence River habitats. Duration: 3 years
14. Identification and characterization of critical habitats which may be impacted by additional locks and other navigational improvements. Duration: 2 years
15. Physical, chemical, and biological features of critical channel reaches in the St. Lawrence River. Duration: 3 years
16. Development of a contingency plan to minimize the impact of oil and toxic substances spilled as a result of navigation. Duration: 3 years
17. Coordination and censuses of baseline data to generate an aquatic model for the St. Lawrence River. Duration: 3 years
18. Coordination and censuses of baseline data to generate a terrestrial-riverine model for shoreline communities along the St. Lawrence River. Duration: 3 years
19. Development of a computer-based data storage, geographic indexing, and impact characterization system for the St. Lawrence River. Duration: 3 years

These baseline studies and others in relation to the overall study of the St. Lawrence River ecosystem will involve a dynamic process. As our understanding of the river develops, so may the study orientation. At this time and in anticipation of studies for fiscal year 1979, as was discussed in our letter of May 12, we are examining the need for additional efforts which would help us assess the impact of present and increased navigational use of the St. Lawrence River. Likewise, in this fiscal year there is a need for data collection and preliminary work which anticipates more detailed studies in upcoming fiscal years. FY 78 study work should include preliminary data collection in the area of the Wiley-Dondero Canal and habitat mapping for that reach. In support of many future studies, aerial photography will be needed now for the entire river to allow habitat mapping. A proposal and specifications for such is being coordinated with your District through the Permit Branch in cooperation with the Waterways Experiment Station. Such photography will be useful to the St. Lawrence River environmental study efforts as well as to other ongoing operational efforts such as the Permit Program. Also, information will be needed this year to begin the development of the computer-based data storage and retrieval system to accommodate the collection of data in future studies.

We suggest a meeting between our respective staffs be arranged with a view towards initiating some of these environmental studies and arranging for funding transfers this fiscal year. Since the photography element is still in the preliminary stages with estimates being made by the Waterways Experiment Station, it may be difficult to pinpoint the precise cost of that effort until July 1978. The preliminary field work, habitat mapping, and biological data system should begin as soon as possible.

As we have stated in the past we feel that basic environmental studies are needed to determine the feasibility of all major construction proposals on the St. Lawrence River. We understand your possible plans for phasing the authorization of the Additional Locks and other Channel Modifications effort so as to accommodate, in the event the first phase is found to be justified, an international study effort to examine the total feasibility of the proposed modifications of the St. Lawrence River. We are not prepared at this time to comment on that possibility and will not be until we have enough information to satisfy the needs for complete impact assessment for the river. An international ecological study of the St. Lawrence River in advance of the planning for the projects addressed in our last letter may be a solution to the general lack of data for the St. Lawrence River.

As we have indicated in the study proposals, the level of effort required will entail a large amount of data collection over a three year period and the modeling of the system to facilitate impact assessments. It may still be possible, however, as the study progresses to indicate early in the planning process which possible projects are not acceptable from an environmental standpoint. Such input could be part of the fiscal year 1980 effort when preliminary assessments of alternatives would be useful to the plan formulation process.

We would also like to clarify our understanding of the actions being considered as part of this study as was discussed in our last letter. As a result of coordination with your staff on this project we understand now that it may be possible to twin the existing locks without expanding the size of the Wiley-Dondero Canal. We also understand that were the new canal alignment chosen, you would plan to construct one eighty-six foot lift lock in lieu of two forty-three foot lift locks. A correction to our letter of May 12, 1978 is on page 5, in the last sentence, wetlands constitute 4 percent not 40 percent of the area.

In another note we would like to express our satisfaction with your staff working on this project. At both the public workshops and at our coordination meetings they have displayed highly professional and exemplary performances. They are Mr. Thomas Vogt, Project Engineer, and Mr. Thomas Burke, Project Biologist, and we extend our appreciation to your for their efforts.

Sincerely,

Paul P. Hamilton

Paul P. Hamilton
Field Supervisor

NCBED-PE 5 July 1979

Orin Lehman, Commissioner
State Historic Preservation Officer
Attn: Mr. Bruce Fullem
Division for Historic Preservation
New York State Office of Parks and Recreation
Agency Building No. 1 Empire State Plaza
Albany, NY 12238

Dear Mr. Fullem:

The U.S. Army Engineer District, Buffalo, is undertaking a study to determine the adequacy of the existing locks and channels in the U.S. section of the St. Lawrence Seaway in light of present and future needs, and the advisability of their rehabilitation, enlargement, or augmentation. In order to aid in attaining compliance with Section 106 of the National Historic Preservation Act and Executive Order 11593, we wish to establish coordination between our respective offices regarding this study.

In order to facilitate this coordination, enclosed are a series of USGS 7-1/2 minute quadrangle maps which show the study area. Several of these maps show locations which at this time appear to be the most likely areas where work would take place. If impacts occur outside of areas presently showing work, they will be confined to an area not more than one mile from the river bank. Please review these maps and provide us with information on known cultural resources within the identified areas as well as your comments and recommendations. This information should be sent to the following address:

U.S. Army Engineer District, Buffalo
1776 Niagara Street
Buffalo, NY 14207
Attn: Environmental Resources Section

NCBED-PE
Orin Lehman, Commissioner

If you have any questions regarding this matter, please contact staff archaeologist Richard H. Lewis at (716) 876-5454, ext. 2171.

Thank you for your cooperation.

Sincerely yours,

1 Incl
as stated

DONALD M. LIDDELL
Chief, Engineering Division

CF:
NCBED-PE

Lewis______
Bryniarski____
Bennett______
Karsten______
Kelly______
Gilbert______
Hallock/
Liddell______

NCPED-PE 5 July 1979

Bennie Keel, Chief
Interagency Archaeological Services - Atlanta
Heritage Conservation and Recreation Service
1595 Phoenix Boulevard
Atlanta, GA 30349

Dear Dr. Keel:

The U.S. Army Engineer District, Buffalo, is undertaking a study to determine the adequacy of the existing locks and channels in the U.S. section of the St. Lawrence Seaway in light of present and future needs, and the advisability of their rehabilitation, enlargement, or augmentation. In order to aid in attaining compliance with Section 106 of the National Historic Preservation Act and Executive Order 11593, we wish to establish coordination between our respective offices regarding this study.

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U.S. Army Engineer District, Buffalo
1776 Niagara Street
Buffalo, NY 14207
Attn: Environmental Resources Section

SW/0171

NCBED-PE
Bennie Keel, Chief

If you have any questions regarding this matter, please contact staff archaeologist Richard H. Lewis at (716) 876-5454, ext. 2171.

Thank you for your cooperation.

Sincerely yours,

1 Incl
as stated

DONALD M. LIDDELL
Chief, Engineering Division

CF:
NCBED-PE

Lewis________
Bryniarski_____
Bennett_______
Karsten_______
Kelly________
Gilbert_______
Hallock/
Liddell_______

United States Department of the Interior
HERITAGE CONSERVATION AND RECREATION SERVICE
INTERAGENCY ARCHEOLOGICAL SERVICES-ATLANTA
1895 Phoenix Boulevard
Atlanta, Georgia 30349

IN REPLY REFER TO
740
S7221-IAS-A

JUL 1 5 1979

Mr. Donald M. Liddell
U. S. Army Engineer District, Buffalo
1776 Niagara Street
Buffalo, New York 14207

Attn: Environmental Resources Section

Dear Mr. Liddell:

This is in response to your letter of inquiry requesting information on cultural resources in the U.S. section of the St. Lawrence Seaway.

Our office does not maintain listings of known cultural resources, and therefore, we are unable to provide you with a summary of known significant resources or sensitivity zones within the study area.

As an alternative means of identifying significant cultural resources in the study area, you may wish to contact the New York State Preservation Office. However, given the nature and scope of the proposed project, an inventory of existing data will not be sufficient to adequately assess the distribution of significant cultural resources, and an independent reconnaissance level study should be included in project planning.

The only reference listed in our cultural resources library holdings for the above mentioned area is:

Dekin, Albert A., Jr and Robert L. Ewing
1973 The South Bank of the Saint Lawrence River between Robinson Bay and Pollyp Gut - 1971, 1972 and 1973. The State University of New York College at Potsdam, Report of Archeological Investigations, No. 1 56 pp.

If we can be of any further assistance, please do not hesitate to contact our office.

Sincerely yours,

fn Stephanie H. Rodeffer
Acting Chief

APPENDIX H

PRIOR AND ON-GOING STUDIES AND REPORTS

APPENDIX H

PRIOR AND ON-GOING STUDIES AND REPORTS

Although the following studies and reports may not specifically address the St. Lawrence Seaway, they were found to be pertinent to the conduct of the Additional Locks Study.

PRIOR STUDIES AND REPORTS

St. Lawrence River - Lake Ontario to the Canadian Border. This study by the Corps of Engineers, published as House Document No. 1591, 65th Congress, 3rd Session, dated 16 December 1918, was a preliminary examination of the St. Lawrence River from Lake Ontario to the Canadian border with a view to providing navigation facilities suitable for ocean-going ships. The study recommendation was that much improvements were not deemed advisable at that time.

Joint Study of the Canadian Temporary Great Lakes - Saint Lawrence Basin Committee and the United States St. Lawrence Advisory Committee. This report dated 3 January 1941 served as the reference document for authorization of construction of the existing U.S. navigation development on the St. Lawrence by the 1954 Wiley-Dondero Act, (Public Law 358, 83rd Congress, as amended).

Great Lakes Harbors Study. The final report, dated November 1966, together with 38 interim reports included recommendations that 30 harbors be improved and one harbor be built to provide a 27-foot safe draft depth commensurate with the 27-foot depths provided in the connecting channels, the Welland Canal, and the St. Lawrence River. These reports contain the economic and physical data and analyses used to justify improvements made during the late 1950's and early 1960's.

Great Lakes Basin Framework Study. This study was conducted by the Great Lakes Basin Commission. There are 24 appendices to the Framework Study, each of which describes studies of a specific area associated with economic, social, environmental and physical fields related to the Great Lakes Basin. Appendix C-9 to that report relates to commercial navigation on the Great Lakes.

Origin - Destination Study of Bulk Commodity Movement Upper Great Lakes Region. This study identifies the role of waterborne transportation in making possible unique bulk resource combinations which permit the processing of raw materials and related manufacturing in the upper Great Lakes Region for Great Lakes, national and overseas markets. This report, dated June 1972, was prepared by the North Central Division, U.S. Army Corps of Engineers, under cooperative agreement with the Upper Lakes Regional Commission.

Water Levels on the Great Lakes. Studied the damage resulting from changes in levels of the Great Lakes and the feasibility of regulating the lakes to reduce that damage. Conducted jointly between Canada and the United States for the International Joint Commission.

Survey Report on Great Lakes and St. Lawrence Seaway Navigation Season Extension (Feasibility Study - 1969). This study is a preliminary investigation outlining the existing and prospective commerce and vessel fleet, difficulties attending winter navigation, methodology considered to extend the navigation season, and general costs and benefits derived from winter navigation on the Great Lakes.

Waterways Systems Simulation and Great Lakes Simulation Studies. These studies were completed by the Pennsylvania Transportation and Traffic Safety Center of the Pennsylvania State University under contract with the Corps of Engineers, North Central Division. Computer simulation models were developed to simulate lock operations and vessel traffic. These simulation models provide an analytical tool for determining lock and system capacities and effects of operational changes on the system.

St. Lawrence Seaway System Plan For All-Year Navigation (SPAN). This study was conducted by Arctec, Inc. under contract with the St. Lawrence Seaway Development Corporation, completed February 1974. The report describes a systems analysis of the problems and factors which adversely affect or halt navigation on the St. Lawrence River between Montreal and Lake Ontario during the winter season. The objective of the study was to develop a plan which if implemented would provide cost effectuve navigation of the system in the winter.

Lake Erie - Lake Ontario Waterway. This study investigated the feasibility of constructing an all-American waterway connecting Lake Erie and Lake Ontario. The report provided for five locks and channels to accommodate vessels up to 1,000 feet long and a 105-foot beam.

St. Lawrence - Eastern Ontario Shoreline Study. This study was completed in 1972 by the St. Lawrence - Eastern Ontario Commission. This study of the natural resources of the shoreline provides data and information in a summary report and seven technical reports.

Coastal Resources - Goals and Objectives. This is a volume in a series of technical reports on the coastal zone of Eastern Lake Ontario and the St. Lawrence River, in U.S. territory. It is the first step a process aimed at producing a comprehensive resources development program. Completed by the St. Lawrence - Eastern Ontario Commission, this report identifies specific goals and objectives for the preservation, restoration, and development of the natural, man-made, and social resources of the area.

Ongoing Studies and Reports

Great Lakes Connecting Channels and Harbors Study. This study is being conducted by the Detroit, Corps of Engineers, in conjunction with the St. Lawrence Seaway Additional Locks Study. It is a comprehensive survey scope study with a view to determining the advisability of further improvements in the upper Great Lakes, their connecting channels, and harbors in the interest of present and prospective deep-draft commerce. Together with the Additional Locks Study, optimization of commercial navigation development on the entire Great Lakes - St. Lawrence Seaway system will be accomplished.

Great Lakes - St. Lawrence Seaway Navigation Season Extension Demonstration Program. This program, authorized by Section 107(b) of the River and Harbor Act of 1970 and directed by the "Winter Navigation Board," is aimed at demonstrating the practicability of extending the navigation season on the Great lakes - St. Lawrence Seaway System. Four annual reports displaying the annual activities and achievements since 1971 have been prepared by the Board. A Special Status report on the first three years of the program was sent to Congress in February 1975. Another report on the findings and conclusions of the Demonstration Program through the winter 1975-76 has also been completed and forwarded to Congress. Section 107 of the Water Resources Development Act of 1976 extended the program from 31 December 1976 to 30 September 1979.

Great Lakes - St. Lawrence Seaway Navigation Season Extension Feasibility Study. This study was authorized by Section 107(a) of the River and Harbor Act of 1970 and is also directed by the "Winter Navigation Board." This study is a feasibility level investigation using in part information gathered during the Demonstration Program, will (1) assess the means, practicability, impacts (environmental, social, etc.), economic justification and advisability of a navigation season extension program, (2) determine the economic, environmental and social feasibility of the program, (3) define the extent of Federal participation and (4) if favorable, provide to Congress recommendations to implement a permanent navigation season on the system including any appropriate mitigation measures needed as a result of the program.

Great Lakes - St. Lawrence Seaway Navigation Systems Study. This study is a systems analysis or model whcih, through an iterative process, (1) determines the impact of alternative improvement plans on the demand for both domestic and foreign waterborne commerce during both a normal and extended navigation season, and (2) identifies beneficial and adverse effects on national economic efficiency resulting from each of the alternative improvement plans. In essence it establishes, on a quantitative basis, the role of transportation in the market decision making process as defined through (1) shipper preference interviews, (2) traffic forecasts, (3) transport rate/cost structures, and (4) transport modal advantage including physical system components and technological impacts of competing modes. This computer model consists of four segments: (1) traffic forecast study, (2) rate and cost study, (3) systems interrelationship study, and (4) secondary economic impact analysis.

Lake Erie Regulation Study. This is an International Joint Commission which will investigate the possibilities for limited regulation of Lake Erie. This study will also consider work or other measures which might be required in the International and Canadian reaches of the St. Lawrence River to accommodate flows resulting from the limited regulation of Lake Erie.

This section is not meant to be a listing of all studies concerning the GL/SLS system but only those studies and reports which because of their respective nature or scope have or may represent important sources of input to the study. Other references are listed in APPENDIX J - BIBLIOGRAPHY.

APPENDIX I

STUDY SCHEDULE AND COSTS

DETAILED CPM'S APPEAR IN CORPS OF ENGINEERS COPIES OF THIS REVISED PLAN OF STUDY ONLY.

RCS:

STUDY COST ESTIMATE (PB-6)
($000)
For use of this form, see ER 11-2-220

APPROPRIATION TITLE: General Investigations

CATEGORY: Surveys

CLASS: Navigation

NAME OF STUDY: St. Lawrence Seaway Additional Locks

SUBCLASS:

LINE NO.	SUBACCOUNT NUMBER	SUBACCOUNT TITLE	CURRENT FEDERAL COST ESTIMATE: ACCOUNT STAGE 1	STAGE 2	STAGE 3	TOTAL	PREVIOUS FEDERAL COST ESTIMATE AND DATE APPROVED (Aug 78)	REMARKS
	a	b	c	d	e	f	g	h
1	.00	Costs through 30 Sep 79	993	20	—	1013	1013	
2	.01	Public Involvement		34	44	78	75	
3	.02	Institutional Studies		2	2	4	4	
4	.03	Social Studies		11	47	58	55	
5	.04	Cultural Resource Studies		11	42	53	50	
6	.05	Environmental Studies		105	84	189	180	
7	.06	Fish and Wildlife Studies		137	80	217	217	
8	.07	Economic Studies		122	95	217	206	
9	.08	Surveying and Mapping		4	79	83	75	
10	.09	Hydrology and Hydraulics Inv.		11	11	22	20	
11	.10	Foundation and Materials Inv.		16	11	27	25	
12	.11	Designs and Cost Estimates		88	134	222	212	
13	.12	Real Estate Studies		—	5	5	5	
14	.13	Study Management		28	17	45	43	

DATE PREPARED: 26 Mar 79

DIVISION: North Central

DISTRICT: Buffalo

REGION: Great Lakes

BASIN: Northeastern Lake Ontario – St. Lawrence

RCS:

STUDY COST ESTIMATE (PB-6) ($000) For use of this form, see ER 11-2-220	APPROPRIATION TITLE: General Investigations	NAME OF STUDY: St. Lawrence Seaway Additional Locks
	CATEGORY: Surveys	
	CLASS: Navigation	SUBCLASS:

LINE NO.	SUBACCOUNT		CURRENT FEDERAL COST ESTIMATE				PREVIOUS FEDERAL COST ESTIMATE AND DATE APPROVED	REMARKS
			ACCOUNT			TOTAL	(Aug 78)	
	NUMBER	TITLE	STAGE 1	STAGE 2	STAGE 3			
	a	b	c	d	e	f	g	h
1	.14	Plan Formulation		37	15	52	49	① Change in cost
2	.15	Report Preparation		64	67	131	124	estimate is due
3	.20	Other Studies				0	0	to salary increases.
4								
5								
6								
7	.31	Supervision and Administration		68	81	155	147	
8								
9		TOTAL	993	758	820	2571 ①	2500	
10								
11								
12								
13								
14								

DATE PREPARED	DIVISION / DISTRICT	REGION / BASIN	
26 Mar 79	DIVISION North Central DISTRICT Buffalo	REGION Great Lakes BASIN Northeastern Lake Ontario - St. Lawrence	Page 2 of 2

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APPENDIX J

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BIBLIOGRAPHY

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APPENDIX K

COMMENTS AND RESPONSES

APPENDIX K

ST. LAWRENCE SEAWAY - ADDITIONAL LOCKS

COMMENTS AND RESPONSES

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APPENDIX K

COMMENTS AND RESPONSES

INTRODUCTION

This appendix has been prepared to list and respond to all comments received on the Plan of Study for the SLS-AL Study dated June 1978. This Revised Plan of Study has many of these comments incorporated into it. Other comments are addressed directly in this appendix and where indicated, will be further investigated in the Stage 2 document. Several comments are very similar and the response is addressed to the main theme of such comments.

COMMENTS/RESPONSES

The comments and their individual responses are listed and answered in the approximate order they were received by the Buffalo District, Corps of Engineers. The commenting agency and date of their letter are acknowledged with the individual comments and responses following.

Association of American Railroads - 8/17/78

Comments:

1. ". . . the real need for the project must be determined in the marketplace with Seaway shippers paying all project costs."

". . . recommends the Plan of Study address such fundamental issues as who benefits from the Seaway, who pays for the Seaway, what are the benefits and tolls per ton of traffic by commodity groups, and a separation of costs and benefits between Canada and the United States . . . what level of tolls would make the SLS self-liquidating and what would be the impact of this level of tolls on SLS traffic?"

". . . until a determination is made of tolls required to make the incremental investment self-liquidating, no meaningful estimates can be made of SLS traffic and associated benefits. This applies equally to Canadian investments in the SLS."

"The concept of making all incremental investments in the SLS self-liquidating is in accord with the President's water policy statement."

Response:

Projected traffic increases will be affected by the assumed levels of tolls. Existing levels of tolls at the Seaway locks and Welland Canal will be part of the base case condition. However, since project benefits are calculated on the basis of the "most probable" with and without conditions, alternate levels of tolls will be used in determining the sensitivity of forecasted traffic and benefits.

This procedure is in conformance with the draft of the recent Water Resources Council (WRC) "Manual of Procedures for Evaluating Benefits and Costs of Federal Water Resources Projects" (7 March 1979). Specific reference is directed to Section III-D on user charges which requires sensitivity analysis of two alternative levels of tolls. Average annual benefits will be computed assuming that additional user charges which recover: (1) 50 percent of and, (2) 100 percent of the average annual cost of the improvement under study are in effect.

Comment:

2. ". . . it is essential for the Plan of Study to perform a post evaluation of the existing SLS."

Response:

Additional summary statistics have been added to Appendix C to indicate the changes in vessel sizes used to transport historical tonnages. The period of analysis is about twenty years and summarizes several important changes that have occurred since the opening of the improved Seaway. Rapid changes have already occurred in terms of the types of vessels operating within the system and in terms of their individual carrying capacities and related physical characteristics. At the present time, large vessels are being constructed which are either captive to the Upper Great Lakes or which cannot enter the system at Montreal, Quebec. Subsystem saturation appears likely at the Welland Canal (reference Table 3-2, Chapter 3 "Problems and Needs") in the short-term and at the Soo Locks and St. Lawrence River section over the long-term.

It is generally concluded that the trend of future traffic is rising and will eventually approach the maximum capacity of the other locks and channels. A general discussion on the level of historical utilization for the St. Lawrence Seaway can be found on page C-2 while short terms are summarized on pages C-2 through C-7.

Comment:

3. " . . . the correct measure of navigation benefits, that is, economic efficiency gains, is a comparison of carriers' marginal costs, including the incremental costs of the SLS. A simple comparison of one mode's rates with another mode's costs cannot measure national economic efficiency gains although it may reveal the approximate redistribution of income from alternate modes and the general taxpayers to Seaway shippers.

"The methodology for computing navigation benefits proposed by the Plan of Study can result in overstating benefits and the double counting of benefits. The President's water policy statement clearly attempts to insure that such errors in project evaluation are avoided."

Response:

The benefit evaluation of proposed commercial navigation projects is based upon the legislative requirements presently in effect. Public Law 89-670; 89th Congress, Second Session, Section 7(a) "Transportation Investment Standards" explicitly states that:

> "The primary direct navigation benefits of a water resource project are defined as the product of the savings to shippers using the waterway and the estimated traffic that would use the waterway; where the savings to shippers shall be constructed to mean the difference between (a) the freight rates or charges prevailing at the time of the study for the movement by the alternative means, and (b) those which would be charged on the proposed waterway; and where the estimate of traffic that would use the waterway will be based on such freight rates, taking into account projections of the economic growth of the area . . ."

Pursuant to PL 89-670, each Corps navigation study will include an estimate of savings to shippers via the considered waterway, measured as the product of the estimated waterway traffic and the estimated unit savings to shippers from the movement of that traffic via the waterway. The unit savings will be measured as the difference between the rates shippers are actually paying for transportation at the time of the study and the rates they probably would pay for transportation via the improved waterway. This requirement is also reiterated in Engineering Regulation 1120-2-114 which is the basic guidance for field elements to be used in the evaluation of all Corps navigation improvement studies. The main text and supporting appendicies of each navigation study report will explain clearly the basis and derivation of the rates used in the analysis and the rationale for the division of traffic between the waterway and competing modes.

Power Authority of the State of New York - 8/21/79

Comment:

1. "Appendix D, pg. 47 - It is difficult to preceive that the capacity of the system would be increased proportionately to the additional time available for lockages when referring to season extension. Any extension to the present season would be into the winter months when navigation has traditionally had to terminate operations on the St. Lawrence. Vessel transits during the ice season would involve increased lockage times, in addition to ice breaker assistance."

Response:

The Maximum Ship Size Study (December 1977) was completed at a time when preliminary economic studies for the survey report on season extension required an assessment of the impact of season extension on tonnage throughput at locks and channels. A proportional relationship, initially used for this purpose, was later revised as more information on this subject was developed.

Future economic studies for the Additional Locks Study will attempt to use a more realistic relationship between vessel approach and lock cycle time in those sensitivity studies that will address season extension scenarios as an alternative to structural improvements. The Draft Survey Report on Navigation Season Extension can be consulted for additional information on the relationship between winter operating conditions, lock service times and impact on tonnages expected to benefit from season extension activity in the GL/SLS.

Comment:

2. "Appendix F, pg. F-7, 29 & 32 - Most of the questions raised under the headings of 'Lake and River Levels and Flows' and 'Energy and Power Production' will likely require expansion once assessment takes place."

Response:

These areas will be expanded and undergo further assessment in the PFR, Stage 2 and future levels of the Additional Locks Study.

U. S. Coast Guard - Ninth Coast Guard District - 8/24/78

Comment:

1. ". . . reference on Page 60 of Appendix D to Bridge and Tunnel Estimated Costs appears to be a typographical error. No reference to such costs could be determined from our review of Appendix H."

Response:

The sentence has been removed. It referred to an appendix in the "Maximum Vessel Size Study."

Comment:

2. ". . . request more detailed information concerning any modifications, alterations, or construction planned for the harbor bridge at Duluth, as referenced on Page 60 of Appendix D."

Response:

A letter to North Central Division supplied this information derived under the "Maximum Vessel Size Study."

Comment:

3. "Any bridges crossing navigable waters are under Coast Guard jurisdiction and require a bridge permit."

Response:

The required permits would be applied for as needed.

Conrail - 8/25/78

Comment:

1. "One of the most outstanding flaws in the Plan of Study is that it makes no attempt to outline the potential impact of navigation improvements for the Seaway upon the national transportation system."

Response:

Improving the GL/SLS navigation system may divert traffic away from alternative competing modes or away from the Eastern and Gulf coastal ports toward the Great Lakes. Detroit District, Corps of Engineers, is currently conducting an analysis of the potential impacts of shipping additional tonnage during the extended navigation season via water. Incremental tonnage expected to move via the Great Lakes system as a result of season extension is based upon changed shipper preceptions of a longer navigation season and lower waterborne rates. This additional tonnage will be an input into an intermodal impact analysis. Losses or gains in carrier revenues for each significant change in tonnage forecast will be related to the current financial structure of rail, truck, and barge line operators. If tonnage losses represent a substantial level of a specific modal operator's revenues, impacts of possible service abandonment will be investigated and the likelihood of Federal assistance to insure continued service will also be assessed.

This study methodology is closely related to the potential modal impacts that might occur if additional locks are constructed along the St. Lawrence River. The results of the present contract effort will be reviewed for possible use in the revised Plan of Study. Additional investigations will be considered for those possible intermodal impacts that may be unique to improvements now considered for the Welland Canal and St. Lawrence Seaway.

Comment:

2. "In light of the recent past performance levels of traffic on the Seaway, it is hard to understand why the annual rate of growth employed in the Plan of Study for forecasting future demands was 3.3 percent . . . by employing this unjustifiably high estimate for future traffic growth, it is erroneously concluded that the Seaway capacity will be met between 1995-2005 . . . Thus, current growth rates do not support the need for increasing the Seaway's capacity."

Response:

Levels of commercial traffic were one of several variables that are considered in the ARCTEC, Inc., lock capacity analysis in estimating the timing of near capacity conditions at the Welland and St. Lawrence River section. Changing the rate of growth for future traffic would alter the timing of the date of capacity. Other variables such as vessel carrying capacity, fleet mix characteristics and distribution of traffic flow between upbound and downbound movements plus assumptions as to the length of navigation season would also alter the date of near capacity conditions.

Domestic labor problems (i.e., strikes at the upper or lower lakes ore mines), domestic legislative policy as it relates to the level of foreign steel allowed to enter Great Lakes ports (i.e., trigger pricing) and international demand for agricultural products (i.e., grains) have historically affected the level of GL/SLS commercial traffic.

A review of the historical annual tonnages for the St. Lawrence River and Welland Canal since the opening of the Seaway in 1959 indicates a long-term increase in cargo tons shipped via the GL/SLS. Selection of individual years as a basis for forecasting the long-term growth in Seaway traffic can be misleading. A graphical summary of historical traffic statistics is shown on Figure K-1.

A rapid period of growth followed for almost 10 years after the initial 1959 navigation season. Growth since 1968 has occurred at an annual rate below the average for the period 1959-1968. Post 1968 growth for the Montreal-Lake Ontario and Welland Canal sections is estimated to be 1.75 percent and 1.35 percent, respectively. Growth rates for both of these sectors are relatively close to the long-term annual increase of 1.9 percent for all commodities.

Each commodity family has been forecasted to move in an unconstrained GL/SLS system and is shown in Table C-10. Individual commodity types may be growing at a rate which may be higher or lower than the average for all commodities. Total traffic for all commodities has been forecast to rise at a rate which closely approximates the average rate of growth for the last 10 years at the Welland Canal and St. Lawrence Seaway.

Comment:

3. "In light of the universally accepted principles of benefit-cost analysis, the methodology employed in the Plan of Study is both totally incorrect and greatly biased to the end that navigational improvements appear beneficial when in fact they are not.

" . . . Employing a low (discount) rate results in drastically overstating project benefits."

Response:

The interest rate to be used by Federal agencies in the formulation and evaluation of plans for water and related land resources is 6-7/8 percent for the period 1 October 1978 through and including 30 September 1979. The rate has been computed in accordance with Chapter IV, D, "The Discount Rate" in the "Standards for Planning Water and Related Land Resources" of the Water Resources Council, as amended (39 FR 29242), and is to be used by all Federal agencies in plan formulation and evaluation of water and related land resources projects for the purpose of discounting future benefits and computing costs, or otherwise converting benefits and costs to a common time basis.

Further information on the procedures and criteria of establishing the appropriate interest rate to be used in Federally funded water resource projects can be obtained by reviewing the following references:

a. Water Resources Council, Principles and Standards for Planning Water and Related Land Resources, 38 FR 24778-24869, 10 September 1973.

b. Section 80, Public Law 93-251, (88 Stat. 12), Water Resources Development Act of 1974, 7 March 1974.

Project interest rates prevailing at the time of the preliminary feasibility studies will be used in the benefit/cost studies. Impacts of using a higher interest rate in the economic analysis in conjunction with changing other study inputs such as traffic forecasts, fleet mix, length of season, etc., will be evaluated in terms of how they might affect the economic efficiency of any selected plan in a separate section entitled "Sensitivity Studies."

Benefits are measured as the prevailing level of rate differentials for those water susceptible commodity movements and the next best alternate mode's rate. Rate differentials are required by PL 89-670, Section 7 "Transportation Investment Standards" and will be used in future Corps economic studies.

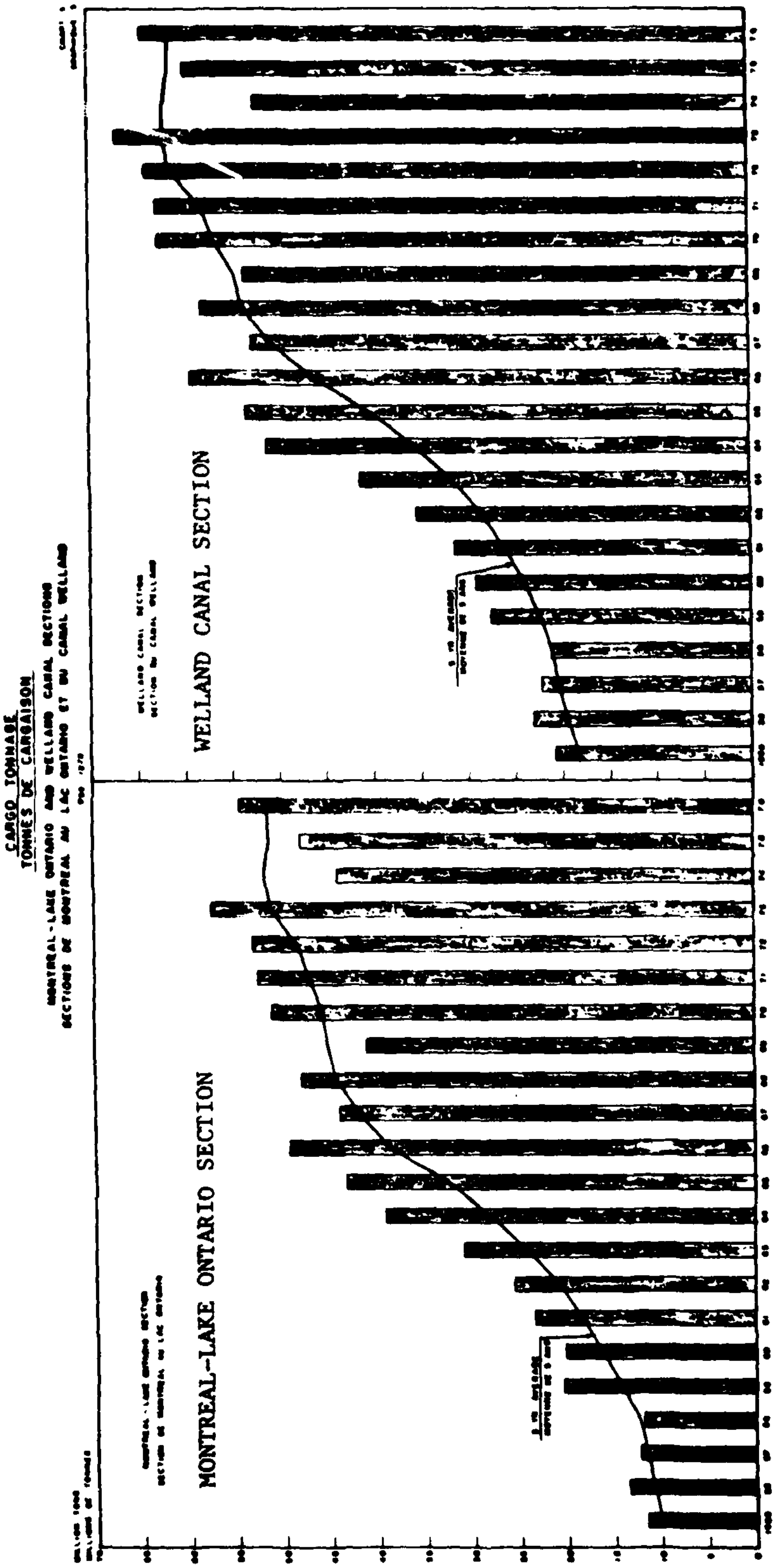
Comment;

4. " . . . the Plan of Study incorrectly computes economic benefits . . . to assume that all cost savings in excess of the 'required freight rate' will be passed to shippers is in absolute contradiction of past history. The entire concept of the required freight rate . . . ignores the fact that rates are set in an economic environment of supply and demand . . . there is no guarantee that cost savings will indeed by passed onto the shippers."

Response:

The policies governing the activities of the Corps of Engineers flow from the Constitutional powers of the three branches of the Federal Government. Those policies originating in the Executive Branch generally concern the methods and prodedures for implementing laws adopted by the Legislative Branch to address general and specific resource needs and problems. The Judicial Branch, through court cases, clarifies and tests the legal basis of proposed actions. Additionally, the Executive Branch, through the Office of Management and Budget (OMB), develops priority and budgetary recommendations and presents them to the Congress in the name of the President. Laws, both general and specific, and directives of higher authority provide a continually evolving dynamic balance among Federal, State, public, and private activities. Basic policies are defined within the frame-work of law and administrative guidance. Approval of policy decisions in the Corps of Engineers is reserved to the Chief of Engineers, except as explicitly delegated.

FIGURE K-1



SOURCE: TRAFFIC REPORT OF THE ST. LAWRENCE SEAWAY, 1976

Engineering Pamphlet 1165-2-1 "Digest of Water Resources Policies" summarizes the existing administrative and legislative water resources policies pertinent to the civil works activities of the Corps of Engineers. These policies apply to all OCE elements and all field operating agencies that have Civil Works responsibilities. The following material has been extracted from EP 1165-2-1 and is relevant to the evaluation of structural improvements of the St. Lawrence River locks.

11-3. Inland Waterways - Deep-Draft Harbors. The formulation of plans for inland waterway and deep-draft harbor development involves logical sequential steps to determine the benefits that would result from a proposed improvement. The principal benefits utilized in the justification of navigation projects are transportation savings. Other benefits may include reduction in losses due to hazardous or inadequate operating conditions, enhancement of land values from landfill, national defense, flood control, bank stabilization and shore protection.

a. Transportation Savings. The determination of transportation savings requires delineation of the trade territory that is economically tributary to the improvement under consideration, the types and volumes of commodities shipped into or out of the tributary area; the supply and demand for such commodities; the volumes of commodities that would reasonably move over the waterway improvement under study, and the size and characteristics of vessels used in the transportation of the commodities, projected over the project life.

b. Basis for Evaluation. The basis for evaluation of navigation benefits is Section 7(a) of the Department of Transportation Act of 1966 (PL 89-670). This act requires that each Corps navigation study will include an estimate of savings to shippers via the considered waterway, measured as the product of the estimated waterway traffic and the estimated unit savings to shippers from the movement of that traffic via the waterway. The unit savings will be measured as the difference between the rates shippers are actually paying for transportation at the time of the study and the rates they would pay for transportation via the improved waterway.

c. Estimate of Savings. The estimate of savings for inland waterways is developed by comparing the full charges for movement from original to destination via the prevailing mode of transportation with the full charges via the waterway being studied. The charges for each mode include all applicable handling, switching, and accessorial charges. Net differences in inventory, storage or other costs due to the change in transportation mode are recognized. The alternative modes of transportation used in estimating savings to shippers are those actually in use at the time of the study for moving that traffic. Where there are no existing traffic movements, the alternative mode of transportation is chosen on the basis that the shipper would take advantage of the mode affording him the lowest total charges. For deeper harbors, the estimate of savings is developed primarily by computing the difference in vessel operating cost for cargo movement on the existing project with those movements resulting from improved navigation conditions. The element of competition by alternative transportation mode is generally not involved in the computation of savings for deepsea harbors except where landside transportation becomes a factor for alternative port considerations.

d. Rates to be Used.

(1) Waterway Rates. Often there will be no existing rates for waterway movement over the proposed waterway. Inland waterway rates are based on water-carrier rates or charges existing elsewhere at the time of the study which are most nearly applicable to the type and volume of expected traffic on the improved waterway. For this purpose, use is made of water-carrier tariffs filed with the Interstate Commerce Commission, State regulatory agencies, and of unpublished data secured from other recognized authorities in the transportation industry, including barge-line operators. Rates and charges based on these sources, if applicable, may be applied directly to the waterway under study on a ton-mile basis or by establishing the relationship between prevailing waterway rates and the estimated cost of movement (including normal return on investment), and in turn applying this relationship to the estimated cost of movement on the considered waterway.

(2) Rates for Alternative Modes. On inland waterways where the traffic is currently moving and the volume and characteristics of the movement are similar to the proposed waterway movements, the prevailing rates for moving the traffic are used for comparison with the waterway rates. If the rate for the prevailing movement is not available or if the characteristics of the movement via the present mode differ from those anticipated on the waterway, charges via the present mode must be constructed. Constructed rates are based on those existing elsewhere at the time of the study which are most nearly applicable to the type and volume of the expected waterway movements. The constructed rates used should be based on a sufficiently large sample of existing rates to assure that they are reasonably representative. In selecting rates for use as prevailing rates, or for constructing rates, care should be taken to limit consideration to rates actually in use.

Comment:

5. "A similarly large and important omission in the Plan of Study is the lack of an evaluation relating increased investment in the Seaway and the ability of the current structure to sufficiently cover additional operating and fixed costs. . . to the extent that toll revenues are short of expense levels, a subsidy to shipper interests exists and the effect of this subsidy upon other modes, including railroads, must be addressed."

". . . when tolls are insufficient to cover the costs of new investment, vessel operating costs are understated and the extent to which benefits can be passed onto shippers is further overstated."

Response:

See reply to the Association of American Railroads (8/17/78) comment Number 1. on page K-2.

Norfolk and Western Railway Company - 8/28/78

Comment:

1. ". . . the availability of transportation in the Great Lakes/St. Lawrence Seaway market area is sufficient to meet the needs of shippers and receivers in the foreseeable future and that there is no economic justification for the expenditure of taxpayers' money for this project."

Response:

Alternate modes of transport within the economic hinterland of the GL/SLS compete against each other for the total freight traffic available. Each mode has a distinct competitive advantage for individual commodities that have volume and value relationships that make choice of one means of transport an easy decision that minimizes transport costs. Many commodities do not have such a clear cut choice of transport and can be shipped by more than one mode of transport along two or more origin/destination routings.

The waterborne mode is limited in the maximum amount of tonnage that can be shipped each year. This constraint is a function of length of season, vessel characteristics, operating drafts, lockage time, traffic forecasts, and other related variables. Constraints to waterborne movement were identified in the "Problem and Needs" section in the Plan of Study to be the three lock locations in the Soo, Welland, and St. Lawrence Seaway. No attempt has been made to measure the maximum volume of freight that may be moved by alternate transport modes. The immediate problem area has been identified as the Welland Canal with near-capacity conditions occurring in 1980.

Comment:

2. ". . . public policy must be established before the decision to spend more money on the St. Lawrence Seaway is made."

"Is the proposed project consistent with the National Transportation Policy?"

Response:

The Department of the Army and the Corps of Engineers are charged by Congress with the major Federal program of water resources development. Study authorizations, which are required before the Corps can initiate feasibility studies, reflect the priorities, goals and objectives of Congress or its members who comprise the House and Senate Committees on Public Works. It is this group, representing the general public, who vote on and approve funds for planning agencies such as the Corps of Engineers.

However, in the past, water resources projects have been funded, studied, and constructed based upon a "single management and regulation of rivers and harbors" outlook without a comprehensive water policy in step with national economic development and environmental conservation objectives. Budgetary constraints and regional political biases have also hindered development of a national transportation policy as it relates to waterway improvements.

Numerous attempts have been made to improve the planning and evaluation process for Federal water resources programs and projects. Recently, the Executive Branch of Government has issued Presidential Directives which implement new water policy initiatives. The "Water Resources Policy Reform Message" of 6 June 1978 now represents, in summary form, the reforms desired by the Executive Branch of the Federal Government. All criteria mentioned in the 6 June 1978 policy statement will be addressed during the preparation of feasibility studies for the construction of additional locks in the St. Lawrence River.

Comment:

3. "What is the trade-off for our nation between the benefits derived from the proposed improvement and the negative impact on integral parts of our economy, such as the Gulf Ports, the Eastern Seabord Ports, the steel and automobile industries in the Great Lakes region, the barge lines and, . . ., the railroads?"

"What potential dislocations of industry will result from the increased imports?"

Response:

All coastal port ranges (i.e., Atlantic, Pacific, Gulf, and Great Lakes) are considered to compete against one another for their share of total foreign traffic. Their success is determined by service considerations, costs, and institutional biases that exist to predetermine commodity routings.

Construction of additional locks to alleviate anticipated future constraints to commercial navigation at the Soo, Welland, and St. Lawrence Seaway locks will allow the GL/SLS to maintain its existing market share of a growing national market for general cargo imports and exports. The extent of participation of the GL/SLS in the movement of the majority of these general cargo commodities is forecasted to be less than 15 percent of the total potential traffic. This relatively small market share is attributed to rate and service advantages that alternate port ranges presently have over the GL/SLS. Great Lakes ports are the most competitive route for only a few commodity families, the most important of which is iron and steel imports. Traffic forecasts for a normal season indicate that the GL/SLS may capture about 45 percent of the total traffic within this commodity group which is potential to the 19-State Great Lakes hinterland.

Improvements to the GL/SLS will not increase the total tons of general cargo imported or exported or create dislocations within our domestic economy, but may redistribute the total forecasted potential traffic among the competing coastal ranges. Therefore, dislocations of industry cannot be attributed to improvements to the St. Lawrence Seaway locks.

Comment:

4. "Is there any need to begin a study at this time in view of statements made in Appendix D, page 48, regarding season extension delaying need for increased capacity until after the year 2000?"

Response:

Initial analysis and conclusions of the impact of season extension on the existing capacity at the Poe Lock, Welland Canal, and St. Lawrence Seaway locks included in Appendix D "Maximum Vessel Size Study" have been superceded by the ARCTEC, Inc., lock capacity study effort. Their work, completed in April 1979, will be summarized in Appendix C in the revised Plan of Study, at which time will become the most current analytical work effort completed to date on this topic to be used as input to future Corps planning documents for the season extension, connecting channels, and additional locks study authorities. Therefore, their results and conclusions on the timing of near-capacity conditions will supercede any earlier estimates of the impact of season extension activity on tonnage throughput at the three critical lock subsystems.

Comment:

5. "What increased user charges and tolls must be levied to recover full costs?"

"What are the specific benefits, quantified, to the public?"

Response:

See reply to the Association of American Railroads - 8/17/78, Comment Number 1, on page K-2.

Toledo Metropolitan Area Council of Governments - 8/29/78

Comment:

1. "Consideration needs to be given to the cost effectiveness of improving the movement of goods by water where the cost of developing the infrastructure for waterborne shipping is high. A comprehensive multimodal plan for shipping needs to be developed in the Great Lakes Region."

Response:

See reply to St. Lawrence Environmental Management Council's (9/13/78) comment on page K-26, Comment 4.

Ohio Department of Natural Resources - 8/29/78

Comment:

1. "Section I, third paragraph: The statement is made that the amount of tonnage passing through the system has steadily increased since 1959. The Corps' own annually published tonnage figures refute this statement, showing a sharp decline in the late 1960's and early 1970's. Only since the mid-1970's has the tonnage at most Great Lakes ports begun to increase and then only slightly and uncertainly."

Response:

All references to historical traffic movements at the Welland Canal and St. Lawrence Seaway locks will be changed to read as follows: "Although traffic moving through the Welland Canal and St. Lawrence River has fluctuated from year to year, the long-term trend since 1959 has been in a generally upward direction."

New York State Department of Environmental Conservation - 9/6/78

Comment:

1. ". . . the Plan of Study should be more specific as to the type and scope of environmental and economic studies that will be conducted."

Response:

It is assumed that environmental studies to be conducted would be those suggested by U. S. Fish and Wildlife Service in Section 6 and by the NYSDEC in the 5 January 1978 letter, funds permitting. See Response Number 3 below.

Comment:

2. "The Plan of Study . . . must include the necessary environmental studies to provide for an environmental baseline."

Response:

A Scope of Work has been initiated with the U. S. Fish and Wildlife Service to do field habitat mapping and identification of ecologically sensitive areas. Existing aerial photography will be used where available and will be supplied to USF&WL Service by the Corps. Physical and biological sampling may be necessary for certain areas (i.e., Wiley Dondero Ship Canal).

Comments:

3. ". . . environmental and economic studies must be interrelated with the evaluations and other investigations being conducted in conjunction with the Winter Navigation Study."

"The work elements must include a detailed economic assessment to determine the impact both in gains and losses on local, regional, and New York State economics."

". . . the Plan of Study should be more specific as to the type and scope of environmental and economic studies that will be conducted."

Response:

Future economic studies, including regional impact studies, will be conducted to determine the impact of project construction and operation on the geographic area adjacent to the St. Lawrence River. Section 6, Study Management, Work to be Performed, Economics Studies provides additional information on the methodology to be used in measuring positive and negative impacts at the project site. Impacts on a much larger regional area have been addressed in a contract study effort by Bcoz, Allen, and Hamilton for the Detroit District, Corps of Engineers, Survey Study for Navigation Season Extension. Their approach will be reviewed and adopted, where possible, to measure the regional impacts of the construction of additional or larger locks in the St. Lawrence River. The scope of environmental studies is responded to in Comment 1.

Comment:

4. "These (studies number 8, 10, 11, and 12 cited in letter of 5 January 1978) should be included in the Additional Locks Study and evaluated in coordination with the winter navigation studies . . . the effects of oil and toxic substance vessel spills (number 13 of my 5 June letter) on the river ecosystem are not addressed in the Plan of Study."

Response:

Studies number 8, 10, 11, and 12, as cited in the NYSDEC letter dated 5 January, have been added to Section 6 of the POS. Oil and toxic substance vessel spills are addressed in Section 4 under environmental concerns and in Section 6 under Ecosystem baseline studies.

Comment:

5. ". . . studies of this nature must be done on an international basis. Therefore, the earliest possible involvement of Canada and the United States through the International Joint Commission (IJC) is necessary."

Response:

Paragraph 3 on page 1-2 recognizes the need for Canadian improvements to the other locks in the Seaway System. Handling of "Canadian Coordination" is discussed on page 6-11 and again is mentioned on page 6-15.

U. S. Fish and Wildlife Service - Newton Corners - 9/6/78

Comment:

1. "The Plan of Study seeks to achieve a level of detail that will permit determining the desirability, feasibility, and level of devel-opment of the St. Lawrence Seaway, which is in the best interest of the United States. Philosophically, the Service supports that approach and will assist you to the extent that available funding and on-line commitments will permit, with regard to the interaction of the proposed study with living natural resources, including endangered or threatened species."

Response:

No response required.

2. ". . . we conclude that action taken to date in the 'Plan of Study' will not jeapordize the continued existence of bald eagles."

Response:

No response required.

3. ". . . we suggest that consultation be reinitiated when the 'Summary of Environmental Considerations' . . . becomes available. Another point at which the reinitiation of consultation would seem appropriate would be at the end of 'Stage 3' when the Draft Environmental Impact Statement will be circulated."

Response:

Concur.

St. Lawrence Seaway Authority - 9/11/78

Comment:

1. "Our latest tonnage forecast indicates only 88 million tons of cargo are likely to move through the Welland Canal in 1990. This latest estimate is considerably below your figure of 95 million."

Response:

Traffic forecasts in Table C-14 indicate future levels of traffic at the Welland Canal and Seaway locks under the "ideal situation" of no constraints at the interconnecting locks and channels. Near-capacity conditions at the Soo Locks will dampen growth in traffic at the Welland Canal and St. Lawrence Seaway locks. Constrained traffic forecasts for the normal length of season (about 15 April to 15 December) were prepared for the revised Plan of Study and are shown as Tables C-11 and C-12.

Comment:

2. "Section 3, Page 3-8, Paragraph 1, Line 2; Paragraph 4, Line 1 and Line 5 - 'draft of 25".9" should be changed to 26'.0" as the allowable draft has been 26'.0" since November 1970."

Response:

The correction has been made in all sections of the revised POS.

Comment:

3. "Section 3, Page 3-11, . . . this page and the first two paragraphs of Page 3-12 should follow Page 3-7, as the content relates more to the capacity discussion than to weather and ice conditions."

Response:

Section 3 was rewritten and reorganized for this revised POS.

Northeast Ohio Areawide Coordinating Agency - 9/12/78

Comment:

1. Resolution dated 6 September 1978. "Section 1. That the plan of the U. S. Army Corps of Engineers for St. Lawrence Seaway -Additional Locks has had appropriate review and is endorsed."

Response:

No response required.

Robert E. Martin, President, Lake County (Ohio) Commissioners NOACA - 9/12/78

Comment:

1. "If this has any bearing on the raising of the water level in Lake Erie, I am opposed."

Response:

Impacts from this study and possible improvements in the St. Lawrence River are not anticipated to have any effect on the water level in Lake Erie.

St. Lawrence County Environmental Management Council - 9/13/78

Comment:

1. "Coordination between these studies (SLS-AL and Winter Navigation Program) is essential. Both projects involve similar environmental, economic, and social concerns and both require baseline date for adequate assessments and impact statements. The construction of additional locks is likely to be a stepping stone to extended navigation or vice versa."

Response:

These studies are being closely coordinated between Detroit and Buffalo Districts, Corps of Engineers. In addition, the Great Lakes Connecting Channels Study is being coordinated with the two refered to in the comment. The Corps is aware of the similarities of these studies and will attempt to utilize all data developed in an efficient and complimentary method.

Comment:

2. ". . . if additional locks are separated from extended navigation, a realistic economic evaluation may not be possible."

Response:

Analysis of additional locks and extended season studies have not been separated for individual detailed studies. Section 4, page 4-15, Economic Benefits and Costs, Methodology, describes, in general, how the analysis will include a "no action" base case and a range of alternative futures that includes season extension activities in place prior to additional locks and vice versa. A range of assumptions for season extension and size of locks will also be an important part of future sensitivity studies. The major reason for separating season extension from lock improvements is the interdependence of each program upon the other. The timing of benefits and costs for each program is a function of whether or not season extension is part of the base case of whether additional locks preceeds season extension activity. Therefore, separation of each type of improvement is necessary in order to evaluate each plan incrementally.

Comment:

3. ". . . a valid evaluation of an action should include an analysis of trade-offs between project costs and nonmonetary considerations such as environmental impacts and social consequences . . . we recommend that you incorporate such techniques in the economic analysis."

Response:

Assessment of impacts of alternative plans in multiobjective planning; consistent with WRC Principles and Standards (P&S), the National Environmental Policy Act of 1969 (NEPA) and related policies is required by ER 1105-2-240.

This guidance specifies that the location, timing, and duration of each significant impact should be determined. The method used to show this information is the System of Accounts which summarizes the beneficial and adverse contributions made to each planning objective by each alternative. Emphasis is required on quantifying environmental and social impacts while economic impacts will be quantified in dollar terms. The System of Accounts will be developed at the end of each iteration of the planning process. Development of such a display of any plans output assists in identifying opportunities for increasing project outputs or decreasing project costs, or both.

Comment:

4. "In the economic analysis, one should consider the following. Water transportation is generally considered one of the cheapest modes of moving bulk commodities. From a total cost standpoint, this is not necessarily valid. It should be pointed out that linehaul cost comparisons of modes of transportation are less credible than total cost comparisons of linehaul modes given a definite origin and destination. Linehaul costs form only a portion of the total cost of any shipment. Water travel frequently involves short but expensive access and egress transport by truck or rail. The cost of delivery for a commodity could very well be cheaper, both in money and energy, by other modes if one actually considered a specific origin and destination. Consequently, one cannot generally conclude that water is the cheapest mode; each case has to be considered individually."

Response:

Transportation routing decisions in the traffic forecast model estimated origin to destination movements of the freight. Total costs of using the GL/SLS Traffic Forecast Model was developed on the basis of actual origin/destination movements that were obtained by sampling waterborne movements via the GL/SLS for each commodity group on a Bureau of Economic Analysis Region to BEAR basis, U. S. Department of Transportation ICC one percent Waybill sample data and Bureau of Census Foreign Trade Statistics. The traffic moving between domestic BEAR's and to/from overseas trade areas was grouped into 37 commodity groups and 266 geographic area codes. Commodity flows were assigned to 6,805 origin/destination/commodity units for the year 1972.

Freight rates were subsequently developed for these specified O/D pairs identified as potential to the GL/SLS. This work was performed by Bcoz, Allen, and Hamilton under contract to North Central Division, Corps of Engineers. The first phase of their investigation was the development of a rate-calculator model capable of producing any land or water freight rate based on the origin and destination points of movement and the characteristics of the commodity. This model consists of a series of rate calculator equations developed by regression analysis of approximately 2,000 actual freight rates supplemented with a limited number of actual freight movements.

The traffic forecast model uses an estimate of potential traffic that moves into or out of the 19-state economic hinterland, adjusts the potential downward to reflect institutional or service deficits relative to completing coastal ranges and then splits the remaining traffic to the GL/SLS and alternate routes based on the level of estimated freight rates for specified origin/destination/commodity flows. The model does not arbitrarily allocate traffic to the Great Lakes whenever the waterborne commerce was found to be the cheapest mode. Estimated freight rates and the extent of variation between the G. L. rate and next best alternate are used to allocate traffic between each competing route.

U. S. Fish and Wildlife Service - Cortland - 9/15/78

Comment:

1. "In general, we found that the Plan of Study addresses our concerns for fish and wildlife resources and their support habitats."

Response:

No response required.

Comment:

2. "This new information (Environmental Assessment of the FY 1979 Winter Navigation Demonstration on the St. Lawrence River) may change portions of the study plan, as is to be expected in a dynamic planning process."

Response:

The FY 1979 Winter Navigation Demonstration for the St. Lawrence River did not take place. However, the new information developed in the EA will be utilized in future planning efforts.

Pennsylvania Department of Environmental Resources - 9/19/78

Comment:

1. "The Feasibility Study is therefore quite appropriate at this time. We encourage its endorsement."

Response:

No response is required.

St. Lawrence Seaway Development Corporation (Messena, NY) - 9/29/78

Comment:

1. "Section 1 - Page 1-1, paragraph 3, line 2: After the word 'tonnage', insert a comma and then add the word 'size'."

Response:

This sentence has been rewritten in the text.

Comment:

2. "Section 2 - Page 2-8, paragraph 3, line 7: Delete the phrase 'during the navigation season'."

Response:

The entire sentence has been rewritten in the text.

Comment:

3. "Section 2 - Page 2-9, paragraph 1: Delete the first sentence and insert the following: 'The regulation of Lake Ontario began in July 1958'."

Response:

This change was incorporated.

Comment:

4. "Section 2 - Page 2-28, paragraph 1: Insert at the end of the paragraph the following: 'Another private dock facility is located downriver near Massena, New York at the Metropolitan Petroleum Company, Inc. site. The facilities are located approximately 150 yards from the Seaway channel and are utilized exclusively for receiving of Seaway vessels delivering oil products to the terminal'."

Response:

This addition was incorporated.

Comment:

5. "Section 3 - Page 3-1, paragraph 3, line 1: Change '540' to '527'.
line 4: Change '105' to '113'.
line 5: Change '435' to '414'.
line 6: Delete the last two sentences of the paragraph and substitute the following: 'The International Section of the river is operated for commercial navigation purposes as a joint venture of the Saint Lawrence Seaway Development Corporation and the St. Lawrence Seaway Authority of Canada. The Corporation is authorized, under its

enabling act, Public Law 358, 83rd Congress, approved May 13, 1954, as amended, to develop, construct, operate, and maintain that part of the Seaway within the territorial limits of the United States and to collect tolls and other charges for the use of its facilities. The St. Lawrence Seaway Authority is authorized by the St. Lawrence Seaway Authority Act to perform similar functions in the Canadian waters of the Seaway'."

Response:

These changes were incorporated.

Comment:

6. "Section 3 - Page 3-7, paragraph 1, line 2: After '50 miles wide.' add the following sentence: 'The regulation of Lake Ontario is in accordance with the International Joint Commission's Order of Approval of October 29, 1952 and the Supplementary Order of July 2, 1956 and is under the direct supervision of the Commission's International St. Lawrence River Board of Control'."

Response:

This addition was incorporated.

Comment:

7. "Section 3 - Page 3-8 does not follow page 3-7. Page 3-11 appears to follow page 3-7."

Response:

This correction was made.

Comment:

8. "Section 3 - Page 3-8, paragraph 1, line 2: Change '25 feet 9' to '26 feet 0'."

Response:

All references to allowable draft have been changed to '26 feet 0 inches.'

Comment:

9. "Section 3 - Page 3-9, paragraph 3, line 4: At the end of the sentence, delete the period and add 'in the upper lakes, i.e. above the Welland Canal'."

Response:

This change was incorporated.

Comment:

10. "Section 3 - Page 3-15: Delete the entire section on 'Structural Integrity of Eisenhower Lock' and substitute the following:

'Eisenhower Lock has experienced a long history of concrete problems, particularly those relating to serious concrete deterioration. The first evidence of this deterioration was noted in April 1962 at the downstream miter gate recesses in the lock walls. Additional deterioration was found near diffuser openings, in the lower sill, and along the lower lock walls in the lock chamber. An inspection of the filling and emptying culverts in December 1962 disclosed some minor erosion damage near the valves and valve bulkhead slots and a large rock pocket in the ceiling of one of the culverts but no serious deterioration. During the 1962-1963 and 1963-1964 winter shutdowns, repairs were made to some of the damaged concrete in the culverts but there was still no report of serious deterioration occurring in the lock structure. However, when the locks were dewatered at the end of the 1964 navigation season, widespread and deep-seated deterioration of concrete was discovered in the culverts as evidenced both by erosion of up to 10 inches or more of concrete in some areas and the existence of hollow-sounding and cracked concrete in other areas.

'A major concrete investigation program was consequently conducted by the Saint Lawrence Seaway Development Corporation and the Corps of Engineers during the winters of 1965-66 and 1966-67 to determine the extent and cause of the deterioration. On the basis of a Corps of Engineers' in-depth analysis, the poor performance of the concrete in Eisenhower Lock is attributed to freezing and thawing damage of an inferior quality concrete. The inferiority of the concrete is considered to be related to the use of an inert natural cement as a replacement for part of the cement component. This had the effect that the exposed concrete at Eisenhower Lock was of the quality intended to be used in the interior, and the interior concrete was of an inferior quality not intended to be used anywhere in the project.

'Repairs to the deteriorated concrete have been accomplished both by contract and by work forces of the Saint Lawrence Seaway Development Corporation since deterioration was first noted in 1962, with major rehabilitation being performed during the winters of 1967-68 and 1968-69. Repairs have generally consisted of removal of deteriorated concrete to reasonably sound original material and/or a specified depth and replacement to original lines using conventional concrete placement or shotcrete with necessary reinforcement. All repairs have been effective in that they have accomplished their intended purpose.

'The concrete deterioration, however, continues with future repairs scheduled to maintain the structural adequacy of Eisenhower Lock and thus assure continutiy of operations'."

Response:

The writeup provided was incorporated with the exception of the last paragaraph.

Comment:

11. "Section 3 - Page 3-18, paragraph 5, line 5: Between the words 'by' and 'the', insert 'natural wind generated waves and'. Also delete the last two sentences in this paragraph."

Response:

The change was made and the last two sentences modified.

Comments:

12. "Section 4 - Page 4-9, paragraph 7, line 7: After the word "lock", delete the rest of the sentence and substitute 'in United States territory (Figures 4-1 and 4-2)'."

"Section 4 - Page 4-11, Figure 4-1: Add another arrow from the box 'Possible Location of New Twin Locks' and direct the arrow toward Snell Lock."

Response:

Both changes were incorporated.

Comment:

13. "Section 4 - Page 4-14, paragraph 3: Delete entire paragraph entitled 'Alternate Trade Route'."

Response:

This change was not incorporated. The paragraph points out a possible alternate to Seaway development and the need to consider all alternates in the development of this study. The New York District Corps of Engineers is presently working on this study and applicable portions will be incorporated into the SLS-AL Study as information becomes available.

Comment:

14. "Section 6 - Page 6-3, paragraph 2, line 4: Delete the period and add ', not only for the twinning scheme but for the one lock-new canal plan'."

Response:

This change was incorporated.

Comments:

15. "Appendix A-Page A-1, paragraph 2, line 1: Change '557' to '527'.
line 4: Change '125' to '113'.
"Appendix A - Page A-1, paragraph 3, line 7: Change '59 to '49'.

line 10: Delete '800 feet long' and add '860 feet from gate pintle to gate pintle'.
line 11: Change '75' to '76'.
line 13: Change '25.5' to '26'."

"Appendix A - Page A-2, paragraph 4, line 10: Change '252' to '125'."

"Appendix A - Page A-5, paragraph 5, line 11: Delete the last sentence."

Response:

These changes were incorporated.

Comments:

16. "Appendix A - Page A-15, paragraph 1, line 10: Change '241,000' to '240,000'."

"Appendix A - Page A-15, paragraph 5, line 2: Change '241,000' to '240,000'."

Response:

These changes were incorporated.

Comment:

17. "Appendix A - Page A-17, paragraph 2, lines 7 and 8: Delete 'during the navigation season'."

Response:

The entire sentence has been rewritten.

Comments:

18. "Appendix B - Page B-12, paragraphs 2, 3, 4, and 5 are almost exact duplicates of the material on page 3-1, paragraphs 3, 4, and 5 and page 3-7, paragraph 1."

"Appendix B - Pages B-15 and B-17 are almost exact duplicates of pages 3-5 and 3-6."

Response:

Although these paragraphs are similar, they are required to make the appendices "stand on their own."

St. Lawrence Seaway Development Corporation (Washington, DC) -9/29/78

Comment:

1. ". . . it is not clear . . . if significant involvement of the Seaway Corporation in the study effort, particularly respecting coordination with Canada's Seaway Authority, is intended."

Response:

The section, "Canadian Coordination," on page 6-11 directly states that Canadian participation for the Plan of Study stage will be accomplished by informal coordination with the St. Lawrence Seaway Authority. After the first stage of the study requiring informal coordination is completed, the U. S. State Department will determine the required channels for formal coordination. Clarification is made in the text.

Comment:

2. ". . . the Additional Locks POS appears deficient in its treatment of the identification (of needs and problems) task and that a second and more meaningful iteration of stage one is essential before the project moves to stage two.

"The Problems and Needs Section of the POS seems to require better organization. The discussion of the need for the proposed project is interspersed with discussion on "Problems Attending Navigation" and the reader is not provided with a strong, coherent explanation as to why the proposed project is needed."

Response:

Modifications have been made to Section 3 to present the problems and needs clearly and in more detail.

Comments:

3. "The POS furnishes voluminous data covering a number of areas with minimal assessment of their relevance, and little or no data relating to significant areas, such as present traffic conditions. The adequacy of existing information and the status and applicability of analytical tools (e.g., Traffic Forecast and Capacity Models) are not evaluated."

"Those problems identified do not appear to have received sufficient in-depth treatment."

Response:

Additional data is presented and evaluations are made in Section 3 to answer these comments.

Comment:

4. "Vessel transits and numbers have declined; vessel size and tonnage throughout has increased. The rate of shift to larger vessels, laker and ocean, has been faster than the rate of growth in tonnage demand for carriage." (Section 1)

Response:

The sentence to which this comment refers was changed to correctly address this fact.

Comment:

5. "Need a fuller explanation explanation of 'economic efficiency' under WRC objectives of National Economic Development (NED). (Section 1)

Response:

Improving the economic efficiency of a component of the national transportation network would result in a reduction in the national resources required to move a specified unit of freight. Improvements to be made to the water component of the national transportation network would allow either more vessels of the existing fleet size or fewer, but larger vessels to move the forecasted level of freight. Increasing the efficiency of any transportation system subsequently reduces the nation's freight bills and releases these unused resources for more productive investments elsewhere in the economy.

Comment:

6. "Principles and Standards and 1975 multiobjective planning framework document should be included as appendicies." (Section 1)

Response:

Engineer Regulation 1105-2-200 is available to most reviewers and the public. Therefore, enclosure of the full regulation in this document is not warranted.

Comment:

7. "Need better explanation of how study will deal with Canadian facilities in planning framework." (Section 1)

Response:

Paragraph 3 on page 1-2 recognizes the need for Canadian improvements to the other locks in the Seaway system. Handling of, "Canadian Coordination," is discussed on page 6-11 and again mentioned on page 6-15.

Comment:

8. "Majority of data presented drawn from USFWS study, St. Lawrence River Ecological Studies - Biological Characterization. This report is preliminary and as it points out, is not sufficient to establish baseline conditions." (Section 2)

Response:

The information presented in Section 2 provides a broad introductory view of existing conditions in the Great Lakes-St. Lawrence River Basin. To supplement this, a scope of work for additional baseline studies of fish and wildlife in FY 79 has been initiated by the Corps with the U. S. Fish and Wildlife Service, Cortland, NY.

Comment:

9. "The environmental part of this section should (1) clearly indicate the extent of site - specific data available, (2) identify gaps and deficiencies in that data base, and (3) indicate the types of monitoring programs and baseline studies that will be conducted to remove these gaps and deficiencies." (Section 2)

Response:

Section 6 includes an outline the baseline fish and wildlife studies that the U. S. Fish and Wildlife Service feels are necessary for the St. Lawrence Seaway-Additional Locks Study. These studies would also identify gaps in the existing data and identify on-going and proposed studies to fill these gaps and accomplish necessary investigations to complete a baseline inventory.

The U. S. Fish and Wildlife Service effort for the Additional Locks Study will involve habitat mapping and identification of ecologically sensitive areas. The habitat mapping will follow the methodology utilized in Technical Report N of the Environmental Assessment of the FY 79 Winter Navigation Demonstration on the St. Lawrence River, and will be a continuation of that information.

Comment:

10. "It should be demonstrated that a sound analytical base is available for projection of commodity flows. Related models should be updated and calibrated to a base year. Forecasting assumptions should be reviewed by major commodity and resources for general forecasts identified." (Section 3)

Response:

The basic analytical framework for the Additional Locks POS is based upon the GL/SLS Traffic Foremost Model developed in 1976. Related model components (Logistics Price File-1977 and Lock Capacity-1979) have been recently updated and now comprise a comprehensive planning tool which can measure the potential benefits of improving the GL/SLS navigation system. Extension of the navigation season or construction of additional/duplicate locks will allow greater levels of waterborne tonnages to move on the GL/SLS transportation system compared to existing conditions.

Traffic forecasts and other portions of the systems model will be revised and updated during FY 80. This work will be performed under contract for North Central Division and will help keep the model calibrated and updated to the most current base year possible.

Comment:

11. "Timing of capacity saturation is weak. Feasibility studies now may be premature unless proven otherwise. Tonnage estimates and ship capacity definition are shaky." (Section 3)

Response:

The capacity discussion in Section 3 (Problems and Needs) has been revised using the analysis and conclusions of ARCTEC, Inc., developed during their lock capacity study effort, which was completed in April 1979. New capacity estimates for the Soo, Welland, and St. Lawrence River locks have been derived using actual traffic and vessel characteristics moving commercial traffic at these three nodes in 1976. The Welland Canal is expected to reach capacity in 1980, Soo Locks in 1990, and Seaway Locks in 2000. Documentation of their findings is now summarized in Appendix C - Capacity.

Comment:

12. "Pilotage is a problem subject to short-run solution and would seem to have no place in context of this study." (Section 3)

Response:

Pilotage is an important problem which certainly needs to be identified as a subject for additional investigations in future study levels.

Comment:

13. "The problem of water level regulation and conflicting demands should be given more attention." (Section 3)

Response:

These problems require further investigation to determine the magnitude of their impact. These problems will be addressed in future study levels.

Comment:

14. "The following should be included:

a. A clear statement of alternatives, including nonstructural and 'no change'.

b. Plans which maximize NED benefits, plans which maximize Environmental Quality (EQ) benefits, and mixed plans individually identified.

c. Mention of other Federal programs or industry plans.

d. Analysis of previously established regional water needs, development priorities, or environmental concerns including power.

e. Consideration of nodal impact." (Section 4)

Response:

a. The POS only formulated measures. Its primary objective is to identify problems and needs. Alternatives will be addressed in detail in the PFR Stage 2, which would evaluate these alternatives with regard to NED, EQ, RD, and SWB as required in Corps regulations. "Nonstructural" alternatives are discussed in Sections 4 and 5 (i.e., all-weather navigation, operating prodedures, season extension, etc.)

b. At the present level of study, the plans have not been developed in sufficient detail to make these identifications.

c. The Federal studies have been included. Industry plans have not been investigated to date.

d. Such analysis would be part of the more detailed stages of this study. Environmental concerns are identified in Section 4 of the POS.

e. Nodal impacts will require more detailed study than this preliminary level document can effectively cover. Some of these impacts are being investigated in other related studies mentioned in Section 4.

Comments:

15. "A preliminary assessment of the impacts of likely alternatives, or the procedures for doing so, should be given." (Section 5)

"The statement of environmental, socioeconomic and engineering concerns is good, but it is not clear how these concerns were related to evaluation criteria." (Section 5)

"Measures for assessing nonmonetary impacts could be useful." (Section 5)

Response:

The POS is the initial stage for planning. Its major task is to identify the range of issues related to resource management in the study area. The scope of the study is established and the broad management actions necessary to carry it out are described. Evaluation criteria indicated in Section 4 would be used to measure a plan's responsiveness to the identified concerns.

Comment:

16. "The analysis should identify the primary types of impacts for each solution." (Section 5)

Response:

A preliminary list of "effects" (or impacts) is presented in Section 5. This list gives a basis from which evaluation will take place during the planning process. Impacts will be analyzed for significance in the next study stage.

Comment:

17. "The relationship between impact evaluation and benefit-cost analysis needs clarification." (Section 5)

Response:

Three additional line items will be added to the preliminary listing of significant effects for each alternative on page 5-2. These items are "benefits", "costs", and "benefit/cost ratio." This will help to summarize the extent of the contribution of each plan to the NED account while a summary of each plan's costs will help to measure the extent of the nation's economic resources required to implement a plan. The display of the benefit/cost ratio will also help to determine the economic efficiency of each plan. Judgement can then be made concerning the beneficial and adverse nature of the contributions of an alternative to establish its overall desirability.

Comment:

18. "Order of magnitude preliminary cost information would be helpful in the POS." (Section 5)

Response:

It may be possible to evaluate a twinning scheme by use of price levels and the original cost of the American portion of the Seaway.

But there are many scenarios involving different project depths, channel widths, etc., which require a given amount of development before the magnitude of costs can be determined. Therefore, preliminary cost information will be developed in the next study stage.

Comment:

19. "It is not clear how energy consumption will be included in the evaluation." (Section 5)

Response:

Many factors affect the total cost of moving a unit of freight by a particular mode for an individual origin/destination/commodity flow. Fuel efficiency of one mode may be more than offset by the additional distance that must be traveled. On the Great Lakes, there are many commodity routings that have a longer distance between origin-destination than the next most competitive mode.

Energy consumed per ton-mile to transport future traffic beyond the date of system saturation will be addressed as a future study. Levels of energy consumption for extended season navigation studies have already been considered by the Detroit District, Corps of Engineers in their March 1979 Draft Survey Report. Levels of energy consumption were based upon operation of the larger vessels in the existing Great Lakes fleet beyond the normal navigation season. Extended season energy consumption, relative to that level of energy consumed by the alternate mode which would otherwise be required to transport the seasonal traffic, is only slightly lower. Energy consumption savings were acknowledged by Detroit District in their Draft Survey Report as "small but positive."

Construction of locks which would allow use of larger vessels would likely result in fuel economies due to the greater carrying capacity of larger vessels expected to be in use after completion of the improvement. Construction of additional locks of the same size in the Seaway would result in greater tonnage throughput using the same Great Lakes fleet as is presently in operation. This plan would allow forecasted traffic to continue to move at existing rate differentials during the project planning period. Energy consumption savings under existing conditions will be estimated and used to forecast future savings if additional locks of the same size are constructed.

The results of the Energy Consumption Study will be input to the evaluation process for selection of one of the detailed plans for implementation.

Comment:

20. "A reference to sensitivity analysis to determine how sensitive the preliminary evaluation of each alternative solution is to analytic assumptions, especially transportation rates and traffic forecasts should be included." (Section 5)

Response:

Sensitivity studies on the traffic forecasts, estimates of nodal capacity, cost sharing scenarios and other study parameters will be acknowledged in a separate section of Appendix C - Capacity in the revised Plan of Study. The results of these investigations will be separately displayed in summary format in Stage II and Stage III planning documents.

State of New York, Department of Agriculture and Markets (Albany, NY)
10/16/78

Comment:

1. "It is hoped that as the study progresses, that the impact on agricultural land will be properly addressed and evaluated."

Response:

As the study progresses, impact(s) on agricultural land will be addressed and evaluated, especially with regard to prime and unique agricultural land and identification of designated agricultural districts (if any) that exist in or near the potential project locale.

Comment:

2. "It is also noted in the proposed study draft, APP. "A" Natural Environment, page A-19, that the St. Lawrence River has a class "A" rating, which makes it suitable for drinking water, or food processing. There are eight communities along the river and all but one, Waddington, used the river water for its water source. Waddington uses groundwater for its water supply. However, it is not known at this time the number of communities in the province of Canada that rely on the St. Lawrence River for their water supply. These are initial impacts which should be studied."

Response:

These impacts will be addressed in future studies. However, there is presently information available identifying 38 municipal and seven industrial intakes in 24 Canadian counties. This inventory of Canadian water intakes on the St. Lawrence River is presented in Table C-29, Appendix C of the "Regulation of Great Lakes Water Levels."

Illinois Central Gulf (Chicago IL) - 10/18/78

Comment:

1. "We strongly disagree with the capacity assumption stated in the Plan of Study as justification for spending $15.8 billion to upgrade the SLS. This staggering outlay of tax dollars, which exceeds total Federal expenditures for all waterway projects prior to 1977, demands a much more comprehensive evaluation of the transportation needs of the Great Lakes Region. Is it in the public interest to have excess capacity in one area of the transportation sector and yet spend billions of tax dollars to expand another? This issue is not addressed in the Plan of Study."

Response:

Waterway transportation improvements constructed by the Corps of Engineers since 1966 have been made under tansportation investment standards explicitly stated in PL 89-670 (15 October 1966). This legislation created the Department of Transportation to coordinate the executive functions of various agencies of the Government concerned with transportation related issues, by consolidation into one comprehensive agency.

One of the main purposes of the legislation related to the standards and criteria for the investment of Federal funds in transportation. Waterway investment standards were explicitly stated in the legislation although the Secretary was to develop future criteria for highways, air transport, and railroads for the approval of Congress. Primary direct navigation benefits of a water resource project are defined as the product of the savings to shippers using the waterway and the estimated traffic that would use the waterway. Rate comparisons between modes are to be based upon those charges by other modes before the waterway comes into existence.

Evaluation of the economic feasibility of an incremental Federal investment in additional locks in the U. S. portions of the St. Lawrence River will be measured by the interaction of future traffic and the level of rate differentials between each mode for individual commodity family groups. The rate file developed for use in the GL/SLS Traffic Forecast Model reflects the present legislative requirements in PL 89-670.

Comment:

2. "Lastly, ICC concurs with the AAR's recommendation that the study be suspended. Estimates of future traffic levels (Appendix D. p. 48) indicate that capacity constraints will not be a problem until the year 2009 on the Welland Canal locks and 2025 on the SLS between Montreal and Lake Ontario. Clearly, completion of a project study plan by 1982 is not warranted since the project will not be needed until 27 years later."

Response:

An evaluation of the maximum tonnage throughput under near-capacity conditions has been developed by ARCTEC, Inc., under contract to North Central

Division, Corps of Engineers to be about 75.5 million short tons at the Welland Canal. This estimate of maximum tonnage throughput is significantly lower than earlier estimates and is the output of a mathmatical queueing model which analyzes steady-state lock operations and vessel-lock operations.

The locks at the Welland Canal are concluded to be rapidly approaching capacity conditions using the decision following criterion:

- 87.5 percent lock utilization
- Average vessel waiting time of four hours
- Average vessel queue length of three ships

A summary of the most current estimates of capacity at the three critical lock subsystems are described in Table 3-1.

The Contractor's findings on the adequacy of the existing Welland Canal and Seaway Locks in light of the most recent traffic forecasts by commodity groups reinforces the need for the present study that will address the economic, environmental, and engineering feasibility of additional locks in the U.S. section of the St. Lawrence Seaway.

New York State Department of Transportation (Albany, NY) - 11/16/78

Comment:

1. "We noted that this proposed study will be closely coordinated with the Great Lakes Connecting Channels and Harbor Study; which will investigate the needs of the upper Great Lakes connecting channels and harbors. Although no mention was made of it, we assume that this study will also be coordinated with a study being done by the New York District of the Corps of Engineers on the rehabilitation and modernization of the New York State Barge Canal System and a proposed future study to determine the feasibility of a deep draft canal from the Great Lakes to the Atlantic Seaboard."

Response:

Close coordination between the two studies is essential and will be utilized throughout the planning of the project.

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