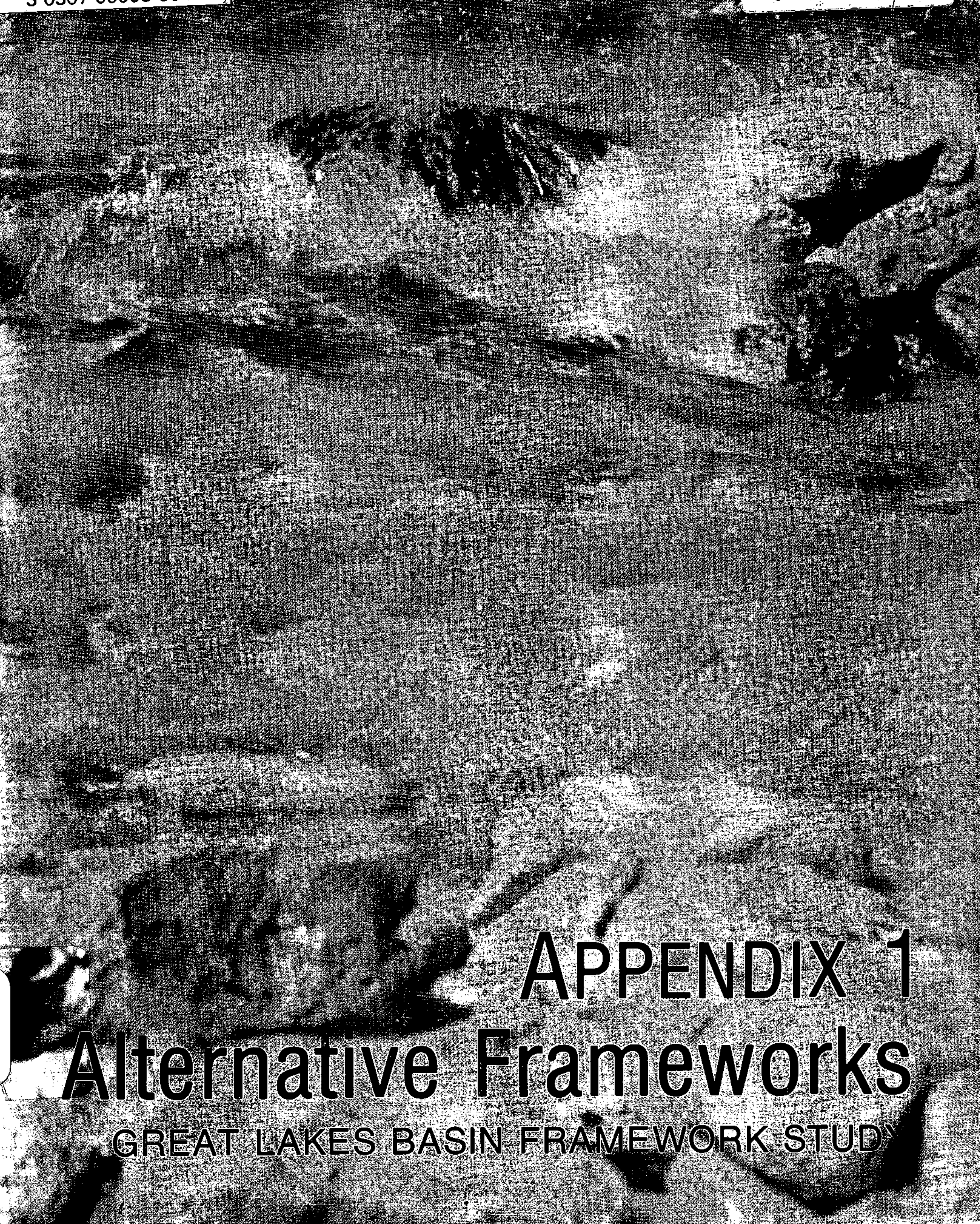


APPENDIX 1
Alternative Frameworks

GREAT LAKES BASIN FRAMEWORK STUDY

GREAT LAKES BASIN COMMISSION FRAMEWORK STUDY ERRATA SHEETS

VOLUME	PG.	COL.	LINE	TABLE	CHANGE
EIS	101	1	12–14		Change "According to Carter, some 60 million tons/ year of sediment are due specifically to shore erosion," to "According to Carter, the total fine-grained sediment load derived from the Lake Erie shore is estimated at 15 to 16 million tons/year."
	141	2	Item (10) of page 3, Ohio EPA letter		
Appendix 1	Title Page				Delete: "Prepared by Surface Water Hydrology Work Group Sponsored by the U.S. Department of the Army Corps of Engineers
	4	2	last	1–3	Add "Roscommon" under PSA 2.4
Appendix 2	2	1	4		Change "Paper 1677." to "Paper 1677.[9]"
	26	2	20		Change "Handbook." to "Handbook.[7]"
	37	1	28		Change "1677.[8]" to "1677.[9]"
	37	2	19		Change "Council, Bulletin 15" to "Council, Bulletin 15[10]"
	38	2	47		Change "drology.[9]" to "drology.[7]"
	72	1	14		Change "40.[12]" to "40.[3]"
	129	1	3		Change "Beara" to "Beard"
Appendix 3	29	2	3		Change "Milwaukee" to "Wauwatosa"
	96				Figure 3–4: In the legend, the third block, which depicts "Greater than 3,000" should be dark pink.
Appendix 4	ii				Delete 2nd paragraph of disclaimer, i.e., "The material in this appendix...common law revised."
					Figures 4–93, 4–97, 4–103, 3–104, 4–105, 4–232, 4–235, 4–260, 4–267, 4–268, 4–292: New reproductions of these figures are attached.
Appendix 6	68	1	new line	6–32	Under "1970" insert "Self-Supplied" between "Total Water Withdrawal" and "Water Consumed." All columns in the new line should have dashes, except the final column, which should have "91.2"
	120	5	heading	6–61	Change "SIC 35" to "SIC 33"
	202	8	4		Change "1051" to "1112"

GREAT LAKES BASIN COMMISSION FRAMEWORK STUDY ERRATA SHEETS (Cont.)

VOLUME	PG.	COL.	LINE	TABLE	CHANGE
Appendix 7	143	2	31	7–43	Change "Table 7–43" to "Table 7–44"
	144	1	31	7–44	Change "Table 7–44" to "Table 7–45"
	144	2	13	7–45	Change "Table 7–45" to "Table 7–46"
	148	2	26		Change "Figure 7–31" to "Figure 7–32"
	148	2	31	7–46	Change "Table 7–46" to "Table 7–47"
	209	2	25		Change "$53 million" to "$78 million"
	209	2	26		Change "$24 million" to "$54 million"
	209	2	27		Change "$65 million" to "$90 million"
	209	2	30		Change "$6.7 million" to "$3.1 million"
	209	2	31		Change "$10.8 million" to "$4.4 million"
	210	1	28		Change "$5.2 million" to "$2.4 million" and change "$7.1 million" to "$3.6 million"
	210	2	22		Change "$1.3 million" to "$0.6 million" and change "$1.7 million" to "$0.8 million"
	56			7–16	In title, insert "Advanced" between "Municipal" and "Wastewater"
	163	2	heading	7–56	Delete "($ Million)"
	163	3	heading	7–56	Delete "($ Million)"
	187			7–61	Add this footnote: "Note: Numbers in parentheses are explained in text directly above."
	198			7–64	In title, change "5.1" to "5.2"
Appendix 10	13			10–4	In list of utility abbreviations add: "TOEC PRI Toledo Edison Co."
	42			10–12	Add to title: "(million kWh)"
	74			10–19	Add to title: "(acre-feet per year)"
	75			10–20	Add to title: "(acre-feet per year)"
	77			10–24	Add to title: "(acre-feet per year)"
	77			10–25	Add to title: "(acre-feet per year)"
Appendix 13	42	7	2nd line from bottom	13–34	Change "(52.0)" to "(3.7)"
	42	8	2nd line from bottom	13–34	Change "3,855.0" to "272.4"
	45		footnotes	13–39	Change "**Less than 50 units to "**Less than 500 units"

GREAT LAKES BASIN COMMISSION FRAMEWORK STUDY ERRATA SHEETS (Cont.)

VOLUME	PG.	COL.	LINE	TABLE	CHANGE
Appendix 15	v	2	8		Change "few" to "fewer."
Appendix 17	34	1	final line	17–26	Change "4.4" to "4.1"
	79	1	6th line from bottom		Change "laws" to "lawns"
Appendix 19	8			19–7	Wrong table under correct title. Substitute attached table.
	97			19–65	Add "05083, Duluth-Superior, Wisconsin" to title.
	110	1	1–4		Move to top of column 2, page 109.
	169			19–158	In title, change "Lane" to "Land"
	172			19–162	In title, insert "of Pulpwood" between "Production" and "in"
Appendix 21	140	1	6th line from bottom		Change "Defiance" to "Tiffin"
	158				Figure 21–84: Change "Lomo" to "Como"
	159	1	2nd line from bottom		Change "Highes" to "Hughes"
Appendix 23	88	2	11		Change "hepatitis" to "encephalitis"
	88	2	12		Change "virema" to "viremia"
Report	42	1	13		Add "some of" between "in" and "the"

TABLE 19-7

Raw Steel Production by Districts

District	Production 1968	Production 1970	Percent 1968	Percent 1970
Districts on Great Lakes				
Buffalo	7,210,640	5,778,552	5.5	4.4
Chicago	26,744,918	28,236,109	20.4	21.5
Cleveland	7,735,050	7,091,860	5.9	5.4
Detroit	9,177,178	9,587,144	7.0	7.4
Total	50,867,786	50,693,665	38.8	38.6
Districts Partially Served by Great Lakes Ports				
Pittsburgh	25,302,790	24,558,848	19.3	18.7
Youngstown	10,750,408	10,112,467	8.2	7.7
Cincinnati	6,030,717	6,172,545	4.6	2.7
St. Louis	3,146,461	3,677,260	2.4	2.8
Total	45,230,376	44,521,120	34.5	33.9
Other Districts				
Northeastern	18,092,150	18,123,642	13.8	13.8
Southern	8,390,562	9,587,144	6.4	7.3
Western	8,521,665	8,405,167	6.5	6.4
Total	35,004,377	36,115,953	26.7	27.5
U.S. TOTAL	131,102,539	131,330,738	100.0	100.0

List of Counties in Each District:

Buffalo District
- Cortland, N.Y.
- Onondaga, N.Y.
- Niagara, N.Y.
- Chautauqua, N.Y.
- Erie, N.Y.
- Erie, Pa.
- Warren, Pa.

Chicago District
- Cook, Ill.
- Whiteside, Ill.
- Kankakee, Ill.
- Lake, Ind.
- Howard, Ind.
- Allen, Ind.
- Henry, Ind.
- St. Louis, Minn.
- Ramsey, Minn.

Cleveland District
- Cuyahoga, Ohio
- Lorain, Ohio

Detroit District
- Wayne, Mich.
- Macomb, Mich.

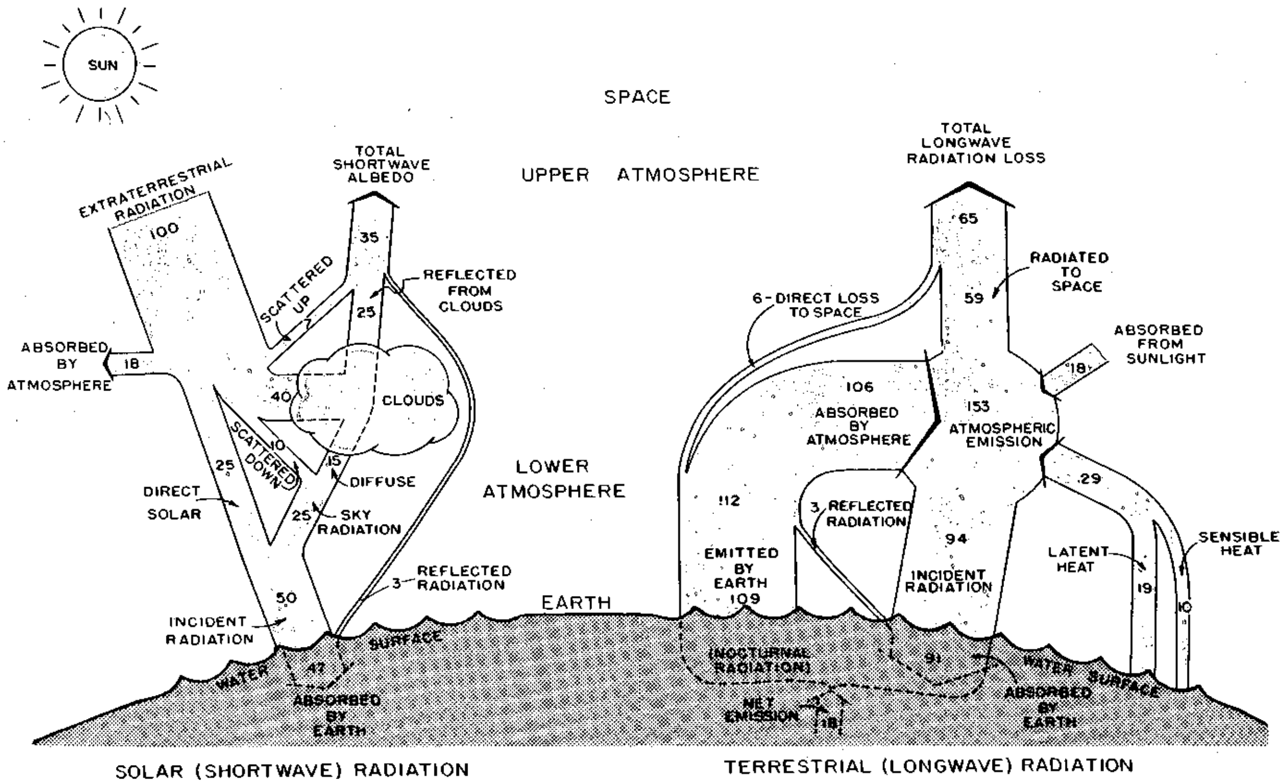
Pittsburgh District
- Cambria, Pa.
- Washington, Pa.
- Westmoreland, Pa.
- Beaver, Pa.
- Butler, Pa.
- Allegheny, Pa.
- Hancock, W. Va.
- Jefferson, Ohio

Youngstown District
- Lawrence, Pa.
- Mercer, Pa.
- Mahoning, Ohio
- Trumbull, Ohio
- Stark, Ohio
- Richland, Ohio

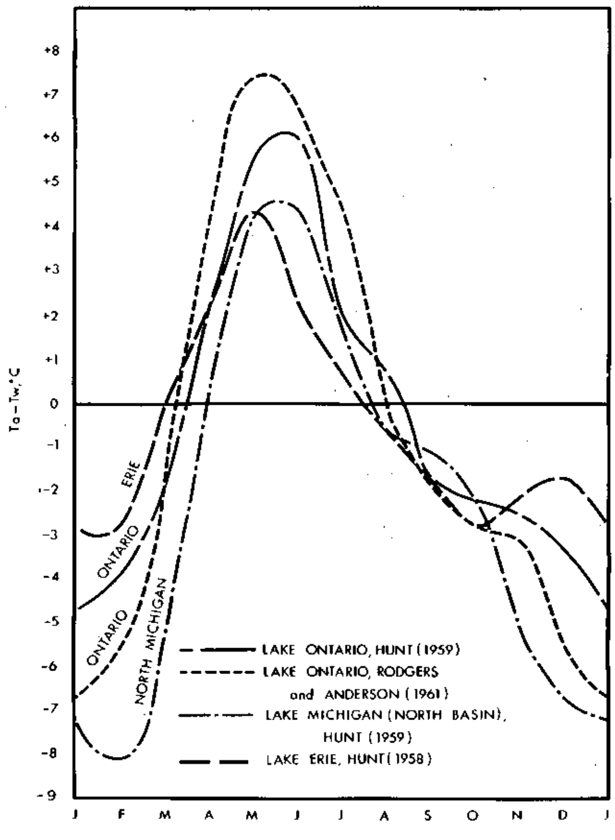
Cincinnati District
- Cabell, W. Va.
- Hamilton, Ohio
- Butler, Ohio
- Scioto, Ohio
- Boyd, Ky.
- Campbell, Ky.
- Daviess, Ky.

St. Louis District
- Peoria, Ill.
- Madison, Ill.
- Jackson, Mo.

SOURCE: Penton Publications, Marketing Library, Cleveland, Ohio



Replaces Figure 4-93



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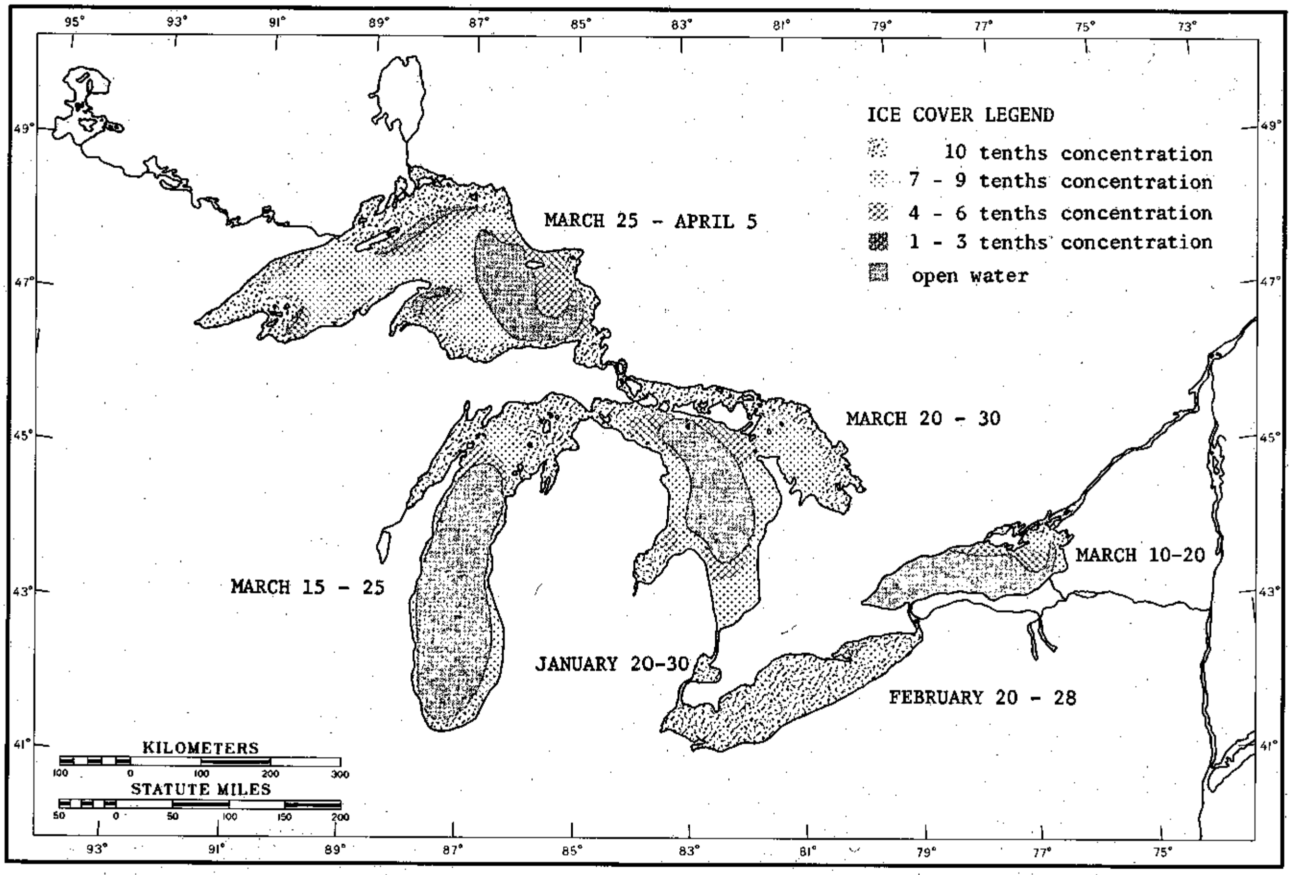

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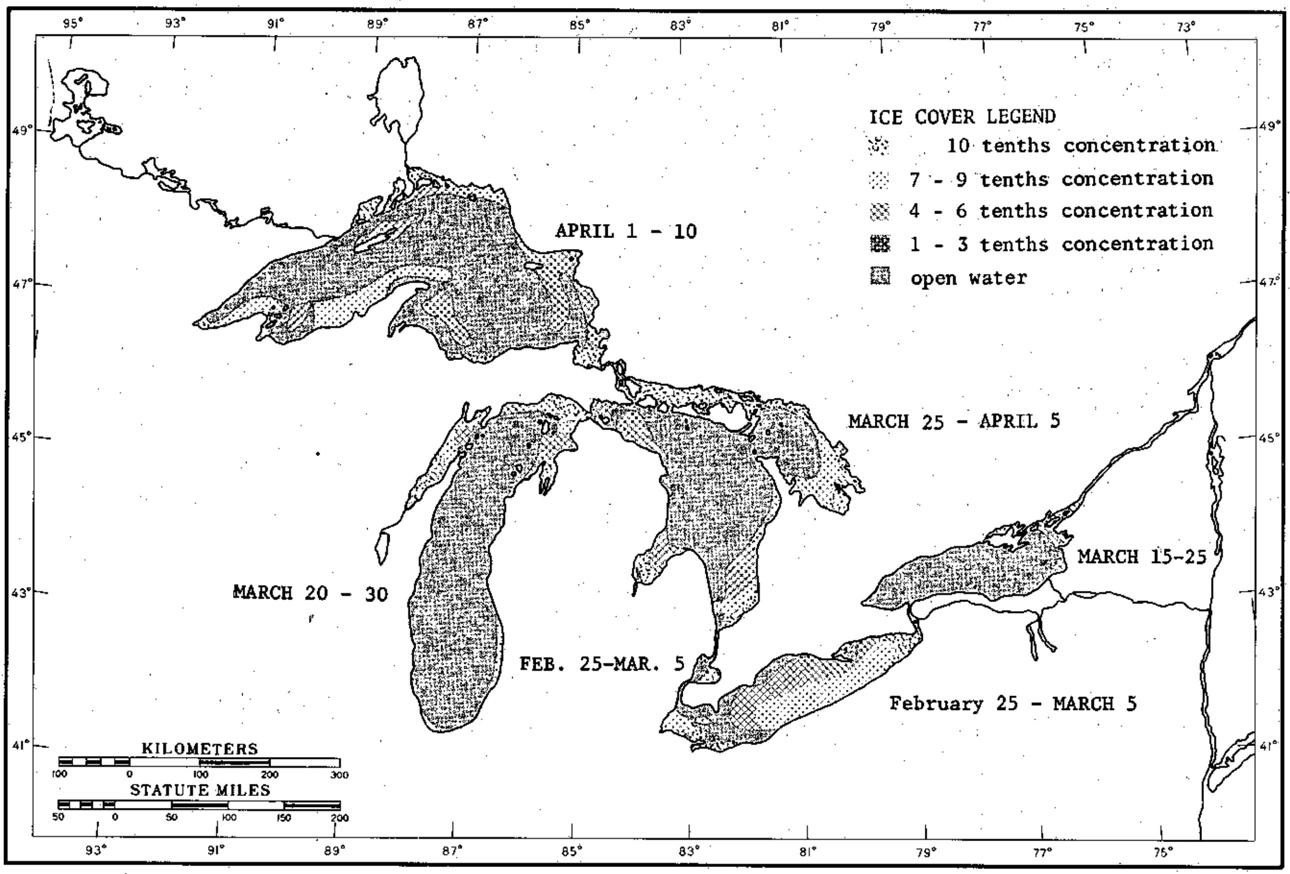

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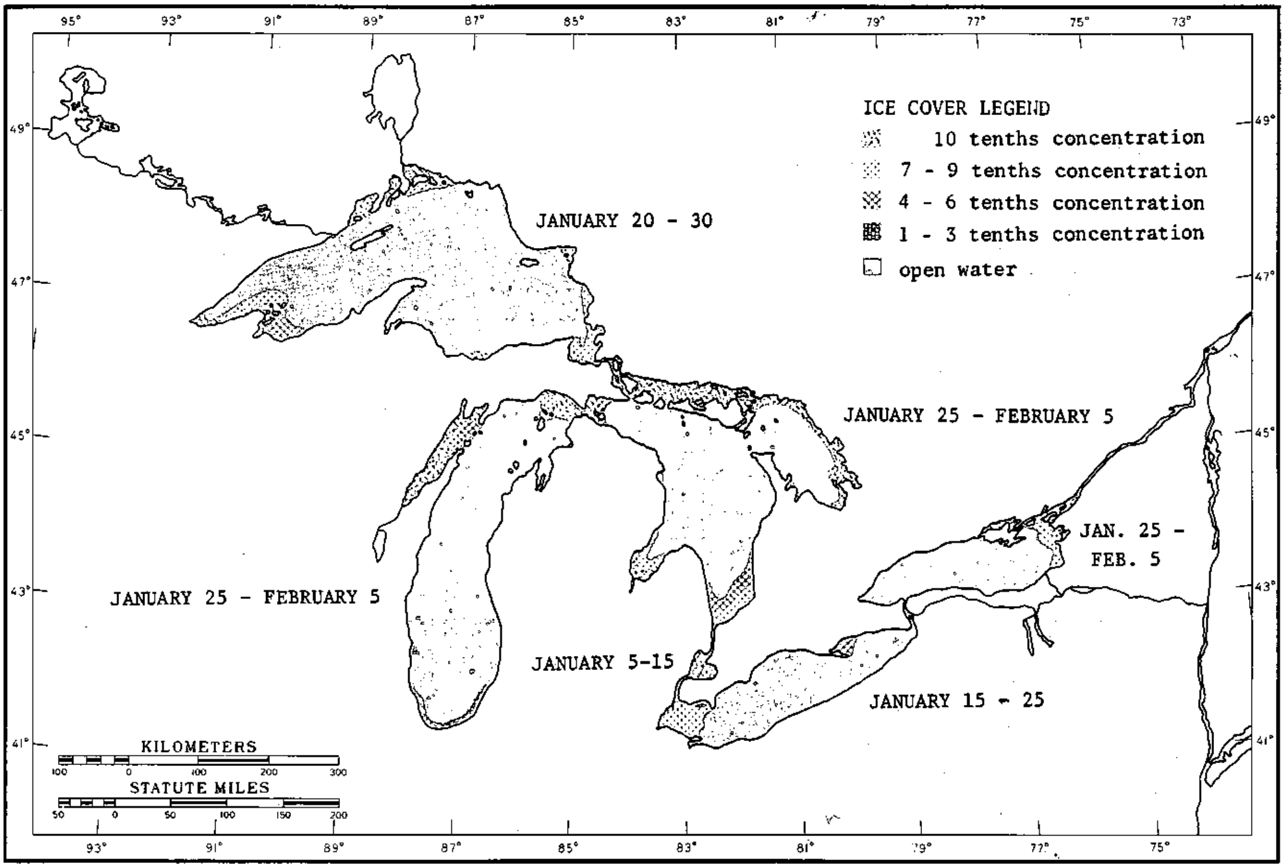

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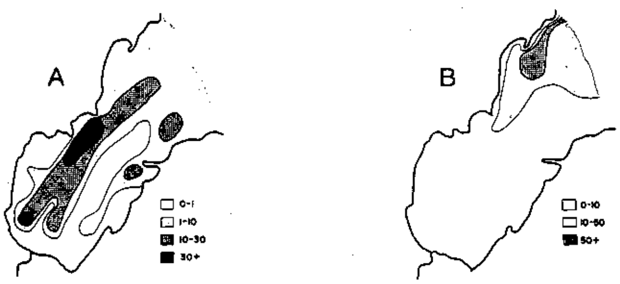

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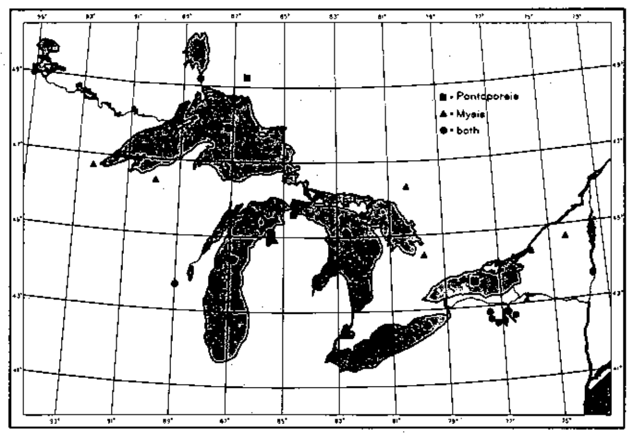

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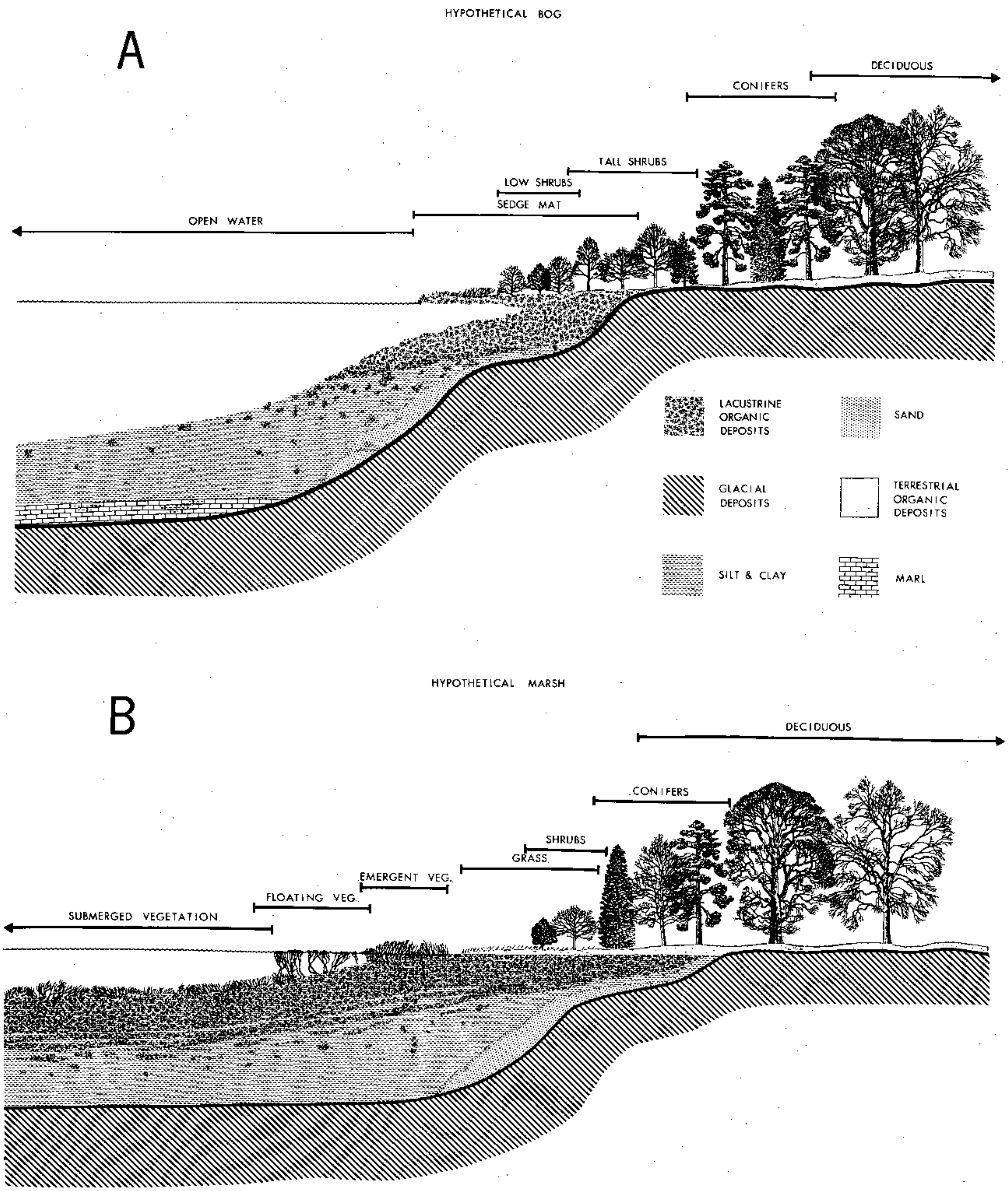

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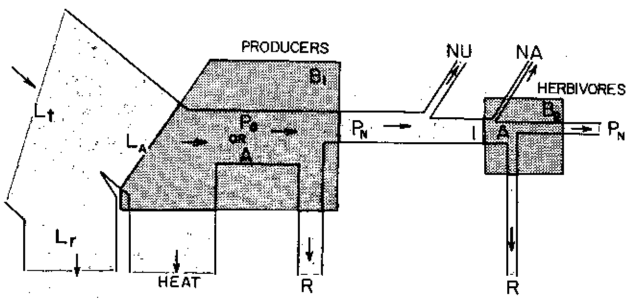

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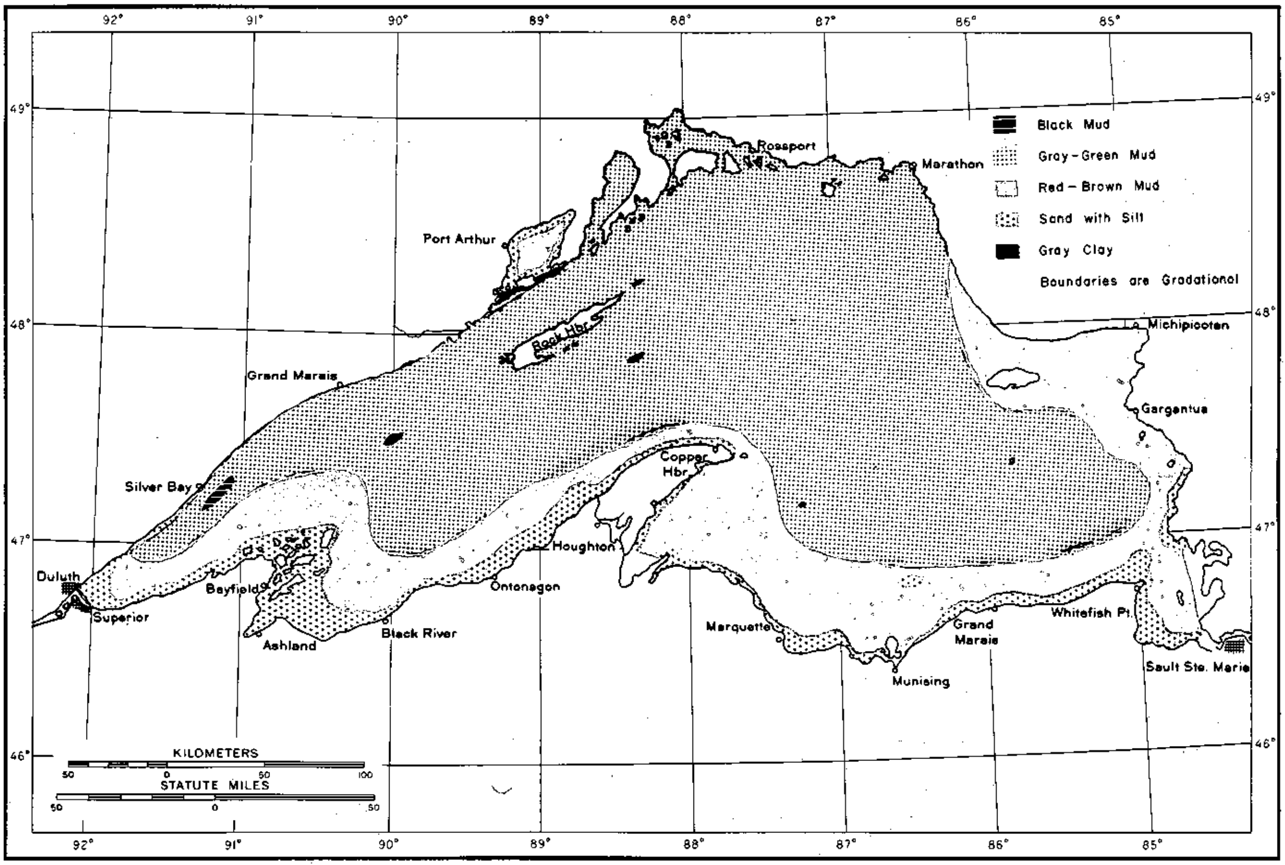

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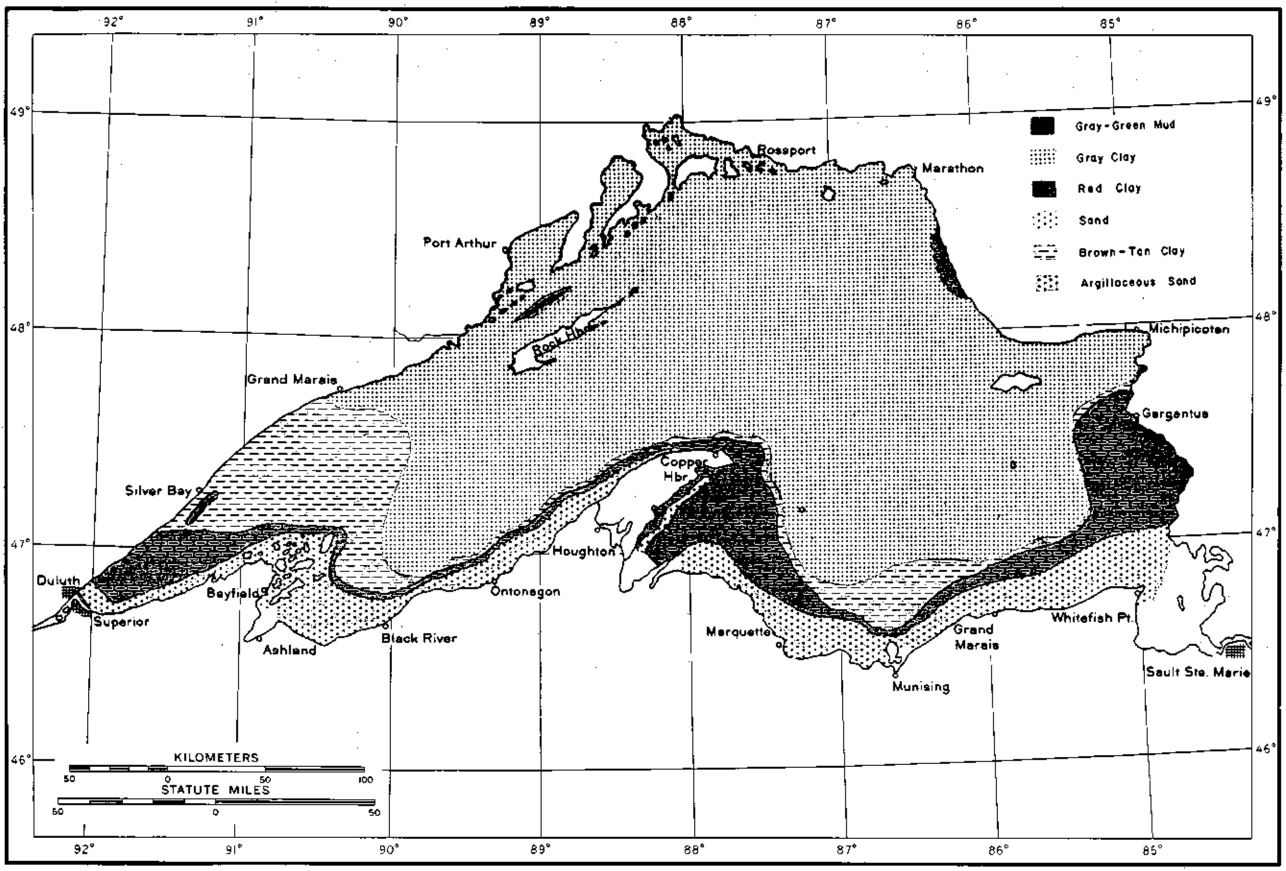

Replaces Figure 4-268

Great Lakes Basin Framework Study

APPENDIX 1

ALTERNATIVE FRAMEWORKS

GREAT LAKES BASIN COMMISSION

Prepared by Surface Water Hydrology Work Group

Sponsored by U.S. Department of the Army

Corps of Engineers

Published by the Public Information Office, Great Lakes Basin Commission, 3475 Plymouth Road, P.O. Box 999, Ann Arbor, Michigan 48106. Printed in 1976.
Cover photo by Kristine Moore Meves.

This appendix to the Report of the *Great Lakes Basin Framework Study* was prepared under the auspices of the Great Lakes Basin Commission to provide data for use in the conduct of the Study and preparation of the *Report*. The conclusions and recommendations herein are not necessarily those of the Basin Commission. The recommendations of the Great Lakes Basin Commission are included in the *Report*.

OUTLINE

include appendix # after title

SYNOPSIS

This appendix describes the formulation carried out as a part of the Framework Study and the results of those formulation procedures, including the anticipated results of the framework solutions or programs selected. Costs are estimated to the end of the study period, which is the year 2020.

The appendix contains sufficient description of the Basin, its economic and demographic characteristics, and its water and related land resources to permit an understanding of the existing situation and the problems anticipated. It describes the basis on which projections of requirements and needs were made for the years 1980, 2000, and 2020, and the quantification, where practicable, of 23 resource needs at these years.

The methods used to determine the ways to meet needs are described, and tables are included to show the results to be expected from the solutions or programs chosen. Estimates of capital cost and of operation, maintenance and replacement costs are provided by time periods, broken down into Federal costs, public non-Federal costs, and private costs. Summary cost tables are provided.

Two separate frameworks are included. One is the Normal Framework (NOR), based almost entirely on projections stemming from the OBERS Series C Economic and Demographic Projections (National Economic Development, or NED, objective). The other is the Proposed Framework (PRO), which differs from the Normal Framework in certain respects. It is an effort to reflect the desires of the people in various parts of the Basin and the decisions of the Great Lakes Basin Commission with respect to certain developments. Both frameworks are fully treated with respect to outputs and costs.

The appendix provides information broken down by States, Lake basins and by planning subareas or river basin groups.

For additional detail on the existing situation, the methodology used in making projections, the single-purpose solutions proposed, and some of the cost estimating procedures, reference should be made to the 22 basic resource appendixes.

FOREWORD

The *Great Lakes Basin Framework Study* is the first study undertaken by the Great Lakes Basin Commission, a State-Federal organization established by Executive Order No. 11345, dated April 20, 1967, under the authority of Section 201 of Public Law 89–80, the Water Resources Planning Act of 1965. Under this act the Great Lakes Basin Commission 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. Appendix 1, *Alternative Frameworks*, and the Framework Study of which it is a part, represent the first steps towards preparation of a Comprehensive Coordinated Joint Plan (CCJP) for the development and utilization of the water and related land resources in the Great Lakes Basin. The CCJP is one of the major responsibilities of the Commission under the Water Resources Planning Act.

The authority of the Great Lakes Basin Commission, and therefore the scope of the 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 Framework Study represents the combined efforts of all the Great Lakes Basin Commission member agencies, coordinated by the Commission staff headquartered in Ann Arbor, Michigan. The States of Illinois, Indiana, Michigan, Minnesota, New York, Ohio, Pennsylvania, and Wisconsin played a major role in the formulation of frameworks for those planning subareas and Lake basins within their geographic areas. Because of their heavy involvement in water and related land resources programs, the U.S. Army Corps of Engineers and the Department of Agriculture were represented on all framework formulation task forces. The Department of the Interior was often involved through the Bureau of Outdoor Recreation and the Fish and Wildlife Service (formerly the Bureau of Sport Fisheries and Wildlife). The Environmental Protection Agency was represented in most cases, or provided input on special request. Matters dealing specifically with the Lakes involved the Lake Survey Center of the Department of Commerce. Other agencies were represented as appropriate. Even when representatives were not actually present at task force meetings, they provided background information and represented their agency's concerns during the decision-making process. Planners from regional agencies, representatives from private groups such as American Association of University Women and League of Women Voters, as well as concerned and interested individuals, also served on the task forces for formulation or acted as observers.

Thus, it is believed that the framework formulation fairly represents the professional knowledge of the Federal and State agencies having specific responsibilities in the Basin and also the judgment, aspirations, and desires of the people in each part of the Basin.

The 15 plan formulation task forces worked under the general direction of the Plan and Program Formulation Committee. A member of the staff of each Commissioner, either the Commissioner or a technical assistant, comprised the committee. The Chairman was Leonard T. Crook, Executive Director and Planning Director, Great Lakes Basin Commission.

The chairmen of the task forces were members of the Commission staff. The following Commission staff members directed the work in the various Lake basins toward preparation of the initial drafts of text and tables reporting the formulation process and results.

Lake Superior
  Eugene A. Jarecki
Lake Michigan
  Eugene A. Jarecki
  John L. Hull
  David C. N. Robb
Lake Huron
  John L. Hull
Lake Erie
  Kenneth E. McElroy
  Paul Vachon
  Leonard T. Crook
Lake Ontario
  Kenneth E. McElroy
  Paul Vachon

Alfred Behm of the Corps of Engineers, North Central Division, provided coordination with the Upper Mississippi River Comprehensive Basin Study in River Basin Group 2.2.

Throughout the study period many permanent and temporary members of the Basin Commission staff participated in calculations and preparation of tables. Suzanne Braley and Susan Green were responsible for compiling many of the final tables throughout the appendix.

Compilation of the appendix, including writing of Section 1 to 5 and Sections 11 and 12, was the responsibility of O. C. Reedy of the Commission staff, with the assistance of Martha W. Deline. M. Annette Ketner supervised the design and production of the volume.

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INTRODUCTION

The primary function of the Alternative Frameworks Appendix is to document the *Great Lakes Basin Framework Study* plan formulation process and to present the results of that process. In draft form, it also served as a basic working document for those individuals and organizations directly involved.

The reader is referred to the *Report* for a description of the Framework Study, its conclusions and recommendations. Basic information on available resources and present and projected requirements, needs, and problems related to the water and related land resources in the Great Lakes Basin are presented in Appendixes 2 through 23. The *Environmental Impact Statement* contains information on the effects the Proposed Framework may have on the environment.

The basic purpose of the *Great Lakes Basin Framework Study* is to identify geographic areas and resource categories where future demands as compared with available supplies may create problems in meeting the needs of the people of the Basin for water and related land resources. Geographic areas and resource categories where potential conflicts exist between competing resource uses are also identified. As a first step toward a comprehensive coordinated joint plan for management of the resources of the Great Lakes Basin, this study provides a rational framework to formulate and evaluate the relative merit of alternative courses of action to solve the current and potential problems, resolve the potential conflicts, and meet the needs of the people at a minimum cost.

The Framework Study was accomplished under guidelines established by the United States Water Resources Council. These were initially dated October 1967, but were upgraded to reflect the multiobjective concepts stated in the 1970 draft "Principles and Standards." These were not rigorously applied but had considerable influence on the planning process. The objectives are:

(1) to enhance national economic development
(2) to enhance the quality of the environment
(3) to enhance regional development
(4) to enhance social well-being or quality of life for all people.

While the Great Lakes Basin Commission recognized the validity of the objectives promulgated by the Water Resources Council, it also recognized that to identify one objective as environmental was to imply that the others might not consider environmental quality, and that this might be misleading.

Accordingly, other terms were adopted and the objectives are referred to in this study as Normal Growth (NOR), Limited Growth (LIM), and Accelerated Growth (ACC).

The Framework Study is a broad appraisal of the needs and desires of citizens of the Great Lakes Basin for the conservation, development, and utilization of water and related land resources. It identifies the regions (hydrologic, political, economic, etc.) that have current or potential problems and require more detailed investigations and analyses. It recommends implementation of plans and programs in areas not requiring futher study. It considers Federal, State, and local means, both structural and nonstructural, for dealing with the problems within the framework of the major objectives stated previously.

The *Great Lakes Basin Framework Study* did not involve basic data collection, cost estimating, or detailed formulation of projects. It was not designed to give specific answers to what should be done; rather, it was intended to indicate possibilities that should be considered and consequences of these choices.

The Framework Study formulation process consisted of five major steps. Step 1 involved an assessment of the present resource capability. In Step 2, the goals, objectives, subobjectives, criteria, and problems of water and related land resources in the Great Lakes Basin were defined, mainly in qualitative terms. In Step 3, the quantitative requirements and needs for water and related land resources were derived. In Step 4, alternative programs were proposed to meet the needs determined in Step 3 and solve the problems. Finally, in Step 5, the economic, demographic, and physical consequences of the alternative programs proposed in Step 4 were estimated.

In assessing the present resource capability the year 1970 was selected as a standard base, and the results are summarized in the tables provided in this appendix. Resource capability is summarized in the *Report* and described in detail in Appendixes 2 through 23.

The process of defining goals, objectives, subobjectives, criteria, and problems is discussed in detail in the body of this appendix. Three time spans were considered in this and other framework studies throughout the nation: a short-range period ending in 1980, a medium-range period ending in the year 2000, and a long-range period ending in the year 2020. It must also be recognized that in multiobjective planning the goals, objectives, subobjectives, criteria, and problems differ greatly and dynamically among many other factors. For example, the aspirations of an individual change dramatically both from day to day and over a long time as changing circumstances and varying physical and intellectual contingencies have their effects. The interests of an individual are usually much narrower and more immediate than those of an interest group, local government, State government, Federal government, or international body. These differences become dramatically evident in the process of attempting to quantify requirements and needs. For the majority of categories of water and related land use, requirements are a function of total population and the direct or indirect per capita demand for the resource. Since needs are simply the difference between requirements and available developed supply, determination of needs to be met in the formulation process depends heavily on projected levels of population and per capita demand.

Traditionally, planning has been predicated on the basic concept that growth is inevitable; indeed, that it is good and therefore desirable. Thus, future populations and per capita demands have normally been projected within relatively narrow ranges of variability by extrapolating trends by simple or elaborate methods. The development of requirements and needs was basically a matter of a simple mathematical calculation, and problem identification was basically the process of identifying unmet needs in time and place. The plan formulation process then became one of selecting alternative means of meeting those needs that would not be detrimental to the economy of the environment.

The last decade, however, has seen a radical change in planning philosophy. Questions, which at one time were never asked, or whose answers were considered extraneous to the planning process, have now become a part of the planning process itself. These include questions as to whether a *laissez-faire*, perpetual growth philosophy is really desirable or acceptable, let alone inevitable. The new environmental awareness has forced a shift in emphasis from rather simple single-purpose structures for water supply and pollution control to coordinated management schemes involving nonstructural as well as structural measures for total environmental management. Goals of social wellbeing and environmental quality have become major considerations to the public and major problems for the planner who must translate them into quantitative criteria, standards, requirements, and needs. These significant shifts in the desires of individuals and collective groups at all levels of government have made the planning process substantially more complex, but at the same time more relevant and controversial.

To facilitate the planning process, the Great Lakes Basin was subdivided into five Lake basins numbered in downstream order: Lake Superior, 1.0; Lake Michigan, 2.0; Lake Huron, 3.0; Lake Erie, 4.0; and Lake Ontario, 5.0. See map of Great Lakes Basin (Figure 1–1). The Lake basins were then subdivided into 15 river basin groups with two to four to each Lake basin, depending upon stream configuration, political boundaries, and population concentrations. Because much of the information to be used was available only on a political subdivision basis, the Region (the political boundary equivalent of the Basin) was also subdivided into 15 planning subareas, utilizing county lines as boundaries to approximate as closely as practicable the hydrologic boundaries of the river basin groups. This subdivision is illustrated on Figure 1–2.

Section 1 contains a list of the counties in the Basin, arranged by planning subareas, and a list of the river basins and complexes arranged by river basin group.

As an initial phase of the planning process, the task of assembling information on available resources and on needs and problems was divided among 22 work groups, each having a specific subject area or function for study and analysis. The general procedure was for each work group to assemble data pertinent to its subject field from published and unpublished information. Historical information to show trends was utilized, and the most recent information available was obtained. The base year adopted for common data comparisons was 1970, and in those cases where the latest best information was for another year, an estimate was made for the base year. Projections were made of the requirements or demands for the particular resource under study for each of the three target years, 1980, 2000, and 2020. The projections were based on the projected population and economic growth presented in the OBERS studies, a population and economic growth study of the nation prepared by the Office of Business Economics (OBE), Department of Commerce; and the Economic Research Service (ERS), Department of Agriculture. As a result of reorganization, the OBE was renamed Bureau of Economic Analysis, but the acronym OBERS is still used. These studies were appropriately disaggregated to the 15 planning subareas.

The requirements or demands generated by each resource use, or function, were compared with the available developed resource for each function in each planning subarea. The developed resource in each planning subarea in 1970, known as the supply, compared with the demands or projected demands for the base year and the three target years, provided information on the needs to be met in each of these years. Needs are, in other words, the measure of the extent to which the presently developed resources fail to meet the projected requirements. Each of the work groups also identified existing and potential problems in its subject area, and each of them suggested ways in which the problems could be solved and the needs met.

This historic information and the projections, together with the estimates of requirements, needs, supply, the statement of problems, and the analysis of the ways to solve problems and meet needs, provided the basic input to framework formulation. The actual formulation was undertaken by 15 task forces, one for each planning subarea in the Basin. Each task force consisted of a member of the Commission staff, representatives of the Departments of Agriculture and the Army, representatives of the States, and representatives of other Federal agencies as appropriate. The initial work of formulation was generally undertaken independently by the task forces. In some cases the task forces met with representatives of local interest groups or with individuals who had particular qualifications or interest in the area and were in a position to spend time working in the formulation process. In other cases the local input was obtained through existing reports, consultation with professional personnel in the area who had knowledge of local attitudes, and by written communication.

For each of the functions all conceivable alternative ways of meeting needs and solving problems were listed and considered by the task forces. Some of these could be quantified as having a specific identifiable effect on the needs to be met. Others were qualitative only, and some had so little impact that they were dropped from further consideration. The solutions chosen by the task forces in each case were identified in sufficient detail to permit reconstructing the planning process. The necessary documentation was prepared and tabular presentations made of needs, problems, needs met, needs unmet, types of solutions adopted, costs to Federal, non-Federal, and private entities, and other pertinent information.

In some cases needs arising in one planning subarea could be met in another, and a fully developed formulation procedure would include a formal transfer of needs and selection of programs in the receiving area to meet these needs. In the present study such a formal procedure has not been followed. For some functions the methodology for quantifying needs incorporated patterns of meeting needs that included the use of resources in one area by persons from another. In outdoor recreation, for example, established patterns of travel result in the recreation requirement (need) at the forest campground rather than at the permanent residence. Also, for some functions such as commerical navigation, the whole of a Lake basin rather than a single planning subarea is the element to be considered. If the availability of a resource in a certain planning subarea permitted, programs were sometimes selected that would develop the capability of the resource above the needs in that planning subarea. This would help offset the inability of that resource to meet the needs in other planning subareas.

The frameworks for each Lake basin and for the Great Lakes Basin are obtained by summing up the planning subarea quantities. Thus, for some functions, unmet needs in one area are absorbed by surplus resource capability in another. This assumption of transferability is not always appropriate. An examination of the specific circumstances must be made in each case, and some adjustments may be required.

In the six-county area in Illinois in Planning Subarea 2.2, needs met by programs adopted for the *Upper Mississippi River Comprehensive Basin Study* were transferred to that study area and the remainder were met, insofar as possible, in *Great Lakes Basin Framework Study* programs.

The formulation process was initially carried through for projections based on the Normal Growth (NOR) objective, developed from the OBERS projections, and subsequently the same process was repeated to a limited extent and with appropriate modifications for two additional objectives, labeled ACC and LIM for accelerated and limited growth.

The ACC and LIM frameworks were only partially developed, not as potential alternative frameworks for consideration by the Commission, but rather as planning tools to define and limit the extreme positions of high and low demands on the water and related land resources of the Basin. They were not fully developed in any respect, and are not published. These frameworks bracket the NOR Framework, and they provided the planners with guidelines to assist in selecting the final mix of developmental and environmental considerations for the Proposed Framework. The elements of ACC framework reflected needs for water and related land resources based on maximum possible population and maximum possible per capita demand on all portions of the resource base. The LIM framework, on the other hand, was based on requirements projected on the basis of limited population growth in the Great Lakes Basin and decreasing per capita use of the resources.

The frameworks prepared by the task forces were reviewed by a subcommittee of the Plan and Program Formulation Committee (Subsection 2.2) and by that Committee itself, and recommended to the Commission for consideration. At this time a series of meetings was held throughout the Basin to obtain the reactions of local interest groups and individuals to the emphasized objectives in the various parts of the Basin, and the detailed components of the frameworks developed pursuant to the objectives. Appropriate modifications were then made in the frameworks, and the information presented in this appendix is the result.

During the framework formulation process and in the preparation of this appendix, a number of annexes were suggested. These would cover certain items in more detail than required in the appendix, and would provide a permanent repository and reference for some information, keeping the size of the appendix within manageable limits. As work progressed, it was found that information in some of the five suggested annexes might be incorporated elsewhere, that some annexes should not be published because of questionable widespread value, and that others could be made available to persons who would have use for them. Because of frequent references to the letter designations of the annexes and the publication of Annex E in 1972 for use as a planning tool, the letter designations of the annexes have been retained, even though some of them are not now actively in use. The information below indicates the designations associated with the various annexes and the status of each with respect to publication and the data contained therein.

Annex A contains a list of counties by planning subarea and a list of basins and complexes by river basin group. This information has been incorporated into Section 1 of Appendix 1, and the annex is therefore not being prepared.

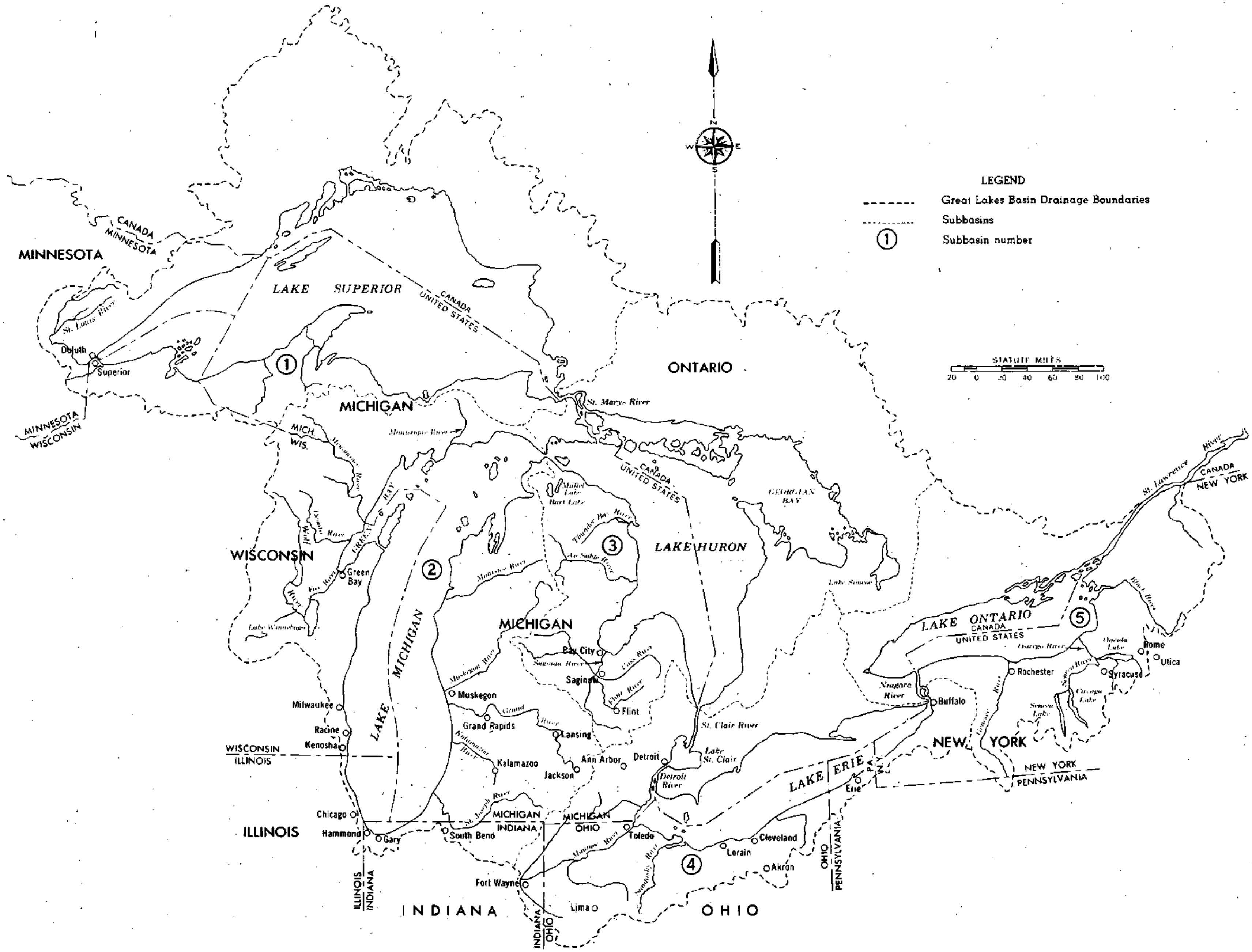
Annex B, "Procedures for Determination of Alternative Futures in the Great Lakes Basin Framework Study," gives a detailed discussion of alternative requirements including Alternative Demand Supply and Needs (ADSUN). This annex has been prepared and will be reproduced in limited quantity with copies available for reference to persons who need the information. It principally supplements Section 3 of Appendix 1.

Annex C consists of tables of requirements, supply, and needs by river basin groups for all time frames. This annex was proposed when it was expected that there would be separate needs developed for NOR and PRO Frameworks and that the working draft would also include the rudimentary ACC and LIM frameworks. When it was decided not to prepare separate needs for PRO, the annex became less desirable, and it was decided not to compile the information in this form. There will be no Annex C.

Annex D, "Issues and Alternatives," provides a record of the issues raised before the Commission, the decisions reached thereon, and the alternatives considered for the solution of problems and meeting of needs in the various resource use categories. It will be reproduced in limited quantity and will be available for reference to persons who have need for this information.

Annex E, "Programs, Capital Costs, and OM&R Costs," compiles work sheets used in the framework formulation process. It consists of tables that are a basic record of the program selections and the costs for the various elements of these program selections. Because of refinement in the data and a number of internal changes in the program selections and capital costs and OM&R costs, the annex is not correct and up-to-date and does not reflect accurately the information given in the tables of the appendix. However, it is the only record which shows the breakdown of program selections and the cost of these various components. It is not being corrected or updated because of the work involved. A number of copies have been distributed to persons who participated in the Framework Study, and additional copies, prepared in late 1972, are available in the Commission office for reference use and loan. The annex should be used with caution. The data should be checked against the information in Appendix I and the latter considered more reliable. However, for persons who wish to know some of the details of the preparation of the appendix and the selection of the frameworks, Annex E is a valuable document.

FIGURE 1-1 Great Lakes Basin



Section 1

BASIN DESCRIPTION

1.1 General

The physical setting of the Great Lakes Basin has influenced the development of the Basin, including the economic activities, the population, and the distribution of the population. The setting also played a principal role in determining the frameworks which were suggested for the conservation, control, and use of the water and related land resources of the Basin. The most significant single element in the physical setting is the series of five Great Lakes, the largest series of freshwater bodies in the world. This unique water feature, coupled with the mineral resources of the Basin and the agricultural opporunties afforded by the land, has produced a highly developed industrial and agricultural area, supporting 14 percent of the U.S. population in 4 percent of the total U.S. area, and contributing far more than its share of the country's economic activity.

Executive Order No. 11345 established the Great Lakes Basin Commission on April 20, 1967, and defined its jurisdiction to "extend to those portions of the Great Lakes States of Illinois, Indiana, Michigan, Minnesota, New York, Ohio, Pennsylvania, and Wisconsin that are drained by the St. Lawrence River system, including the Great Lakes, their tributaries, and tributaries to the St. Lawrence River which reach that river within the United States. . . ."

As defined, 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 (Figure 1–1). The Basin extends nearly 900 miles from west to east and 525 miles between its north-south extremes. General area information for the entire Basin as well as the study area is presented in Table 1–1.

1.2 Planning Subdivisions

For planning purposes the study area has been subdivided into five major subbasins, and further into fifteen river basin groups. The five subbasins are drainage areas in the United States of the five Great Lakes: Superior, Michigan, Huron, Erie, and Ontario including the St. Lawrence River. For convenience, these major subbasins are usually referred to as basins (Figure 1–1).

Some of the information needed for the study was available only by counties, without regard to drainage basin boundaries. Consequently, the term Great Lakes Region was adopted for this study as an approximation by county boundaries of the Great Lakes Basin. The Region does, however, include certain selected additional counties having an important economic relationship to the Basin. The Region is divided into five subregions having a similar county-boundary relationship to the five Lake basins. These subregions are shown on the maps as plan areas and use the same numbers, 1 through 5, as the corresponding basins. Each of the five plan areas has been further divided into groups of associated counties, called planning subareas (PSAs). The planning subareas are counterparts of the river basin groups. Both are numbered as decimal subdivisions of the respective plan areas and basins (Figure 1–2).

This breakdown of the study area considered many criteria including the utilization of existing water management study areas; the recognition of intrastate, State, interstate, and international interests; the collection, processing, and presentation of hydrologic, economic, and demographic data; and each area's potential for comprehensive water management. Many of these considerations are complementary, others are competitive. The adopted breakdown is consistent with these criteria.

The relationship of the various levels of subdivisions is illustrated in the partial listing in Table 1–2, which also shows the numbering system adopted.

1.2.1 Counties

Table 1–3 shows the counties in the Great Lakes Region, arranged by plan area and planning subarea. There are no duplications in this listing. All counties in the Great Lakes Region are shown, and none are shown which are not in the Region.

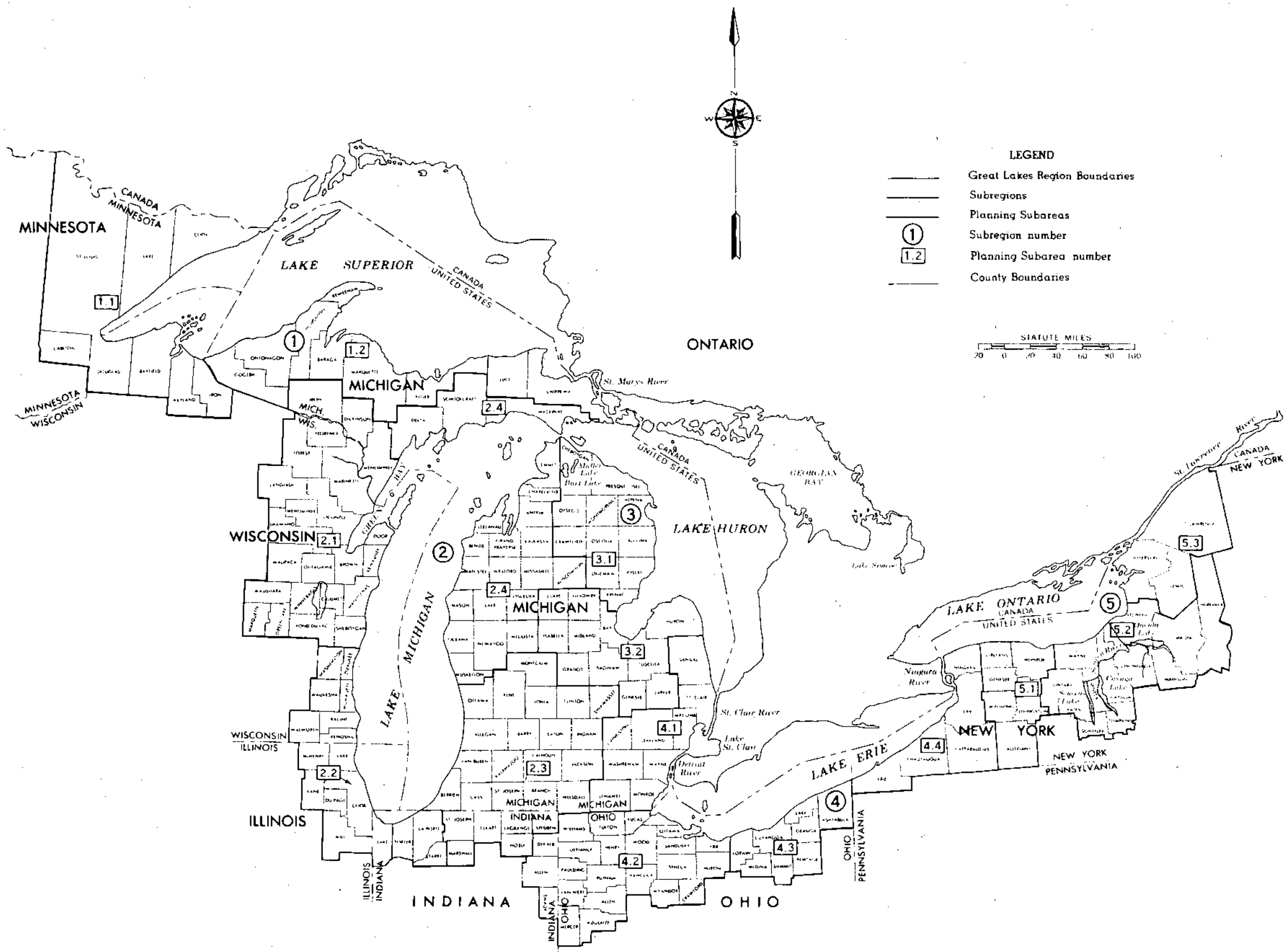


FIGURE 1-2 Great Lakes Region Planning Subareas

TABLE 1-1 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.

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 1-2 Hydrologic and Political Subdivisions

HYDROLOGIC SUBDIVISIONS	POLITICAL SUBDIVISIONS
GREAT LAKES BASIN	GREAT LAKES REGION
2.0 Lake Michigan Subbasin	2.0 Lake Michigan Plan Area
2.3 Lake Michigan Southeast River Basin Group	2.3 Lake Michigan Southeast Planning Subarea (25 counties)
St. Joseph River Basin Black River Complex Kalamazoo River Basin Ottawa Complex Grand River Basin	

1.2.2 River Basins and Complexes

Table 1–4 shows the interrelationships among the Lake basins, river basin groups, and hydrologic areas (river basins and complexes).

1.3 Land and Water Areas

The areas of the Region and Basin are given in Table 1–5 and Table 1–6, the information for which came from Appendix 13, *Land Use and Management.* The area by political boundaries (the Region) shows the water area (rivers, lakes, and embayments) and the remainder as land in thousands of acres. The area by hydrologic boundaries (the Basin) is shown in both square miles and thousands of acres for comparison. The basic measurements were made by different processes and treat some nearshore portions of the lakes differently.

The distribution of the area among the States is also shown in Figure 1–3.

1.4 Natural Characteristics

1.4.1 Geology, Physiography, Topography

Most of the rock formations that underlie the Great Lakes Basin were formed within the last half-billion years or since the end of Precambrian Era. A geologic reconstruction of the Region suggests that many forces have been at work, from superheated lavas and volcanics to widespread glacial action. In the Paleozoic Era, which was 500

TABLE 1–3 Counties in the Great Lakes Region by Plan Area and Planning Subarea

LAKE SUPERIOR--PLAN AREA 1.0

PSA 1.1--L. Superior West

MINNESOTA
Carlton
Cook
Lake
St. Louis

WISCONSIN
Ashland
Bayfield
Douglas
Iron

PSA 1.2--L. Superior East

MICHIGAN
Alger
Baraga
Chippewa
Gogebic
Houghton
Keweenaw
Luce
Marquette
Ontonagon

LAKE MICHIGAN--PLAN AREA 2.0

PSA 2.1--L. Michigan NW

MICHIGAN
Dickinson
Iron
Menominee

WISCONSIN
Brown
Calumet
Door
Florence
Fond du Lac
Forest
Green Lake
Kewaunee
Langlade
Manitowoc
Marinette
Marquette
Menominee
Oconto
Outagamie
Shawano
Sheboygan
Waupaca
Waushara
Winnebago

PSA 2.2--L. Michigan SW

ILLINOIS
Cook
Du Page
Kane
Lake
McHenry
Will

PSA 2.2 continued

INDIANA
Lake
La Porte
Porter
Starke

WISCONSIN
Kenosha
Milwaukee
Ozaukee
Racine
Walworth
Washington
Waukesha

PSA 2.3--L. Michigan SE

INDIANA
Elkhart
Lagrange
Marshall
Noble
St. Joseph
Steuben

MICHIGAN
Allegan
Barry
Berrien
Branch
Calhoun
Cass
Clinton
Eaton
Hillsdale
Ingham
Ionia
Jackson
Kalamazoo
Kent
Montcalm
Ottawa
St. Joseph
Shiawassee
Van Buren

PSA 2.4--L. Michigan NE

MICHIGAN
Antrim
Benzie
Charlevoix
Delta
Emmet
Grand Traverse
Kalkaska
Lake
Leelanau
Mackinac
Manistee
Mason
Mecosta
Missaukee
Muskegon
Newaygo
Oceana
Osceola

PSA 2.4 continued

Schoolcraft
Wexford

LAKE HURON--PLAN AREA 3.0

PSA 3.1--L. Huron North

MICHIGAN
Alcona
Alpena
Arenac
Cheboygan
Crawford
Iosco
Montmorency
Ogemaw
Oscoda
Otsego
Presque Isle

PSA 3.2--L. Huron Central

MICHIGAN
Bay
Clare
Genesee
Gladwin
Gratiot
Huron
Isabella
Lapeer
Midland
Saginaw
Tuscola

LAKE ERIE--PLAN AREA 4.0

PSA 4.1--L. Erie NW

MICHIGAN
Lenawee
Livingston
Macomb
Monroe
Oakland
St. Clair
Sanilac
Washtenaw
Wayne

PSA 4.2--L. Erie SW

INDIANA
Adams
Allen
De Kalb

OHIO
Allen
Auglaize
Crawford
Defiance
Erie
Fulton
Hancock
Henry
Huron

PSA 4.2 continued

Lucas
Mercer
Ottawa
Paulding
Putnam
Sandusky
Seneca
Van Wert
Williams
Wood
Wyandot

PSA 4.3--L. Erie Central

OHIO
Ashtabula
Cuyahoga
Geauga
Lake
Lorain
Medina
Portage
Summit

PSA 4.4--L. Erie East

PENNSYLVANIA
Erie

NEW YORK
Cattaraugus
Chautauqua
Erie
Niagara

LAKE ONTARIO--PLAN AREA 5.0

PSA 5.1--L. Ontario West

NEW YORK
Allegany
Genesee
Livingston
Monroe
Orleans
Wyoming

PSA 5.2--L. Ontario Central

NEW YORK
Cayuga
Herkimer
Madison
Oneida
Onondaga
Ontario
Oswego
Schuyler
Seneca
Tompkins
Wayne
Yates

PSA 5.3--L. Ontario East

NEW YORK
Jefferson
Lewis
St. Lawrence

million to 250 million years ago, the Basin was covered by shallow seas teeming with aquatic life. Sediment and evaporites from these seas formed the bedrock deposits of limestone, dolomite, other carbonates, sandstones, and shales, which characterize the Basin. Some of the world's greatest salt deposits occur in the lower Lake Michigan and Erie-Ontario regions, with thickness of almost 2000 feet reported.

Depressions in sedimentary strata over the Basin were the beginnings of the present five Lakes. Ice up to two miles thick covered the entire Region during thousands of years of climatic change. As the glaciers advanced and receded they scoured and

TABLE 1–4 River Basins and Complexes in the Great Lakes Basin

LAKE SUPERIOR BASIN 1.0

Lake Superior West, River Basin Group 1.1

- Superior Slope complex
- St. Louis River
- Apostle Islands complex
- Bad River
- Montreal River complex

Lake Superior East, River Basin Group 1.2

- Porcupine Mountains complex
- Ontonagon River
- Keweenaw Peninsula complex
- Sturgeon River
- Huron Mt. complex
- Grand Marais complex
- Tahquamenon River
- Sault complex

LAKE MICHIGAN BASIN 2.0

Lake Michigan Northwest, River Basin Group 2.1

- Menominee complex
- Menominee River
- Peshtigo River
- Pensaukee complex
- Oconto River
- Suamico complex
- Fox River
- Sheboygan-Green Bay complex

Lake Michigan Southwest, River Basin Group 2.2

- Chicago-Milwaukee complex

Lake Michigan Southeast, River Basin Group 2.3

- St. Joseph River
- Black River complex
- Kalamazoo River
- Ottawa complex
- Grand River

Lake Michigan Northeast, River Basin Group 2.4

- Muskegon River
- Sable complex
- Manistee River
- Traverse complex
- Seul Choix-Groscap complex
- Manistique River
- Bay de Noc complex
- Escanaba River

LAKE HURON BASIN 3.0

Lake Huron North, River Basin Group 3.1

- St. Marys complex
- Les Cheneaux complex
- Cheboygan River

River Basin Group 3.1 continued

- Presque Isle complex
- Thunder Bay
- Alcona complex
- Au Sable River
- Rifle-Au Gres complex

Lake Huron Central, River Basin Group 3.2

- Kawkawlin complex
- Saginaw River
- Thumb complex

LAKE ERIE BASIN 4.0

Lake Erie Northwest, River Basin Group 4.1

- Black River
- St. Clair complex
- Clinton River
- Rouge complex
- Huron River
- Swan Creek complex
- Raisin River

Lake Erie Southwest, River Basin Group 4.2

- Maumee River
- Toussaint-Portage complex
- Sandusky River
- Huron-Vermilion complex

Lake Erie Central, River Basin Group 4.3

- Black-Rocky complex
- Cuyahoga River
- Chagrin complex
- Grand River
- Ashtabula-Conneaut complex

Lake Erie East, River Basin Group 4.4

- Erie-Chautauqua complex
- Cattaraugus Creek
- Tonawanda-Buffalo complex

LAKE ONTARIO BASIN 5.0

Lake Ontario West, River Basin Group 5.1

- Niagara-Orleans complex
- Genesee River

Lake Ontario Central, River Basin Group 5.2

- Wayne-Cayuga complex
- Oswego River
- Salmon River complex

Lake Ontario East, River Basin Group 5.3

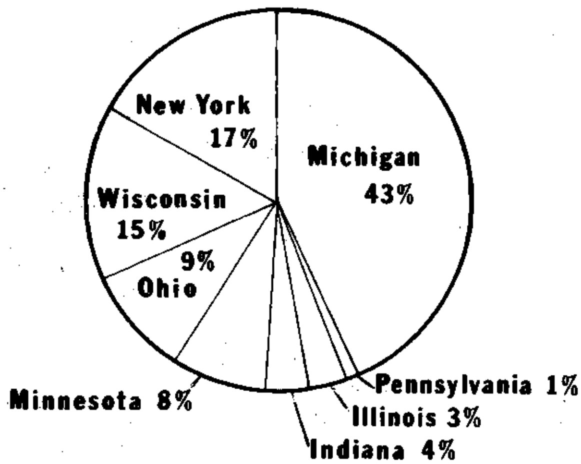
- Black River
- Perch River complex
- Oswegatchie River
- Grass-Raquette-St. Regis complex

TABLE 1-5 Land and Water Area, Great Lakes Region and Basin; by Plan Area, PSA or RBG, and State

Plan Area Planning Subarea & State	Political Boundaries 1000s Acres Total Area	Rivers, Lakes, and Embayments	Land Area	Hydrologic Boundaries Total Area 1000s of Acres	Square Miles	% of RBG	% of Lake Basin	% of Great Lakes Basin
1.0--Lake Superior	16,998.4	1,083.1	15,915.3	10,870.4	16,985	---	100	14.4
1.1	10,324.5	851.0	9,473.5	5,906.5	9,229	100	54.3	7.8
Michigan	---	---	---	83.8	131	1	----	----
Minnesota	7,317.8	737.9	6,579.9	3,930.9	6,142	67	----	----
Wisconsin	3,006.7	113.1	2,893.6	1,891.8	2,956	32	----	----
1.2	6,673.9	232.1	6,441.8	4,963.9	7,756	100	45.7	6.6
Michigan	6,673.9	232.1	6,441.8	4,905.0	7,664	99	----	----
Wisconsin	---	---	---	58.9	92	1	----	----
2.0--Lake Michigan	33,283.1	1,010.7	32,272.4	29,011.0	45,330	---	100	38.5
2.1	10,401.9	391.2	10,010.7	10,791.0	16,861	100	37.2	14.3
Michigan	1,936.6	46.8	1,889.8	2,300.8	3,595	21	----	----
Wisconsin	8,465.3	344.4	8,120.9	8,490.2	13,266	79	----	----
2.2	5,315.8	103.7	5,212.1	1,391.9	2,175	100	4.8	1.9
Illinois	2,401.3	34.0	2,367.3	38.4	60	3	----	----
Indiana	1,194.2	19.9	1,174.3	426.2	666	30	----	----
Michigan	---	---	---	106.2	166	8	----	----
Wisconsin	1,720.3	49.8	1,670.5	821.1	1,283	59	----	----
2.3	9,126.4	171.0	8,955.4	8,291.8	12,956	100	28.6	11.0
Indiana	1,608.3	27.9	1,580.4	1,084.8	1,695	13	----	----
Michigan	7,518.1	143.1	7,375.0	7,207.0	11,261	87	----	----
2.4	8,439.0	344.8	8,094.2	8,536.3	13,338	100	29.4	11.3
Michigan	8,439.0	344.8	8,094.2	8,536.3	13,338	100	----	----
3.0--Lake Huron	8,628.4	186.5	8,441.9	10,357.8	16,184	---	100	13.8
3.1	4,167.0	149.2	4,017.8	5,207.7	8,137	100	50.3	6.9
Michigan	4,167.0	149.2	4,017.8	5,207.7	8,137	100	----	----
3.2	4,461.4	37.3	4,424.1	5,150.1	8,047	100	49.7	6.9
Michigan	4,461.4	37.3	4,424.1	5,150.1	8,047	100	----	----
4.0--Lake Erie	15,876.0	197.6	15,678.4	13,734.4	21,460	---	100	18.2
4.1	4,062.1	81.7	3,980.4	3,328.0	5,200	100	24.2	4.4
Michigan	4,062.1	81.7	3,980.4	3,313.3	5,177	99	----	----
Ohio	---	---	---	14.7	23	1	----	----
4.2	6,368.7	49.2	6,319.5	6,634.9	10,367	100	48.3	8.8
Indiana	884.5	3.9	880.6	820.5	1,282	12	----	----
Michigan	---	---	---	328.3	513	5	----	----
Ohio	5,484.2	45.3	5,438.9	5,486.1	8,572	83	----	----
4.3	2,332.2	23.6	2,308.6	2,081.9	3,253	100	15.2	2.8
Ohio	2,332.2	23.6	2,308.6	1,978.9	3,092	95	----	----
Pennsylvania	---	---	---	103.0	161	5	----	----
4.4	3,113.0	43.1	3,069.9	1,689.6	2,640	100	12.3	2.2
New York	2,588.8	38.0	2,550.8	1,466.9	2,292	87	----	----
Pennsylvania	524.2	5.1	519.1	222.7	348	13	----	----
5.0--Lake Ontario	11,721.0	449.3	11,271.7	11,308.8	17,670	---	100	15.0
5.1	2,476.8	18.1	2,458.7	2,249.6	3,515	100	19.9	3.0
New York	2,476.8	18.1	2,458.7	2,188.8	3,420	97	----	----
Pennsylvania	---	---	---	60.8	95	3	----	----
5.2	5,682.6	255.2	5,427.4	4,362.9	6,817	100	38.6	5.8
New York	5,682.6	255.2	5,427.4	4,362.9	6,817	100	----	----
5.3	3,561.6	176.0	3,385.6	4,696.3	7,338	100	41.5	6.2
New York	3,561.6	176.0	3,385.6	4,696.3	7,338	100	----	----
TOTAL	86,506.9	2,927.2	83,579.7	75,282.4	117,629	---	----	----

TABLE 1-6 Land and Water Area, Great Lakes Region and Basin, by State

	Region--Political Boundaries			Basin--Hydrologic Boundaries		
	1000s Acres			Total Area		
State	Total Area	Rivers, Lakes, and Embayments	Land Area	1000s of Acres	Square Miles	% of Great Lakes Basin
Illinois	2,401.3	34.0	2,367.3	38.4	60	0.05
Indiana	3,687.0	51.7	3,635.3	2,331.5	3,643	3.10
Michigan	37,258.1	1,035.0	36,223.1	37,138.5	58,029	49.33
Minnesota	7,317.8	737.9	6,579.9	3,930.9	6,142	5.22
New York	14,309.8	487.3	13,822.5	12,714.9	19,867	16.89
Ohio	7,816.4	68.9	7,747.5	7,479.7	11,687	9.94
Pennsylvania	524.2	5.1	519.1	386.5	604	0.51
Wisconsin	13,192.3	507.3	12,685.0	11,262.0	17,597	14.96
TOTAL	86,506.9	2,927.2	83,579.7	75,282.4	117,629	100.00



State	Total Area in Region (1,000,000 acres)
Michigan	37.3
New York	14.3
Wisconsin	13.2
Ohio	7.8
Minnesota	7.3
Indiana	3.7
Illinois	2.4
Pennsylvania	0.5
Total Area in Region	86.5

FIGURE 1-3 Percentage of Total Region Area in Each State

gouged the land, leaving thick deposits of glacial material over much of the Basin. It was only after the retreat of the Wisconsin ice sheet about 11,000 years ago that the waters of the present Great Lakes began to collect. Subsequent isostatic readjustment of the earth's crust, some independent crustal warping, and natural erosion led to a drainage system that constitutes the Great Lakes Basin.

The areal geology of the Basin provides a separation of the entire Great Lakes drainage basin into three major physiographic provinces (Figure 1-4). The Superior Highlands of northern Minnesota, northern Wisconsin, and northwestern Michigan are in the Laurentian Uplands Province, or Laurentian Plateau. This area is generally characterized by low-lying swamps, poorly drained areas, and occasional ranges of hills. Elevations range from 600 to 1,200 feet. An outlying portion of the Laurentian Plateau includes the Adirondack Mountains of New York, east of Lake Ontario and south of the St. Lawrence River. Here the relief is sharply defined, with elevations up to 4,500 feet above sea level. The four lower Lakes and much of the drainage basin are in the Interior Lowlands Province, which is better drained than the Laurentian Uplands. Its pronounced ridges consist largely of glacial moraines and outcrops of resistant, dipping, older bedrock. The latter appears as the Niagara Peninsula of New York and Ontario and the Door Peninsula of Wisconsin. Elevations in the Interior Lowlands range from 700 to 1,000 feet. Minor portions of the drainage basins of Lake Ontario and Lake Erie are in the Appalachian Plateau Province. The adjacent higher area, which forms the Basin boundary, is the Allegheny Mountains, or Allegheny Plateau.

1.4.2 Climate

In general, the Great Lakes Basin experiences a

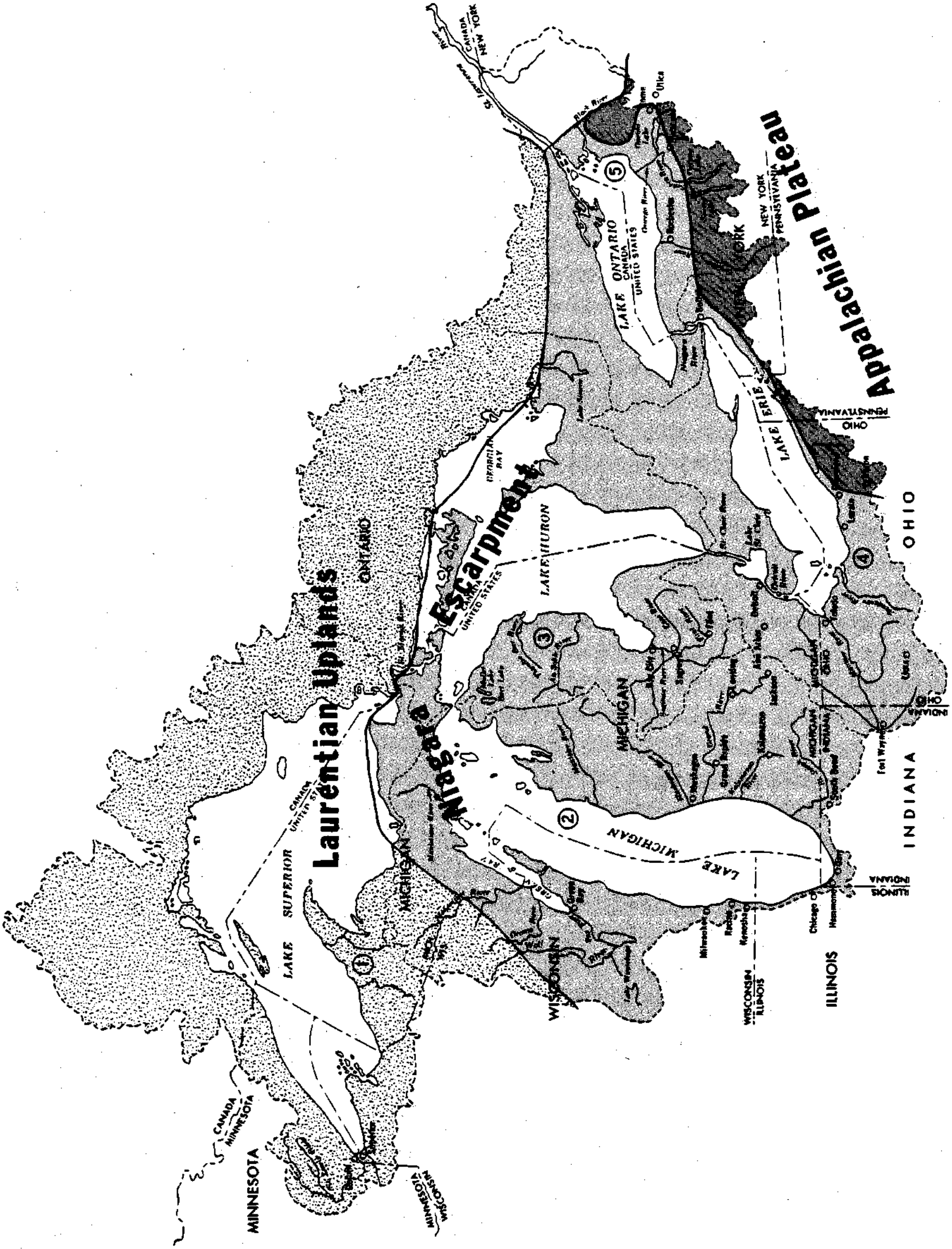


FIGURE 1–4 Physiography of the Great Lakes Region

continental to semimaritime climate that is largely determined by westerly atmospheric circulation (cyclonic storms), the Basin's latitudinal position between 40°30′ and 48°20′ N, and the modifying influence of the Great Lakes on local weather. Climate over the Region is normally humid throughout the year, with cold winters and cool summers in the north and warm summers in the south. Average annual frost-free season is about four months at the northern extremity of the Basin about six months at the southern extremity.

Prevailing winds in the Great Lakes area are from the west, although winds do blow from any sector. Winter winds of highest frequency and magnitude are from the west in the western half of the Basin. In the eastern half of the Basin, winter winds are most frequently from the west, southwest, and northwest. Summer winds are usually from the southwest and south throughout the Basin. There is a strong tendency for maximum wind vectors to be aligned with the long axes of the Lakes.

Mean annual surface air temperatures over the Basin range from approximately 39°F on Lake Superior to 49°F on Lake Erie. Minimum and maximum monthly temperatures occur in February and July, respectively, on all the Great Lakes. Differences in latitude cause a decrease in average monthly temperatures of about 10°F from south to north. The Great Lakes, which comprise about one-third of the area of the Basin, act as a medium for heat exchange between the water masses and the atmosphere. The Lakes tend to moderate temperature differences in adjacent land areas. Thus, the interiors of Michigan's upper and lower peninsulas are colder than the coastal areas at the same latitudes.

Short-term local variations in surface air temperatures can be extreme. It is not unusual for intense cells of cold arctic air to lower temperatures as much as 50°F in one day.

In addition to moderating air temperatures, the Great Lakes also change Basin humidity by contributing thousands of tons of moisture by evaporation. Estimates of the annual rate of evaporation on the surface of the Great Lakes range from a minimum of approximately 1.5 ft. on Lake Superior to approximately 3.0 ft. on Lake Erie. On an annual average the Great Lakes increase the humidity of the Basin approximately 15 percent.

Annual precipitation over most of the Great Lakes Basin including rainfall, snow, and less important modes of transfer of water from the atmosphere to the earth surface ranges from less than 28 to more than 37 inches. Annual snowfall ranges from 40 inches to 120 inches. In the southeastern and eastern portions of the Basin, the Adirondack Mountains and the Allegheny Plateau, the total annual precipitation increases to more than 47 inches. The relative uniformity of precipitation over a large area is due to the lack of any major topographic variation in the Basin and the uniformity of exogenous weather. Increases in precipitation on the southeastern edge of the Basin are caused by the higher elevations of those areas.

Precipitation decreases somewhat from the south to north and from east to west. Precipitation decreases with increased latitude because the colder atmosphere at high latitudes does not contain as much moisture as the warmer, southern atmosphere. The east-to-west precipitation decrease is caused by the interaction of the Lakes (moisture sources), the prevailing westerly winds, and Basin configuration. The prevailing exogenous winds have reduced moisture content after having crossed the plains. They receive moisture from the Lakes, and precipitation amounts increase toward the east. The Allegheny and Adirondack highlands trigger orographic precipitation in the eastern portions of the Basin.

Seasonally, the lake effect influences precipitation patterns in the Basin. Spring and summer precipitation is greater inland than over the Lakes and coastal areas. Conversely, winter precipitation is greater over the Lakes and coastal areas than inland.

1.4.3 Water Resources

The 95,000 square miles of Great Lakes surface area covers 32 percent of the entire Great Lakes drainage area in the United States and Canada. Relatively short, immature streams, inland lakes, and minor embayments constitute more than 2.9 million acres (4,500 square miles) of additional surface water in the Basin. Ground water is present throughout the Basin, but it is in very limited quantity in the areas where the basement rock is near or at the surface.

Surface and subsurface water resources are interconnected and in ample supply over the entire Great Lakes Basin. These water resources are constantly moving through a complex hydrologic cycle, in which water may be stored, be captured and used by local flora and fauna, be evaporated, or run off without use. Generally speaking, about one-third or 12 inches (63.2 billion gallons per day) of the water which falls annually as precipitation runs off the land into streams, lakes, and ultimately into the Great Lakes. Average annual runoff from major U.S. tributaries ranges from 9 to 38 inches due to differences in temperature, vegetation, terrain, surficial features, geology, and land use, as well as to differences in annual precipitation distribution. General low topographic relief and surfi-

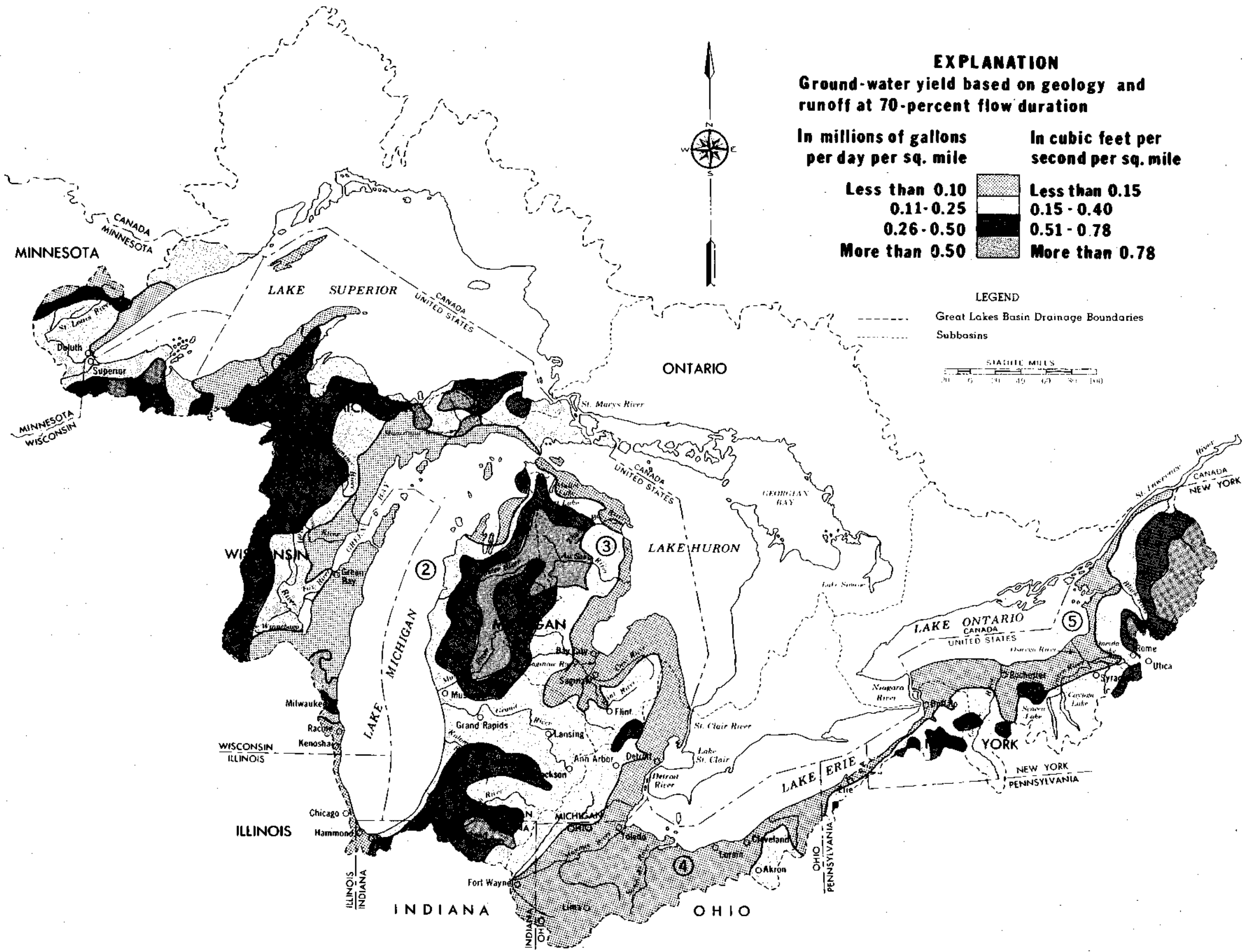


FIGURE 1-5 Estimated Ground Water Yield in the Great Lakes Basin

cial glacial deposits encourage infiltration of water, while numerous lakes, marshes, and peat bogs reflect poor development of regional surface drainage systems. Area streams are generally short, and their average annual flows are low for the amount of area drained.

Base flow of regional streams is derived largely from ground-water sources. Figure 1-5 shows that nearly half of the Basin's land area is underlain by aquifers that yield more than 0.25 million gallons per day per square mile (mgd per sq. mi.). Well yields in the Basin can range as high as 5,000 gallons per minute (gpm) in these areas. Average annual yield from ground-water systems in the Basin is estimated at 26 bgd (Table 1–7).

TABLE 1–7 Ground Water Potential, Based on 70% Flow Duration

Basin	Yield (mgd)
Lake Superior	4,240
Lake Michigan	11,710
Lake Huron	3,215
Lake Erie	1,945
Lake Ontario	4,910
TOTAL	26,020

The areas adjacent to Lake Superior and in the Adirondack region of New York have low yields because the underlying bedrock is the Precambrian crystalline complex. Elsewhere, in Pennsylvania, Ohio, and much of New York, the sedimentary bedrock formations also are low-yielding aquifers. In some Michigan and Indiana areas the water is too saline for use. Fresh water is present throughout the Basin, but saline water may be encountered in one or more aquifers almost any place in the Basin.

The Great Lakes represent the greatest freshwater storage system in the world (Table 1–8). Waters from Lake Superior, Lake Michigan, and the Georgian Bay all drain into Lake Huron, which transmits the water from these basins, as well as its own supply, to Lake Erie through the St. Clair River, Lake St. Clair, and the Detroit River. Lake Erie in turn transmits all of this water, plus the contribution of its own basin, through the Niagara River to Lake Ontario. The Lake Ontario outlet is the head of the St. Lawrence River. The factors of water supply to the Lakes are shown in Figure 1–6.

There is a progressive drop in surface elevation through the series of Lakes, as shown in Figure

TABLE 1–8 Great Lakes Surface Area, U.S. and Canada

Lake	Area (sq.mi.)	World Ranking (Freshwater)
Superior	31,700	1
Huron	23,000	4
Michigan	22,300	5
Erie	9,910	11
Ontario	7,340	14
TOTAL	94,250	

1–7. Twenty-two feet in elevation separate Lake Superior and Lake Huron. Lake Huron and Lake Michigan are one large reservoir at approximately the same level. Only eight feet in elevation separate Lakes Huron and Erie. The drop from Lake Erie to Lake Ontario is 325 feet, largely concentrated at Niagara Falls.

The chemical and biological characteristics of the Great Lakes system are undergoing rapid change except in Lake Superior. The Lakes changing the most are those surrounded by the greatest concentrations of human population. Significant increases in the last 40 years in levels of total dissolved solids, largely phosphates, calcium, sodium, sulfates, and chlorides, particularly in Lakes Erie and Ontario, are generally considered to correlate with the rapidly aging aquatic systems.

Total alkalinity (as $CaCO_3$) ranges from 46 parts per million (ppm) in Lake Superior to 113 ppm in Lake Michigan. The pH ranges from 8.0 to 8.5 for most of the waters, except Lake Superior, where the range is from 7.0 to 8.0. Sulfate concentrations are greater than chloride concentrations in the upper Lakes, and sulfates and chlorides are almost equal in Lakes Erie and Ontario. The proportions of calcium, magnesium, and sodium in the upper Lakes are about 10:3:1. Potassium usually averages around 1 ppm in all the Lakes. Silica usually fluctuates between 2 and 3 ppm, although only trace amounts of silica occur at times in the highly productive waters of Lake Erie. Concentrations of total phosphorus are low in the upper Lakes and are usually less than 5 ppm in the open waters of Lake Superior. The phosphorus content of water from Lake Erie is about six times greater than that in the the other Lakes. The dissolved oxygen content of much of the Great Lakes water is near saturation, even at the greatest depths, and supersaturation is common. However, dissolved oxygen concentrations of less than 1 ppm have been found

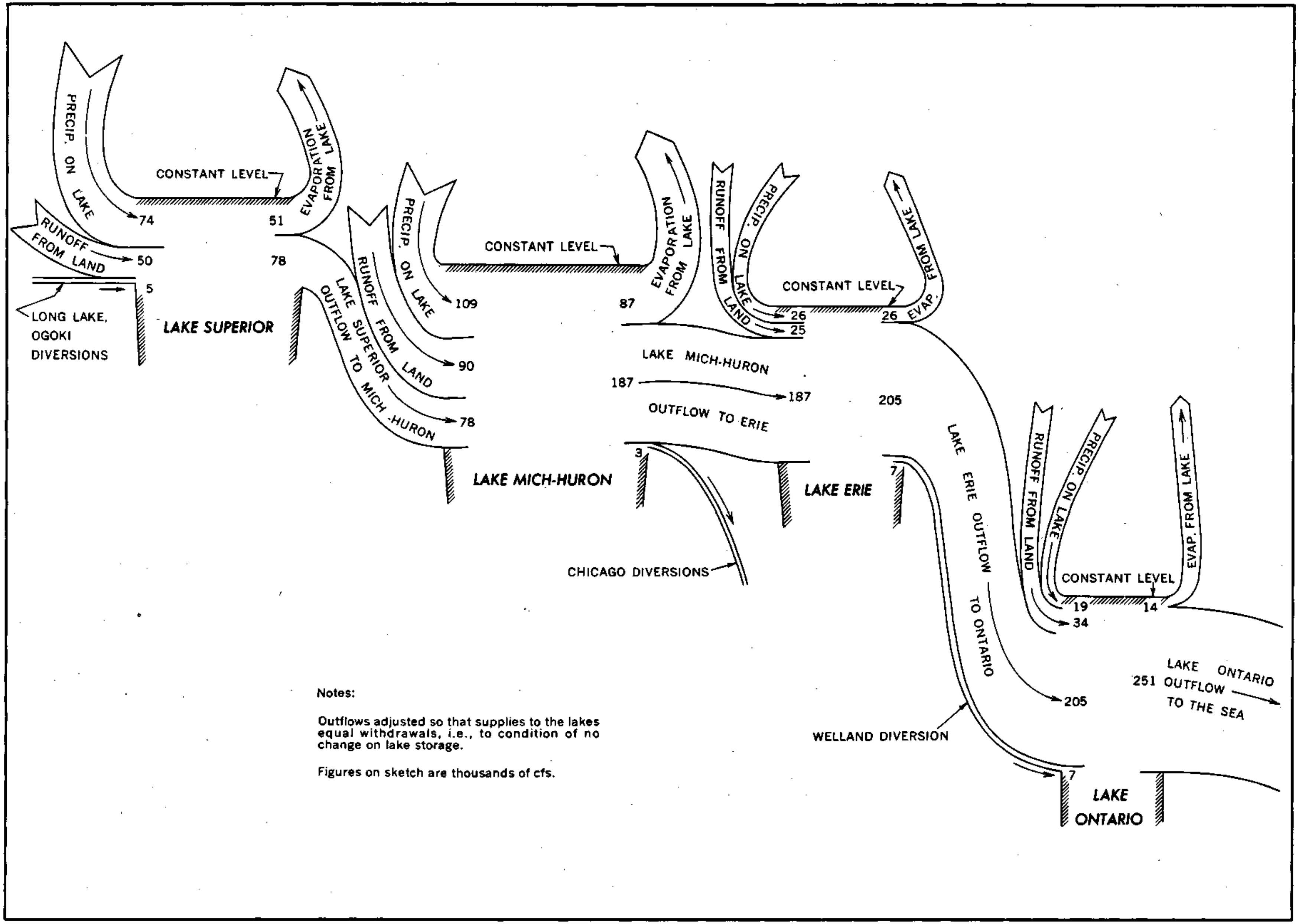


FIGURE 1–6 Factors of Water Supply to the Lakes, Average Values for Oct. 1950 to Sept. 1960

in Lake Erie in the bottom waters in an area of several hundred square miles of the central basin.

The plankton composition found in the Great Lakes is characteristic of large and deep lakes. Diatoms are the most important constituents of the plankton, although zooplankton may occasionally equal the diatoms in biomass but not in numbers. Blue-green and green algae are at times especially abundant in Lake Erie and Lake Ontario. However, even in Lake Erie diatoms usually comprise 75 percent of the phytoplankton.

1.4.4 Related Land and Other Natural Resources

A number of complex climatic, topographic, geologic, and human factors have combined to create basinwide differences in the quantity, quality, and distribution of soils, forests, minerals, fish, and wildlife resources.

1.4.4.1 Soils

The soil types of the Great Lakes Basin are determined by past and present climatic conditions, natural drainage, vegetative cover, and the breakdown of parent glacial material. The entire Basin was glaciated and left with drift that ranges in thickness up to 1,100 feet. Lacustrine deposits generally characterize the present lake shore areas while organic soils are common in inland swamp and marsh areas.

The soils of the Basin are best described in terms of areal groups which reflect soil origin and composition in terms of management practices. In Minnesota, the Upper and northern Lower Peninsulas of Michigan, and the related Wisconsin area, the soils are influenced by the cool, moist forest and are light-colored, acid, rather infertile, and low in organic matter. They vary greatly because of differences in parent material. In the northern portion, the topography is uneven due to intense glaciation. Stones, sands, and gravels are common, and there are swamps and marshes in which organic soils have formed. A small amount of good soil is intermixed with the poor. The primary vegetative cover is pine, spruce-fir, and hardwood forest.

In the southern part of this area, sands with sandy or gravelly subsoils predominate. Some crops can be grown, but productivity is limited, and the area is best suited to pine forest. There are some gently sloping to flat plains on the shores of Lake Superior in all three States that are relatively smooth, stone-free, usually rich in lime in the subsoil, and thus suitable for limited farming. Much of the land remains in forest. Most of the rolling uplands have loamy soils. The more level and stone-free areas are good to excellent cropland. Much of the less suitable land remains in forest cover. There are a few rocky highlands like the Porcupine Mountains in the area.

In eastern Wisconsin and southern Michigan nearly all the soils were formed under forest vegetation and are light in color and low in organic matter except in areas of poor natural drainage. All of the soils in these two areas were heavily glaciated. Most of the soils usually are quite acid, therefore, liming is a first essential for crop production, especially for alfalfa. Fertilization with phosphorus and potassium is also generally required for efficient crop production, and nitrogen fertilizer usage has increased greatly in recent years. Soil drainage, both internal and surface drainage, is required for efficient economic operations.

The largest area of productive soils is in the eastern Wisconsin area where the topography generally is level or gently rolling. Most of the soils are loams to clay loams and of good permeability and water-holding capacity. Scattered areas of organic soils (peats and mucks) are in the poorly drained areas. Limited areas of sandy soils also occur. In Southern Michigan the glacial material varies in texture from sand to clay. The soils are quite variable in texture, permeability, and management requirements. The topography is nearly level to gently rolling, although glacial knolls and hills are common in some places. The least productive of these soils are found near the western Basin boundary in Wisconsin. The soils are primarily droughty sands and loamy sands and poorly drained organic soils.

The muck and peat soils of the eastern Wisconsin and southern Michigan area have special requirements. They are potentially productive when they are drained. Fertilization of these soils is necessary for crop production. They can be utilized for either specialized or general crops.

Northern Indiana, eastern Illinois, northwestern Ohio, and extreme southern Michigan have been heavily glaciated. The soils that were formed under forest vegetation are generally light in color and low in organic matter, although there are also extensive areas of dark-colored, poorly drained soils, developed from various types of glacial material. These differ considerably in texture. Fine-textured soils, such as the Hoytville and Paulding clays, are extensive in the lacustrine lake plain area of northwestern Ohio. Sands and sandy loam soils occur in northwestern Indiana. Most of the soils in other areas, however, have a friable loam to silt loam surface layer.

The land is mostly level to gently rolling, except

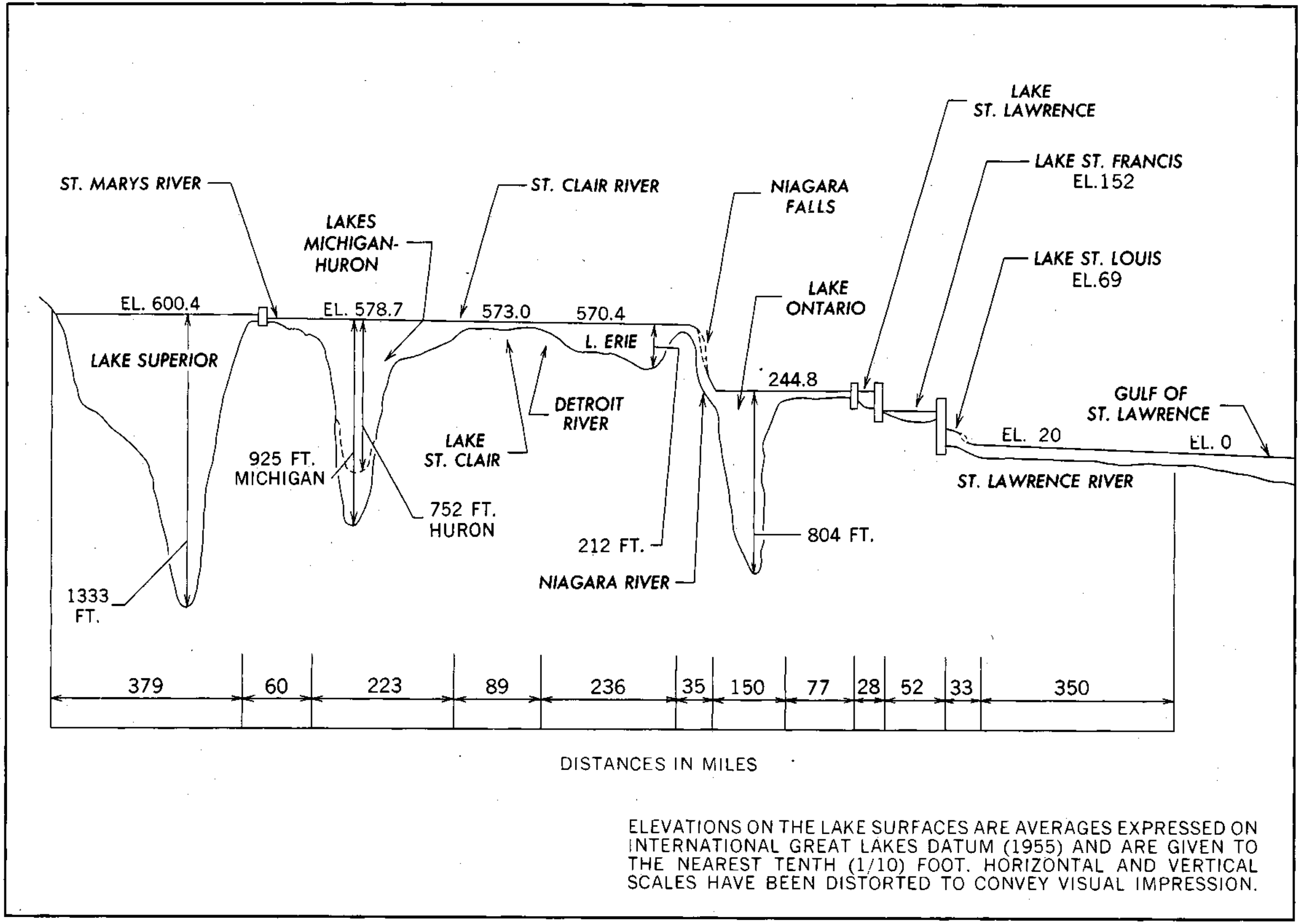


FIGURE 1–7 Profile of the Great Lakes System

on moraines and near main streams where the land may be rolling to steep. Much of the land was originally poorly drained; most of it is now artificially drained, but inadequate drainage is still a problem in many areas. Peat and muck soils are rather extensive in northwestern Indiana and are intensively used.

The northeast area of the Basin includes portions of northeastern Ohio, the northern portion of Erie County, Pennsylvania, and northern New York. The soils were derived from parent material that varied from hard crystalline rock to lake-plain sands and clays. Most of the region was covered by glaciers from the north. They mixed older soils with various kind of rocks, such as sandstone, shales, limestones, and clays. Most of the soils are in the gray-brown podzolic group and are quite deficient in lime and phosphorus. The surface horizons are fairly high in organic matter. There is a considerable area of more productive soils which developed from calcareous glacial drift south of Lake Ontario in New York.

Poor drainage is a serious problem in northeastern Ohio and Erie County, Pennsylvania, or where the soils have been developed from sandstone or shale.

Along the southern shores of Lake Erie and Lake Ontario is the Lake Plain Province. It averages 3 to 5 miles in width along Lake Erie and is generally 10 to 25 miles wide along Lake Ontario. The land is generally level to gently rolling, and dairy farming is prominent in this area.

1.4.4.2 Forests

Before settlement, most of the land area of the Basin was occupied by virgin forest. Forest cutting and clearing began in the early 1800s and increased during the settlement period. Not only was the land cleared for agricultural uses, but the nation's lumber needs were increasingly supplied from the Basin's forests, particularly during the last half of the nineteenth century. The dramatic harvest of the original stands attracted the growth of wood-using industries which soon outstripped the sustained yield and eventually moved to other areas. By the early 1900s, most of the virgin forests had been cut, and the lumber companies' operations were gone. Approximately 39.6 million acres, nearly half of the Basin, are now classed as forest land. Most of the forest cover has been reestablished by natural regeneration and forest management practices. States with the highest percentage of the forest resources are Minnesota, Wisconsin, Michigan (northern half), and New York. Common species are conifers, such as pines, spruce, and fir, which dominate the upper Basin and the New York mountainous regions, and hardwoods, which cover much of the southern and central Basin. Agricultural land use in central lower Michigan, Ohio, Pennsylvania, and New York has replaced forested lands. The forests are used now for the multiple purposes for which they are suited.

1.4.4.3 Minerals

The distribution of the rocks and sediments of each of the three geologic eras represented in the Great Lakes Basin also defines the type and location of mineral resources and mineral production within the Basin. Virtually all of the metal resources, including iron, zinc, lead, silver, and copper are found in the Precambrian rocks. Hence, these resources are produced in the northwestern and extreme eastern parts of the Basin in Michigan, Minnesota, and New York. The Paleozoic rocks contain the mineral fuels of oil, gas, and coal, and nonmetallic minerals including limestone, dolomite, sandstone, shale, salt, gypsum, and natural brines, and are largely found in lower Michigan, Ohio, Illinois, Indiana, and New York. The occurrence and production of these mineral fuels and nonmetals depend on the geographic distribution and accessibility of certain formations. The nonmetal deposits of sand and gravel, clay, marl, and peat found throughout the Basin are contained in the unconsolidated Cenozoic sediments.

1.4.4.4 Fish

Fish habitat provided by inland streams and lakes, as well as by the Great Lakes, supports a wide variety of cold- and warm-water species for sport fishing and a limited commercial fishery.

About 173 species in 75 genera and 29 families are represented in the Great Lakes system. In addition to those which found their way to the Great Lakes by natural means there are 11 species which have been purposely or accidentally introduced and have established themselves. An additional 7 species were introduced but failed to establish permanent populations.

However, of all these species supported by the Great Lakes, only 53 have, at various times, consistently contributed to the commercial fishery as food. An additional 8 species contributed in a marginal way. Of the total, 26 are definite sport fishes, 11 are marginal sport fishes, and 28 species are, or have been, both commercial and sport fishes. An additional 10 or 12 species, principally minnows, are of commercial importance as the basis of a bait business associated with sport fishing. The maximum number of utilized species is about 110, but only 14 of the 173 species have been considered prime species, readily acceptable on the market and commanding a price commensurate with the cost of capture and processing. Another group of prime species is that considered adequate for sport and food by the angler. These two groups are listed in Table 1-9. Not all of these species can be taken today; some are endangered, and some are extinct.

TABLE 1-9 Historically Important Commercial and Sport Fishes of the Great Lakes

Common Name	Genus and Species
COMMERCIAL FISH	
lake sturgeon	*Acipenser fulvescens*
lake trout	*Salvelinus namaycush*
lake whitefish	*Coregonus clupeaformis*
cisco (lake herring)	*Coregonus artedii*
bloater	*Coregonus hoyi*
deepwater cisco	*Coregonus johannae*
blackfin cisco	*Coregonus nigripinnis*
kiyi	*Coregonus kiyi*
northern pike	*Esox lucius*
white bass	*Roccus chrysops*
yellow perch	*Perca flavescens*
sauger	*Stizostedion canadense*
walleye	*Stizostedion vitreum vitreum*
blue walleye (blue pike)	*Stizostedion vitreum glaucum*
SPORT FISH	
rainbow trout	*Salmo gairdneri*
brown trout	*Salmo trutta*
brook trout	*Salvelinus fontinalis*
lake trout	*Salvelinus namaycush*
northern pike	*Esox lucius*
muskellunge	*Esox masquinongy*
smallmouth bass	*Micropterus dolomieui*
largemouth bass	*Micropterus salmoides*
yellow perch	*Perca flavescens*
walleye	*Stizostedion vitreum*

Habitat conditions vary over inland lakes and streams with coldwater species dominating in the northern half of the Basin and warmwater species most common in the southern portion. Trout fishing is good in many lakes and streams in Minnesota, Wisconsin, Michigan, Pennsylvania and New York. Some of these lakes and streams are stocked on a "put and take" basis.

Sport fishing for warmwater species such as smallmouth bass, northern pike, walleyes, largemouth bass, and muskellunge is a multimillion dollar business. In addition, panfish such as bluegill, perch, and other species are abundant throughout the Basin. The number of fishermen seeking these species may exceed those angling for game fish. Salmonid fishing is also noteworthy. Recent stocking of the Great Lakes with coho and chinook salmon has made these fish abundant in streams tributary to Lakes Michigan, Superior, and Huron.

The introduction and immigration of exotic species has modified the native species distribution greatly. Carp were introduced the latter part of the 19th century, and substantial populations were well established by 1900. Smelt were stocked in a lake tributary to Lake Michigan in the 1920s, and spread quickly throughout the upper Great Lakes and into Lake Erie. The sea lamprey and the alewife, now abundant in most of the Lakes, were unknown except in Lake Ontario prior to the opening of the Welland Canal. It is generally accepted that the sea lamprey entered Lake Ontario after 1880 via the Erie Canal. The first record of alewives in Lake Ontario was in 1873. Carp and smelt have contributed substantially to the commercial take. Alewife, despite its abundance, is difficult to market. The white perch is a recent immigrant. A large population is established in Lake Ontario in the Bay of Quinte and in eastern Lake Erie. The relationship of these exotics to other species is as yet unknown, except in the case of the sea lamprey, which, because of its parasitic nature, has caused drastic decreases in the abundance of certain native fishes. Control measures have been undertaken by both the U.S. and Canada.

1.4.4.5 Mammals and Birds

Nearly all of the Great Lakes Basin is wildlife habitat. In the U.S. portion of the land area, there are 75 million acres of habitat or resource base out of a total of 84 million acres. The shoal waters in the U.S. portion of the Great Lakes total 610,000 acres. Of this total, 491,000 acres are important to wildlife. All of the open waters are used from time to time by migrating waterfowl. The value of this habitat varies greatly, but the important consideration is that all nonurbanized land, some urban land, and all waters have some value to wildlife.

The eight kinds of Basin wildlife habitat include northern wilderness forests, farmland woodlots, blocks of eastern hardwood forest, river bottom woodlands, scrub and brush lands, open fields and meadows, cropland, and freshwater wetland.

As a rule, the supply of wildlife habitat other than cropland is good in the northern and far eastern areas of the Basin and is only fair south of these areas. The country north of the Milwaukee-Buffalo line is forested and sparsely settled, while south of this line the area is heavily settled and is primarily industrial and agricultural.

The single most important factor affecting Basin wildlife and habitat is human population growth and the resultant increase in intensity of land use, which causes both degradation and loss of habitat.

The varieties of wildlife that occupy this habitat are diverse, and include big game, small game, and furbearers, waterfowl, shorebirds, wading birds, and song birds. There are about 63 species of mammals and 300 species of birds native to the Basin. Some of these animals and birds are rare, some are endangered, and some are common.

The Lake Superior basin is the northernmost of the five Great Lakes basins and has ecological characteristics that differ from the others. The soils, waters, and the Lake are of low fertility. The geology of the basin and the weather are responsible for the vegetative types and lack of productivity. Topsoils are thin and acidic and support only specialized plant species. The runoff is low in nutrients. Streams, lakes, and marshes are infertile and Lake Superior is a cold, infertile or oligotrophic lake.

The wildlife species of the Lake Superior basin reflect the soil types and plant ecology. They are fewer in species diversity, lower in density, and more specialized than elsewhere in the Great Lakes Basin. Of all the wildlife species of the basin, perhaps the timber wolf demonstrates best the influence of the environment. The wolf requires a vast unbroken wilderness with few human intrusions. He also requires white-tailed deer and moose populations as well as smaller mammals in sufficient numbers to sustain him through the winter. Prey species require a special habitat to thrive, and natural or man-caused disturbances in the habitat can diminish prey species populations and thereby diminish the wolf population.

Other Lake Superior basin species include coyote, red fox, snowshoe hare, ruffed grouse, black bear, bald eagle, osprey, sharp-tail grouse, woodcock, spruce grouse, bobcat, lynx and furbearers including otter, fisher, beaver, mink, muskrat, and pine marten.

Lake Michigan and its extensive drainage basin encompass a wide variation in vegetative and climatological situations. The basin's northern extremities are forested on both sides of the Lake, but in Wisconsin the forest cover begins to change and gives way to agricultural lands at the Green Bay latitude. In Michigan the forest cover extends further south to approximately the Muskegon-Clare-Midland line. Land around the southern tip of the Lake (exclusive of urban areas) is completely agricultural with little tree cover remaining in Indiana and Illinois.

Wildlife species in the Lake Michigan basin's northern areas are the same as those of Lake Superior basin with the exception of the timber wolf, which is very rare. The black bear is found throughout the northern region. Further south the wildlife species become less specialized. Farm game such as the ring-necked pheasant, cottontail rabbit, and gray and fox squirrel, and big game such as the white-tailed deer and black bear are common.

Michigan contains a pocket of prairie chicken habitat, which supports a low population of these rare birds. Another rare species found in the area is the Kirtland's warbler which nests in a special habitat niche in young pine forest lands. Bald eagles and ospreys, which used to be common in the Green Bay area and in the islands and bays on the opposite side of the Lake, are becoming less common but are still present seasonally. Remaining waterfowl marshes in the Green Bay area support nesting and idle waterfowl. Significant waterfowl marshes exist in the Fox River and Wolf River drainage basins and at Seney, Michigan. Small waterfowl marshes also exist at river mouths around the Lake.

Degraded habitat in the urbanized southern Lake Michigan basin supports little wildlife. However, some paradoxes occur here. Large flocks of resting waterfowl are to be found off the Gary, Indiana, steel complex during the fall. City parklands and forest preserves support small populations of rabbits, squirrels, furbearers, and numerous species of songbirds. These are important because they provide recreation and outdoor enjoyment right in the urban areas.

The northern half of the Lake Huron basin has a rolling topography vegetated with a variety of cover types including northern forest jack pine and other timber, open grassy areas, wooded bogs, and brush lands. Many small lakes and marshes are present, and this region is of high wildlife value. The southern half is generally flat, heavily agriculturalized, and less wooded. The streams are slow-moving and of lower quality than the northern streams, but wetlands important to wildlife are present.

Many thousands of acres of fine waterfowl marsh surround the open waters of Saginaw Bay and extend inland up the Saginaw River system, creating a nationally known waterfowl concentration area. Inland wetlands also support nesting populations of geese and ducks.

The Lake Huron Area has a variety of wildlife species such as black bear, white-tailed deer, elk, turkey, sharp-tailed grouse, prairie chicken, mourning dove, ring-necked pheasant, woodcock, ruffed grouse, cottontail rabbit, snowshoe hare, gray squirrel, fox squirrel, aquatic and terrestrial furbearers, bobcat, waterfowl, shore birds, passerine birds, and other songbirds. Eagles, osprey, and the endangered Kirtland's warbler can also be found in the basin.

The western part of the Lake Erie basin is a flat lake plain, heavily farmed and urbanized. Cover consists of brushy, idle farmland, small woodlots, and wooded stream bottoms. Stream gradients are very gentle and streams are wide, shallow, and slow-moving. The tree and shrub species are those of the eastern deciduous forest.

The very gently sloping character of the west end of the Lake Erie basin changes almost imperceptibly eastward, first to rolling topography and then to plateaus and glaciated valleys in New York. The cover here is much more extensive than in the western half of the basin. Tree and shrub species are the same as in the western basin, but also include conifers and shrub species associated with northern hardwoods. The wildlife of this area includes those species adapted to farmed areas and a low-to-medium population of forest species. Some white-tailed deer are found in the western basin, but the Allegheny Plateau in the east is the best forest wildlife habitat, with white-tailed deer, black bear, turkey, ruffed grouse, and squirrels present. Probably the most important wildlife populations of the basin are the waterfowl in the highly productive marshes of the western basin and in scattered areas in the eastern basin.

The Lake Ontario basin contains a wide variation of sometimes complicated topographic features. The level plain around the edge of the Lake gives way to rolling, glaciated topography. The uplands are plateaus or glaciated hills with steep slopes. The total relief from the St. Lawrence River to the Adirondack Mountains is the greatest in the Basin.

Wildlife habitat in the Lake Ontario basin is varied and is generally of high quality for wildlife production. Farming is restricted to localized areas of suitable soils. Elsewhere, secondary forest cover remains. Tree species are those of the northern forests, including balsam fir, white pine, hemlock, birch, spruce, maple, and aspen. In the lower elevations of the western half of the basin, only deciduous species are found.

Bays, river mouths, and shoreline estuaries in the St. Lawrence River include many thousands of acres of some of the finest freshwater marshes in New York State. There are also high quality inland marshes in the river system, particularly downstream from the Finger Lakes and in the St. Lawrence Plain.

Wildlife species in the Lake Ontario basin include waterfowl and shorebirds, and farm and forest wildlife. White-tailed deer, black bear, ruffed grouse, and other forest species are found in medium densities. Furbearers are well established. Cottontail rabbit, ring-necked pheasant, squirrels, and other farm game species are found in medium-to-high densities, as are waterfowl species.

1.5 Human Characteristics

Water and related land resources have historically played a key role in economic development and population distribution over the Great Lakes Basin. By 1850 the exploitation of the iron, copper, timber, and agricultural resources had begun, and the Great Lakes were now to become a main commercial waterway for the nation. Railways came to the Lakes during this time encouraging more settlement. Locks and canals built during this century provided Great Lakes ports and cities new opportunities for growth.

The Great Lakes also supported a thriving commercial fishing industry, famous for whitefish, lake trout, and other species, which peaked in the 1890s and has generally declined since that time. The industry felt particularly the deadly effects of the sea lamprey.

The Great Lakes Region has water supply, mineral resources, and transportation routes which have combined to create major industrial developments and population concentrations at former trade centers or port cities. The lower Lake basins have developed most rapidly, while some northern areas of the Basin have declined in population in recent years, largely because of the relatively harsh climate and isolation.

1.5.1 Population and Economic Factors

The availability and high quality of natural resources continue to be major factors in development patterns of the Basin. Consequently, a majority of the people in the Basin are concentrated in port and industrial centers along the shores of the Great Lakes or near the junctions of major land and water transportation routes. In addition to this growth of urbanized centers, some rural nonfarm areas continue to grow rapidly.

1.5.1.1 Population

Although the Great Lakes Region constitutes only 4 percent of the nation's area, the population has consistently accounted for approximately 15 percent of the people in the United States in the census decades from 1940 to 1970 (14.4 percent in 1970). The population density for the Region is four times the national average. There is considerable variation among the Lake basins in population distribution and in urban-rural balance. The Lakes

TABLE 1-10 Population Distribution, Great Lakes Basin

Plan Area Planning Subarea & State	Number of Persons					Population Distribution		
	Actual		Projected					
	1960	1970	1980	2000	2020	% of PSA	% of Plan Area	% of Gt Lks Basin
1.0 Lake Superior	544,784	533,539	537,900	594,600	668,800	---	100	1.8
1.1	358,722	345,155	366,600	417,200	475,000	100	68.1	1.2
Michigan	---	---	---	---	---	---	----	----
Minnesota	276,599	265,539	288,188	334,297	386,147	77	----	----
Wisconsin	82,123	79,616	78,375	82,950	88,890	23	----	----
1.2	186,062	188,384	171,300	117,400	193,800	100	38.2	0.6
Michigan	186,062	188,384	171,294	177,377	193,767	100	----	----
Wisconsin	---	---	---	---	---	---	----	----
2.0 Lake Michigan	12,041,378	13,516,965	15,542,300	19,645,400	24,829,500		100	46.1
2.1	896,396	1,005,023	1,082,100	1,357,600	1,726,000	100	7.4	3.4
Michigan	65,786	62,153	66,059	74,089	86,114	6	----	----
Wisconsin	830,610	942,870	1,016,073	1,283,534	1,639,932	94	----	----
2.2	8,481,097	9,492,823	10,999,000	13,844,500	17,385,700	100	70.2	32.4
Illinois	6,220,913	6,978,947	7,884,751	9,625,841	11,782,042	74	----	----
Indiana	686,570	757,989	914,612	1,221,634	1,611,178	8	----	----
Michigan	---	---	---	---	---	---	----	----
Wisconsin	1,573,614	1,755,887	2,199,616	2,996,976	3,992,508	18	----	----
2.3	2,211,001	2,522,579	2,914,000	3,771,900	4,876,400	100	18.7	8.6
Indiana	440,573	478,991	527,185	635,519	778,309	19	----	----
Michigan	1,770,428	2,043,588	2,386,807	3,136,340	4,098,081	81	----	----
2.4	452,884	496,540	547,200	671,400	841,400	100	3.7	1.7
Michigan	452,884	496,540	547,187	671,372	841,443	100	----	----
3.0 Lake Michigan	1,056,577	1,236,265	1,411,000	1,809,200	2,324,400		100	4.2
3.1	119,007	142,064	164,300	208,700	267,000	100	11.5	0.5
Michigan	119,007	142,064	164,285	208,655	266,959	100	----	----
3.2	937,570	1,094,201	1,246,800	1,600,500	2,057,400	100	88.5	3.7
Michigan	937,570	1,094,201	1,246,751	1,600,538	2,057,431	100	----	----
4.0 Lake Erie	10,465,813	11,513,853	13,299,600	16,794,200	21,280,500		100	39.3
4.1	4,291,457	4,848,153	5,801,700	7,425,200	9,567,600	100	42.1	16.5
Michigan	4,291,457	4,848,153	5,801,693	7,425,197	9,567,643	100	----	----
Ohio	---	---	---	---	---	---	----	----
4.2	1,565,736	1,725,351	1,963,500	2,473,800	3,116,200	100	15.0	5.9
Indiana	285,110	338,163	403,574	561,272	775,863	20		
Michigan	---	---	---	---	---	---	----	----
Ohio	1,280,626	1,387,188	1,559,893	1,912,551	2,340,323	80	----	----
4.3	2,825,417	3,098,513	3,476,400	4,389,200	5,526,500	100	26.9	10.6
Ohio	2,825,417	3,098,513	3,476,359	4,389,182	5,526,520	100	----	----
Pennsylvania	---	---	---	---	---	---	----	----
4.4	1,783,203	1,841,836	2,058,000	2,506,000	3,070,200	100	16.0	6.3
New York	1,532,521	1,578,182	1,764,995	2,143,968	2,617,288	86	----	----
Pennsylvania	250,682	263,654	293,010	362,015	452,944	14	----	----
5.0 Lake Ontario	2,256,046	2,531,673	2,775,600	3,494,900	4,393,100		100	8.6
5.1	797,364	946,131	978,200	1,221,800	1,538,000	100	37.4	3.2
New York	797,364	946,131	978,212	1,221,785	1,538,044	100	----	----
Pennsylvania	---	---	---	---	---	---	----	----
5.2	1,236,359	1,361,399	1,571,700	2,015,900	2,556,500	100	53.8	4.6
New York	1,236,359	1,361,399	1,571,672	2,015,912	2,556,549	100	----	----
5.3	222,323	224,143	225,700	257,200	298,600	100	8.8	0.8
New York	222,323	224,143	225,655	257,172	298,586	100	----	----
TOTAL	23,364,598	29,332,295	33,566,400	42,338,300	53,496,300			

Michigan and Erie plan areas have accounted for about 46 and 39 percent, respectively, of the total population of the Region in the period 1940 to 1970. The other plan area percentages are Lake Ontario, 9 percent; Lake Huron, 4 percent; and Lake Superior, 2 percent. Details of actual and projected population are given in Table 1–10, in which populations for State portions of planning subareas are taken from Table 19–41 of Appendix 19, *Economic and Demographic Studies*, and populations for PSAs are taken from Tables 19–11 to 19–40 inclusive, in which the projected data are rounded and adjusted. The State data do not correspond exactly with the data broken down by PSAs for the projected years 1980, 2000, 2020. Summaries of total and urban population by plan areas and States are shown in Tables 1–11 and 1–12.

Most of the 29 million people in the Great Lakes Basin reside in urban port areas along the shores of the lower Great Lakes. Major urban complexes accounting for a dominant share of the Region's population include Milwaukee, Wisconsin; Chicago, Illinois; Detroit, Michigan; Cleveland, Ohio; and Buffalo, New York. Over 80 percent of the population is classified as urban. Data on Standard Metropolitan Statistical Areas (SMSAs) are given in Table 1–13.

The northern and inland portions of the Basin are more sparsely populated than areas situated along or near the Great Lakes shoreline. Population densities are lowest in the northern portions of Minnesota, Wisconsin, Michigan, and New York. Declines in population have been noted in some counties in these areas.

TABLE 1–11 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	23,526,255	80.2

TABLE 1–12 Great Lakes Region Population and Urban Population by State, 1970

State	1970 Population	Percent of Great Lakes Region	Urban Population	Percent of Region Population
Illinois	6,978,947	23.8	6,710,912	22.9
Indiana	1,575,143	5.4	1,206,116	4.1
Michigan	8,875,083	30.2	6,553,773	22.3
Minnesota	265,539	0.9	175,612	0.6
New York	4,109,855	14.0	2,851,286	9.7
Ohio	4,485,701	15.3	3,691,014	12.6
Pennsylvania	263,654	0.9	197,659	0.7
Wisconsin	2,778,373	9.5	2,139,883	7.3
TOTAL	29,332,295	100.0	23,526,255	80.2

TABLE 1-13 Population Data by SMSA for the Great Lakes Basin, 1960 and 1970

SMSA and State	1960	1970
TOTAL GREAT LAKES BASIN	26,364,598	29,332,295
TOTAL 30 SMSAs in GREAT LAKES BASIN	22,022,603	24,974,257
ILLINOIS	6,220,913	6,978,947
Chicago	6,220,913	6,978,947
INDIANA	1,076,801	1,193,853
Fort Wayne	232,196	280,455
Gary-Hammond-E. Chicago	573,548	633,367
South Bend	271,057	280,031
MICHIGAN	5,962,457	6,806,151
Ann Arbor	172,440	234,103
Bay City	107,042	117,339
Detroit	3,762,360	4,199,931
Flint	416,239	496,658
Grand Rapids	461,906	539,225
Jackson	131,994	143,274
Kalamazoo	169,712	201,550
Lansing	298,949	378,423
Muskegon-Muskegon Heights	149,943	157,426
Saginaw	190,752	219,743
Toledo, Ohio-Mich. (Mich. portion only)	101,120	118,479
MINNESOTA	231,588	220,693
Duluth-Superior, Minn.-Wis. (Minn. portion only)	231,588	220,693
NEW YORK	2,934,097	3,209,055
Buffalo	1,306,957	1,349,211
Rochester	732,588	882,667
Syracuse	563,781	636,507
Utica-Rome	330,771	340,670
OHIO	3,422,739	3,745,840
Akron	605,367	679,239
Cleveland	1,909,483	2,064,194
Lima	160,862	171,472
Lorain-Elyria	217,500	256,843
Toledo, Ohio-Mich. (Ohio portion only)	529,527	692,571
PENNSYLVANIA	250,682	263,654
Erie	250,682	263,654
WISCONSIN	1,923,326	2,172,235
Appleton-Oshkosh	231,990	276,891
Duluth-Superior, Minn.-Wis. (Wis. portion only)	45,008	44,657
Green Bay	125,082	158,244
Kenosha	100,615	117,917
Milwaukee	1,278,850	1,403,688
Racine	141,781	170,838

NOTE: Subsequent to the 1970 census the definitions of the SMSAs have been changed, some areas modified, and new SMSAs identified. These changes are not reflected in the table. One of the new SMSAs is Battle Creek, Michigan. Changes affecting area and/or title have been made in Fort Wayne, Indiana; Detroit, Flint, Kalamazoo, Lansing, Muskegon-Muskegon Heights, Michigan; Toledo, Mich-Ohio; Rochester, New York; and Lima, Ohio.

SOURCE: 1960 and 1970 Census of Population, U.S. Department of Commerce, Bureau of the Census, for the above states.

1.5.1.2 Economic Base

From the viewpoint of economic development the dominant characteristic of the Great Lakes Region is its location within the highly industrialized and heavily populated north central United States. Furthermore, the Great Lakes area lies astride the transcontinental link between the agricultural production regions of the north central States and the consuming areas to the east. Included in the area are the major routes through the United States manufacturing belt and the direct line between the metropolitan complexes of Chicago and New York. Moreover, the 95,000 square miles of water surface provide the means of transporting over 100 billion ton-miles of waterborne freight per year over the Great Lakes-St. Lawrence Seaway navigation system.

The Great Lakes Region is typified by a wide variety of economic conditions and occupational pursuits. The northern Basin is characterized by industry dependent on forest and mineral resources and the growth of the year-round recreation and tourist industry. Low family incomes, outmigration, and poor farming are typical in many of these northern areas. Agriculture and diversified manufacturing are concentrated in the central section of the Basin, while on the Lake shores there are a number of centers for heavy industry, with emphasis on iron, steel, petroleum, and chemical production. General farming is practiced over large areas in the southern part of the Basin, while specialized crops are grown along the lee sides of the Lakes. The recreation industry is important in the northern and eastern sections of the Basin.

About 50 percent of the nation's steel production comes from the Great Lakes Region. Value added in manufacture in the Region reached $58.1 billion in 1967, 22 percent of the nation's total. Nearly 8 percent of the nation's mineral production value, or approximately $1.5 billion, came from the Region in 1968. Slightly more than 71 percent of the nation's iron ore dollar value was derived from the Great Lakes area in that year.

Agricultural sales in 1964 of crops, livestock, and livestock products were $2.4 billion, which represented nearly 7 percent of the national total (Tables 1–14 and 1–15). Forest production values of timber cut (stumpage) in 1962 was more than $19 million, while harvested forest resources were valued at $85 million for the Region. Value added in timber-based economic activities in 1962 amounted to almost $2 billion.

In 1970 approximately 11.3 million persons (38.5 percent of the population) found employment in agriculture, forestry, fisheries, mining, manufacturing, trades and services, and other occupations in the Region (Figure 1–8). Since 1940 the Region

TABLE 1-14 Great Lakes Region Share of United States Total for Selected Agricultural Commodities, 1964

Commodity	Percent of U.S. Total
Alfalfa	12.7
All Hay	10.3
Dry Field Beans	49.6
Corn Silage	15.7
Oats	14.7
Potatoes	8.7
Corn, Grain	8.5
Sugar Beets	7.2
Soybeans	6.8
Wheat	6.8
Rye	5.8
Barley	0.1
Sour Cherries	90
Sweet Cherries	35
Apples	23
Pears	7
Grapes	5
Peaches	4
Cucumbers & Pickles	33
Snap Beans	30
Cabbage	21
Dry Onions	18
Sweet Corn	17
Green Peas	16

has employed about 15 percent of the nation's total work force. Projections for the next 50 years indicate an overall decline in the Region's share for national employment to 13.6 percent by 2020. Data on employment by selected industries for plan areas are shown in Table 1-16, and for the Region in Figure 1-8. The breakdown of "other" in this figure is based on total earnings which represent employment for the Basin with reasonable accuracy.

TABLE 1-15 Great Lakes Basin Share of Total United States Production of Livestock and Livestock Products

Item	Percent of Total U.S.
Value of livestock & livestock products	7.4
No. of milk cows	15.3
Pounds of milk sold	18.4
No. of cattle sold	4.2
No. of calves sold	5.0
No. of hogs & pigs sold	5.2
No. of sheep & lambs sold	2.7
Dozens of eggs sold	7.1
No. of broilers sold	0.6
No. of hens & roosters sold	7.0

Source: U.S. Department of Commerce, Agricultural Census, 1964

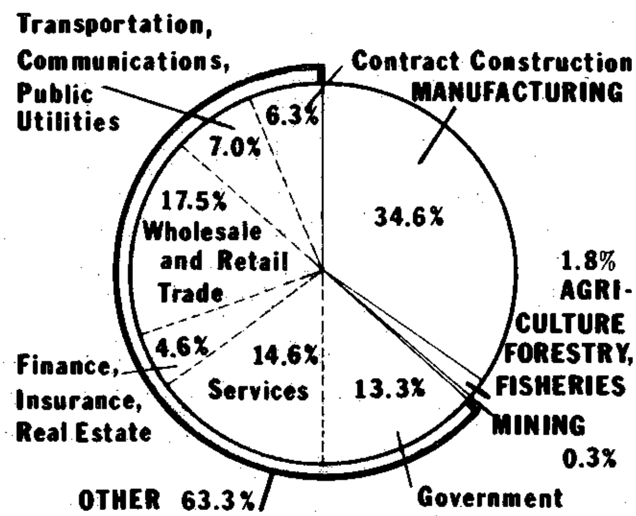


FIGURE 1-8 Employment, Great Lakes Region. The breakdown of "other" is based on total earnings which represent employment with reasonable accuracy.

In 1970 nearly $114 billion (18 percent of the national total) in total personal income was generated in the Region. The heavy concentration of industrial activity has supported per capita income and personal income at a level 20 percent higher than for the nation as a whole. Additional information is provided in Section 3 of this appendix.

TABLE 1–16 Employment by Selected Industries, 1950–1970 and Projected 1980–2020 (in thousands)

Industry & Plan Area	Actual 1950	Actual 1960	Actual 1970	Projected 1980	Projected 2000	Projected 2020
Agriculture Forestry & Fisheries						
1.0	18.3	7.6	3.8	4.5	2.9	1.8
2.0	220.0	142.2	95.1	97.0	69.5	49.7
3.0	40.6	21.3	11.4	12.4	7.3	4.5
4.0	131.8	87.2	58.7	60.0	43.0	30.5
5.0	69.0	47.3	31.7	31.6	22.6	16.1
Total	479.7	305.8	200.7	205.5	145.3	102.6
Mining						
1.0	19.3	21.9	17.0	17.2	16.8	16.6
2.0	7.2	7.3	8.4	6.1	6.2	6.1
3.0	2.3	2.0	1.7	1.8	1.6	1.5
4.0	5.8	5.7	8.7	5.3	5.5	5.7
5.0	3.8	3.6	3.2	2.4	2.1	1.9
Total	38.7	40.5	39.0	32.8	32.2	31.8
Manufacturing						
1.0	33.4	27.7	25.5	29.6	31.5	34.8
2.0	1,544.6	1,769.1	1,808.4	2,101.3	2,357.4	2,705.0
3.0	120.3	146.6	165.4	201.3	247.1	305.9
4.0	1,422.6	1,532.5	1,597.4	1,816.0	2,015.6	2,286.7
5.0	264.2	295.2	308.8	355.8	413.9	485.8
Total	3,385.1	3,771.0	3,905.5	4,504.0	5,065.5	5,818.2
Other (Including Federal Military)						
1.0	109.2	117.3	125.5	143.8	170.5	198.3
2.0	2,339.8	2,756.9	3,436.0	4,172.6	5,673.9	7,436.2
3.0	137.9	186.1	243.5	315.7	442.4	595.4
4.0	1,808.4	2,175.9	2,731.3	3,401.9	4,672.1	6,207.5
5.0	407.2	488.2	620.7	718.8	972.9	1,271.5
Total	4,802.5	5,724.6	7,157.1[1]	8,752.8	11,931.8	15,708.9
Total Employment						
1.0	180.2	174.5	171.8	194.8	221.8	251.5
2.0	4,111.6	4,675.4	5,347.9	6,378.0	8,107.8	10,198.0
3.0	301.5	356.0	422.1	530.2	698.0	907.0
4.0	3,368.6	3,801.4	4,396.2	5,283.2	6,736.1	8,530.1
5.0	744.1	834.6	964.4	1,108.8	1,411.8	1,776.2
Total	8,706.0	9,841.8	11,302.3	13,495.0	17,175.5	21,662.8

[1]See Figure 1-8 for breakdown of "other".

NOTE: Entries may not add to total because of rounding.

1.5.2 Institutional Arrangements

The responsibilities for managing the conservation, development, preservation, and use of water and land resources in the Basin are complex and diffused among various international, Federal, State, and local levels of government, and numerous nongovernmental institutions.

As the problems concerning the Lakes have increased, so have the interests and concerns of people and organizations. This has resulted in increased activity by governments, organizations, and private citizens. In recent years the number of institutions concerned with the Great Lakes has increased dramatically. Missions sometimes are uncoordinated and overlapping, and there are some gaps in coverage. Cohesiveness and definition of purpose among these institutions requires strengthening. (The responsibilities, history, and activities of many of the institutions mentioned here are described in the Great Lakes Basin Commission publications, *Great Lakes Institutions,* June, 1969, and *Great Lakes Directory,* March, 1976.)

More than one-third of the boundary between the United States and Canada traverses the Great Lakes. Because of the nature of the Lakes and their importance to the two countries, it has long been recognized that close international cooperation between the United States and Canada in the management and control of the Great Lakes is beneficial to both countries. This cooperation is conducted through two international commissions and other less formal institutions. The International Joint Commission, established in 1909, deals with all boundary waters. The Great Lakes Fishery Commission was organized in 1955. Less formal international institutions working within the Basin include: Coordinating Committee on Great Lakes Basin Hydraulic and Hydrologic Data (1953), Great Lakes Study Group and Federal Interagency Committee (1962), International Association for Great Lakes Research (1967), and International Field Year on the Great Lakes (1968–74).

In the United States portion of the Great Lakes Basin, the Federal government has definite statutory responsibilities for planning and management of Basin resources. Institutions most directly responsible on the Federal level include the U.S. Departments of Agriculture, Army (Corps of Engineers), Commerce, Health, Education and Welfare, Housing and Urban Development, Interior, and Transportation; the Federal Power Commission; and the Environmental Protection Agency. The Great Lakes Basin Commission and Upper Great Lakes Regional Commission are State/Federal organizations active in resource planning for their respective jurisdictional areas. In 1955 the eight States of the Basin established by compact the Great Lakes Commission for more effective management of certain Lake resources.

Under the Federal system, all powers not specifically granted to the Federal government are reserved for the States. State regulation of water use is specifically derived from the general police powers.

In turn, the political subdivisions of the States, that is, local governmental units, may exercise only those powers delegated by the State constitution or State legislative body. Through such enabling legislation, municipalities, counties, and townships have received authorization to engage in varied water resources functions throughout the Basin. In addition, the various State legislatures have sanctioned the creation of a host of special purpose districts with powers to furnish different water services.

All such special purpose districts and all units of local government operate under enabling statutory provisions which define their financial, proprietary, and regulatory powers. These limitations are extremely important with regard to the effectiveness of local governmental units in meeting the needs for water services and in solving related problems.

Complex aggregation of county agencies into regional commissions is also common in the Basin. The Northeast Illinois Planning Commission, for example, represents six counties and more than 1,700 separate local governments. Added to these public institutions is a rapidly growing number of special interest groups.

1.6 Use of Resources

The uses of resources for specific purposes and as they relate to the selection of programs making up the frameworks are discussed in other appropriate sections.

1.6.1 Land Use, Treatment, and Management

The availability, distribution, control, and use of water influence the use of land resources. Conversely, land use, treatment, and management practices are closely associated with the quality and quantity of water resources in the Great Lakes Basin. Ownership of the 83.6 million acres of land in the Great Lakes Region is shown in Figure 1–9.

Urban areas dominate the western and southern shores of Lakes Michigan, Erie, and Ontario; forests are mainly concentrated in northern Minnesota, Michigan, Wisconsin, and New York; and agricultural lands are primarily found in eastern Wisconsin, northern Indiana, northern Ohio,

TABLE 1-17 Water Area and Land Use, Base Year 1966-1967, (in thousands of acres)

Plan Area and PSA	Total Area[1]	Rivers Lakes, and Embayments	Total Land Area	Urban Built-Up	Land Resource Base: Cropland	Pasture Range	Forest Land	Other	Total
PSA 1.1	10,324.5	851.0	9,473.5	284.5	430.1	99.5	8,354.9	304.5	9,189.0
1.2	6,673.9	232.1	6,441.8	137.8	262.8	65.8	5,909.6	65.8	6,304.0
Plan Area 1.0	16,998.4	1,083.1	15,915.3	422.3	692.9	165.3	14,264.5	370.3	15,493.0
PSA 2.1	10,401.9	391.2	10,010.7	464.0	3,316.4	356.7	5,116.5	757.1	9,546.7
2.2	5,315.8	103.7	5,212.1	1,210.5	2,843.4	237.4	340.7	580.1	4,001.6
2.3	9,126.4	171.0	8,955.4	818.5	5,374.8	459.4	1,704.7	598.0	5,136.9
2.4	8,439.0	344.8	8,094.2	414.8	1,481.5	351.8	5,434.3	411.8	7,679.4
Plan Area 2.0	33,283.1	1,010.7	32,272.4	2,907.8	13,016.1	1,405.3	12,596.2	2,347.0	29,364.6
PSA 3.1	4,167.0	149.2	4,017.8	179.6	531.2	173.6	2,914.3	219.1	3,838.2
3.2	4,461.4	37.3	4,424.1	389.0	2,370.0	185.2	1,194.7	285.2	4,035.1
Plan Area 3.0	8,628.4	186.5	8,441.9	568.6	2,901.2	358.8	4,109.0	504.3	7,873.3
PSA 4.1	4,062.1	81.7	3,980.4	759.5	2,215.6	117.7	665.7	221.9	3,220.9
4.2	6,368.7	49.2	6,319.5	567.8	4,735.1	213.8	453.4	349.4	5,751.7
4.3	2,332.2	23.6	2,308.6	609.0	741.3	131.3	538.8	288.2	1,699.6
4.4	3,113.0	43.1	3,069.9	485.0	858.7	252.6	1,364.5	109.1	2,584.9
Plan Area 4.0	15,876.0	197.6	15,678.4	2,421.3	8,550.7	715.4	3,022.4	968.6	13,257.1
PSA 5.1	2,476.8	18.1	2,458.7	271.1	1,055.1	162.9	871.5	98.1	2,187.6
5.2	5,682.6	255.2	5,427.4	250.7	1,759.1	443.7	2,545.7	428.2	5,176.7
5.3	3,561.6	176.0	3,385.6	145.9	633.9	254.4	2,215.4	136.0	3,239.7
Plan Area 5.0	11,721.0	449.3	11,271.7	667.7	3,448.1	861.0	5,632.6	662.3	10,604.0
TOTAL	86,506.9	2,927.2	83,579.7	6,987.7	28,609.0	3,505.8	39,624.7	4,852.5	76,592.0

[1]Area measurement by county boundaries.

TABLE 1-18 State Summary of Water Area and Land Use, Base Year 1966-1967, (in thousands of acres)

State	Total Area[1]	Rivers Lakes, and Embayments	Total Land Area	Urban Built-Up	Land Resource Base: Cropland	Pasture Range	Forest Land	Other	Total
Illinois	2,401.3	34.0	2,367.3	678.0	1,249.6	98.7	93.0	248.0	1,689.3
Indiana	3,687.0	51.7	3,635.3	381.4	2,392.5	203.1	302.6	355.7	3,253.9
Michigan	37,258.1	1,035.0	36,223.1	2,594.8	11,338.2	1,268.4	19,347.7	1,674.0	33,628.3
Minnesota	7,317.8	737.9	6,579.9	162.5	258.3	62.0	5,981.5	115.6	6,417.4
New York	14,309.8	487.3	13,822.5	1,103.6	4,164.6	1,072.4	6,773.4	708.5	12,718.9
Ohio	7,816.4	68.9	7,747.5	1,074.6	4,837.5	304.5	920.3	610.6	6,672.9
Pennsylvania	524.2	5.1	519.1	49.1	142.2	41.2	223.7	62.9	470.0
Wisconsin	13,192.3	507.3	12,685.0	943.7	4,226.1	455.5	5,982.5	1,077.2	11,741.3
Great Lakes Total	86,506.9	2,927.2	83,579.7	6,987.7	28,609.0	3,505.8	39,624.7	4,852.5	76,592.0

[1]Area measurement by county boundaries.

southern Michigan, and parts of New York. Table 1-17 provides information for the Region on land use by plan area and planning subarea. Table 1-18 provides the same information by State. Information on land use is displayed in Figure 1-10.

Approximately 47 percent of the Region is covered by forests. More than 95 percent of the Region's forest land is classed as commercial, with about 58 percent of those lands in farm and miscellaneous private ownership. Seven national forests, seven purchase units, and eight land utilization project areas lie partly or wholly within the Great Lakes Region.

State, county, and private forest lands account for more than 85 percent of the Region's forested area. While some of that area has received adequate land treatment, more than half the area, and some national forest land as well, can profit from additional treatment programs and management plans.

The protection and proper use of the soil resource and the orderly disposal of surplus waters

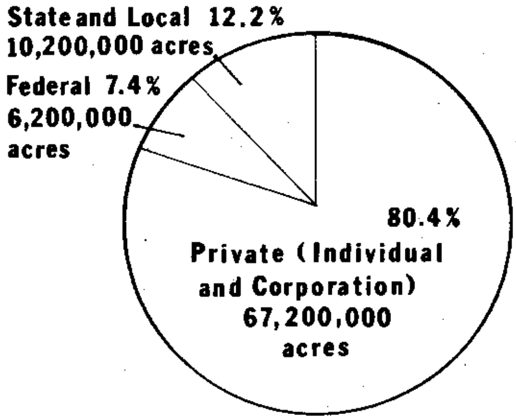


FIGURE 1–9 Land Ownership, Great Lakes Region

are primary concerns in all parts of the Basin. Federal, State, and local governmental agencies and private individuals are involved in numerous programs to provide adequate land treatment and management to land resources in the Great Lakes Region.

There are 189 soil conservation districts and/or soil and water conservation districts which cover nearly all of the Basin. These districts, organized under State law, are locally managed. The districts are responsible for land conservation planning, and the implementation of wise land treatment and conservation practices. As of 1970, these districts have sponsored or cosponsored six resource conservation and development projects which cover 28 counties in four Basin States, Minnesota, Wisconsin, Michigan, and New York.

Watershed projects under the Watershed Protection and Flood Prevention Act (PL. 82–566), are concerned with proper land treatment, agricultural water management, and flood prevention. There have been more than 100 applications for planning

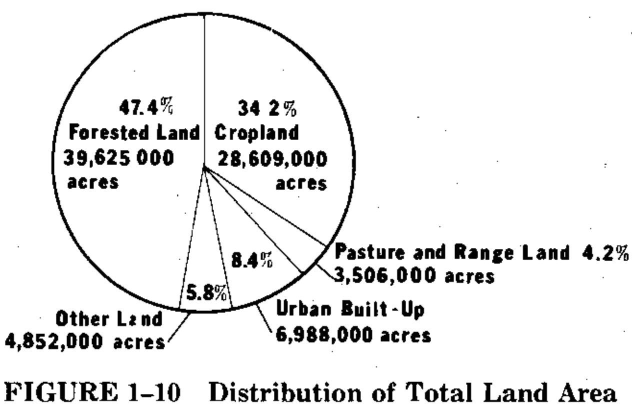


FIGURE 1–10 Distribution of Total Land Area by Land Use, Great Lakes Region, 1967–68

assistance under this program. As of January 1, 1970, 38 projects were authorized for planning, 10 had been approved for construction, and 7 had been completed. The flood prevention project at Buffalo Creek, New York, has also been completed.

Some of the more common conservation and land management measures applied to reduce erosion, control sediment runoff rates, and assist in controlling both surface and subsurface water are conservation cropping systems, contour farming, strip cropping, pasture and hayland plantings, crop residue management, minimum tillage, diversions, and tile drains. Conservation practices are needed and feasible on 16.7 million acres of cropland, 2.4 million acres of pasture, and 1.3 million acres of other land. As of July 1, 1969, treatment has been adequately applied on 11.9, 1.0, and 3.6 million acres of cropland, pasture, and other land, respectively.

As of 1965, nearly 183,000 acres of land had been disturbed by mining operations in the Great Lakes Region. The counties in Minnesota, Wisconsin, Illinois, Indiana, and Michigan that make up the Lake Superior and Lake Michigan basins accounted for 61 percent of the 1965 total.

Slightly more than half of the U.S. mainland shoreline in the Great Lakes Basin has been subject to erosion or flooding damages. About 10 percent of the total shoreline is protected by shore protection structures. Reaches of major shore protection works are located in Cook County, Illinois; Lake County, Indiana; and Macomb and Wayne Counties, Michigan. Five Federal beach erosion control projects have been completed on the shores of Wisconsin, Illinois, Pennsylvania, and New York. Private individuals have also constructed local shore protection works in damage areas.

An accurate measure of land and water developed for aesthetic and/or cultural enjoyment is not available for the entire Basin. Many areas have been reserved for historical and cultural purposes throughout the Basin States.

1.7 Problems, Needs, and Trends in the Great Lakes Basin

Natural resources and human elements are interrelated and must be considered together in any discussion of problems in the Basin. The following general discussion of Great Lakes problems and trends is arbitrarily divided into natural and human resource sections and represents what are considered to be important areas of systemwide concern. Specific problems relating to water and land resources are discussed as part of the treatment of each geographic subdivision.

1.7.1 Natural

There are a number of significant water resource problems facing the Great Lakes and their tributary stream systems. In gross terms it is safe to say that water quality and not water quantity is a major problem in the Great Lakes Basin. Quality control problems are becoming serious in areas of high population concentration like Chicago-Gary, Detroit, Cleveland, and Buffalo. Lake Erie and southern Lake Michigan are experiencing accelerated eutrophication as a result of large quantities of untreated or inadequately treated substances entering the Lakes. The loss of recreational use of beaches and fish and wildlife habitat on the Great Lakes and on interior lakes and streams illustrates the intensity of growing pollution problems. Waste must be controlled at its source, and additional research is required to help answer the many questions surrounding the pollution problem. The projected expansion of power facilities in the Basin raises a concern over the dissipation of large quantities of heat from condenser cooling systems. The kinds and quantities of agricultural substances applied to Basin lands must be carefully scrutinized in light of their potential effects on water quality.

In addition to excess waste and inadequate waste treatment in many parts of the Basin, long-term Great Lakes level fluctuations and discharge variations are a major problem. Significant damage and lost economic opportunity arise from lake level fluctuations. Abnormally high levels cause flooding and erosion damage to shorelines and structures. During periods of abnormally low lake levels, less draft is available to commercial navigation, resulting in higher shipping costs; flows decrease in connecting channels, causing a decrease in hydoelectric power generation; fish and wildlife habitat is exposed and threatened; recreation craft are excluded from canals and waterways; and the recreation value of water and shoreline is reduced. Some modification of the levels of Lake Superior and Lake Ontario has been effected by control works at their outlets. The desirability and means of exercising further control of lake levels is under consideration by the International Joint Commission.

Commercial and recreational uses of the Great Lakes are increasing. The completion of the St. Lawrence Seaway has greatly expanded the economic development opportunities for the Basin. The trend toward larger commercial ships which draw more water may require the enlarging and deepening of existing projects and channels and extending the navigation season. An expanding recreational fleet of larger size and deeper draft will create problems of overcrowding and inadequate depths in existing facilities and waterways. The disposal of dredged material in the Great Lakes is a problem of large proportions.

From the land resource viewpoint, inability to keep up with recreational demand, loss of high-value agricultural land, and uncontrolled urban sprawl are major problems in the Basin. In general, one of the most critical needs for recreation in the Basin is the provision of high-capacity facilities for day use and weekend use close to major metropolitan areas. Accessibility to all city residents must also be provided. The shorelines and islands of the Great Lakes offer great opportunity for recreation, but there is a constant fight to prevent industrial, commercial, and private ownership from excluding public access to the regional land and water resources.

Flooding problems occur on an estimated 556,000 acres in the Basin. Although this flooding may be serious locally, it has no measurable effect on the flow regimes of the Great Lakes system. Damages are highest in urban flood plains where there is development that is susceptible to flooding damages.

Based on conditions of the late 1960s, it is estimated that over 164 million tons of solids erode from the drainage area each year. Local regions with the most critical problems include the Chicago-Milwaukee-Gary area, RBG 2.2; the southwest Michigan-northwest Indiana area, RBG 2.3; and the northwest Ohio-Indiana-Michigan area, RBG 4.2. More than 50 percent of the total eroded solids come from these three regions.

Land treatment is necessary to reduce runoff, erosion, and sedimentation, and to improve water management. Urban runoff must be controlled and studied in view of the trend towards increasing urbanization in the Basin. Significant trends in land use include a general decline in total and commercial forest land, a decline in agricultural land, and an increase in lands used for highways, powerlines, urban areas, and recreational and industrial developments.

1.7.2 Human

The availability and use of natural resources account largely for the concentration of population and industrial growth in the Basin. In the next 50 years, the population of the Region is predicted nearly to double. With industry moving to the lakeshores, population areas may also concentrate there. A developing Great Lakes megalopolis may also create problems of magnitude far greater than those experienced with only 29 million persons in the Basin. Problems of congestion, social unrest, and unemployment are magnified in heavily urbanized areas. In the northern portions of the Basin, outmigration and a declining economy are critical factors.

The natural resources of the Great Lakes Basin are vast but not unlimited, and the interrelationships arising from their use are quite complex. However, plans can be made which will facilitate utilizing the resources effectively and yet judiciously, and the selection of frameworks is an attempt to do this in an orderly fashion.

One of the most difficult problems facing the system is coordinating the numerous levels and activities of the institutions which man creates to manage his resources and himself. The number of governments and laws controlling portions of the system is astounding. Canada is faced with similar problems, and yet no institution exists to place the numerous demands made upon the Great Lakes system in a proper perspective.

The International Joint Commission, established under the Boundary Waters Treaty of 1909, is responsible for matters affecting the boundary waters of the United States and Canada. It acts on request from the two governments. Its level of activity has increased under the provisions of the Water Quality Agreement of April 15, 1972, but it has neither the authority or the staff to collect new data or plan studies in the Basin.

Environment Canada and other agencies of the Canadian government and the government of the Province of Ontario have responsibilities for water resource matters in their respective jurisdictions. It is expected that, at an appropriate time, studies may be undertaken in Canada similar to the *Great Lakes Basin Framework Study* in the United States. In the meantime close liaison is maintained through formal channels and by informal contacts among various representatives of the two countries to facilitate work in both countries and to insure that no action will be taken that is not in the interest of both countries.

Section 2

GOALS, OBJECTIVES, SUBOBJECTIVES, AND CRITERIA

2.1 Introduction and Definition

A study which seeks ways of managing water and related land resources must have a sense of direction. It should be oriented toward the goals of the public. Often there are different "publics" which have different goals, and these must be recognized. For such a range of goals the steps must be identified which lead to each goal. This enables initial steps to be selected in full knowledge of where they lead. Thus, such steps will not be selected as ends in themselves, or solely for their own ends, which may be short-sighted, but will also be selected with a concern for broader, long-range goals.

The goals of the public include aspirations for social, economic, and environmental well-being. The steps leading toward them may be defined in many ways. One hierarchy of terms used in this and other planning studies lends itself to definitions of alternatives at various levels. Thus, the path may be traced back from the goal to the selection of the initial step and proper choice identified at each fork in the path.

The following definitions apply to this discussion of goals, objectives, subobjectives, and criteria.

(1) Goal—the end to which a plan is directed. The goal provides a specific direction in which to proceed in order to approach the ideal condition, but it is not necessarily obtainable. In the plural, goals are the aspirations that people have for their social, economic, and environmental well-being.

(2) Objective—an attainable step to be taken or point to be emphasized on the way toward meeting or attempting to meet a goal. In the plural, objectives are groupings of subobjectives related to each other, which collectively define one of the four objectives of water resource planning—social well-being, national economic development, regional development, and environmental quality.

(3) Subobjective—an action which allocates human and natural (water and related land) resources and/or utilizes other programs to move toward a defined goal. Some subobjectives are general in nature, while others are quite specific in terms of either geographic location or program content.

(4) Criterion—a quantifiable constraint or assumption which assists the planner in selecting programs responsive to a specified subobjective. Criteria are not needed where subobjectives are specific enough to enable the planner to make selections among programs for a particular framework.

A number of guidelines have been proposed for defining the objectives by which planning studies will attempt to reach the goals of the people. Work on the Framework Study was commenced under the "Guidelines for Framework Studies," October 1967, prepared by the Water Resources Council. These guidelines did not specifically define objectives, but the procedures outlined and the general instructions tended to emphasize the national economic development objective. The three other objectives listed below were also expected to be recognized in the selection of solutions to problems and ways of meeting needs. During the course of the Framework Study, a special task force reported to the Water Resources Council in July 1970 on suggested principles and standards for planning the use of water and related land resources. The task force suggested that each of the objectives of national economic development, environmental quality, regional development, and social well-being be given equal consideration in the planning process. Following considerable discussion and some modification, the "Proposed Principles and Standards" were printed in the *Federal Register*, December 21, 1971, and public reaction was sought. In this proposal national economic development and environmental quality objectives were specified, but with the provisions that the evaluation of projects should also consider regional development and social well-being or quality of life. Congressional policy, as expressed in Section 209 of P.L. 91–611, the Flood Control Act of 1970, expressly stated that all four items were considered to be objectives. This was the situation during most of the period of formulation of the Framework Study.

Subsequently the "Principles and Standards" were published in the *Federal Register*, September 10, 1973, containing only the two objectives specified in the "Proposed Principles and Standards," with the other two considered in analysis and formulation. The "Principles and Standards" became effective on October 31, 1973, following a brief period of litigation. The Congress, however, in P.L. 93–251 directed the President to review the use of all four objectives in planning and formulating water resource projects.

The two objectives in the effective "Principles and Standards" are stated as follows:

(1) to enhance national economic development by increasing the value of the nation's output of goods and services and improving national economic efficiency

(2) to enhance the quality of the environment by the management, conservation, preservation, creation, restoration, or improvement of the quality of certain natural cultural resources and ecological systems.

The other two objectives are:

(1) to enhance social well-being by the equitable distribution of real income, employment, and population, with special concern for the incidence of consequences of a plan on affected persons or groups; by contributing to the security of life and health; by providing educational, cultural, and recreational opportunities; and by contributing to national security

(2) to enhance regional development through increases in a region's income; increases in employment; and improvements of its economic base, environment, social well-being, and other specified components of the regional objective.

The pattern for framework formulation for the Framework Study was set during the period in which three objectives were specified for use. As a practical matter, the Framework Study was predicated heavily on the national economic development objective, with all possible consideration given to maintenance of a high-quality environment in all respects. Regional development was also taken into account, and the overriding character of social well-being was recognized.

The Great Lakes Basin Commission was concerned about identifying one objective as environmental because the possible inference might be drawn that other objectives did not consider environmental quality. It was felt that this might be misleading both to the persons working in the Study and to reviewers and those making use of the final product. In order to prevent any such misinterpretation, the Commission relied on the relationship between three chosen objectives and the rates of growth of the population and the economy. The objectives are accordingly identified in this Study as the following:

(1) Normal Growth—represents the traditional national economic development objective because the latter is the reflection of a continuation of past trends.

(2) Limited Growth—reflects the traditional environmental quality objective because, as growth of population and the economy is limited, there is more emphasis on the enhancement and preservation of the natural resources.

(3) Accelerated Growth—encourages development in a part of the Basin or the entire Basin, through employment of unused or external resources that will increase the population in the area and increase the economic growth.

The objectives are sometimes referred to in this study as Normal Growth objective, Limited Growth objective, and Accelerated Growth objective. Theses terms are often abbreviated to NOR, LIM, and ACC.

In applying each of these objectives to the elements of the Framework Study the overriding objective is to enhance the well-being of the people or the quality of life. This may be done by improving the distribution of employment opportunities, population, and income; helping to provide for educational, cultural, and recreational opportunities; and by improving the security of life, health, and property.

A framework includes programs for the conservation, use, preservation, and development of water and related land resources. The outputs in various resource categories considered collectively will achieve goals.

2.2 Derivation of Goals, Subobjectives, and Criteria

The Water Resources Planning Act, P.L. 89–80, provides in Section 201(b)(1) that each river basin commission shall ". . . serve as the principal agency for the coordination of Federal, State, interstate, local and nongovernmental plans for the development of water and related land resources in its area, river basin, or group of river basins. . . ." The Great Lakes Basin Framework Study, therefore, incorporates Federal, State, interstate, local, and nongovernmental goals, subobjectives, and criteria. Goals, subobjectives, and criteria expressed by the International Joint Commission are also considered.

For the purposes of preparing alternative frameworks, the Great Lakes Basin Commission established a Plan and Program Formulation Committee. One of the responsibilities of this committee was the derivation of goals, subobjectives, and criteria for the alternative frameworks. This committee established a plan formulation task force in each of the fifteen of the river basin groups that included both governmental and nongovernmental personnel. As framework formulation proceeded, these task forces developed and refined the list of subobjectives which were initially provided by the States for each river basin group. A subcommittee of the Plan and Program Formulation Committee reviewed the alternative frameworks for each river basin group and Lake basin and commented on the goals, subobjectives, and criteria that emerged from the task force efforts. The comments covered tradeoffs among the NOR, LIM, and ACC growth objectives, as well as geographic tradeoffs among the various parts of the Great Lakes Basin.

The Commission drew upon various sources for the goals, subobjectives, and criteria to be used in the initial formulation of alternative frameworks:

(1) Federal departments and independent agencies were contacted for those items they wished to contribute.

(2) The public was afforded opportunities to contribute through representation on the task forces and through public involvement meetings. These were held in Green Bay, Wisconsin; Elkhart and Fort Wayne, Indiana; Toledo, Ohio; and Duluth, Minnesota.

(3) Meetings were held with groups of State department and bureau heads from Ohio, Minnesota, Pennsylvania, New York, and Illinois.

(4) Reports from State agencies, regional planning agencies, and other sources were reviewed by the task forces.

(5) The goals, subobjectives, and criteria were considered and more clearly defined at the 15 public meetings to review the preliminary frameworks.

2.3 Social Well-Being

The broad categories of the social well-being objective mentioned earlier can be articulated in a somewhat parallel but slightly different way as follows:

(1) economic health: to provide opportunities for orderly planned growth and stability in economic output, employment, and income, consistent with the aspirations of residents of the Great Lakes Basin. These opportunities will require an orderly regional growth pattern based on optimum use of the area's physical and cultural resources; adequate transportation facilities for production of goods and services; and high-quality public facilities for water supply and waste disposal services at a reasonable cost.

(2) social welfare and mobility: to utilize the Region's physical and cultural resources in contributing to the security of life and health; in providing for aesthetic, cultural, and recreational opportunities for all residents; and in promoting the maximum opportunities for each person to improve his social conditions and to contribute to the fullest extent of his abilities.

(3) environmental balance: to provide the mechanisms for optimal use of water and land resources over time with full cognizance and promotion of high environmental standards of health, beauty, and diversity.

In describing the relationship of these somewhat general social well-being subobjectives to the task of framework formulation for a Great Lakes Basin framework for management of water and related land resources, we must assume that government has an obligation to assure all citizens opportunities which will permit maximum utilization of their abilities. In order to maximize the development of human potential, it is necessary to coordinate activities related to income maintenance, training programs for the unemployed, and provision of other appropriate social services.

Few of these activities are within the realm of water and related land resources planning. Natural resources development in the United States during the twentieth century is but one component of the total process of technological change which has brought the American people from an agrarian lifestyle to one of urban industrialism. It is clear that planning and development of land and water resources take place in the broad context of national, State, and local levels of social, economic, and political planning and priority-setting for the optimization of a variety of cultural functions. Consequently, resource development competes for investment dollars with social welfare, highway development, and other governmental functions.

For water and related land resources, the following social well-being subobjectives constitute the overriding social well-being objective that is to be provided for the formulation of the frameworks to meet any of the three growth objectives—NOR, ACC, or LIM:

(1) to make available to all communities where feasible an adequate supply of raw water to support a stable, diversified economy

(2) to provide adequate water-oriented outdoor recreation facilities to meet the needs of the residents of the Great Lakes Basin within reasonable distances of their homes

(3) to attain and maintain water quality suitable for water contact activities without danger to public health throughout the Great Lakes Basin and especially near urban areas

(4) to identify flood-prone areas and to eliminate all dangers of drowning due to floods in these areas

(5) to provide adequate reserve capacity for municipal and industrial water supply to protect

against interruption of services at times of critical need such as droughts or fires

(6) to protect the public health by recommending limits on biologically concentratable toxic substances.

2.4 Normal Growth

The major components of normal growth include increases in the gross national product (GNP), national income (NI), and personal income (PI).

While investment in water resources development is only one of many kinds of investment contributing to national economic development, the availability of water resources program outputs in sufficient quantity and quality is an important base for many kinds of economic activity.

Development of water and related land resources increases the productivity of natural resources and the productivity of labor and capital used with these resources. Increases in crop yields, increased earnings through changes in land uses, expansion of recreational use, and increased peaking capacity for power systems are examples of direct increase in productivity from water and related land development that contribute to the national product. In addition to the value of goods and services derived by users of program outputs, there may be external gains to producers and consumers as well as gains resulting from the employment of otherwise unemployed or underemployed resources. Output may also be increased by cost savings which release resources for employment elsewhere.

Droughts, floods, and fluctuating water supplies cause disruption in economic activity. Reduction in direct economic losses through water and related land resource projects will reduce losses to other dependent activities and thereby contribute to economic stability.

The Normal Growth objective includes an assumption that the economy tends to be in an equilibrium condition in which production and consumption are balanced by the forces of a competitive economy. This objective also assumes that public investment changes income flows by alterations in the use of economic resources, the level and composition of output, and patterns of consumption.

The Normal Framework is based on the Great Lakes Region's share of the national economy, specifically the disaggregation of the gross national product to a regional gross product, national population to a regional population, national income to regional income, and national employment mix to regional employment mix. The Normal Framework assumes that past trends will be followed for the parameters listed below.

(1) population of the working age

(2) labor force participation rate

(3) employment rate

(4) proportion of employment in the private economy

(5) hours per person per year in the private economy.

The OBERS projections, provided on a national basis, were disaggregated to the Great Lakes Basin level. They were made useful for planning within the Basin at the level of smaller geographic areas by the Economic and Demographic Work Group. Appendix 19, *Economic and Demographic Studies,* contains the projections for planning subareas (used with necessary adjustments in river basin groups) and in some cases for specific purposes for still smaller areas.

The basic framework analysis for the Great Lakes Basin has, therefore, been based on the national economic development or Normal Growth objective, as reflected in demographic and economic characteristics projected for the entire United States and disaggregated to the Great Lakes Basin and its planning subareas. The framework constitutes a starting point in the development of alternative frameworks for the Basin and permits a comparison of the basic framework with similar frameworks developed for other basins of the United States.

The Normal Growth subobjectives are considered in Subsection 2.7, which includes a listing of the specific subobjectives and criteria of the three objectives categories for the entire Great Lakes Basin.

2.5 Accelerated Growth

The Accelerated Growth objective emphasizes the enhancement of regional development through increases in the Great Lakes Region's share of national income and employment; improvement of its economic base, environment, and social well-being; and increased attainment of other specified regional subobjectives.

General components of the Accelerated Growth objective include:

(1) increases in regional income which may yield several benefits:

(a) the value to the users of increased outputs of goods and services from a plan

(b) the value to users of output resulting from external economies

(c) the value of output resulting from the use of resources otherwise unemployed or underemployed

(d) additional net income from the construction or implementation of a plan for regional growth increases and from other economic activities induced by the operation of such a plan

(2) increases in regional employment. Employment opportunities are a special concern as they provide the means to retain any increase in the base population and otherwise to contribute to attainment of a viable economic and social community. Although there will be exceptions, it may be generally anticipated that increases in regional income will be compatible with the objective of increasing regional employment.

(3) diversification of the regional economic base. A major subobjective within the Great Lakes Region is the attainment of a flexible and responsive economic posture that enables the Region to withstand changes in the composition of its gross regional product over time due to advances in technology, changes in consumer behavior affecting intermediate and final demands, and related changes in production. Where the existing economic base may be too narrow and specialized, private and public investments, including those for water and related land resources, can make effective contributions toward broadening it.

(4) other specially identified subobjectives. Where there are other subobjectives of special concern to a particular subregion within the Great Lakes Region, these are specified as components of the Accelerated Growth objective. Such subobjectives are expected to be derived from the task force efforts.

Subsection 2.7 includes Accelerated Growth subobjectives and criteria that are deemed applicable throughout the Great Lakes Basin.

2.6 Limited Growth

The Limited Growth objective is responsive to society's concern for reduced consumption of limited natural resources and a conviction that this reduction can come through a reduction in population and per capita consumption. A Limited Growth objective permits a greater emphasis on the conservation, preservation, creation, restoration, or improvement of the quality of natural and cultural resources and ecological systems, and the maintenance of the natural environment as a source of present enjoyment and a heritage for future generations. This is the kind of concern upon which the National Environmental Policy Act of 1969 is founded.

Planning for the Limited Growth objective explicitly recognizes the desirability of diverting a portion of the Great Lakes economic and natural resources from production of market-oriented goods and services in order to conserve, preserve, create, restore, and improve natural environment values. It also recognizes that as incomes and living levels increase, society appears less willing to accept environmental deterioration in exchange for additional marketable goods and services. In response to man's varied spiritual, psychological, recreational, and material needs, the LIM objective reflects this abiding concern with the quality of the natural physical-biological system in which all life is sustained.

The Limited Growth objective includes the following general components:

(1) protection, enhancement, restoration, or creation of areas of natural beauty for human enjoyment such as streams, inland lakes, the Great Lakes, and their banks, shores, and adjacent land, recognizing that some unspoiled, visually attractive water areas and adjacent lands must be preserved and, in appropriate instances, enhanced for public use and enjoyment

(2) preservation or enhancement of especially valuable or outstanding archaeological, historical, biological (including fish and wildlife habitat), and geological resources

(3) enhancement of the values of water, land, and air by control of pollution, including solid wastes

(4) prevention of erosion and restoration of eroded areas, including emphasis on the control and treatment of watersheds, mined areas, and critical erosion areas such as lake shorelines, gulleys, streambanks, roadsides, and beaches. The negative effects of sedimentation within streams, lakes, and beaches must also be prevented.

(5) reduction in losses to the environment elsewhere in the nation. For example, deterioration of water quality in Lake Erie places more pressure on natural resources for recreational use outside the Basin.

(6) avoidance of nonreversible decisions.

The Limited Growth subobjectives and criteria that are deemed applicable to the entire Great Lakes Basin are discussed in Subsection 2.7.

2.7 Specific Subobjectives and Criteria in the Great Lakes Basin

The subobjectives and criteria presented in Table 1–19 will be applied to the extent possible throughout all of the river basin groups and Lake basins in the Great Lakes Basin. These subobjectives and criteria were derived from the above definitions and background material and from the synthesis of subobjectives expressed by international, Federal, State, and local governmental personnel, and by nongovernmental and public sources throughout the Great Lakes Basin. In those few

TABLE 1–19 Subobjectives and Criteria for Resource Use Categories

Resource Use Categories and Objectives	Subobjective	Criteria
WATER WITHDRAWALS		
Municipally Supplied		
Objective-- NORMAL GROWTH	Invest in capital and annual costs to provide water to meet projected output of goods and services.	Select alternative programs that maximize net benefits taking into account adverse environmental effects. Consider rehabilitation of existing systems, small-scale groundwater development systems and large-scale regional systems for Lake Michigan. Emphasize groundwater development with minimum potential for small regional water systems for Lake Huron.
Objective-- ACCELERATED GROWTH	Development of additional source capacity to maximize net effects on region's income, employment, population, economic base, environment, and social development.	Include alternative programs most likely to result in net regional economic gains. Emphasize large-scale regional systems, rehabilitation of existing systems and pipelines to the Lakes.
Objective-- LIMITED GROWTH	Satisfy needs with emphasis on minimum disruption of the environment with full consideration of environmental protection.	Limited development to areas where environmental gains result. Limit programs to in-place resource capability. Minimize transport and consumptive use of waters.
Self-Supplied Industrial		
Objective-- NORMAL GROWTH	Invest in capital and annual costs to meet projected output of goods and services. Minimum investment in the Lake Superior area.	Select alternative programs that maximize net benefits taking into account adverse environmental effects probably mixing groundwater and lake sources. Reuse wherever possible.
Objective-- ACCELERATED GROWTH	Increase region's share of national industrial output by supplying water needs to meet all potential regional economic gains at minimum cost.	Select alternative most likely to result in regional economic gains and net regional economic benefits. Consider lake intakes with industries sharing intake's cost.
Objective-- LIMITED GROWTH	Satisfy needs with minimum disruption to the environment. Avoid industrial development and locations at surface water interfaces.	Minimize new water intakes. Use highest possible level of recirculation. Decrease consumptive use as much as possible.
Rural Dom. & Livestock		
Objective-- NORMAL GROWTH	Meet needs with safe (health) supply. Encourage ground-water development.	Include least cost alternative. Don't preclude resource development that would contribute to national economic growth.
Objective-- ACCELERATED GROWTH	Invest to meet all needs with a safe supply (health) to maximize regional net income from production of food and fiber.	Develop rural and agricultural water supply that will result in regional economic gains. Possibly include reservoirs and pipelines to streams and lakes.
Objective-- LIMITED GROWTH	Maintenance of minimum stream flows takes priority over rural withdrawals. Protect ground-water quality and levels.	No withdrawals allowed that would make stream flow less than 7 day-10 year low flow.
Irrigation		
Objective-- NORMAL GROWTH	Meet needs where economically and environmentally feasible.	Irrigate only to increase production, reduce costs, or improve quality. Select alternative programs that maximize net benefits.
Objective-- ACCELERATED GROWTH	Invest to maximize region's share of economic gains through increased irrigation water uses.	Encourage groundwater and lake source development. Insure regional benefits justify investment.
Objective-- LIMITED GROWTH	Only produce where there is no loss of aesthetic or cultural values. Preserve high value agricultural land.	Limit withdrawals to those quantities that do not deplete streams below 7 day-10 year low flow. Limit development of new lake sources.
Mining		
Objective-- NORMAL GROWTH	Region produces its share of national production.	Satisfy needs with least cost alternative. Don't preclude future use of minerals.
Objective-- ACCELERATED GROWTH	Maximum possible development of deposits to capture greater share of market for region.	Encourage lakes as source of water for minerals production.
Objective-- LIMITED GROWTH	Limit new surface water development. No production allowed in designated environmental or natural areas.	Limit production to areas where there is no loss of aesthetic, environmental, or cultural values.
Thermal Power Cooling		
Objective-- NORMAL GROWTH	Meet the needs with least possible disruptive impact.	Use least cost alternative that is consistent with environmental standards.
Objective-- ACCELERATED GROWTH	Increase production to maximize region's share of the national economy.	Lake sources encouraged with least cost alternative. Emphasize cost over environmental impact for plant and power line sites.

TABLE 1-19 (continued) Subobjectives and Criteria for Resource Use Categories

Resource Use Categories and Objectives	Subobjective	Criteria
Thermal Power cont'd		
Objective-- LIMITED GROWTH	Avoid water withdrawals or discharges in locations producing any environmental damages.	Predetermined site locations for environmental protection. Minimize flow through cooling. Strive to reverse present consumptive use rate structure. Emphasize environmental impact over costs in plant and power line siting.
NON-WITHDRAWAL WATER USES		
Municipal Wastewater Discharge		
Objective-- NORMAL GROWTH	Attainment and maintenance of water quality standards and schedules with provisions for opportunity to upgrade standards and speed up schedules.	Use least cost alternative. Encourage regional systems where applicable, including municipal and industrial waste handling.
Objective-- ACCELERATED GROWTH	Attainment and maintenance of water quality standards and schedules with provision for opportunity to adjust schedules for short time periods.	Less uniform geographic investment. Increase outside government investment in regional systems and urban areas. Minimum restraint to high growth rate for economic development. Emphasis on Lake Superior.
Objective-- LIMITED GROWTH	Continue upgrading water quality standards and emphasize speeding up of schedules to attain the highest level of water quality that is technically feasible.	Invest in programs and projects to reduce pollution discharge as expeditiously as possible. No pollutant discharges by 1980. Place heavy emphasis on abatement of point- and non-point sources of wastes for Lake Superior.
Industrial Wastewater Discharge		
Objective-- NORMAL GROWTH	Attainment and maintenance of water quality standards and schedules with provision for opportunity to upgrade standards and speed up schedules.	Use least cost alternative. Encourage regional systems where applicable, including municipal and industrial waste handling.
Objective-- ACCELERATED GROWTH	Attainment and maintenance of water quality standards and schedules with provision for opportunity to adjust schedules for short time periods.	Less uniform geographic investment. Increase outside government investment in regional systems and urban areas. Minimum restraint to high growth rate for economic development. Emphasis on Lake Superior.
Objective-- LIMITED GROWTH	Continue upgrading water quality standards and emphasize speeding up of schedules to attain the highest level of water quality that is technically feasible.	Invest in programs and projects to reduce pollution discharge as expeditiously as possible. No pollutant discharges, including vessel wastes, by 1980. Place heavy emphasis on abatement of point- and non-point sources of wastes for Lake Superior.
Hydroelectric Power		
Objective-- NORMAL GROWTH	Develop hydroelectric power where economically and environmentally feasible. Not applicable for Lake Erie.	Consider least cost alternative for pump-storage sites or other options. Not applicable for Lake Erie.
Objective-- ACCELERATED GROWTH	Preserve future power generation options. Not applicable for Lake Erie.	Predesignate any pumped storage or other hydro sites. Not applicable for Lake Erie.
Objective-- LIMITED GROWTH	Limit hydroelectric expansion. Include development if it minimizes detrimental environmental effects. Not applicable for Lake Erie. No hydroelectric expansion in Lake Superior.	Minimize environmental damages by improved operations and proper removal of obsolete facilities. Maintenance of minimum low flows has priority over power production in Lake Ontario.
Water-Oriented Outdoor Recreation		
Objective-- NORMAL GROWTH	Investment in keeping with national economic constraints and maintenance of well being of people tantamount to the objective.	Include programs to increase benefits from existing high quality surface water. Encourage more efficient use of existing surface water. Include programs that provide parks near urban areas.
Objective-- ACCELERATED GROWTH	Invest in programs to enable region to attract a greater share of recreation industries from other areas.	Designate and develop streams, lakeshores, and unique natural areas with emphasis on high quality recreation user attraction.
Objective-- LIMITED GROWTH	Acquisition or preservation and management of all water front and unique natural areas for public benefit.	Acquire all streams for future use. Acquire all lakeshore and phase out over time non-public use which may cause environmental harm. Acquire other areas with recreational potential as needed to satisfy subobjective.
Sport Fishing		
Objective-- NORMAL GROWTH	Invest in development programs where benefits will justify investment. Also, maintain the existing resource, at least at present level.	Selected investment in programs to round out balanced national fishing opportunity. Protect and enhance existing wetlands, stream, and lake habitat; acquire additional areas.

TABLE 1-19 (continued) Subobjectives and Criteria for Resource Use Categories

Resource Use Categories and Objectives	Subobjectives	Criteria
Sport Fishing cont'd		
Objective-- ACCELERATED GROWTH	Maximize regional share of fishing opportunities on a sustained basis.	High level of investment in stocking program. Planting and habitat programs to provide maximum fishing opportunities. Protect wetlands and acquire additional fishery areas.
Objective-- LIMITED GROWTH	Preserve all streams and lakes to highest possible natural level of quality and correlative fishing experience. Enhance all fishing experiences. Preserve all anadromous fishing streams.	Designate and protect all public waters. Enhance fishing through stocking and new species introduction. Set aside and protect all anadromous streams, wetlands, and other areas. Acquire additional public waters.
Recreational Boating		
Objective-- NORMAL GROWTH	Modest investment in keeping with national economic constraints.	Adequate ports of refuge. Navigational aids to meet demands. Few new reservoirs. Encourage better use of existing areas.
Objective-- ACCELETERATED GROWTH	Invest to attract a greater portion of the national recreational boating activity.	Develop new recreational boating facilities including harbors and marinas.
Objective-- LIMITED GROWTH	Preserve all recreational opportunities with minimum disruption of natural environment.	Encourage rehabilitation of existing sites adapted to the natural environment.
Commercial Fishing		
Objective-- NORMAL GROWTH	Invest in programs and developments where benefits will justify investment, and where the fishery is compatible with sport fishery management.	Select investments to round out balanced commercial fishing opportunity.
Objective-- ACCELERATED GROWTH	Maximize commercial fishing opportunities on a sustained yield basis, and maintain compatibility with sport fishery management.	High level of investment in stocking programs; planting and habitat programs to provide maximum fishing opportunities.
Objective-- LIMITED GROWTH	Maintain commercial fishing as a means of fish management. Avoid exploitation in order to preserve all species, and maintain compatibility with sport fishery management.	Designate and protect all public waters. Maintain fishery by stocking, introduction of new species,and managed harvests. Set aside and protect all anadromous streams.
Commercial Navigation		
Objective-- NORMAL GROWTH	Maintain region's projected share of national commerce.	Invest in harbor and channel projects, and other developments with economic justification, for low cost, deep draft navigation and the provisions of incremental improvements to the navigation system in the Great Lakes and St. Lawrence Seaway.
Objective-- ACCELERATED GROWTH	Increase region's share of national commerce thru technically feasible, economically justified,and environmentally acceptable means.	Supplement investment to yield more and better ports, handling facilities, deeper channels, and extension of the navigation season. Implement more competitive rate structure.
Objective-- LIMITED GROWTH	Avoid navigation improvements which have detrimental environmental effects.	To the extent technically feasible and environmentally acceptable, maintain efficient, low cost, deep draft navigation and the provision of incremental improvements to the connecting channels, harbors, locks, canals, dams, and extension of the season. Plan to orient barge canal to recreational use.
RELATED LAND USE AND PROBLEMS		
Agricultural Land Treatment		
Objective-- NORMAL GROWTH	Include region's share of erosion control and land treatment programs.	Annual damages must exceed annual costs of correcting damages. Continuation of ongoing programs. Meet 42% of total needs by 2020.
Objective-- ACCELERATED GROWTH	Include all projects and programs which would enhance the region's agricultural development opportunities.	Meet 88% of total needs by 2020. Ongoing plus accelerated programs. Emphasize economic gain over environmental losses.
Objective-- LIMITED GROWTH	Emphasize land treatment programs resulting in environmental gains.	Meet 100% total needs by 2020. Aesthetic wildlife and recreation values take precedence over economic return from land treatment.
Cropland Drainage		
Objective-- NORMAL GROWTH	Invest in projects or programs that are economically and environmentally feasible.	Select justified alternative. Include drainage projects that increase production and efficiency and reduce cost.

TABLE 1–19 (continued) Subobjectives and Criteria for Resource Use Categories

Resource Use Categories and Objectives	Subobjective	Criteria
Cropland Drainage cont'd		
Objective-- ACCELERATED GROWTH	Invest in all projects and programs which would enhance regional agricultural development opportunities.	Returns and reduced damaging may not exceed fiscal and environmental costs of corrective action.
Objective-- LIMITED GROWTH	Emphasize environmental and natural habitat losses over economic gains.	No drainage of agriculture land. Emphasize aesthetic wildlife and recreation values over economic return from agricultural land.
Forest Land Treatment		
Objective-- NORMAL GROWTH	Invest to enhance output of forest products. Include region's share of erosion control and land treatment programs.	Maintain programs that are consistent with land use plans. Plan to meet 50% of total needs by 2020.
Objective-- ACCELERATED GROWTH	Invest to increase region's share of fibre production nationally.	Include all projects and programs which would enhance the region's forest development opportunities. Plan to meet 60% of total needs by 2020.
Objective-- LIMITED GROWTH	Emphasize land treatment programs resulting in environmental gains.	Aesthetic and wildlife and recreation values take precedence over economic return from forest land treatment programs. Plan to meet 100% of total needs by 2020.
Shoreland Erosion		
Objective-- NORMAL GROWTH	Balanced use of shorelands to meet national standards. Assume treatment of all critical non-protected areas is in national interest.	Include structural and institutional measures with maximum net benefits. Correct erosion problem for all critical non-protected areas by 1980.
Objective-- ACCELERATED GROWTH	Manage shoreland for uses which maximize regional economic gain. Assume treatment of all critical and non-critical non-protected areas is in regional economic interest.	Increase investments in water related enterprises. Correct erosion problem for all critical and non-critical non-protected areas by 1980.
Objective-- LIMITED GROWTH	Preservation of shorelands as a unique resource. Only include corrective programs where environmental gains would exceed environmental losses.	Acquire or manage designated environmental and natural areas on shorelands for public benefit. Endorse developmental setbacks for all shoreland areas unless public benefits can be shown to outweigh public disadvantages.
Streambank Erosion		
Objective-- NORMAL GROWTH	Invest in projects and programs where economically and environmentally feasible.	Damages must exceed fiscal and environmental costs of corrective action.
Objective-- ACCELERATED GROWTH	Include all projects and programs which would enhance region's developmental opportunities.	Emphasize economic gain over environmental losses. Assume complete abatement of all damages is in regional interest.
Objective-- LIMITED GROWTH	Limit investment to programs and projects that have positive environmental effects.	Emphasize environmental and natural habitat preservation over economic gains.
Flood Plain Management		
Objective-- NORMAL GROWTH	Maximize net benefits from national point of view. Minimize future flood plain development.	Use non-structural measure first. Include structural measures where justified. Encourage flood plain management.
Objective-- ACCELERATED GROWTH	Use flood plain to maximize regional economic benefits.	Include non-structural and structural projects. Scale projects larger than NOR projections.
Objective-- LIMITED GROWTH	Utilize flood plain to minimize disruption to natural environment.	Shift all land area subject to flooding to non-damaging uses with high number of environmental corridors. Use 100 year flood plain as area to be set aside.
Wildlife Management		
Objective-- NORMAL GROWTH	Plan for increase in state and federal investment to increase national net benefit.	Coordinate with competitive uses to maximize net benefits from wildlife program.
Objective-- ACCELERATED GROWTH	Invest so that region will attract a greater share of wildlife industry from other regions.	Emphasize habitat management and program expansion including production of game species and fur-bearing animals.
Objective-- LIMITED GROWTH	Protect all endangered species. Preserve natural wildlife habitat and manage for species protection.	No physical alterations detrimental to wildlife habitat. Management of wetlands for environmental preservation and habitat improvement.
Aesthetic and Cultural		
Objective-- NORMAL GROWTH	Only preserve those values whose user fees would exceed costs plus such extra values needed to maintain a level for the well being of people tantamount to the objective.	Designate caves, historical structures, and other aesthetic and cultural areas desirable to maintain the well being of people.

TABLE 1-19 (continued) Subobjectives and Criteria for Resource Use Categories

Resource Use Categories and Objectives	Subobjectives	Criteria
Aesthetic & Cultural cont'd		
Objective-- ACCELERATED GROWTH	Only preserve those aesthetic and cultural resources needed to provide for that level of social well being of people necessary to furnish a liveable place in which to earn a livelihood.	No environmental corridors beyond those required to provide a minimum acceptable level for the well being of people.
Objective-- LIMITED GROWTH	Maximize availability of aesthetic and cultural resources for future generations.	Preserve all areas inventoried in framework studies plus all other areas having significant potential. Implement long-range land use planning.
Outdoor Recreation		
Objective-- NORMAL GROWTH	Investment in keeping with national economic constraints and maintenance of well being of people tantamount to the objective.	Include programs that would likely yield net benefits (fiscal, physical, and social).
Objective-- ACCELERATED GROWTH	Invest in programs to enable region to attract a greater share of recreation industry from other areas.	Development of stream, lakeshore, and unique areas with emphasis on high quality recreation user attraction.
Objective-- LIMITED GROWTH	Protect all high value open space recreational opportunity areas and unique natural areas for public benefits.	Acquire, preserve, or manage all recreational lands for public benefit.

instances where the subobjective or criterion for a Lake basin differs from that of the Great Lakes Basin, the difference is pointed out at the appropriate place in the matrix.

Generally speaking, it is difficult to articulate a set of goals, subobjectives, and criteria at the outset of a study. These emerge as the public has an opportunity to respond to preliminary framework proposals based on tentative assumptions of goals.

It is equally difficult to apply goals, subobjectives, and criteria explicitly in the formulation process. Sometimes the criteria will point toward specific programs, but usually they only point in a general direction. The process of working out the detailed statements, of defining the terms used, and of drawing distinctions has made both those persons responsible for plan formulation and those persons concerned with planning issues better able to articulate their goals. Thus, the planning process has been enhanced.

In preparing the framework to meet the Normal Growth objective, it was found that the subobjectives and criteria were rather specific for some of the resource use categories and quite general for others. Because this objective reflects trends and is most familiar to planning personnel as well as to the public, the conceptual tie between a given criterion and a program selection is relatively strong. In fact the criterion may have evolved as a statement which would support a specific selection or class of selections associated with traditional ways of meeting a recognized need.

In a similar fashion, the subobjectives and criteria for the Accelerated Growth and Limited Growth objectives were used as guides to the kinds of programs which might be selected—more so in connection with some resource use categories than with others. Because frameworks were not developed for the Accelerated Growth and Limited Growth objectives, the process was not carried to a conclusion, but the direction which planning could take was identified by the subobjectives and criteria.

On the other hand, when it came time to select programs for a Proposed (PRO) Framework (described in Section 4), which would represent a proposal which the Commission selected from a number of alternatives, no specific subobjectives or criteria were stated. Rather, programs within the specific resource use categories were selected in relationship to those which reflected normal growth, accelerated growth, and limited growth.

Section 3

FUTURE GROWTH ASSUMPTIONS AND RESOURCE REQUIREMENTS

What do the next fifty years hold for the Great Lakes Basin? Are the pressures of population growth on a collision course with efforts to achieve and maintain a high quality environment? The answers are uncertain. What is clear is that in the past we have too often failed to evaluate the environmental consequences of growth primarily for economic gain. Throughout the United States, scientists, economists, and planners are studying our history to give us a grasp on the future. Ideas which challenge the values and goals of perpetual growth are providing the impetus for consideration of new directions for our rapidly changing technological society.

The Great Lakes Basin Framework Study established dynamic planning tools for projecting new growth directions for the Region. Traditionally, long-range studies (50 years) have relied upon what we know best, the past, to project the future. Since it is not possible to foresee the future, projections must necessarily be based on modifications of past relationships believed to have future relevance. The choice of the past relationships to be extended and the methodology for extending them are based on assumptions. Some of these assumptions are stated explicitly and some are implicit in the activity and land use expected to prevail during the projection period. In the course of this study, the Great Lakes Basin Commission broke with tradition. The Commission recognized that any major urban area, like the Great Lakes Region, that is undergoing a process of megalopolitan formation has the option and responsibility to project alternative futures that could differ significantly from past trends.

In the extreme, alternative futures for the Great Lakes Region mean changes in the competitive economic position of the Region with respect to the nation, and changes in per capita demands on the resource base of the Great Lakes Basin over the next fifty years. This is illustrated in Table 1–20.

The logic behind the development of extreme projections, or upper and lower limits, emanates from the recognition of a wide divergence of opinion of national, regional, State, and local goals for future resource development. That is, given a range of quantitative projections of accelerated, normal, and limited growth and associated resource requirements that encompass the high and low extremes of all perceptions of the future for the Great Lakes, there exists a framework within which the interrelationships between developmental growth and natural resource quality can be balanced. The following sections quantify the alternative futures of accelerated, normal, and limited growth for the Great Lakes Basin. Annex B documents the assumptions and methodology used for the data presented. (See Introduction for availability of Annex B.)

3.1 Economic and Demographic Projections

A range of population and economic activity levels has been projected for the next fifty years in the Great Lakes Region. The preparation of these multiple projection levels was accomplished in two major steps:

(1) The Great Lakes regional disaggregation in 1968 of the national economic and demographic projections, known as OBERS projections, was assumed to reflect normal growth conditions.

(2) The accelerated and limited growth projections resulted from a Great Lakes Basin Commission computer program (ADSUN—Alternative Demand, Supply, Needs) utilizing the OBERS series of "Effects of Alternative Assumptions on Projections of Gross National Product for the years 1980, 2000, 2020," prepared in late 1971. No new assumptions concerning national and regional economic structure were made for accelerated and limited growth projections.

Two key factors should be remembered in the interpretation of regional projections for the Great Lakes. First, all projections in the study were made on a national basis and then disaggregated to the Great Lakes Region based upon judgments that established the Region's share of a national economic and/or demographic parameter. Second, there are no confidence limits placed upon any of

TABLE 1–20 Key Variables for Alternative Future Growth Conditions, Great Lakes Region

Future Growth Condition	Population	Economy: Gross Regional Product	Economy: Per Capita Income	Resource Consumption: Per Capita Demand
ACC[1] (Accelerated)	High	High	High	High
NOR[2] (Normal)	Medium	Medium	Medium	Medium
LIM[3] (Limited)	Low	Low	Low	Low

[1]Maximum possible development and natural resource demand

[2]Trend development and resource demand

[3]Minimum development and natural resource consumption

the projected growth levels. Judgments were made to shift the regional competitiveness of the Great Lakes to represent accelerated and limited growth levels. The study did not evaluate where relative gains and losses would take place within other regions of the nation. Subregional shifts in relative shares of projections were assumed for the planning subareas within the Great Lakes Region itself.

The upper and lower limits of projections for the Great Lakes Region theoretically encompass any possible high or low levels of development ultimately to be attained in the Basin by 2020. Changing and shifting past economic and demographic trends indicate that man can control his own destiny. National, State, and local policy alterations in the social, political, economic, and natural resource fields are necessary to accomplish desirable changes. The planning task, then, requires a look at the implications of various growth conditions on water and related land resources.

The present and future patterns of water and related land use in the Great Lakes Basin depend, in large part, on its population, industrial development, agricultural economy, forest and mineral production, electrical power production, and standard of living. The following subsections describe the results of projecting new directions for growth in the Great Lakes Region.

3.1.1 Population

Over 29 million people resided in the Great Lakes Region in 1970. More than 85 percent of that total live within 50 miles of the shores of the Lakes Erie and Michigan. Historically, the Great Lakes Region has accounted for a steady 14 to 15 percent of the total U.S. population in the census decades from 1940 to 1970. Normal growth projections pose a gradual decline in the regional share of the national population levels to just over 13 percent, amounting to more than 53 million people by 2020. Accelerated growth projections for the nation and the Region shift population from other parts of the country to the Great Lakes area so that 17 percent of the national total, or 85 million persons, would live in the Region by 2020. Given implicit or explicit policies that would limit national population growth to near zero levels, the Region's population would reach 37 million by 2020, or less than 11 percent of the national total (Figure 1–11). Under limited

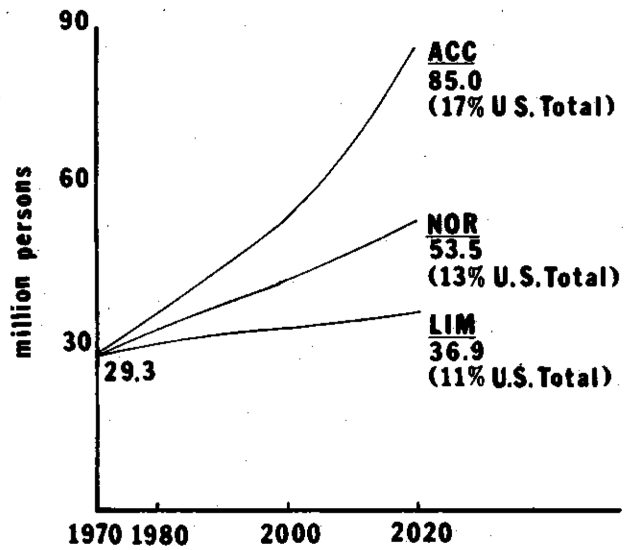


FIGURE 1–11 Population Growth in the Great Lakes Region

TABLE 1-21 Projected Populations, Great Lakes Region and Plan Areas (in thousands)

Growth Assumption and Region	1970	1980	2000	2020
ACC				
1.0--Superior	533.5	677.0	1,061.0	1,822.3
2.0--Michigan	13,517.0	17,026.1	24,338.0	38,236.2
3.0--Huron	1,236.3	1,627.0	2,521.0	4,263.0
4.0--Erie	11,513.8	14,641.0	20,904.0	33,010.0
5.0--Ontario	2,531.7	3,158.0	4,723.3	7,725.3
Total Great Lakes	29,332.3	37,129.1	53,547.3	85,056.8
NOR				
1.0--Superior	533.5	538.1	595.0	669.0
2.0--Michigan	13,517.0	15,492.3	19,645.4	24,829.5
3.0--Huron	1,236.3	1,411.1	1,809.2	2,324.4
4.0--Erie	11,513.8	13,300.0	16,794.2	21,281.0
5.0--Ontario	2,531.7	2,776.0	3,495.0	4,393.1
Total Great Lakes	29,332.3	33,517.5	42,338.8	53,497.0
LIM				
1.0--Superior	533.5	495.2	485.0	478.0
2.0--Michigan	13,517.0	14,162.2	15,676.4	17,087.1
3.0--Huron	1,236.3	1,297.0	1,451.0	1,618.0
4.0--Erie	11,513.8	12,162.0	13,403.1	14,651.4
5.0--Ontario	2,531.7	2,544.4	2,801.0	3,042.4
Total Great Lakes	29,332.3	30,660.8	33,816.5	36,876.9

growth assumptions, all areas in the Great Lakes Region except the Lake Superior region are still projected to gain in population for 50 years (Table 1-21), but population pressures on Great Lakes resources would be curtailed.

3.1.2 Employment

In 1970, approximately 11 million persons were included in the Great Lakes Region's work force. Assuming that the employment participation rate remains at near 40 percent for all growth projections, total employment projections follow population trends in terms of the regional per cent share of national employment. In 1970, 15 percent of the national work force labored in the Great Lakes Region. The Region's share of national employment by 2020 is projected at approximately 17 percent under accelerated growth, 13 percent under normal growth, and 11 percent under limited growth (Table 1-22, Figure 1-12).

3.1.3 Income

In the period from 1940 to 1960, the Great Lakes Region maintained approximately 18 percent of the nation's total personal income while averaging a 20 percent higher per capita income than national

TABLE 1-22 Projected Total Employment, Great Lakes Region and Plan Areas (in thousands)

Growth Assumption and Region	1970	1980	2000	2020
ACC				
1.0--Superior	171.8	256.0	409.3	688.3
2.0--Michigan	5,347.9	7,072.0	10,145.2	15,808.0
3.0--Huron	422.0	624.0	990.0	1,665.0
4.0--Erie	4,396.2	5,870.0	8,475.2	13,329.1
5.0--Ontario	964.4	1,276.4	1,928.2	3,177.0
Total Great Lakes	11,302.3	15,098.4	21,947.9	34,667.4
NOR				
1.0--Superior	171.8	195.0	222.0	252.0
2.0--Michigan	5,347.9	6,378.0	8,108.0	10,198.0
3.0--Huron	422.0	530.2	698.0	907.0
4.0--Erie	4,396.2	5,283.1	6,673.1	8,530.1
5.0--Ontario	964.4	1,109.0	1,412.0	1,776.0
Total Great Lakes	11,302.3	13,495.3	17,113.1	21,663.1
LIM				
1.0--Superior	171.8	175.0	174.0	176.0
2.0--Michigan	5,347.9	5,667.4	6,163.5	6,611.3
3.0--Huron	422.0	473.0	537.1	598.0
4.0--Erie	4,396.2	4,694.4	5,123.3	5,535.0
5.0--Ontario	964.4	987.3	1,081.0	1,666.0
Total Great Lakes	11,302.3	11,997.1	13,078.9	14,586.3

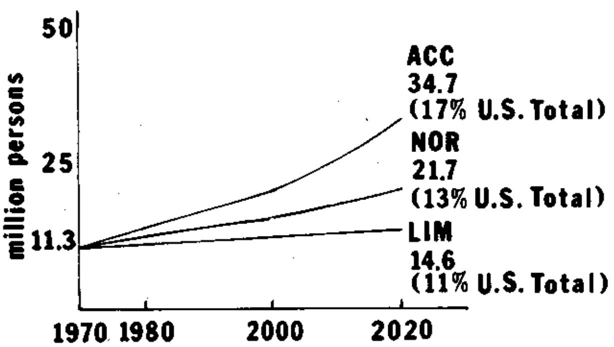


FIGURE 1-12 Projected Employment in the Great Lakes Region

levels. The heavy concentration of industrial activity in the Region has played a major role in its past performance. In 1970, total personal income in the Region neared $114 billion. Projections of personal and per capita income for normal growth conditions are consistent with trends described for population and employment for the Basin with respect to the nation. Accelerated growth assumptions project that the Region will have 18 percent of the nation's personal income by 2020, while limited growth conditions project a decline to near 12 percent of total national personal income (Figure 1-13, Table 1-23). Annual per capita income, while variable over the Great Lakes area, ranged between $3,000

TABLE 1-23 Projected Average per Capita Income, Great Lakes Region and Plan Areas (1967 dollars)

Growth Assumption and Region	1970	1980	2000	2020
ACC				
1.0--Superior	3,037	4,655	9,054	18,395
2.0--Michigan	3,961	5,956	10,834	20,916
3.0--Huron	3,420	5,206	9,967	19,761
4.0--Erie	3,743	5,817	10,623	20,702
5.0--Ontario	3,589	5,434	10,216	20,103
Total Great Lakes	3,802	5,800	10,622	20,646
NOR				
1.0--Superior	3,037	4,183	7,581	13,516
2.0--Michigan	3,961	5,226	8,258	14,717
3.0--Huron	3,420	4,610	8,190	14,270
4.0--Erie	3,743	5,106	8,568	14,575
5.0--Ontario	3,589	4,817	8,375	14,432
Total Great Lakes	3,802	5,101	8,598	14,603
LIM				
1.0--Superior	3,037	3,753	5,964	9,621
2.0--Michigan	3,961	4,727	6,851	10,352
3.0--Huron	3,420	4,156	6,423	10,023
4.0--Erie	3,743	4,618	6,722	10,256
5.0--Ontario	3,589	4,353	6,579	10,168
Total Great Lakes	3,802	4,613	6,746	10,275

NOTE: Average per capita income = total personal income divided by population.

and $4,000 in 1970, with the highest levels in the Lake Michigan and Lake Erie regions.

3.1.4 Production

Economic production provides both the necessities and the luxuries of life for people influenced by the resources of the Great Lakes Basin. Projections of agricultural activity, manufacturing, and forest and mineral production are particularly significant for future planning because they depend upon the utilization of basic natural resources. Some of these resources such as water and trees are renewable; that is, within a reasonable length of time they can be reestablished. Other resources such as minerals and valuable agricultural land, are nonrenewable; that is, once unique deposits are extracted or cropland is taken up by urban expansion, they cannot be replaced. Projected values of economic production are reported for the Great Lakes Basin in Figures 1-14, 1-15, and 1-16 in dollars of total earnings for accelerated (ACC), normal (NOR), and limited (LIM) growth assumptions.

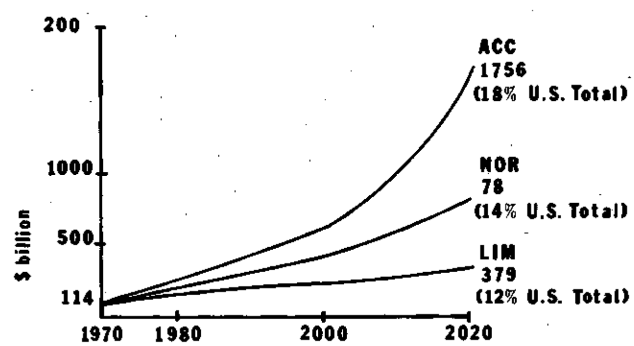


FIGURE 1-13 Projected Growth in Total Personal Income, Great Lakes Region (1967 dollars)

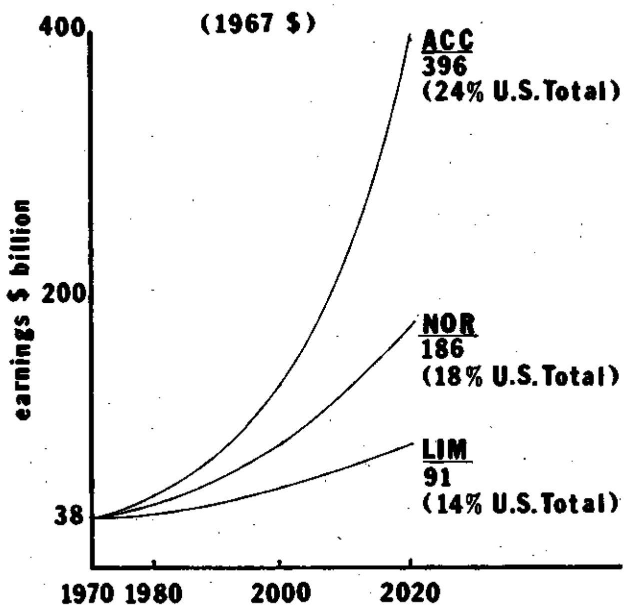


FIGURE 1-14 Projected Earnings in Manufacturing, Great Lakes Region (1967 dollars)

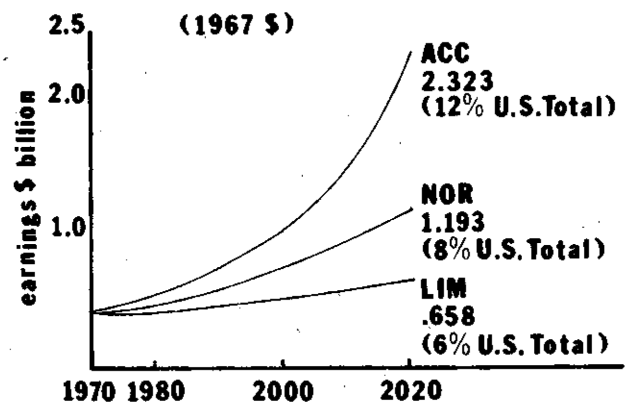


FIGURE 1-15 Projected Earnings in Mining, Great Lakes Region (1967 dollars)

TABLE 1-24 Projected Resource Requirements for the Great Lakes Region

Resource Use Category	Frwk.	Units	Lake Superior Region 1980	2000	2020	Lake Michigan Region 1980	2000	2020	Lake Huron Region 1980	2000	2020	Lake Erie Region 1980	2000	2020	Lake Ontario Region 1980	2000	2020
WATER WITHDRAWALS																	
Municipally Supplied	ACC	mgd	2,870	6,680	13,800	---	1,060	---	3,080	7,300	15,200	---	1,400	2,830	6,460	16,700	35,200
	NOR		2,470	3,230	4,220	---	251	---	2,100	2,830	3,760	---	579	770	5,220	6,950	9,200
	LIM		1,260	1,680	1,620	---	135	---	1,330	1,430	1,460	111	340	341	2,970	3,610	3,610
Self Supplied Industrial	ACC	mgd	1,930	5,930	19,400	477	959	3,600	4,700	7,220	19,500	500	740	2,380	7,780	15,200	46,300
	NOR		3,770	3,730	6,350	491	428	929	3,270	2,700	4,640	388	294	648	8,020	7,260	12,800
	LIM		823	594	1,110	172	122	196	1,990	1,340	1,770	247	176	282	3,300	2,290	3,430
Rural Domestic & Livestock	ACC	mgd	354	459	636	74	105	158	255	282	428	80	100	136	781	978	1,415
	NOR		265	323	362	48	60	72	148	182	209	62	70	78	536	651	738
	LIM		221	205	187	41	41	40	157	133	136	52	44	40	482	433	413
Irrigation	ACC	mgd	975	2,320	3,610	153	292	644	628	1,100	2,300	180	335	724	1,970	4,110	7,420
	NOR		828	1,250	1,700	108	155	232	426	650	904	99	174	262	1,480	2,250	3,140
	LIM		401	582	603	53	62	77	222	248	283	66	79	89	754	983	1,060
Mining	ACC	mgd	130	436	1,320	65	154	477	259	555	1,730	58	121	347	1,460	3,490	10,200
	NOR		85	157	292	33	50	80	163	295	513	31	54	93	927	1,230	1,740
	LIM		45	72	98	23	30	44	109	143	200	22	28	43	580	609	637
Thermal Power Cooling	ACC	mgd	12,600	43,300	93,700	3,310	15,900	38,400	9,370	33,900	68,400	5,700	8,000	15,700	31,500	104,000	223,000
	NOR		8,300	22,200	47,600	1,880	8,070	19,500	7,350	17,600	34,800	5,700	5,890	7,940	23,600	55,300	113,000
	LIM		68	108	3,960	1,020	1,530	446	285	617	5,330	4,700	3,790	188	15,700	6,470	3,540
NON-WITHDRAWAL WATER USES																	
Municipal Wastewater Discharges	ACC	mgd	3,500	6,350	14,000	82	1,010	2,640	2,990	6,930	14,400	493	1,330	2,690	7,310	15,600	33,800
	NOR		964	1,450	2,170	111	175	263	2,130	2,670	3,450	427	585	773	3,690	4,940	6,720
	LIM		1,400	1,590	15,40	101	129	140	1,270	1,360	1,390	230	322	324	3,000	3,380	3,390
Industrial Wastewater Discharges	ACC	mgd	4,780	6,530	15,600	429	863	3,240	4,230	6,500	17,600	503	665	2,140	10,100	14,600	41,500
	NOR		3,310	3,130	5,090	418	262	364	2,980	2,080	2,690	572	490	1,000	7,330	6,010	9,200
	LIM		1,950	1,640	2,060	155	110	176	1,790	1,210	1,600	223	158	254	4,180	3,120	4,080
Hydroelectric Power Flow	ACC	mgd	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	NOR		51,800	51,800	51,800	N/A	N/A	N/A	N/A	N/A	N/A	59,400	75,500	130,000	111,000	127,000	182,000
	LIM		---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Water Oriented Outdoor Recreation	ACC	1000	160,000	255,000	489,000	21,700	39,600	77,100	113,000	189,000	341,000	42,600	65,200	122,000	346,000	564,000	1,060,000
	NOR	Rec	88,300	139,000	201,000	11,600	17,800	25,200	69,600	104,000	149,000	22,800	33,900	48,300	197,000	300,000	431,000
	LIM	Days	101,000	145,000	161,000	12,700	17,200	20,800	70,600	94,900	113,000	22,400	28,100	35,300	211,000	291,000	337,000
Water Oriented Outdoor Recreation	ACC	1000	---	---	---	138	229	357	616	1,010	1,590	217	344	529	2,130	3,490	5,370
	NOR	Acres	1,050	1,740	2,670	---	---	---	---	---	---	---	---	---	---	---	---
	LIM	W.S.[1]	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Sport Fishing	ACC	1000	51,100	74,900	120,000	90,900	15,200	27,200	42,500	60,800	96,100	12,000	18,200	30,000	203,000	179,000	291,000
	NOR	Angler	38,300	48,300	58,400	9,200	11,900	14,900	32,700	42,000	48,600	17,200	21,500	20,800	105,000	133,000	154,000
	LIM	Days	34,100	38,000	41,600	5,610	6,270	7,030	27,800	30,600	33,300	6,240	6,820	7,380	77,400	85,200	92,900
Sport Fishing	ACC	1000	N/A														
	NOR	Acres															
	LIM	W.S.[1]															
Recreational Boating	ACC	1000	---	---	---	6,360	9,100	14,400	29,200	42,700	69,000	8,840	13,000	21,000	76,100	110,000	175,000
	NOR	Boat	16,100	20,400	25,900	4,840	6,130	7,790	7,630	9,650	12,300	4,660	5,760	7,230	35,800	44,900	56,700
	LIM	Days	---	---	---	4,040	4,300	4,570	7,150	8,210	9,090	4,340	4,650	5,000	34,700	37,700	40,700
Recreational Boating	ACC	1000	1,160	1,160	1,160	750	750	750	309	309	309	247	247	247	3,380	3,380	3,380
	NOR	Acres	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
	LIM	W.S.[1]	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Commercial Fishing	ACC	m-tons															
	NOR	year															
	LIM																

Commercial Navigation	ACC	m-tons	129	204	325	34	63	112	231	368	537	2	3	4	505	802	1,258
	NOR	year	111	151	196	28	40	58	192	254	318	2	2	2	423	583	753
	LIM		88	101	127	24	30	38	147	165	201	1	1	1	338	387	483
RELATED LAND USE & PROBLEMS																	
Agricultural Land--Treatment	ACC	1000	8,950	8,950	8,950	2,050	2,050	2,050	6,380	6,380	6,380	2,600	2,600	2,600	20,500	20,500	20,500
	NOR	Acres	8,950	8,950	8,950	2,050	2,050	2,050	6,380	6,380	6,380	2,600	2,600	2,600	20,500	20,500	20,500
	LIM		8,950	8,950	8,950	2,050	2,050	2,050	6,380	6,380	6,380	2,600	2,600	2,600	20,500	20,500	20,500
Agricultural Land--Cropland Drainage	ACC	1000	1,520	1,520	1,520	572	572	572	3,410	3,410	3,410	604	604	604	6,220	6,220	6,220
	NOR	Acres	1,520	1,520	1,520	572	572	572	3,410	3,410	3,410	604	604	604	6,220	6,220	6,220
	LIM		1,520	1,520	1,520	572	572	572	3,410	3,410	3,410	604	604	604	6,220	6,220	6,220
Forest Land Treatment	ACC	1000	9,050	9,050	9,050	2,810	2,810	2,810	2,230	2,230	2,230	3,840	3,840	3,840	17,900	17,900	17,900
	NOR	Acres	9,050	9,050	9,050	2,810	2,810	2,810	2,230	2,230	2,230	3,840	3,840	3,840	17,900	17,900	17,900
	LIM		9,050	9,050	9,050	2,810	2,810	2,810	2,230	2,230	2,230	3,840	3,840	3,840	17,900	17,900	17,900
Shoreland Erosion	ACC	Miles	587	587	587	162	162	162	153	153	153	186	186	186	1,280	1,280	1,280
	NOR		587	587	587	162	162	162	153	153	153	186	186	186	1,280	1,280	1,280
	LIM		587	587	587	162	162	162	153	153	153	186	186	186	1,280	1,280	1,280
Streambank Erosion	ACC	Miles	3,770	3,770	3,770	1,710	1,710	1,710	2,490	2,490	2,490	1,470	1,470	1,470	10,900	10,900	10,900
	NOR		3,770	3,770	3,770	1,710	1,710	1,710	2,490	2,490	2,490	1,470	1,470	1,470	10,900	10,900	10,900
	LIM		3,770	3,770	3,770	1,710	1,710	1,710	2,490	2,490	2,490	1,470	1,470	1,470	10,900	10,900	10,900
Flood Plains--Urban	ACC	1000	412	412	412	142	142	142	536	536	536	99.1	99.1	99.1	1,440	1,440	1,440
	NOR	Acres	412	412	412	142	142	142	536	536	536	99.1	99.1	99.1	1,440	1,440	1,440
	LIM		412	412	412	142	142	142	536	536	536	99.1	99.1	99.1	1,440	1,440	1,440
Flood Plains--Urban	ACC	$1000	74.6	78.5	83.2	8.9	9.9	10.9	120	125	129	16.8	17.3	17.8	226	236	247
	NOR	A.A.D.[2]	74.6	78.5	83.2	8.9	9.9	10.9	120	125	129	16.8	17.3	17.8	226	236	247
	LIM		74.6	78.5	83.2	8.9	9.9	10.9	120	125	129	16.8	17.3	17.8	226	236	247
Flood Plains--Rural	ACC	1000	23,200	50,500	119,000	974	1,700	3,560	50,500	91,200	140,000	536	1,190	2,660	76,100	146,000	269,000
	NOR	Acres	20,300	40,700	83,500	856	1,380	2,530	44,300	73,400	98,700	475	947	1,910	66,800	118,000	189,000
	LIM		18,400	31,900	58,700	773	1,080	1,780	40,000	57,600	69,500	429	744	1,350	60,400	92,400	133,000
Flood Plains--Rural	ACC	$1000	1,060	1,090	1,090	293	292	291	732	728	723	249	248	248	2,560	2,550	2,540
	NOR	A.A.D.[2]	1,060	1,090	1,090	293	292	291	732	728	723	249	248	248	2,560	2,550	2,540
	LIM		1,060	1,090	1,090	293	292	291	732	728	723	249	248	248	2,560	2,550	2,540
Wildlife Management	ACC	1000	5,220	7,020	9,300	1,490	1,900	2,530	11,000	16,200	24,900	2,310	4,210	8,150	20,400	30,000	45,800
	NOR	Acres[3]	4,580	5,660	6,560	1,300	15,00	1,770	9,650	13,100	17,600	2,110	3,440	5,840	18,000	24,200	32,400
	LIM		4,150	4,450	4,620	1,180	1,190	1,250	8,720	10,300	12,400	1,910	2,710	4,120	10,300	19,000	22,800
Wildlife Management	ACC	1000	N/A														
	NOR	User	17,800	20,300	23,400	4,680	5,180	5,770	18,400	19,800	22,600	5,170	5,070	5,470	60,500	64,800	71,900
	LIM	Days[4]	N/A														
Aesthetic & Cultural	ACC	1000	22,100	31,000	45,500	6,080	8,550	13,600	13,600	18,900	28,500	2,310	3,130	4,590	46,700	65,400	48,500
	NOR	Acres	30,900	34,600	38,800	7,660	8,560	9,560	20,100	23,300	13,800	2,510	2,920	3,360	64,300	72,500	68,800
	LIM		13,600	13,800	14,500	3,640	3,610	3,600	8,470	9,230	9,940	1,160	1,140	1,110	28,400	29,600	31,100
Outdoor Recreation--Intensive	ACC	1000	N/A														
	NOR	Acres															
	LIM																
Outdoor Recreation--Extensive	ACC	1000	64.3	106	218	8.3	14.9	35.1	45.8	86.0	172	17.4	32.6	55.2	139	247	502
	NOR	Acres	33.4	50.2	73.3	4.3	6.5	9.6	21.6	31.2	47.8	6.2	9.2	13.0	68.1	100.6	148.2
	LIM		33.4	37.5	53.4	4.1	4.3	6.3	23.3	29.1	36.2	5.9	6.9	8.1	68.7	79.9	106.2

[1] 1000 Acres Water Surface

[2] $1000 Average Annual Damages

[3] 1000 Acres of Potentially Huntable Land

[4] Hunter Day x (2) = Use Days

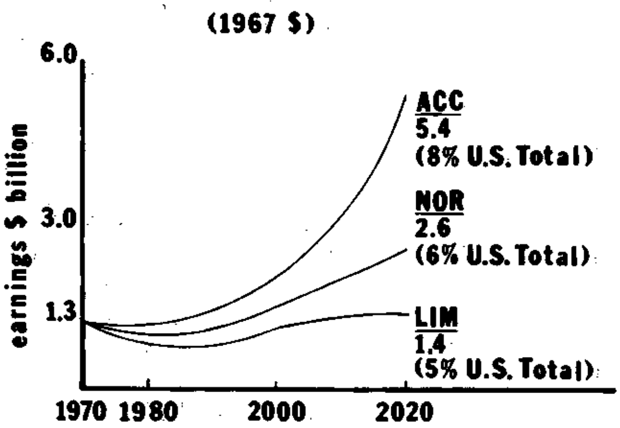


FIGURE 1–16 Projected Earnings in Agriculture, Great Lakes Region (1967 dollars)

Economic base projections for the normal growth conditions have been extensively reported in Appendix 19, *Economic and Demographic Studies.* Measures of economic production are major factors in the determination of resource requirements described in the following subsection.

3.2 Resource Requirements

What do projections of accelerated, normal, and limited growth mean for the environment of the Great Lakes Basin? The Framework Study interprets this question to have both quantitative and qualitative aspects. That is, people's needs for food, clothing, water, recreation, etc., depend not only upon an adequate amount of water and land capable of supplying those needs, but also upon an assurance that the natural resources of the Basin will not be degraded in quality so as to preclude future use. Some projected resource requirements, such as those for water for drinking and for economic production, will increase. Other resource requirements, such as forest land treatment, which are tied more directly to maintenance and enhancement of resource conditions, remain relatively constant over time. Both general types of resource requirements are reported here for futures based upon accelerated, normal, and limited growth assumptions. Water and related land requirements for normal growth are extensively documented in the 24 functional appendixes prepared for this study. Resource requirements projected for accelerated and limited growth derive both from the Alternative Demand, Supply, Needs (ADSUN) computer program and from input and judgments supplied by functional work groups. The judgmental inputs for determining accelerated and limited growth resource requirements differed from those for the normal growth projections developed in the 24 appendixes.

3.2.1 Methodology

The methodologies used by the Framework Study work groups and by the ADSUN program to translate economic and demographic projections into water and land requirements were basically a function of an economic and/or demographic variable, a unit per capita demand for resources, and a use efficiency factor:

$$R = A \times D \times e$$

where

R = water or land requirements

A = economic and/or demographic activity variable; e.g., population, economic production in dollars.

D = unit demand for water or land resources; e.g., gallons per person per day, recreation days per person

e = use efficiency ratio.

In determining resource requirements, the ADSUN program represented the alternative limited and accelerated growth conditions by varying unit demand coefficients as well as economic and/or demographic activity levels in determining resource requirements of normal growth conditions. The Framework Study functional appendixes and Annex B of Appendix 1 show the detailed methodologies for translating projections into water and land requirements. See the Introduction for availability of Annex B.

3.2.2 Projected Water and Related Land Requirements

All water and land requirements developed for the accelerated, normal, and limited growth assumptions were included in three categories: water withdrawal uses, nonwithdrawal water uses, and related land uses. On a functional use basis, some overlap occurs within these three major categories. In the following description, each functional resource use is described only once though its associated requirements may appear more than once in Table 1–24 which presents projected resource requirements for the Great Lakes Region and its five plan areas. The unusual terms and units of measure are presented in the Glossary.

Water users in the Basin rely on the Great Lakes, inland lakes and streams, and ground-water resources. Projections of accelerated, normal and limited economic and demographic growth were translated into projected point withdrawal requirements for municipal, industrial, rural, agricultural, mineral, and electric power uses.

Water withdrawn for residential, commercial, public, and industrial (not self-supplied) purposes through centralized collection and distribution systems was projected in the municipal water supply category. Under the normal growth projection, unless there was reason to support an exception, per capita water usage for domestic and commercial purposes was assumed to accrue at a rate of 1 percent per year to 108 gallons per capita per day (gpcd); then at a rate of 0.25 percent per year to a maximum of 130 gpcd if this figure were attained prior to 2020. Accelerated growth projections assumed per capita rates by planning subarea above the normal level. In contrast, limited growth projections assumed a leveling off of per capita water use, generally by the year 2000.

Except for consideration of recirculation factors, projections of industrial water requirements were made on a unit demand basis, as they were for municipal use requirements. The determination of the normal growth relationships between industrial output and water use helped determine the extent to which the numerical coefficients of water use would vary above the normal level for accelerated growth and below the normal level for limited growth. Recirculation of industrial water due to technological advances was assumed in all future industrial water requirements.

An important though relatively minor category of water requirements is rural water. Uses considered in estimating rural water supply requirements include rural farm and nonfarm uses for domestic water, livestock, pesticide spray water, and water for sanitizing and cleaning. Rural water use factors were applied to projections of population, livestock, and crop production to generate water requirements for normal, accelerated, and limited growth.

Estimated economic production of food and minerals was a key factor in determining future water and land requirements for crop irrigation and mining. Again using a variable demand coefficient, total water use for accelerated, normal, and limited growth was determined after dollar production estimates were made. Projected population participation in golfing activities was translated into water and land estimates for the future.

Electric power generation in the Great Lakes Basin is dependent on water resources to supply cooling water for condensers or to supply water for conventional hydroelectric power plants and those using pumped storage facilities. Nuclear-fueled steam-electric plants require much more cooling water than fossil-fueled plants at the present time. It is anticipated that improved design and operating experience will reduce this difference soon.

Depending on cooling water temperature rise, plant efficiency, and type of plant, some 100 to 200 acre-feet of water are required for each million kilowatt hours produced by generating plants using flow-through cooling systems. However, most of the water is returned to the source with only about one percent being consumed. Plants which use supplemental cooling systems divert much less water from the source but have a higher consumptive use than flow-through plants.

Thermal electric cooling water diversions made by flow-through and supplemental (cooling tower) systems were estimated for normal growth. Maximum and minimum per capita energy and cooling water requirements for accelerated and limited growth were projected using normal projections as a base.

Projected requirements for municipal and industrial wastewater treatment were based on estimates of municipal and industrial water supply requirements with emphasis on organic or oxygen-consuming wastes. Requirements for advanced waste treatment or flow management were based on an analysis of low-flow characteristics at node points in Basin streams.

Water-oriented outdoor recreation activities included in this study are swimming, picnicking, camping, hiking and sightseeing. Requirements for alternative growth conditions were projected in terms of recreation days and in terms of land and water surface area. A recreation day is defined as a visit by an individual to a recreation area during all or a significant portion of a 24-hour day.

Projected requirements for sport fishing and recreational boating depend entirely upon license sales and boater registration estimates. For the normal growth projection, assumptions were made to account for transfer of demand into and out of the Basin. As in the recreation category, accelerated and limited growth requirements for sport fishing and boating were projected on a per capita use basis.

The future outlook for Great Lakes commercial fishery resources is very complex and must be analyzed by individual fish species. Most species have rather specific geographical, ethnic, religious, or cultural appeals that bear upon future market demand for fishery production. Characteristics of the past and future supply base, and maximum sustained yield estimates are extensively documented in Appendix 8, *Fish*.

Low, medium and high projections of prospective commercial traffic were developed to represent a range of possible futures for navigation in the Basin. Low traffic projections were assumed if the limited growth objective were pursued throughout the Region. Medium projections were assumed for the normal growth or national economic development objective, while high projections were assumed for the accelerated growth objective for maximum regional development.

Estimates of opportunities for agricultural and forest land treatment were based upon an evaluation of present resource conditions and the objective of preventing future resource degradation. Estimates of drainage requirements quantify in acres the opportunities for increasing the efficiency of agricultural production by draining cropland soils presently degraded because of wetness. Streambank and shoreland erosion and associated damages to be prevented were based on the present and projected severity of the erosion problems in the study area. It was assumed that the estimated annual damages would continue at their present levels unless preventive action were taken.

Average annual flood damages provided the basis for flood prevention requirements. Damages were projected to occur in both urban and rural flood plains assuming no preventive actions were taken.

Wildlife pressures were documented in terms of wildlife habitat requirements as well as user-day estimates. Projections of user-days by hunters based on license data represent one-half of the projected user-day estimates. Nonconsumptive wildlife uses, such as bird watching, wildlife observation, photography and the like, represent the other half.

Requirements for aesthetic and cultural resources were not defined in quantitative terms for the Framework Study.

3.2.2.1 Table of Projections

Table 1–24 displays projections of requirements for the various resource use categories for 1970 (existing situation) and the three target years for accelerated (ACC), normal (NOR), and limited (LIM) growth assumptions. The NOR data are essentially the historical and projected quantities provided by the work groups in the resource appendixes and constitute the basis for framework selection in the study. ACC and LIM growth projections, on the other hand, were not developed as viable projections for use in framework analysis. As stated in Section 3.1, they are intended to encompass any high or low levels of population or economic development conceived to be attainable by the year 2020. They set limits within which any deviations from the normal growth and its related frameworks will fall. This concept must be kept in mind in referring to Table 1–24 and in analyzing the data.

Section 4

FRAMEWORK DEVELOPMENT

4.1 The Idea of a Framework

The *Great Lakes Basin Framework Study* is the manifestation of one level of a process generally referred to as planning. In this case, it is directed primarily at water and related land resources. Planning takes many forms; it may be very general or very detailed. It may be an inventory, or it may result in quite definitive proposals or plans that are intended to be adopted and carried out with very little modification. The Framework Study falls somewhere between these two extremes. It is a preliminary investigation or reconnaissance intended to provide broad-scaled analyses of water and related land resource problems and furnish a general outline of the probable nature, extent, and timing of measures for their solution.

The result is not a plan but rather several combinations of possibilities. From these combinations, proposals to be studied in more detail are selected. From this detailed investigation, plans will emerge. The product of the Framework Study is, in the very best sense, a "framework" within which further, more detailed planning can be done and which will serve as a guide to the limit of development and the consequences which may result from various chosen courses of action. The Framework Study and the resultant framework or frameworks are not a panacea for the problems encountered in attempting to wisely use the resources of an area, but they help simplify what could be a complicated resource picture.

4.1.1 Frameworks for the Great Lakes Basin

The Great Lakes Region is unique, because it contains the largest series of freshwater bodies in the world. This resource, coupled with a wealth of forests, minerals, and agricultural products, has resulted in a large concentration of people and industries, and a heavy demand for the services they need. The Lakes contribute a water supply and a transportation route. They also serve as a sink for waste disposal. This creates some of the present problems. The interrelationships of the land and water resources and of the human resources are particularly complex, and the guidance provided by frameworks is helpful for this reason.

Each State in the Great Lakes Basin has responsibility for planning the wise use of its resources, but it has an equal responsibility for planning this use in such a way that other States will not be adversely affected. This requires that there be an understanding of interrelationships and that the effects of alternative choices in resource use be understood. The Framework Study and the frameworks it developed are one effective way of analyzing and reporting these interrelationships. Federal agencies charged with specific functions related to resource use have the same responsibilities as the States. Each agency must know the effects of choices made in its own sphere on other resources and resource uses. A comprehensive analysis, such as the Framework Study, enables these interrelationships to be understood. The Framework Study is coordinated by having all affected State and Federal agencies participate, and it is made comprehensive by including all resource uses and the consequences of the many choices which can be made among these various uses.

The unique features of the Great Lakes Basin are as important to Canada as they are to the United States, and choices made in one country affect the resources of both. The Framework Study is not a joint effort between the two countries, and the frameworks do not encompass resource development in Canada. However, the interchange of information, ideas, and objectives among personnel of the two countries permits the use of the frameworks with reasonable confidence that the interests of Canada are properly considered.

4.1.2 Frameworks for Future Time Periods

As pointed out above, the frameworks which are a product of the Framework Study provide a guide for future, more detailed planning, and for analyzing the way in which specific plans will mesh together in the entire Basin or in the smaller study areas of the Basin. The frameworks also provide a means for analyzing the timing of resource development and use. A situation is analyzed as it exists in mid-1970 and as it is expected to develop in the years of 1980, 2000, and 2020. The changes which occur in population, economic development, and resource use, and their interrelationships are estimated for these dates. This permits an analysis of the solutions to problems and the measures needed to utilize effectively the resources at a level of development consistent with population and economic change. It permits adjusting a total program over a period of time to accommodate fiscal and other limitations and gives administrative and legislative branches of the various levels of government an opportunity to schedule water resource programs in coordination with programs in other fields, taking into account finances of the total program rather than of simply part of it.

4.1.3 Constraints

There are both institutional and legal constraints connected with any framework developed in this study. To some extent, they are interrelated.

The most obvious constraint is that the study and the frameworks do not include the Canadian portion of the Great Lakes Basin. The legislative act under which the Great Lakes Basin Commission operates specifically provides that the jurisdiction, powers, and prerogatives of the International Joint Commission will not be affected by the act. By Executive Order, the Water Resources Council is directed to consult with the Department of State as appropriate on matters under consideration by the Great Lakes Basin Commission that relate to the areas of interest to and under the jurisdiction of the International Joint Commission and the Great Lakes Fishery Commission. This order also restricts the area of jurisdiction of the Great Lakes Basin Commission to the United States. These constraints do not, however, preclude the exchange of technical data and information between representatives of the two countries or discussion of the problems of the Great Lakes Basin. Thus, although the frameworks do not include Canada, implementation of the proposals they make will not adversely affect Canada and Canadian interests.

A second constraint is that the Framework Study can not study, plan, or recommend diversions into or out of the Great Lakes Basin. Existing diversions are, of course recognized, as are possible adjustments of present diversion uses within the limitation of 3200 cubic feet per second (cfs) total diversion prescribed by U.S. Supreme Court.

A third constraint inherent in the concept of the Framework Study is the difficulty of obtaining and compiling current, accurate, and useful information. Because data are not collected specifically for a study during the same period of time, but rather are incorporated from different time periods as available, they may not have consistent relationships. Furthermore, over the protracted period of a study, new data, new emphases, and a new social or economic climate can come into the picture. The presentation of consistent conclusions drawn from basic data accumulated during different time periods is a very difficult task.

4.1.4 Who Will Use the Frameworks

Adherence to the frameworks in carrying out further studies or in management of resources is not mandatory for any governmental entity. It is the hope and expectation that having participated in the development of the frameworks, the several levels of government will wish to consider them in further work. It may be that the Congress and legislatures will use the frameworks as a guide for controlling the expenditure of funds. There was no statutory obligation to participate in the Framework Study, although all the States in the Basin and most of the affected Federal agencies have found it in their interest to do so. However, the priority accorded to this work has varied so widely among and within the States and over the period of the study that the input has not been uniform. Therefore, it can be reasonably anticipated that the utilization of the product, the frameworks, will not be uniform. Much depends on the attitude of the public and its acceptance of the frameworks as representing a high-level, professional product consistent with the public good.

The first National Water Assessment prepared by the Water Resources Council after the Framework Study is completed will incorporate data from the Framework Study in the Great Lakes portion of the Assessment. Thus, the Study will permit comparison of Great Lakes needs and other parameters with those of the nation and of other regions.

4.2 The Process of Framework Formulation

The process of framework formulation is relatively simple in concept, but each of the steps becomes quite complex when carried out in an area as large as the Great Lakes Basin. The following are these steps in their basic form:

(1) projecting, to specific dates in the future, economic and demographic factors relating to the Basin

(2) estimating, for these dates, the requirements of the people, specifically for those resource uses, or functions, which involve use of water supplies or the related land

(3) determining the developed supplies of resources for the various functions selected, and specifically in terms of use of water and related land

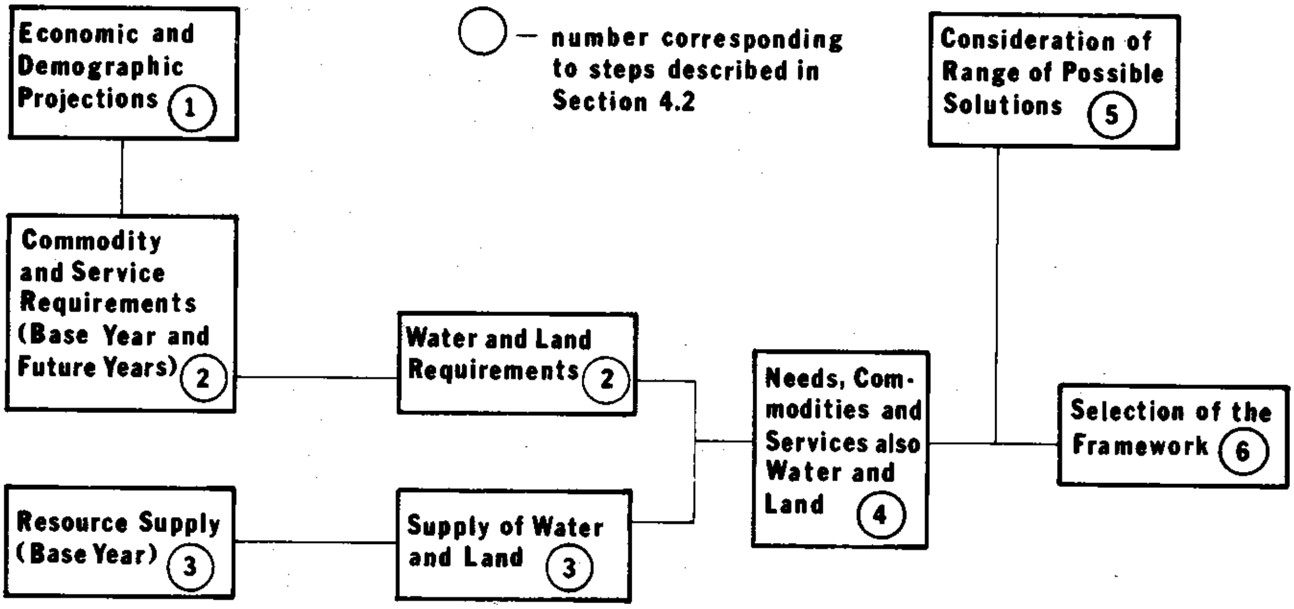


FIGURE 1–17 Schematic Diagram of Framework Selection

(4) comparing the developed supply with the requirements at one of the selected dates to determine the needs at that date

(5) selecting from the range of possible ways of meeting the need, a solution or combination of solutions best adapted to the circumstances

(6) analyzing and adjusting the solutions to determine which ones can serve more than one purpose, which ones may be mutually exclusive, and which ones should finally be included in the selected frameworks.

Figure 1–17 illustrates this very simplified description of framework formulation. The remainder of this section is devoted to more detailed description of various parts of the process and contains references to the location in the appendix of descriptions of other parts. Coverage is not necessarily in the order in which the procedures above have been listed nor in the order in which they are actually carried out. Many processes go on concurrently in framework formulation.

4.3 Objectives and Alternative Frameworks

Section 2 of this appendix describes the range of objectives which will influence the extent and kind of development and use of water and related land resources. That section also describes the characteristics of three levels of growth related to the objectives. These levels of growth influence the way in which frameworks are developed and resources utilized.

4.3.1 Normal Growth and OBERS Projections

On a nationwide basis, the national economic development objective, which has been equated with normal growth in this study, is the basis for the framework studies of water and related land resources. The projection of economic and demographic trends into the future on a nationwide basis has been a function of the OBERS studies. (See Introduction for further discussion.)

The demographic and economic levels determined in these studies and disaggregated to the Great Lakes Basin and smaller areas are related to amount and occurrence of resource use (quantities of water withdrawn for use, uses of water in the stream or lake, and related land uses). The use relationships were developed for a number of specific functions, such as municipal water supply, irrigation, minerals production, recreational boating, wildlife, land-based water-oriented recreation, and a number of others. The nature of the relationship and the quantities of resource use at the present time (in this study taken to be mid-1970) were analyzed, and from the relationships, projections were made of resource use or requirements for the target years. These requirements are further discussed in Section 3 of this appendix.

4.3.2 Other Alternatives

The OBERS projections, described previously, are one of three sets of projections used in the *Great Lakes Basin Framework Study*. The other sets of projections are related to the accelerated growth and limited growth objectives. The objectives themselves are discussed in Section 2 of this appendix, and the projections are discussed in Section 3.

The underlying philosophy of developing the accelerated and limited growth objectives, and the projections related to them, was that these would constitute extremes of growth not expected to be realized but serving as limits to guide the judgment of the people in the Basin and the planning staffs in the development of the Proposed Framework. Consequently, while requirements were estimated based on the projections related to accelerated and limited growth, and the process of determining needs and selecting frameworks was carried out to some extent for each growth assumption, the results were so extreme as to be misleading unless used in a very limited context. However, they have been an aid in guiding the judgment of planning staffs, and some selective parameters have been used for illustrative purposes to indicate what extreme conditions might exist if the objectives were fully pursued. The details are not included in the published record of the study but are in the files of staff working papers.

4.3.3 Proposed Framework

No separate set of projections was made for use in formulating the framework adopted and recommended by the Great Lakes Basin Commission. This framework is called the Proposed (PRO) Framework.

No economic growth rate was assumed for the Basin, nor for any part of the Basin. Rather, the desires of the local people and their governments as communicated to planning personnel were reflected in the elements of the framework which were selected. Further discussion is provided in Subsection 4.10.

4.4 Water and Land Resources

The Framework Study deals basically with water and related land resources and the ways in which these resources may be made most useful to people. The uses to which the resources are put vary as do the effects of uses on the resources. In order to provide for orderly and consistent consideration of these uses or functions and to permit uniform treatment and comparison in the 15 river basin groups, the resource use categories have been classified as follows:

Resource Use Categories	Unit[1]
Water Withdrawals	
Municipally Supplied	mgd
Self-Supplied Industrial	mgd
Rural Domestic and Livestock	mgd
Irrigation	mgd
Mining	mgd
Thermal Power Cooling	mgd
Nonwithdrawal Water Uses	
Municipal Wastewater Discharges	mgd
Industrial Wastewater Discharges	mgd
Hydroelectric Power	mgd
Water Oriented Outdoor Recreation	1000 Recreation Days; 1000 acres W.S.
Sport Fishing	1000 Angler Days; 1000 acres W.S.
Recreational Boating	1000 Boat Days; 1000 acres W.S.
Commercial Fishing	m tons per year
Commercial Navigation	m tons per year
Related Land Use and Problems	
Agricultural Land	
—Treatment	1000 acres
—Cropland Drainage	1000 acres
Forest Land	
—Treatment	1000 acres
Shoreland Erosion	miles
Streambank Erosion	miles
Flood Plains	
—Urban	1000 acres; $1000 AAD
—Rural	1000 acres; $1000 AAD
Wildlife Management	1000 acres; 1000 user-days
Aesthetic and Cultural	1000 acres
Outdoor Recreation	
—Intensive	1000 acres
—Extenstive	1000 acres

[1]See Glossary for definitions of units.

4.4.1 Opportunities, Needs, and Problems

Three categories of remedial and enhancement measures arise out of the analysis of water and land resources: opportunities, needs, and problems. Generally, only one of the three applies to each of the resource use categories, but problems may occur in cases where opportunities and needs are also present. Future needs and problems are discussed in Subsection 4.5. They are included at this point only to differentiate among the three. Needs can be quantified. They result from a situation in which the present developed supply of a resource for a particular use is not sufficient to meet the requirements anticipated at a future time. Problems may or may not be quantified. For example, the extent of flooding can be quantified and the extent to which flooding can be alleviated can be

TABLE 1–25 Future Water and Related Land Needs and Opportunities, Great Lakes Basin (Total)—Normal Framework

RESOURCE USE CATEGORIES	UNITS[1]	1970 Supply[2]	Needs and Opportunities[3] Base Year, 1970, to 1980	2000	2020
Water Withdrawals					
Municipally Supplied	mgd	4,300	870	2,810	5,400
Self-Supplied Industrial	mgd	10,600	1,110	4,670	10,300
Rural Dom. & Livestock	mgd	471	64	179	267
Irrigation	mgd*	681	824	1,570	2,460
Mining	mgd	780	148	450	965
Thermal Power Cooling	mgd	17,200	8,210	38,700	96,500
Nonwithdrawal Water Uses					
Mun. Wastewater Dischgs.	mgd[4]	3,060	3,680	4,940	6,720
Ind. Wastewater Dischgs.	mgd[4]	8,580	7,330	6,000	9,210
Hydroelectric Power	mgd	NA	47,300	51,300	105,000
W.O. Outdoor Recreation	1,000 rec. days	100,000	105,000	201,000	329,000
	1,000 acres W.S.	NA	---	---	---
Sport Fishing	1,000 angl. days	80,700	24,800	52,300	79,200
	1,000 acres W.S.				
Recreational Boating	1,000 boat days	29,000	6,820	12,500	19,500
	1,000 acres W.S.*	7,260	7,260	7,260	7,260
Commercial Fishing	million tons/yr.				
Commercial Navigation	million tons/yr.	343	432	583	754
Related Land Use & Problems					
Agr. Land--Treatment	1,000 acres*	20,450	20,450	20,450	20,450
--Cropland Drainage	1,000 acres*	6,210	6,210	6,210	6,210
Forest Land--Treatment	1,000 acres*	27,900	27,900	27,900	27,900
Shoreland Erosion	miles	1,200	1,200	1,200	1,200
Streambank Erosion	miles	10,900	10,900	10,900	10,900
	$1,000 AAD	1,710	1,710	1,710	1,710
Flood Plains--Urban	1,000 acres	222	230	240	251
--Urban	$1,000 AAD	46,300	67,100	118,000	190,000
--Rural	1,000 acres	2,570	2,560	2,560	2,550
--Rural	$1,000 AAD	14,200	18,000	24,200	32,400
Wildlife Management	1,000 acres		2,920	7,990	14,100
	1,000 user days	49,600	15,000	23,900	33,300
Aesthetic & Cultural	1,000 acres				
Outdoor Rec.--Intensive	1,000 acres		30	62	109
--Extensive	1,000 acres		170	348	600

[1]Asterisk denotes opportunity
[2]Includes problems and opportunities
[3]Additional resource requirements beyond 1970 requirements
[4]Total treatment requirement at each time period; footnote[3] does not apply

quantified. But in other cases, such as awkward or ineffective institutional arrangements, the problem cannot be expressed in units of quantity. In some cases, resource uses may present opportunities for enhancement of the resource, alleviation of a problem, or expansion of the range of the uses of the resource. These are classified as opportunities.

For each of the 15 river basin groups and for other planning elements, a table has been prepared entitled "Future Water and Related Land Needs and Opportunities." An example is Table 1–25 for the Great Lakes Basin. The table lists the resource use categories described in Subsection 4.4 and the 1970 supply described in Subsection 4.4.2. It also lists needs and opportunities for the planning target years 1980, 2000, and 2020.

The column "1970 Supply" contains primarily the quantified supply which was compared with requirements to determine needs (see Subsections 4.4.2 and 4.5). It also contains quantified problems, which should be alleviated if practicable, for shoreline erosion, streambank erosion, and flood damages. The column also contains quantified opportunities where the resource may be enhanced for irrigation, recreational boating water surface, agricultural land treatment, agricultural cropland drainage, and forest land treatment. These last five items are identified in the table by an asterisk (*). (On the program work sheets, which are included in Annex E, the symbol (1) was used.) This extent to which the opportunities are utilized is shown in every case in the program sheet and the summaries thereof. However, some exceptions to the general statements above must be noted:

(1) The 1970 supply for municipally supplied water is actually the 1970 average demand or withdrawal requirement. This quantity, rather than actual supply, was used in the work group methodology.

(2) In irrigation and mining, the supply and needs are stated in average mgd for the season during which the water is withdrawn. The length of season varies among the different river basin groups, influenced by several factors. Data are given in Appendix 5, *Mineral Resources*, and Appendix 15, *Irrigation*. If reduced to an annual amount the figure would be less than that shown. It is not proper to add water withdrawal figures for all six categories to obtain a total.

(3) The 1970 supply for municipal wastewater discharges and for industrial wastewater discharges are based respectively on municipal and industrial water requirements for the year. Similarly, treatment needs are assumed to be for the water supply provided. Figures are often not identical because changes made from time to time in one set of estimates were not incorporated into the other set. However, differences are not significant.

4.4.2 Resource Supply

A further step toward development of a framework consists of making an inventory and analysis of the resources available in the area. This analysis considers both the functional resource utilized by the public (for example, the number of recreation days of water skiing that can be provided in a season) and the basic resource which permits this functional use (for example, the number of acres of water surface available for water skiing). This analysis is necessarily related to the individual area being studied. In the case of this Framework Study, these areas are the 15 river basin groups. Details are given in the appropriate parts of Section 5, and Sections 6-10. However, there are some generalizations that can be made with respect to the supply of water and land, and the functions served in the Basin by these two basic resources.

With a few exceptions, all areas of the Basin have an adequate supply of good quality water for municipal, rural domestic, livestock, and industrial uses. Where the amount and quality of ground water are not satisfactory, surface water supplies are used. For communities near the Great Lakes, lake water is used. The choice among the alternative sources often involves overall cost based on both treatment required and the cost of developing the supply. Industries have not developed where a supply was not available, but no industry has been forced to move because of outgrowing its supply. Agricultural irrigation is not practiced on a large scale in the Basin, and water has generally been available for the areas needing it. However, the availability of additional supplies might induce additional irrigation in some places. Supplies of water for condenser cooling of thermal electric power plants have controlled the location of the plants, and the supplies at the selected locations have been adequate. Because of increasing concern about the return of heated water to sources, some problems have arisen with respect to siting of plants, but water as such is adequate. The Basin as a whole does not have much opportunity for conventional hydroelectric development, although in a few cases, notably at Niagara Falls, along the St. Lawrence, and in New York State, there are possibilities, many of which have already been developed. Pumped-storage plants are being constructed, and others are under study. The availability of sites limits the amount of hydroelectric power development. Thermal electric power plants supply the major portion of the power loads in the Basin.

In general, there is a shortage of facilities, including the basic supply of water, for water-oriented outdoor recreation in the southern part of the Basin; and an adequate supply, or often a surplus, in the northern part of the Basin. This relationship exists for the present population, in spite of the fact that many persons from the southern part of the Basin get their recreation in the northern part. There is plenty of water for recreational boating when the Great Lakes are considered, but the distances between adequate harbor facilities make much of the water surface unsafe for use. Thus the effective availability of suitable water supplies for recreational boating is reduced. The sport fishery on the streams, inland lakes, and Great Lakes accommodates all who now go fishing, but more would take advantage of this sport if the pressures were not so great. Consequently, it can be said that, in general, there is a shortage of supply over the Basin. The same situation exists with respect to wildlife. Because of crowding, many people who would like to do not hunt or engage in observing wild animals, bird-watching, and nature photography.

The Basin has far more areas and locations of aesthetic and cultural value than are being effectively utilized. The problem is not one of an adequate supply; but one of access, management, and availability for public use and protection over a long period of time.

For the detailed studies of resource supply in the individual areas, analyses were made of the total availability of the resource and the extent to which it is being developed and used at the present time. Limiting factors were considered. In some cases, the limiting factor is the availability of the resource; e.g., the flow of a stream. In other cases, the availability is related to the extent to which the resource has been developed for use; e.g., an aquifer tapped by a number of wells but not yet fully utilized. In this case, the present limit is the number of wells, whereas the ultimate limit is the capacity of the aquifer to provide water. In some cases the resource capacity is being fully utilized at the present time. In other cases, resource capacity may now be available, having already been developed for future use. This is the situation with most municipal water supply systems, which are seldom developed for the precise requirements at the time of completion, but rather are overdeveloped to permit some expansion.

4.5 Future Needs and Problems

A need is defined for this study as the amount of water and related land which must be developed to meet the deficit in commodities or services identified in the study at a specific time, location, and price. This deficit is determined by the analysis of requirement and supply.

Needs in the present study are determined for years 1980, 2000, and 2020 by comparing the requirements projected for these years (see Section 3), with the resource supply for the base year, 1970. If the requirement for the base year or one of the projection years is greater than the supply, there is a need at that year. Conversely, if the supply is greater than the requirement for a specific year, there is no need at that time, but a surplus.

Needs are perceived by the individual in terms of specifics: food and drink, gasoline for the car, electric power, a place to swim, etc. But in the Framework Study these specific needs are translated into changes in land use and an adequate supply of suitable water. Coupled with this is a need for control of the water in order to have it available at the right place at the right time, and to reduce flooding and other hazards.

These definitions and studies are based on a constant price relationship. This is necessary to avoid the complexity of considering a variable price structure.

Estimating the requirement for a function, such as swimming, and converting this requirement into a requirement for water and land to provide swimming facilities, requires an analysis of many interrelationships. These relationships are different for each function. The methodology for estimating the requirements for the specific functions is contained in the functional appendixes. A summary of the estimation of requirements is given in Section 3 of this appendix.

The discussion in Section 3 includes the derivation of requirements for a level of economic growth based on past trends nationally and in the Great Lakes Basin, and also for accelerated and limited levels of growth. For each of the sets of requirements thus developed, there is a set of needs, obtained by a consideration of the requirements and supply. For the Normal Framework the needs for each river basin group, Lake basin, and the Great Lakes Basin are given in Section 5 and Sections 6–10 of this appendix. The needs determined under the accelerated and limited growth assumptions are questionable because of the inherent wide range of assumptions going into their determination, and they were developed only in selected cases to guide the judgment of planners in connection with framework analysis. They have not been published.

In addition to the needs determined as described above, there are many problems connected with the utilization of resources, and these are also considered in the Framework Study. Problems may be physical, such as flooding or erosion, or they may take the form of conflicts in resource use, legislation that inhibits use or development, institutional arrangements, or other considerations. Each of the functional appendixes contains a discussion of problems related to the function, and throughout plan formulation the problems have been considered together with needs in developing frameworks. Early in the formulation process the problems in each river basin group were listed and classified subjectively as to their significance—minor, moderate, or severe. In this appendix the problems are shown in a matrix. The matrix for the Great Lakes Basin is shown in Table 1–47. The matrix is arranged by river basin group and by locations within the river basin group as well as by type of problem. Matrices for the Lake basins are in Tables 1–51, 1–76, 1–103, 1–131, and 1–159. The frameworks developed for each of the river basin groups take into account not only the quantified needs, but also the problems, and they endeavor to provide solutions for the latter or to indicate where additional research, studies, or legislation may be required to reach a solution.

4.5.1 Ongoing Programs

An identified need or problem may be met in one of two ways. In some cases, there are ongoing programs which have been authorized and for which funding is expected to continue without further authorization. Resources made available by these programs are considered to be available without further action and are utilized in meeting needs at the target dates. Any need not so met is to be met through programs included as a part of the framework. The ongoing programs are discussed in Section 5 and Sections 6 to 10 in relation to the framework formulation for specific areas.

4.6 Program Alternatives

The overall thrust of a framework study is to select a group of devices which will provide solutions to the identified problems and means for meeting the quantified needs for water and related land resources. These devices may be structural or nonstructural. They may serve a single purpose or more than one purpose. They may be independent or interrelated. Whatever they are and of whatever nature, they constitute a framework for dealing with a single set of needs and identified problems.

4.6.1 Alternative Solutions

For some functions, there may be only one way of meeting the need or solving a problem, but for most functions there are a number of ways, among which choices have to be made. For example, a municipality that needs an additional water supply because of projected increase in population or per capita use may be able to meet this need by pumping from ground water, diverting water from a stream or one of the Great Lakes, or building a storage reservoir and capturing flood flows of a stream for use at the appropriate time. It may even be possible to meet a significant portion of the need by controlling waste, metering, and other nonstructural measures that will promote efficient use of the existing supply, and thus postpone the need for increasing the supply. The range of possibilities and procedures for making a selection are discussed later in this section.

Many of the devices or solutions are well known and come to mind quickly in the process of framework analysis, but so that no possibilities would be overlooked, lists were prepared of a wide range of devices or solutions. There were about 150 initially, and these lists were screened as to their applicability in any particular circumstance. Random order was used in the lists so that no priority would be associated with the listing. To illustrate the procedure, the list used for screening solutions for providing water supply is given below. Each of the 17 items listed was considered with respect to its applicability for municipal water supply, self-supplied industrial water, rural, mineral, and irrigation supplies, and thermal electric power plant cooling.

The elements to consider are as follows:

(1) variance of crop patterns to reduce irrigation water use
(2) improved delivery systems
(3) effluent charges
(4) evaporation reduction (storage)
(5) ground-water development, use, and management (including storage)
(6) land use changes
(7) pipelines (from outside river basin group)
(8) pipelines (within river basin group)
(9) process modification in industries
(10) recirculation
(11) reclamation of wastewater
(12) reservoirs—offstream
(13) storage—onstream
(14) advances in technology
(15) water use management including:
  (a) pricing and metering policies
  (b) public education
  (c) per capita demand-supply control
  (d) water rationing
(16) weather modification
(17) zoning of industrial sites.

In most cases, the task forces used their knowledge or judgment or the information given in the functional appendixes to screen out most of the elements rather quickly. Reasons for dropping an element included: the element was not applicable in a particular instance; it was of too little consequence to be justified for consideration; or the costs would be far greater than costs for alternatives. No element was arbitrarily discarded simply because it was innovative or unusual.

Similar lists of devices were utilized for water quality, flood damage prevention, outdoor recreation, both land and water requirements, fishery management, wildlife management, commercial navigation, power production, and managment of water-related land resources. These lists are included in Annex D, Issues and Alternatives. (See Introduction for availability of Annex D.)

4.6.2 Program Categories

A series of undertakings (or solutions or devices, as they may be called) initiated to accomplish chosen objectives may be referred to as a program. A program deals with water and related land resource aspects that have something in common, though the functions themselves which use these aspects of water and related land may differ materially. In order to consider the related aspects as a group and provide multiple-purpose solutions to the maximum extent, the solutions were combined into three general groups of programs, categorized as water management, land management, and common water and related land management actions:

(1) water management programs
  (a) source—Great Lakes
  (b) source—inland lakes and streams
  (c) source—ground water
  (d) reservoir storage—instream and off-stream
  (e) structural, including stream modification
  (f) nonstructural—legislative and institutional
(2) land management programs
  (a) use changes
  (b) treatment
  (c) legislative and institutional
  (d) public acquisition
(3) common water and related land management actions
  (a) increased efficiency
  (b) collection and dissemination of information.

In order to provide an orderly and consistent method of analyzing the outputs of selected devices and their capability for meeting needs and providing solutions to problems, a program sheet was developed. This program sheet served both as a work sheet during the process of plan formulation and as a means of presenting the results. The program sheet for the Great Lakes Basin is shown in Table 1–26. A program sheet consists of a stub entry column in two parts—name and unit—and 48 columns for information. For convenience in handling and reproduction, the program sheet has been prepared in a format with two sets of stub entries, each one followed by 24 columns, with the second set of stub entries and columns shown on the sheet below the first. In using the form, it must be kept in mind, however, that actually the second group of columns is simply a continuation of the first group.

The 37 lines in the form, identified by names in the stub entry column, correspond to the resource use categories listed in Subsection 4.4. Each of the resource uses has a corresponding unit; all of the remaining columnar entries are shown in terms of the appropriate unit (see Glossary). The columns are in groups of three, for the three time periods at which projections and estimates are made—1980, 2000, and 2020. The first 12 columns (four sets of three each) deal with the total quantities of the needs and opportunities covered by the particular program sheets. The last 36 columns (12 sets of three each) deal with the programs and management arrangements by which the needs and opportunities are met.

The first 12 columns are used as follows. Columns 1, 2, and 3 contain the total needs and opportunities. Columns 4, 5 and 6 show the needs satisfied by the programs. (They are the summation of the outputs shown in columns 13 to 48 inclusive.) Columns 7, 8, and 9 are the transfers of needs or opportunities into and out of the Great Lakes Basin.

When the program sheets were set up, it was expected that there might be transfers of needs or opportunities among the river basin groups, affecting a number of different resource use categories. As formulation progressed, however, it became apparent that the work groups had incorporated into the methodology for determining needs most of the transfers which could practicably be made, considering the amount and accuracy of the basic information available. The transfer process was, however, extremely important in connection with RBG 2.2 and PSA 2.2. This planning subarea includes the six counties in Illinois which are also included in the Upper Mississippi River Basin Comprehensive Study. The three transfer columns were utilized in the work sheets to keep records of the adjustments between the Great Lakes Basin and the Upper Mississippi River Basin. The task force working in this area thought in terms of transfers to or from the Mississippi River Basin and affixed an appropriate plus or minus sign in this context. So, the minus sign shows needs transferred from the Upper Mississippi River Basin to the Great Lakes Basin to be met there, whereas the plus sign indicates needs transferred from the Great Lakes Basin to the Upper Mississippi River Basin, to be met there. This concept of the transfer process is necessary in order to interpret correctly the tables affecting PSA 2.2, PSA 2.0, the Great Lakes Basin, and the States of Illinois, Indiana, and Wisconsin.

Columns 10, 11, and 12 indicate needs which cannot be met in the Great Lakes Basin and must be transferred or remain unmet. Columns 13 to 48, in groups of three, consist of the programs in categories of Water Management, Land Management, and Common Water and Related Land Management, as listed in this subsection. They show the amount of needs met by each of the programs selected, and in total equal the amounts in columns

TABLE 1–26 Program Selections, Great Lakes Basin, Normal Framework

	RESOURCE USE CATEGORIES	UNITS	NEEDS AND OPPORTUNITIES ①			NEEDS SATISFIED BY PROGRAMS			TRANSFER—IN(+) OR OUT (-)		
			1980	2000	2020	1980	2000	2020	1980	2000	2020
			(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
1	WATER WITHDRAWALS										
2	Municipally Supplied	mgd	870	2,810	5,400	1,030	2,990	5,550	-(160)	-(180)	-(150)
3	Self-supplied Industrial	mgd	1,110	4,670	10,300	69	3,500	8,220	+(417)	+(1170)	+(2080)
4	Rural Domestic & Livestock	mgd	64	179	267	59	162	245	+(5)	+(17)	+(22)
5	Irrigation	mgd	824	1,570	2,460	684	1,330	2,100	+(140)	+(240)	+(360)
6	Mining	mgd	148	450	965	124	389	837	+(24)	+(61)	+(128)
7	Thermal Power Cooling	mgd	8,210	38,700	96,500	8,210	38,700	96,500			
8	NON-WITHDRAWAL WATER USES										
9	Mun. Wastewater Discharges	mgd	3,680	4,940	6,720	3,680	4,940	6,720			
10	Ind. Wastewater Discharges	mgd	7,330	6,000	9,210	7,330	6,000	9,210			
11	Hydroelectric Power	mgd	47,300	51,300	105,000	47,300	51,300	105,000			
12	W.O. Outdoor Recreation	1000 rec. days	105,000	201,000	329,000	57,300	132,000	190,000	+(8065)	+(19635)	+(26795)
13		1000 acres W.S.	NA								
14	Sport Fishing	1000 angler days	24,800	52,300	79,200	20,300	46,700	72,800			
15		1000 acres W.S.	NA								
16	Recreational Boating	1000 boat days	6,820	12,500	19,500	2,470	6,330	10,800			
17		1000 acres W.S.	7,260	7,260	7,260	+	+	+			
18	Commercial Fishing	m. tons/yr	NA								
19	Commercial Navigation	m. tons/yr	432	583	754	432	583	754			
20	RELATED LAND USES & PROBLEMS										
21	Agricultural Land-Treatment	1000 acres	20,450	20,450	20,450	1,800	5,410	7,570	+(1640)	+(1640)	+(1640)
22	-Cropland Drainage	1000 acres	6,210	6,210	6,210	435	858	1,470	+(335)	+(335)	+(335)
23	Forest Land - Treatment	1000 acres	27,900	27,900	27,900	2,830	8,490	14,200	+(160)	+(160)	+(160)
24	Shoreland erosion	miles	1,200	1,200	1,200	46	125	204			
25	Streambank erosion	miles	10,900	10,900	10,900	585	1,760	2,930	+(112)	+(112)	+(112)
26		$1000 AAD	1,710	1,710	1,710	252	756	1,260	+(25)	+(25)	+(25)
27	Flood Plains - Urban	1000 acres	230	240	251	78	139	199			
28	- Urban	$1000 AAD	67,100	118,000	190,000	52,200	103,000	177,000			
29	- Rural	1000 acres	2,560	2,560	2,550	532	921	1,220			
30	- Rural	$1000 AAD	18,000	24,200	32,400	6,580	11,300	18,100			
31	Wildlife Management	1000 acres	2,920	7,990	14,100	1,170	3,020	4,930			
32		1000 user days	15,000	23,900	33,300	2,250	7,230	12,500			
33	Aesthetic & Cultural	1000 acres									
34	Outdoor Rec. - Intensive	1000 acres	30	62	109	22.2	51.9	75.3	+(3)	+(6)	+(9)
35	- Extensive	1000 acres	170	348	600	151	319	453	+(18)	+(38)	+(51)
36											
37											

	RESOURCE USE CATEGORIES	UNITS	I. Water Management (cont.)								
			E. Structural (incl. Stream Modification)			F. Non-Structural — Legislative and Institutional			A. Use Changes		
			1980	2000	2020	1980	2000	2020	1980	2000	2020
			(25)	(26)	(27)	(28)	(29)	(30)	(31)	(32)	(33)
1	WATER WITHDRAWALS										
2	Municipally Supplied	mgd									
3	Self-supplied Industrial	mgd									
4	Rural Domestic & Livestock	mgd									
5	Irrigation	mgd									
6	Mining	mgd									
7	Thermal Power Cooling	mgd									
8	NON-WITHDRAWAL WATER USES										
9	Mun. Wastewater Discharges	mgd	3,680	4,940	6,720						
10	Ind. Wastewater Discharges	mgd	7,330	6,000	9,210						
11	Hydroelectric Power	mgd	47,300	51,300	105,000						
12	W.O. Outdoor Recreation	1000 rec. days							48,900	116,000	169,000
13		1000 acres W.S.									
14	Sport Fishing	1000 angler days				18,300	41,700	67,000			
15		1000 acres W.S.									
16	Recreational Boating	1000 boat days									
17		1000 acres W.S.									
18	Commercial Fishing	m. tons/yr									
19	Commercial Navigation	m. tons/yr									
20	RELATED LAND USES & PROBLEMS										
21	Agricultural Land-Treatment	1000 acres									
22	-Cropland Drainage	1000 acres									
23	Forest Land - Treatment	1000 acres									
24	Shoreland erosion	miles	46	125	204						
25	Streambank erosion	miles	585	1,760	2,930						
26		$1000 AAD	252	756	1,260						
27	Flood Plains - Urban	1000 acres	60	76	82				✓	✓	✓
28	- Urban	$1000 AAD	48,800	78,000	97,000				✓	✓	✓
29	- Rural	1000 acres	464	725	850				✓	✓	✓
30	- Rural	$1000 AAD	5,590	8,300	10,300				✓	✓	✓
31	Wildlife Management	1000 acres							✓	✓	✓
32		1000 user days							✓	✓	✓
33	Aesthetic & Cultural	1000 acres									
34	Outdoor Rec. - Intensive	1000 acres							22.0	51.7	75.1
35	- Extensive	1000 acres							151	319	453
36											
37											

Legend: V--Not quantifiable, NA--Data not available, +--Surplus of supply over

TABLE 1-26 (continued) Program Selections, Great Lakes Basin, Normal Framework

UNMET NEEDS OR OPPORTUNITIES ① (SURPLUS +)			I. Water Management: A. Source – Great Lakes			B. Source – Inland Lakes and Streams			C. Source – Groundwater			D. Reservoir Storage – Instream & Offstream			
1980 (10)	2000 (11)	2020 (12)	1980 (13)	2000 (14)	2020 (15)	1980 (16)	2000 (17)	2020 (18)	1980 (19)	2000 (20)	2020 (21)	1980 (22)	2000 (23)	2020 (24)	
															1
0	0	0	926	2,610	4,750	23	80	150	68	220	390	13	80	220	2
0	0	0	480	2,650	6,120	140	560	1,440	75	290	660				3
0	0	0				12	38	56	47	124	189				4
0	0	0	69	90	210	320	700	1,120	290	505	715	5	35	55	5
0	0	0	20	50	100	40	135	307	57	194	420	7	10	10	6
0	0	0	8,210	38,700	96,500										7
															8
0	0	0													9
0	0	0													10
0	0	0													11
39,635	49,365	112,205				0	1,000	1,000				8,400	15,000	20,000	12
															13
4,500	5,600	6,400										2,000	5,000	5,800	14
															15
4,350	6,170	8,700	1,440	3,320	5,600	1,030	3,010	5,200							16
+	+	+													17
															18
0	0	0	426	575	744										19
															20
17,010	13,400	11,240													21
5,440	5,017	4,405													22
24,910	19,250	13,540													23
1,154	1,075	996													24
10,203	9,028	7,858													25
1,433	929	425													26
152	101	52										12	17	17	27
14,900	15,000	13,000										1,300	3,000	4,000	28
2,028	1,639	1,330										53	84	110	29
11,420	12,900	14,300										900	1,800	2,300	30
1,750	4,970	9,170													31
12,750	16,670	20,800													32
															33
+427	+636	+851										0.2	0.2	0.2	34
															35
															36
															37

II. Land Management: B. Treatment			C. Legislative and Institutional			D. Public Acquisition			III. Common Water & Related Land Mgt. Actions: A. Increased Efficiency			B. Collection and Dissemination of Information*			
1980 (34)	2000 (35)	2020 (36)	1980 (37)	2000 (38)	2020 (39)	1980 (40)	2000 (41)	2020 (42)	1980 (43)	2000 (44)	2020 (45)	1980 (46)	2000 (47)	2020 (48)	
															1
						✓	✓	✓	0	0	40	✓	✓	✓	2
															3
															4
															5
															6
															7
															8
						✓	✓	✓	✓	✓	✓	✓	✓	✓	9
									✓	✓	✓				10
															11
									✓	✓	✓	✓	✓	✓	12
															13
						✓	✓	✓				✓	✓	✓	14
															15
						✓	✓	✓	✓	✓	✓	✓	✓	✓	16
															17
															18
						✓	✓	✓	6	8	10	✓	✓	✓	19
															20
1,800	5,410	7,570													21
435	858	1,470													22
2,830	8,490	14,200													23
															24
															25
															26
✓	✓	✓	6	46	100				✓	✓	✓	✓	✓	✓	27
			2,100	22,000	76,000				✓	✓	✓	✓	✓	✓	28
✓	✓	✓	15	112	260				✓	✓	✓	✓	✓	✓	29
			90	1,300	5,500				✓	✓	✓	✓	✓	✓	30
770	2,140	3,600	70	130	230	330	750	1,100							31
825	3,340	5,960	475	860	1,120	950	3,030	5,420				✓	✓	✓	32
															33
						427	636	851	✓	✓	✓				34
									✓	✓	✓				35
															36
															37

requirement

*Includes data analyses, monitoring, flood plain information studies

4, 5, and 6. In many cases, no quantity is shown, but the applicability of a program is indicated by a check mark.

Only the program sheet for Great Lakes Basin is contained in Appendix 1 (Table 1–26). The other tables are in Annex E and the figures therein have not been corrected or rounded. (See the Introduction for availability of Annex E.)

There are always opportunities for new, unusual, and innovative solutions to problems and devices for meeting needs. Some of these are recognized in the Framework Study, and others have been developed during subsequent, more detailed studies. However, in most cases, standard, recognized programs are used for meeting needs and solving problems, with the choices among the several alternative programs dependent upon local conditions, public preferences, and cost. In the discussion of the frameworks for the Great Lakes Basin, the five Lake basins, and the 15 river basin groups contained in Section 5 and 6 through 10, information is provided on the devices selected for meeting needs and solving problems. In the following subsections of this section, some generalized information is provided on the ways in which the needs in the various resource use categories are most frequently met.

4.6.3 Water Withdrawals

The functions for resource uses which make up the category of water withdrawals have the common characteristic that water is withdrawn from a source in order to be put to use. In only a few cases is all of the water used. In most cases, some of the water is used, and the remainder is available to be returned to a source for use elsewhere. That which is not available to be returned is spoken of as being consumptively used. The proportion of the water withdrawn which is consumptively used varies with the function. Some of the water is returned very quickly to the source. For example, water used for washing dishes goes immediately into the sewer, the waste treatment plant, and back to a source. Other water is not so quickly returned. For example, water used for watering a lawn and which soaks into the ground may have to percolate some distance before it gets into a ground-water source, whence it is pumped for additional use or appears, sometimes many years later, in a surface water source. In some processes, water is used repeatedly, and only enough is withdrawn to make up for the water which is consumptively used. In other processes most of the water is returned. An example of the latter is the use of water for cooling the condensers of thermal power plants. Often no treatment is given the water after it passes through the condenser, although dissipation of excess heat before the water is returned to the source is becoming more common.

An inspection of the program sheet described in Subsection 4.6.2 (Table 1–26) will show that most needs relating to water withdrawals are met from Great Lakes sources, inland lakes and streams, or ground water, and may include either instream or offstream reservoir storage. In special circumstances, other devices are used. For example, increased irrigation efficiency on land presently irrigated may provide a source of water for additional land. Both the frequently used and the unusual solutions are described in Sections 6–10 for each of the planning subareas.

4.6.4 Nonwithdrawal Water Uses

This group of resource uses involves all kinds of water uses that do not include withdrawal from the source. Hydroelectric power production takes advantage of the energy of falling water. Water-oriented outdoor recreation, recreational boating, and commercial navigation primarily make use of the water surface. Sport fishing and commercial fishing depend on the biological environment for maintaining a fishery. Municipal and industrial wastewater discharges deal with the removal of pollutants from the water and the restoration of the water to a quality that will be suitable for other purposes.

The devices used to meet the needs and solve the problems are of a wider variety than those associated with water withdrawals, simply because nonwithdrawal water uses are of a more diverse nature. Here again, however, there is a fairly standard group of solutions, supplemented in specific instances by some more unusual or innovative opportunities. The treatment of municipal and industrial wastewater discharges generally requires structural solutions, although education, process changes, and increasing the efficiency of existing plants will have some effect. Hydroelectric power production normally involves construction of a reservoir for pumped storage, for diurnal regulation of water supply, or for regulation of irregular annual stream flows. Solutions for water-oriented outdoor recreation rely largely on changes in water and land use. Sport fishing is enhanced by programs on the Great Lakes, inland lakes and streams, and by some reservoir construction. Recreational boating is primarily dependent on the Great Lakes and on inland lakes and streams, but in some instances, reservoir construction may help. Commercial fishing and commercial navigation are both dependent on the Great Lakes.

4.6.5 Related Land Uses and Problems

A great diversity exists among the programs related to land uses and problems. Agricultural land treatment, cropland drainage, and forest land treatment rely on onsite treatment for alleviating problems and meeting needs. Control of shoreland and streambank erosion relies primarily on structural measures, including stream modification. The reduction of flood damages can be accomplished in a number of ways: sometimes through reservoir storage; in other cases through onsite structural measures, including stream modification; and often by institutional arrangements and legislative actions. Wildlife management depends somewhat on land treatment measures, but even more heavily on legislative and institutional arrangements and public acquisition. The effort to maintain aesthetic and cultural features relies heavily on public acquisition and increased efficiency of use. The land required for outdoor recreation can be supplied in some instances by land use changes, but in many cases must be acquired by public bodies. Increased efficiency is viewed as a factor here also.

4.7 Framework Selection, Criteria, and Priorities

The process of developing a framework is largely one of correlating information from a great many sources, interpreting the desires of the local people and of the various governmental levels, and applying experience and judgment in the selection of program elements to meet needs and provide solutions to problems in each specific case. For a river basin group, the needs are compiled, and the elements which may provide solutions are reviewed. Of those which are to be considered, estimates are made to determine which of the elements can contribute to meeting needs or solving problems. Specific quantities are determined where appropriate. Often the information will come from the functional appendix. In some cases, it is developed by the formulation group. Single-purpose elements are considered in the first instance. After all functions have been considered, and the elements screened, it may become apparent that some solutions can be chosen which will serve more than one purpose. For example, a reservoir built to provide a water supply may also be adapted to preventing a certain amount of flood damage; or a proposal to zone a flood plain against building encroachment may permit the development of the area for recreational purposes. When the full range of possible multiple-purpose solutions has been explored and the output of each of the program elements has been determined, the information is summarized on the program sheet, and the needs met at each time period are obtained by adding the outputs of the program elements for the time period.

Where there are optional solutions, cost considerations may be significant. No specific rules can be laid down that will fit all conditions. However, in all consideration of alternative solutions, the effects on the environment and on the well-being of the people become overriding. Maximum social values to the local community and the region and minimum adverse impacts on the environment are sought.

4.8 Framework Costs

During the process of selecting the various elements which go into a framework, a comparison of financial costs is frequently desirable. Both investment cost and operation, maintenance, and replacement (OM&R) costs are important, particularly if the choice among two or more elements cannot be cleanly made using other criteria. Also in the review and ultimate use of the framework, the costs of the various elements help determine which programs will be undertaken first, and how to budget public funds for these undertakings.

The "Guidelines for Framework Studies, October 1967," established by the Water Resources Council provide that general cost estimates for broad components of a framework will be of reconnaissance quality and detail, based primarily on experience in the study region. The elements of framework plans for which costs have been developed include those facilities and programs of a governmental or group type and those individual programs normally financed wholly or in part by public funds. In general, improvements or programs entirely financed by individuals were not costed, although in some categories some private costs were included. The effects of such private investments on water and related land resources were considered. Cost estimates were separated into Federal, public non-Federal, and private elements on the basis of initial investment, not on the basis of reimbursability. Some costs paid initially from Federal funds are reimbursed by beneficiaries and thus are ultimately not Federal costs. Cost tables for the Great Lakes Basin are found in Table 1–27.

4.8.1 General Criteria for Capital and OM&R Costs

Both capital investment costs and annual operation, maintenance, and replacement costs, where appropriate, were developed for programs associated with most of the 22 resource use categories identified in this study. Using the best available

TABLE 1-27 Costs Used in Framework Estimates (dollars) and Program Cost Allocation among Federal, Non-Federal, and Private Sectors (percent)

Resource Use Category	Capital Costs (dollars)	Annual OM&R Costs (dollars)	CAPITAL FED	CAPITAL NON FED	CAPITAL PVT	OM&R FED	OM&R NON FED	OM&R PVT
WATER WITHDRAWALS[1]								
Municipally Supplied	299,000/mgd	29,800/mgd	30	70	0	0	100	0
Self-Supplied Industrial	83,000/mgd	14,800/mgd	0	0	100	0	0	100
Rural Domestic and Livestock	71,000/mgd	14,600/mgd	10	0	90	0	0	100
Irrigation	22,600/mgd	600/mgd	0	0	100	0	0	100
Mining	66,400/mgd	11,900/mgd	0	0	100	0	0	100
Thermal Power Cooling	35,000/mgd	1,800/mgd	0	5	95	0	5	95
NON-WITHDRAWAL WATER USES								
Municipal Wastewater Discharges[2]			75	25	0	0	100	0
NOR Framework	lump sum estimate for RBG	variable by RBG	---	---	---	---	---	---
PRO Framework	$300 per capita	$10 per capita per year	---	---	---	---	---	---
Industrial Wastewater Discharges	lump sum estimate for RBG	variable by RBG	0	0	100	0	0	100
Hydroelectric Power	80-120/kw	variable/kw of installed capacity	---[3]	---	---	---	---	---
Water-Oriented Outdoor Recreation	see below	--------	---	---	---	---	---	---
Sport Fishing	lump sum estimate for RBG	lump sum estimate for RBG	---[4]	---	---	---	---	---
Recreational Boating	lump sum estimate for RBG	lump sum estimate for RBG	35	35	30	0	0	100
Commercial Fishing	not estimated	--------	---	---	---	---	---	---
Commercial Navigation	lump sum estimate for RBG	lump sum estimate for RBG	100	0	0	100	0	0
RELATED LAND USE AND PROBLEMS								
Agricultural								
Land Treatment	lump sum estimate for RBG	.5% of total periodic capital cost	28	0	72	0	0	100
Cropland Drainage	lump sum estimate for RBG	.5% of total periodic capital cost	30	0	70	0	0	100
Forest Land Treatment	lump sum estimate for RBG	variable by RBG	80	5	15	10	20	70
Shoreland Erosion	lump sum estimate for RBG	2% of total periodic capital cost	20	0	80	20	0	80
Streambank Erosion	33,000/mile	2% of total periodic capital cost	28	0	72	0	0	100
Flood Plains	lump sum estimate for RBG	--------[5]	75	0	25	5	95	0
Wildlife Management	lump sum estimate for RBG	not available	10	90	0	0	100	0
Aesthetic and Cultural	not estimated	--------	---	---	---	---	---	---
Outdoor Recreation	lump sum estimate for RBG	lump sum estimate for RBG	35	65	0	20	80	0

[1]Costs presented are for surface water development only. Costs for groundwater development vary more widely over the Basin than do the costs for surface water development. The outside range for capital cost of wells is from $21,000 to $71,000 per mgd, and the range for pumping costs is from $8,000 to $117,000 per mgd. The average cost in unconsolidated aquifers is $32,000 capital cost for the wells and $30,000 for pumping per mgd. In bedrock aquifers the averages are $45,000 capital cost and $27,000 for pumping.

[2]Costs of NOR are based on applying unit treatment costs per mgd on a judgment basis for each RBG. They include only interceptors and treatment. Replacement is included with capital cost. Costs for PRO are based on population and are applied by RBG's. They cover all costs, including sewers, to which Federal grants are available, except separate storm waste control. Replacement is included with O&M.

[3]Either 100% State or 100% private. No Federal money.

[4]40% of sum of Capital plus OM&R is Federal, 60% is State. No private.

[5]Annual OM = 0.1% total Capital Cost for the period if such is greater than $1,400,000. If Capital Cost is less than $1,400,000, annual OM = 0.4% total Capital Cost.

information, these costs were determined for each of the three time periods involved, for each of the 15 river basin groups, and for both the NOR and PRO Frameworks. All costs assume a base price year of 1970 and apply to programs implemented after 1970. OM&R costs for existing program activities are not included in this study. All the costs developed in this Framework Study for the various programs associated with the development, utilization, and conservation of the resources concerned are considered to be of preliminary or reconnaissance nature.

4.8.1.1 Capital Cost Details

Capital costs refer to first-time costs, including installation costs and such related nonstructural program costs as technical and financial assistance. The totals include all costs for labor, materials, equipment, rights-of-way, water rights, relocations, contingencies, engineering, and administration, although individual costs for each of these categories were not recorded.

It is important to note that the capital cost associated with each of the different program components differ according to resource use category. For this reason the following more complete definition of capital costs is provided.

(1) Water Withdrawals

(a) Municipal Water Supply—Capital costs include all predistribution costs, including developing the source, constructing the treatment plant, and conveying the supply to the treatment plant.

These costs do not include those for developing water storage at the source. These are included in reservoir costs where appropriate.

(b) Self-Supplied Industrial—This includes all costs of getting the water from the source to plant, including source development and transmission expenditures. Treatment is not included because this element varies so greatly among plants, depending on the use to which the water will be put.

(c) Rural Domestic and Livestock Water Supply—Costs are similar to those determined for municipal water supply costs except transmission and treatment costs are not included.

(d) Irrigation Water Supply—Costs included are predistribution costs of intake, diversion, well development, and transmission.

(e) Mining—As with self-supplied industrial, capital costs include all expenditures for source development and transmission to site.

(f) Thermal Power Cooling—Costs for this function are limited to intake development.

(2) Nonwithdrawal Water Uses

(a) Municipal Wastewater Discharges—Costs for this function are estimated by different methods for the NOR Framework and the PRO Framework. For NOR the estimates provided by the work group were used. These estimates were based on estimated cost per mgd for capital investment including replacement, and for O&M. The capital costs for this function include the total cost required for plants and facilities, from intercepting sewers to treatment plants and outfalls; advance wastewater treatment costs; and costs for replacement or major repairs for new plant construction, estimated to be necessary every 20 years. O&M costs are also based on unit costs per mgd developed by the work group from available data.

Costs for the PRO Framework reflect changed conditions as a result of the Federal Water Pollution Control Act Amendments of 1972 (P.L. 92–500). This act increased the coverage of the Federal grant program to include construction of sewers, separation of combined sewers, and treatment of separate storm waste. The costs are based on a unit cost per capita for construction and a unit cost per capita for O&M. The estimates for replacement have been added to those for O&M. This is consistent with all other costs in the Framework Study except for the NOR costs for waste treatment described above.

Surveys required under P.L. 92–500 were made in 1973 and 1974 by the States, and the earlier survey data were used in deriving estimates through year 1990 for new construction necessitated by growth, "catch-up", and replacement. The elements included in unit costs include needs for secondary treatment, needs for more stringent treatment where justified, inflow infiltration analysis, rehabilitation or correction of sewers where required, construction of new collector and interceptor sewers, and the separation of combined sewers. This is a much broader group of elements than is considered in the NOR Framework. The treatment of separate storm-water wastes is not included. This is the only element subject to Federal grant and incorporated in the needs survey that is not included in the PRO costs.

Some additional information is given in connection with a discussion of programs selected. See Subsection 5.5.2.1 for NOR and subsection 5.6.2 for PRO.

(b) Industrial Wastewater Discharges—As with municipal wastewater discharges, capital costs for this function include the total costs for plants and facilities, from waste isolation through treatment and outfalls.

(c) Hydroelectric Power—Capital investment encompasses site (land and landrights), power plant (pumping and generating units, accessory electric equipment), reservoir, dam, and waterway costs. These costs are pertinent to pumped storage projects only. No new conventional hydroelectric power generation is anticipated during the period of study.

(d) Water-Oriented Outdoor Recreation—See item 3(i).

(e) Sport Fishing—Costs include all structural and nonstructural measures necessary to satisfy program requirements. Structural measures include fish piers, fish passage structures, impoundments, vessels, and facilities. Non-structural measures apply, basically, to land development and control, although fish production is also included.

(f) Recreational Boating—Construction of harbors and marinas is included as well as additional and improved access. Creating new water surface areas by constructing impoundments and/or navigation channels is not included.

(g) Commercial Fishing—Costs have not been estimated.

(h) Commercial Navigation—All costs associated with dredging, channel deepening, season extension, lock construction, harbor creation, and structure development are included. These costs were developed as of 1970 and do not reflect the increased cost figures that evolved from the findings of the Great Lakes-St. Lawrence Seaway Navigation Season Extension Demonstration and Survey studies.

(3) Related Land Use and Problems

(a) Agricultural Land Treatment—Costs are those associated with the planning and application of standard land treatment measures for multiple use and management of the land, erosion and sediment control, and improvement of hydrologic conditions.

(b) Cropland Drainage—All costs included are necessary to provide interception and removal of water.

(c) Forest Land Treatment—Treatment costs include those for multiple-use plans, reforestation, improved harvesting, forest stand improvement, erosion control, grazing control, and urban forestry.

(d) Shoreland Erosion—Costs included are all those for establishing the structures necessary for the protection of shoreline presently classified as suffering from critical erosion. These structural measures include riprap and sandfill, protective beaches, seawalls, filled groins, stone revetments, bulkheads, artificial beach fill, groins, breakwaters, or various combinations of these.

(e) Streambank Erosion—Capital costs for this function include the costs of providing both structural and nonstructural bank erosion control measures for streambank presently classified as suffering from severe erosion. Structural measures include riprap, groins, piling, gabions, and grade stabilization and side inlet structures. Nonstructural protection is restricted to improving ground cover.

(f) Flood Plains—Capital costs are those associated with providing dams and reservoirs, levees and floodwalls, and such channel modification measures as straightening, deepening, widening, clearing, lining (with concrete), and creating diversions. Some urban flood plain costs are associated with alleviating rural flood damage; however these are a relatively small part of the total cost, and the basic cost data did not permit distinguishing between urban and rural.

(g) Wildlife Management—Capital costs assigned to the structural category are restricted to facility construction or improvement. Nonstructural costs make up the bulk of capital expenditures and include land acquisition, wetlands development, establishment of forest openings, and training of new conservation officers.

(h) Aesthetic and Cultural—Costs have not been determined.

(i) Water-Oriented Outdoor Recreation—Costs are those for the specific facility plus costs for associated parking, sanitary facilities, power, and water. Costs for roads, sewage treatment facilities, administration, landscaping, and signs are also included. Incorporated in these costs are those for land acquisition.

4.8.1.2 Operation, Maintenance, and Replacement Cost Details

With respect to annual OM&R costs, it should be remembered that they are not true annual costs, but include only operation, maintenance, and replacement costs. No allowances for interest or for amortization have been included. Replacement costs of waste treatment facilities are included in capital costs in NOR rather than with O&M costs, consistent with the estimates made by the work group. In PRO the replacement costs are included with O&M costs, as is the case generally in this study.

4.8.2 Cost Summary Table

Table 1–27 presents a summary of unit costs used and indicates the programs for which lump sum (l.s) estimates were made for the river basin group (RBG). Because there is great variability of program costs among planning subareas, it is important to recognize that these costs are only averages.

The breakdown among Federal, public non-Federal, and private costs is shown in Table 1–27.

In most instances the breakdown into Federal and non-Federal cost sharing is based upon current legal and institutional arrangements. In the case of municipal wastewater discharges and shoreland erosion control, however, the percentages presented reflect possible future cost sharing developed through new legislation.

4.9 The Normal Framework

The Normal Framework, NOR, is the initial formulation for the Framework Study. It is described for the entire Great Lakes Basin in Section 5 of this appendix, and for each of the planning subareas in Sections 6 through 10. The development of the Normal Framework was the responsibility of the task force chairmen and the task forces, in consultation with work group chairmen and others. Some of the general characteristics of the NOR Framework and the underlying assumptions and techniques are included here to facilitate an understanding of the specific elements and qualities which are presented later in this appendix.

The needs considered in framework formulation were developed by the work groups. In most cases, they used OBERS projections of economic and demographic data to develop requirements and subtracted the base year supply from requirements to arrive at the needs. In several fields, however, the work groups found it necessary to develop special methodology for arriving at needs and defining resource opportunities. The methodology is given in each case in the resource appendixes. Some additional detail about requirements is given in Section 3 of this appendix.

The work groups also selected programs to meet the needs and described these in the respective appendixes. These programs were generally selected to serve single purposes. They were developed by each work group in the context of its own particular interest. An underlying objective of the work groups was to meet the needs with the resources available whenever possible. Given the choice of alternative programs, elements such as economic efficiency, environmental impact, past trends, Federal and State priorities, and relationship to other areas and to other resource use categories came into consideration. The precise basis for selection is not always identified in the resource appendixes. However, the program selections made by the work groups reflected the national economic development objective. This objective has been the guide in most water resource planning over the last several years, even though it has not always been conformed to specifically.

The objectives for the Normal Framework enunciated in Section 2 of this appendix were developed concurrently with or later than the resource appendixes. However, they too reflect the national economic development objective in terms of normal growth and no inconsistency is noted in the Normal Framework.

In selecting program elements for the river basin groups, the plan formulation task forces considered initially the recommendations of the work groups as contained in the appendixes. These were adopted unless a task force had a basis, such as multipurpose projects, conflicts, or different objectives, for modifying a work group proposal or making a different selection. In the vast majority of individual program selections, those recommendations proposed by the work groups have been included in the Normal Framework; so the Normal Framework emphasizes, with minor exceptions, the national economic development objective.

4.10 The Proposed Framework

The Proposed Framework, PRO, was developed as a proposal of the Great Lakes Basin Commission. The intent was to modify the Normal Framework, NOR, through adjustment of needs where feasible, but principally through changes in the programs selected, in such a way that PRO would represent, to the extent practicable, the views and desires of the people and governments of the Basin as these were understood by the Commission. Sections 2 and 3 provide discussions of some of the factors and influences considered.

After the Normal Framework had been selected, and limits of growth explored, meetings were held at 15 locations in the Basin. The public and representatives of governmental units were invited to express their views on appropriate program adjustments for the area. Written views were also solicited. These views were compiled and made available to plan formulation personnel.

To further define the parameters of the Proposed Framework, several series of issues were formulated, dealing with specific questions relevant to the selection of programs. These were put forth as matters for decision by the Plan and Program Formulation Committee (sometimes initially by a subcommittee) and by the Commission. A description of the process, including the issues themselves, is provided in Annex D. (See Introduction for availability of Annex D.)

Having heard the views of the public and governmental representatives and the issue decisions, the plan formulation task force chairmen, in consultation with task force members and other knowledgeable persons, selected programs for the Proposed Framework. Sometimes uniform treatment over the Basin was prescribed. In other cases the individual programs were selected for each river basin group. Following this selection and the subsequent detailed work of determining outputs, needs met, not met, exceeded, and transferred, the costs were estimated as they were for the Normal Framework and the tabular presentations prepared.

Section 5

ALTERNATIVE FRAMEWORKS FOR THE GREAT LAKES BASIN

5.1 Introduction

This section provides an overview of the Basin as a whole. It describes the existing situation, the use of the land and water resources, and the ongoing programs that are significant in terms of the Framework Study. It considers the problems of the Basin as a whole and those local problems which appear in a number of different places. The section describes the needs for water and land resources in terms of the resource use categories and the opportunities for management of these resources. Finally, it describes the Normal and Proposed Frameworks for the entire Basin and the results that can be expected if these alternative frameworks are implemented.

Much of the information is consolidated from the details provided in Sections 6 through 10. These sections deal with the individual Lake basins, and reference should be made to them for such details.

Some of the resource use categories, the problems and needs related to them, and the solutions adopted in the frameworks are Basinwide in scope and are treated as such. In the majority of cases, however, these elements are treated initially with respect to the river basin groups and are consolidated for presentation for the Great Lakes Basin. In this consolidation, a breakdown by States is shown to facilitate the use of the data in State planning and implementation. Where Lake basin consolidation is desired, the appropriate section should be consulted.

5.2 Existing Resource Use and Development

The water and land resources of the Great Lakes Basin are described in Section 1. The way they are being used at the present time is the subject of this subsection. In general, the information on resource use is derived by consolidating the information for each of the 15 planning subareas or river basin groups in such a way as to provide information for each of the States and for the Great Lakes Basin. A summation of this sort does not give information on the differences among the various parts of the Basin, particularly those differences within a single State. It does indicate the present use of the resources as a background against which the frameworks for future management and use can be considered.

5.2.1 Water Withdrawals

The actual availability of water for withdrawal purposes in the Great Lakes Basin has not at any time been a constraint to an activity. However, the cost of obtaining the water has influenced, in many cases, the location of the activity. The largest single use of withdrawn water is for thermal power cooling.

5.2.1.1 Municipal Water Supplies

Municipal water supply systems range from those utilizing a small, local source to large regional systems withdrawing from the Great Lakes. Information on the present development of municipal water supplies and the sources from which water is withdrawn is given in Table 1–28. In Illinois a large part of the withdrawal is for the Chicago metropolitan area, where most of the population lives outside the Great Lakes Basin but is served by water from Lake Michigan.

5.2.1.2 Industrial Water Supplies

Industrial water supplies provided from private sources are also shown in Table 1–28. The principal sources of self-supplied industrial water are the Great Lakes and connecting channels, with ground-water and other surface supplies utilized where availability and economy dictate.

5.2.1.3 Rural Water Supplies

Supplies for rural domestic and livestock use come principally from ground-water sources. Data are shown in Table 1–29.

5.2.1.4 Irrigation Water Supplies

Irrigation water is principally from ground-

TABLE 1–28 Municipal and Industrial Water Supply Data for the Great Lakes Basin, 1970 (in mgd)

	Municipal									
	1970 Average Demand				Source			Gross	Self-Supplied Industrial	
State	Domestic & Commercial	Industrial	Total	Source Capacity	Great Lakes	Inland Lakes & Streams	Ground-water	Industrial Water Req.	Withdrawal	Consumptive Use
Illinois	1,084.5	252.4	1,336.9	1,843.9	1,566.0	0	277.9	NA	1,348	100
Indiana	117.1	53.9	171.0	397.7	146.8	49.1	201.8	NA	3,251	285
Michigan	738.1	414.8	1,152.9	1,915.9	1,529.4	41.4	345.1	3,833	2,374	224
Minnesota	18.1	7.6	25.7	49.6	38.3	0.2	11.1	153	68	5
New York	435	200	635	909	539	268	102	1,062	1,187	99
Ohio	487	187	674	1,173	886	208	79	2,786	1,605	119
Pennsylvania	36	19	55	78	70	3	5	NA	145	12
Wisconsin	182.3	122.9	305.2	1,042.2	748.9	77.6	215.7	95	595	54
TOTAL	3,098.1	1,257.6	4,355.7	7,409.3	5,524.4	647.3	1,237.6	—	10,575	898

NA--Not Available

TABLE 1–29 Rural Water Supply in the Great Lakes Basin, 1970 (in mgd)

State	Developed Source Capacity	Consumptive Use
Illinois	39.8	10.2
Indiana	40.2	11.4
Michigan	186.9	53.7
Minnesota	5.2	1.5
New York	66	27
Ohio	61.0	19.0
Pennsylvania	3	1
Wisconsin	68.9	26.9
TOTAL	471	151

water sources, with some use of surface supplies. Irrigation is seasonal, varying with crop and location. Both the seasonal rate and average on an annual basis are shown in Table 1–30.

5.2.1.5 Mineral Water Supplies

Most supplies of water for mineral processing are seasonal, but the largest single user, using nearly three-fourths of the total, has a year-round requirement and utilizes a Great Lakes source. Most of the other supplies come from surface sources, with some from ground water. Data are in Table 1–31.

5.2.1.6 Power Development

Power development in the Basin in 1970, the base

TABLE 1–30 Irrigation Water Supply, Great Lakes Basin, by State, estimated (base year)

	Agriculture			Golf Courses			Total Annual
State	Acres 1,000	Seasonal mgd	Annual mgd	Acres 1,000	Seasonal mgd	Annual mgd	Withdrawal mgd
Illinois	3.1	5.63	1.54	6.6	36.93	10.12	11.66
Indiana	4.0	7.30	2.00	8.5	48.78	12.54	14.54
Michigan	125.7	222.23	60.88	5.6	28.40	7.78	68.66
Minnesota	0.0	0.0	0.0	1.6	5.92	1.62	1.62
New York	16.1	27.53	7.54	7.9	37.73	10.34	17.88
Ohio	9.9	16.23	4.44	28.9	137.71	37.73	42.17
Pennsylvania	1.0	1.73	0.47	0.3	1.62	0.44	0.91
Wisconsin	37.0	67.45	18.48	6.7	39.13	10.72	29.20
TOTAL	196.8	348.10	95.35	66.1	333.22	91.29	186.64

TABLE 1–31 Minerals Water Supply, Great Lakes Basin, by State, 1968, estimated (mgd)

State	Total Water Requirements	New Water[1] Seasonal	New Water[1] Annual Average	Annual Consumptive Use
Illinois	3.8	2.2	1.6	0.1
Indiana	23.0	14.3	11.1	0.6
Michigan	241.9	137.8	102.3	15.7
Minnesota	871.0	542.0	542.0	42.0
New York	40.5	25.0	21.0	5.6
Ohio	55.8	42.0	36.9	10.4
Pennsylvania	2.2	1.8	1.2	0.0
Wisconsin	31.0	14.4	10.7	1.0
TOTAL	1,269	780	726	75

[1]New water is that portion of the total supply which is withdrawn from the source during the period considered. The balance of the total requirement is provided by recirculation.

year, is shown in Table 1–32. Many of the plants included in this total are relatively small, with less than 10 MW capacity, but the larger plants supply almost all of the power and energy, except in local areas and for some peaking operations.

5.2.2 Nonwithdrawal Water Uses

This category includes use of the water essentially in place, except for temporary diversion or withdrawal of water for hydroelectric power production. The category also includes waste treatment as a means of maintaining water quality suitable for various uses.

5.2.2.1 Municipal Wastewater Discharges

Table 1–33 shows the average quantities of waste treated in municipal plants and discharged in the Basin. Included are significant quantities of industrial wastes handled in municipal systems.

5.2.2.2 Industrial Wastewater Discharges

Waste discharges from industry-owned treatment plants are also shown in Table 1–33. These are only final treated discharges and do not include in-plant treatment for reuse.

5.2.2.3 Hydroelectric Power

Present use of water for hydroelectric power generation has not been evaluated. The installed capacity is shown with other power data in Table 1–32. It will be noted that the 1872 MW pumped storage plant at Ludington, Michigan, is not included in this table because it began operation in 1973, subsequent to the base year, 1970.

5.2.2.4 Water-Oriented Outdoor Recreation

No accurate identification has been made of water used for outdoor recreation, but some general data are given in Tables 1–45 and 1–46 in Subsection 5.2.3.8.

TABLE 1–32 Power Development, Great Lakes Basin, 1970, by State

State	Installed Capacity (MW): Hydro-electric[1]	Thermal Non-Condensing[2]	Fossil Steam	Nuclear Steam	Total	Steam-Electric Water Withdrawal (mgd)
Illinois	0	113	1,068	0	1,181	580
Indiana	11	106	2,831	0	2,948	1,562
Michigan	285	1,148	9,932	145	11,510	6,149
Minnesota	83	8	307	0	398	250
New York	3,544	45	2,732	1,159	7,480	3,109
Ohio	0	188	4,388	0	4,576	3,400
Pennsylvania	0	4	119	0	123	144
Wisconsin	144	132	3,796	524	4,596	2,044
TOTAL	4,067	1,744	25,173	1,828	32,812	17,238

[1]Conventional hydroelectric except 240 MW pumped storage in New York.

[2]Internal combustion and gas turbine.

TABLE 1–33 Municipal and Industrial Waste Flow

State	Municipal Waste Flow mgd	Industrial Waste Flow mgd
Illinois	7[1]	20
Indiana	223	2,983
Michigan	1,196	1,546
Minnesota	23	32
New York	590	1,551
Ohio	674	1,674
Pennsylvania	46	147
Wisconsin	308	631
TOTAL	3,067	8,584

[1]Work is underway to cease discharging to Lake Michigan and divert out of the Basin.

5.2.2.5 Sport Fishing

Data relating to sport fishing are shown in Table 1–34.

5.2.2.6 Recreational Boating

Recreational boating uses both Great Lakes waters and inland lakes and streams. Most boaters use only one of these environments; very few use both. Data on recreational boating are shown in Table 1–35.

5.2.2.7 Commercial Fishing

Data on commercial fishing were not compiled for this study. However, the general history and present status for the Basin are shown in Figure 1–18.

5.2.2.8 Commercial Navigation

Commercial navigation uses the system of Lakes and connecting channels, often with no reference to the particular State or country constituting the boundary of the waterway. However, the harbors or terminal points and waterway improvements have specific geographic locations. Table 1–36 gives data on cargo movement in various parts of the system.

5.2.3 Related Land Uses and Problems

The water and land area of the Great Lakes Region and present land use are shown in Tables 1–17 and 1–18. The distribution of the land area by use is displayed in Figure 1–10. The areas shown are for the Region as defined by political boundaries, and the total area of 86,506,900 acres is larger than that of the Basin (75,284,000 acres). The comparison by States is shown in Table 1–37.

TABLE 1–34 Current Sport Fishery Uses, Great Lakes Basin, 1970, by State

State	Ponded Water (acres)	Fishing Licenses		Angler Days (thousands)	
		Resident	Non-Resident	Inland	Great Lakes
Illinois	30,364	273,520	1,267	817	800
Indiana	33,393	162,377	12,628	1,101	170
Michigan	789,129	782,954	165,380	21,616	4,582
Minnesota	562,526	94,163	38,851	3,097	10
New York	264,336	367,182	14,649	13,606	1,800
Ohio	58,609	335,530	9,724	11,316	7,880
Pennsylvania	722	17,360	1,050	558	500
Wisconsin	385,761	373,822	95,624	12,932	481
TOTAL	2,124,840	2,406,908	339,183	65,043	16,143

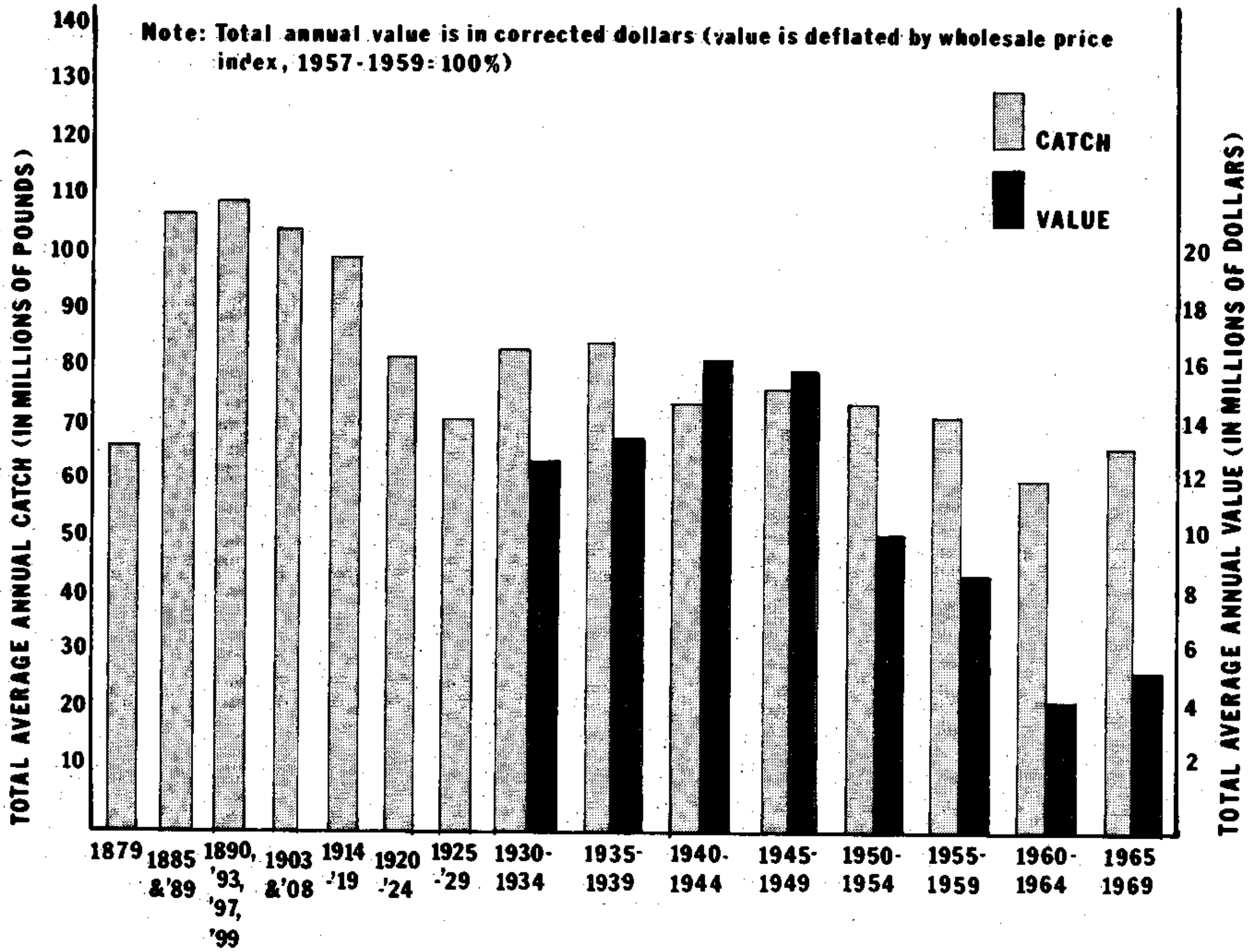


FIGURE 1–18 Total Average Annual Catch and Value of the US Great Lakes Commercial Fisheries

TABLE 1–35 Recreational Boating Use in the Great Lakes Basin, by Lake Basin

State	Great Lakes Harbors	Access Sites	Total Number of Boats: Resident	Non-Resident	Inland	Great Lakes	Total Boat Days in Use: Inland	Great Lakes
Illinois	17	NA	41.8	13.8	18.2	27.4	239.6	359.4
Indiana	7	40	36.9	6.7	28.1	15.4	781.4	388.3
Michigan	94	839	299.2	199.1	362.2	136.1	10,590.4	3,840.9
Minnesota	7	130	36.4	13.5	47.4	2.5	1,275.6	26.0
New York	42	52	123.5	34.4	100.0	57.9	2,949.4	1,089.6
Ohio	27	10	52.8	4.8	33.4	24.2	975.9	699.6
Pennsylvania	5	0	1.3	0.2	0.6	0.9	18.1	25.9
Wisconsin	47	866	116.7	91.6	170.3	38.1	4,463.6	649.3
TOTAL	246[1]		708.6	354.1	760.2	302.5	21,294.0	7,679.0

NA--Not Available

[1]Total includes two harbors each lying in two States, actual number of harbors is 244.

TABLE 1–36 Traffic Carried on the Great Lakes and Connecting Channels by Area, 1959–1973 (million tons)

Area	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973
Lake Superior	60.3	81.8	68.9	70.0	72.7	77.9	78.7	85.3	75.4	76.5	85.3	78.7	71.6	75.6	92.0
St. Marys River	65.9	86.6	74.2	74.5	77.4	83.7	81.3	87.3	77.9	78.7	88.1	81.1	75.9	79.7	97.6
Lake Michigan including the Port of Chicago[1]	81.5	92.0	85.4	85.1	107.4	117.7	117.5	125.9	124.6	120.7	125.5	131.1	121.3	122.9	124.5
Lake Huron	106.4	126.0	113.8	114.9	122.7	136.7	138.9	148.0	136.0	138.5	144.5	141.3	130.8	135.5	155.4
St. Clair River, including Channels in Lake St. Clair	78.9	97.2	84.6	87.2	93.0	103.5	107.0	113.9	101.0	107.1	109.3	109.2	102.9	106.5	118.9
Detroit River	92.6	111.2	96.2	100.0	107.2	120.3	124.5	129.2	118.5	122.6	122.8	125.6	115.7	119.0	131.7
Lake Erie, including Upper Niagara River	100.7	114.9	101.0	107.4	120.2	134.5	140.6	147.5	136.6	143.2	142.7	142.7	129.9	132.6	147.4
Welland Canal	21.0	21.7	21.5	27.5	31.1	38.9	40.6	43.8	41.7	46.6	43.4	45.7	43.3	44.0	49.5
Lake Ontario, including Lower Niagara River	21.4	22.1	21.7	28.0	33.1	38.8	41.0	43.1	41.0	47.1	45.0	45.1	42.9	43.5	49.8
St. Lawrence River[2]	12.5	12.0	12.8	16.3	19.4	25.6	27.7	29.5	27.9	33.1	27.7	30.9	30.4	30.6	37.4
Net United States traffic on the Great Lakes				184.3	209.5	213.3	217.5	231.7	217.3	221.8	225.9	228.2	208.8	214.0	231.9

[1]This area includes Chicago Harbor, North Branch, South Branch, Sanitary Ship Canal, Calumet-Sag Canal, Calumet Harbor and River, and Lake Calumet.

[2]Includes the portion of the River between the International Boundary Line and Lake Ontario.

TABLE 1–37 Comparative Land Areas, Great Lakes Region and Great Lakes Basin (in thousands of acres)[1]

State	Region	Basin
Illinois	2,401.3	39
Indiana	3,687.0	2,333
Michigan	37,258.1	37,138
Minnesota	7,317.8	3,931
New York	14,309.8	12,715
Ohio	7,816.4	7,480
Pennsylvania	524.2	387
Wisconsin	13,192.3	11,262
TOTAL	86,506.9	75,284

[1]The percentage of land in each State (based on political boundaries of the Region) is displayed in Figure 1-3.

5.2.3.1 Agricultural Land Treatment and Cropland Drainage

It is estimated that 20.5 million acres (63 percent) of the 32.1 million acres of agricultural land in the Basin will require some type of conservation treatment in order to maintain fertility. Distribution throughout the Basin is shown in Table 1–38. Drainage systems are needed on 6.2 million acres of the cropland acres. Many of these acres needing drainage will also need other treatment to maintain productivity. Distribution of drainage requirements is shown in Table 1–38 also.

TABLE 1–38 Agricultural Land Needing Treatment by State, 1970

	Agricultural Land (1000s of Acres)		
State	Total	Needing Treatment	Needing Drainage
Illinois	1,348.3	65.1	13.3
Indiana	2,595.6	1,673.0	549.3
Michigan	12,606.5	8,076.3	1,684.3
Minnesota	320.3	216.0	57.5
New York	5,237.0	3,076.6	762.0
Ohio	5,142.0	4,023.9	2,461.8
Pennsylvania	183.4	71.7	23.6
Wisconsin	4,681.6	3,248.6	666.6
TOTAL	32,114.7	20,451.2	6,218.4

5.2.3.2 Forest Land Treatment

There are about 39.6 million acres of forest land in the Region. About 5.1 million acres of Federal and 13.7 million acres of non-Federal forest lands are adequately treated and are at acceptable management levels.

The need for treatment of the remainder is distributed as shown in Table 1–39. Much of the area needing treatment is in private holdings other than those of the forest industry, and the owner either does not recognize the need or does not know where to turn for specific help. Some of the acres shown in

TABLE 1-39 Forest Land Treatment Needs (including National Forests)

State	Forest Land (1000s of Acres) Needing Treatment	Total
Illinois	6.4	93.0
Indiana	275.0	302.6
Michigan	13,892.8	19,347.7
Minnesota	3,835.2	5,981.5
New York	4,732.5	6,773.4
Ohio	732.8	920.3
Pennsylvania	133.5	223.7
Wisconsin	4,346.8	5,982.5
TOTAL	27,955.0	39,624.7

the table have been double-counted because more than one type of treatment is needed on a particular tract.

5.2.3.3 Shoreline Erosion

There are nearly 3,500 miles of Great Lakes shore in the Basin. If connecting channels, Lake St. Clair, Duluth-Superior Harbor, Sandusky Bay, and the St. Lawrence River are added, the total is nearly 4,000 miles. Susceptibility to damage from erosion ranges widely, from negligible to critical. The type of material, physical configuration, and orientation with respect to wind and waves are factors which do not change. A significant variable factor is lake level. In general, the higher the lake levels the greater the damage from erosion. The base year for this study, 1970, was a year in which levels were only slightly above normal, and the extreme erosion of 1972 to 1976 had not yet occurred. Table 1-40 provides information on shoreline and erosion at the base year by State. Table 1-41 provides the same information by Lake basin.

5.2.3.4 Streambank Erosion

The banks of streams in the Basin have been

TABLE 1-40 Great Lakes Shoreline, Use, Ownership, and Condition, 1970, by State

Great Lakes Shoreline	Total	IL	IN	MI	MN	NY	OH	PA	WI
USE									
Residential, commercial & industrial, public lands & buildings	1,362.4	33.5	27.9	687.5	68.8	188.1	128.1	24.8	203.7
Agricultural & undeveloped	583.6	0.6	0.1	282.3	11.0	134.3	16.4	11.9	127.0
Forest	1,134.4	0	0	900.9	69.7	0	3.5	0	160.3
Recreation (public)	334.8	30.9	17.0	125.3	24.2	38.1	33.6	11.6	54.1
Fish & wildlife wetlands	55.4	0	0	27.3	1.2	0	8.7	0	18.2
OWNERSHIP									
Federal	133.1	3.1	9.3	38.2	20.1	0	5.8	0	56.6
Non-Federal public	466.2	35.8	8.7	217.5	19.1	44.7	34.5	11.6	94.3
Private	2,871.3	26.1	27.0	1,767.6	135.7	315.8	150.0	36.7	412.4
PROBLEM IDENTIFICATION									
No problem	1,666.0	0	0	1,203.4	163.5	106.6	21.7	0	170.8
Critical erosion	203.9	10.5	13.0	103.8	0.5	16.8	14.3	6.0	39.0
Noncritical erosion	993.2	0	9.6	479.2	10.9	179.6	37.9	36.0	240.0
Subject to flooding	289.8	0	0	185.7	0	19.1	10.8	0	74.2
Protected	317.7	54.5	22.4	51.2	0	38.4	105.6	6.3	39.3
TOTAL SHORELAND MILEAGE									
Great Lakes	3,470.6	65.0	45.0	2,023.3	174.9	360.5	140.3	48.3	563.3
Other[2]	521.7	0	0	206.2	31.3	154.0	74.5	0	55.7

[1]Mileages estimated for Lake basins and States from tables and small scale maps in *Great Lakes Region Inventory Report, National Shoreline Study*, August 1971, and Appendix 12, *Shore Use and Erosion, Great Lakes Basin Framework Study*.

[2]"Other" includes: MI--St. Marys River 91.2 mi; St. Clair River 37.0 mi; Lake St. Clair 47.0 mi; Detroit River 31.0 mi. MN--Duluth Harbor 31.3 mi. NY--Niagara River 39.0 mi; St. Lawrence River 115.0 mi. OH--Sandusky Bay 74.5 mi. WI--Superior Harbor 55.7 mi.

TABLE 1–41 Great Lakes Shoreline Use, Ownership, and Condition, 1970, by Lake Basin

Great Lakes Shoreline	Total	Lake Superior	Lake Michigan	Lake Huron	Lake Erie	Lake Ontario
USE						
Residential, Commercial and Industrial, Public Lands and Buildings	1,362.4	201.4	552.4	256.6	202.5	149.5
Agriculture and Undeveloped	583.6	40.2	280.6	84.7	68.2	109.9
Forest	1,134.4	599.0	350.0	181.0	4.4	0.0
Recreation (Public)	334.8	70.2	160.8	25.6	48.0	30.2
Fish and Wildlife Wetlands	55.4	1.2	18.2	17.1	18.9	0.0
OWNERSHIP						
Federal	133.1	91.4	25.4	9.5	6.8	0.0
Non-Federal Public	466.2	87.0	219.9	56.4	71.0	31.9
Private	2,871.3	733.6	1,116.7	499.1	264.2	257.7
PROBLEM IDENTIFICATION						
No Problem	1,666.0	738.2	471.8	327.7	68.5	59.8
Critical Erosion	203.9	28.7	130.1	8.0	20.3	16.8
Noncritical Erosion	993.2	127.9	457.4	154.4	84.5	169.0
Subject to Flooding	289.8	11.8	140.7	74.9	44.0	18.4
Protected	317.7	5.4	162.0	0	124.7	25.6
TOTAL SHORELINE MILEAGE						
Great Lakes	3,470.6	912.0	1,362.0	565.0	342.0	289.6

NOTE: Mileages estimated for Lake basins and States from tables and small scale maps in *Great Lakes Region Inventory Report, National Shoreline Study,* August 1971, and Appendix 12, *Shore Use and Erosion, Great Lakes Basin Framework Study.*

TABLE 1–42 Streambank Erosion and Damage, Great Lakes Basin by State

State	Bank Miles of Damage: Moderate	Bank Miles of Damage: Severe	Annual Damage (Dollars): Land Loss	Annual Damage (Dollars): Sedimentation	Annual Damage (Dollars): Other	Total
Illinois	39	7	14,900	600	13,800	29,300
Indiana	277	49	40,700	29,900	4,600	75,200
Michigan	3,817	2,087	277,000	164,200	123,200	564,400
Minnesota	131	33	1,900	500	1,300	3,700
New York	1,420	301	86,400	249,100	45,900	381,400
Ohio	1,029	185	35,700	391,100	5,700	432,500
Pennsylvania	180	3	500	1,300	0	1,800
Wisconsin	1,096	280	139,500	41,400	40,400	221,300
TOTAL	7,989	2,945	596,600	878,100	234,900	1,709,600

TABLE 1–43 Flood Damage from Streams and Area Affected, 1970

State	Estimated Average Annual Damages (In Dollars)		Estimated Acres in Flood Plain	
	Urban	Rural	Urban	Rural
Illinois	0	0	0	0
Indiana	10,637,980	190,750	17,315	52,493
Michigan	27,778,030	5,584,310	118,701	998,772
Minnesota	79,000	45,400	120	103,522
New York	1,032,500	1,922,200	34,345	340,790
Ohio	3,906,220	5,046,300	29,074	388,594
Pennsylvania	9,500	37,400	403	8,630
Wisconsin	2,665,750	1,368,046	15,205	675,390
TOTAL	46,108,980	14,194,406	215,163	2,558,191

TABLE 1–44 Acres of Farm and Forest Game Habitat, Great Lakes Region by State, 1960

State	Total Land Area (in acres)	Farm Habitat		Forest Habitat		Total Habitat	
		Acres	% of Total Land	Acres	% of Total Land	Acres	% of Total Land
Illinois	2,367,300	1,466,500	62	148,100	6	1,614,600	68
Indiana	3,635,300	2,811,800	77	364,800	10	3,176,600	87
Michigan	36,223,100	13,447,700	37	18,993,600	52	32,441,300	89
Minnesota	6,579,900	587,400	9	6,037,500	92	6,624,900	101[1]
New York	13,822,500	6,788,000	49	5,527,900	40	12,315,900	89
Ohio	7,747,500	6,354,500	82	1,089,800	14	7,444,300	96
Pennsylvania	519,100	281,900	54	124,000	24	405,900	78
Wisconsin	12,685,000	5,506,500	44	6,003,200	47	11,509,700	91
TOTAL REGION	83,579,700	37,244,300	45	38,288,900	46	75,533,200	91

[1]Total habitat probably includes some water areas excluded from "land" area.

NOTE: The area of the land resource base, made up of the farmland and forest land, and reported elsewhere, is based on 1966-67 measurements and estimates. Habitat is based on 1960 information and estimates. In some instances changes in land use result in habitat being recorded as greater than the corresponding land base in the PSA or State.

classified according to their degree of erosion. Damages occur from loss of land, sedimentation, and other factors including water quality deterioration, effects on fish and their habitat, etc. The bank-miles of erosion and the estimated average annual losses are shown in Table 1–42. The erosion is classified as 2,945 miles of severe erosion and 7,989 miles of moderate erosion.

5.2.3.5 Flood Plains

Damages from flooding occur in all parts of the Basin, in both urban and rural areas. They include structural damage; loss of land, topsoil, and crops; sediment deposition; interruption of communications; and occasionally loss of life. Data relative to flood damage are given in Table 1–43.

5.2.3.6 Wildlife Management

Of the total land area of the Basin, 91 percent was classified as wildlife habitat in 1960. No later complete data were available at the time of the study. Data are shown in Table 1–44. The habitat area is constantly decreasing as urban expansion, transportation systems, and other uses encroach on forest and agricultural land. However, the principal problem is that much of the habitat area supports only a minimum wildlife population, and much is not accessible for hunting or other uses. Management of habitat land for multiple uses, including hunting and nonconsumptive uses (photography, bird-watching, and other nature study), is one way in which more hunting and other wildlife uses can be accommodated.

5.2.3.7 Aesthetic and Cultural Resources

In the survey of aesthetic and cultural resources a large number of specific features and areas were identified and indicated on maps which appear in Appendix 22, *Aesthetic and Cultural Resources.* The analysis of these areas shows that more than 90 percent of the Basin's significant aesthetic and cultural resource features are located within environmental systems paralleling water systems or areas of strong physiographic relief. These systems can be categorized along the following lines:

(1) Urban buffer zones are environmental systems that, because of their close proximity to existing urban concentrations, serve as natural buffers to urban expansion.

(2) Linkage corridors are those environmental systems that form linking corridors between concentrated urban areas.

(3) Shore zones are environmental systems that parallel and/or encompass portions of the shorelines of the Basin's lakes, streams, and wetlands.

(4) Other zones are those environmental systems that do not fall into the first three categories. Such areas may include significant groupings of resources or single resource features.

(5) Resource clusters are groupings of similar or dissimilar resource features considered important enough to be identified either as part of the environmental systems or separate from them. While these features might not be important individually, when four or more are closely associated as a group, they warrant special planning and management consideration.

(6) Single scattered resource features are sometimes located outside environmental zones, corridors, or clusters. Often these features have the potential to affect development and use patterns around them. Although they are not as great a planning consideration as the zones, corridors, and resource clusters, their identification is important.

Certain environmental zones and corridors, resource clusters, and single isolated significant resources are, by virtue of their location, more likely to be affected by existing and potential human impacts. For this reason, some are in more critical need of planning attention and further detailed study. While the priority given planning varies somewhat in different parts of the Basin, a general Basinwide planning attention and study priority ranking for these zones, corridors, and features is suggested. For the purposes of this priority ranking, the category of "other zones" is not treated due to the general location of such zones in areas not likely to be immediately affected by human activity. However, if existing and projected impact patterns change, these zones will require increased planning attention.

The first priority is buffer zones, which lie immediately adjacent to the expanding urban centers, and thus face the greatest threat to their inherent resource features and the integrity of their environmental systems. These areas are particularly important as places of relaxation and recreation for many urban residents who lack access to private transportation. Immediate planning attention should be given to buffer zones surrounding Chicago, Milwaukee, Detroit, Cleveland, Toledo, and Buffalo.

Linkage corridors are the second priority. Today, many exist as picturesque natural landscapes, rich in cultural and aesthetic features. It is important that they be studied in detail to insure that the resource features will not be destroyed in the expansion of the transportation system. Present linking corridors are especially prevalent south of Green Bay to Milwaukee and Chicago, northward along the eastern shore of Lake Michigan, and east-west across Michigan, linking Detroit with Lansing, Grand Rapids, Lake Michigan, Flint, Saginaw, and Bay City.

Shore zones, the third priority, need constant evaluation. The recent authorization of Apostle Islands, Sleeping Bear Dunes, and Indiana Dunes as national lakeshores reflects an awareness of the importance of proper development of shorelines. The high quality of the Lake Superior shoreline should be actively preserved.

There are clusters of significant resource features which make up the fourth priority for study. These groups of features need to be recognized and studied in greater detail, and many of them could be included in comprehensive plans for environmental zones or corridors.

Last in the general priority schedule, but with individual items which may be near the top, are those single scattered resource features which command individual attention. These may be aesthetic or cultural and could constitute a focus for recreational, historical, or cultural complexes.

5.2.3.8 Outdoor Recreation

Water-oriented outdoor recreation involves providing both land and water in appropriate relationship for a number of recreational activities. The general distribution by major activity groups of requirements for outdoor recreation in the Basin is shown in Figure 1–19. Land-based water-oriented recreation and water surface recreation are the activity groups considered in the Framework Study. In these two groups the activities in 1970 were as shown in Table 1–45.

TABLE 1–45 Land-Based Water-Oriented and Water-Surface Recreation Days, 1970 (in thousands)

Plan Area and PSA	Recreation Days--Annual: Land Based Water Oriented	Water Surface	Total	Recreation Days--Summer: Land Based Water Oriented	Water Surface	Total
Plan Area 1.0	---	---	4,358	---	---	2,574
PSA 1.1	2,273	580	2,853	1,383	391	1,774
1.2	995	510	1,505	596	204	800
Plan Area 2.0	---	---	77,315	---	---	49,176
PSA 2.1	8,302	1,682	9,984	4,970	1,156	6,126
2.2	33,814	7,643	41,457	22,052	5,124	27,176
2.3	17,154	3,465	20,619	10,287	2,384	12,671
2.4	4,372	883	5,255	2,622	608	3,203
Plan Area 3.0	---	---	10,099	---	---	6,219
PSA 3.1	1,649	336	1,985	999	232	1,231
3.2	6,752	1,362	8,114	4,050	938	4,988
Plan Area 4.0	---	---	56,650	---	---	34,814
PSA 4.1	18,398	3,711	22,109	11,018	2,557	13,575
4.2	10,012	2,008	12,020	6,010	1,383	7,393
4.3	12,729	2,559	15,288	7,639	1,761	9,400
4.4	6,021	1,212	7,233	3,612	834	4,446
Plan Area 5.0	---	---	17,901	---	---	11,085
PSA 5.1	5,204	1,030	6,234	3,132	710	3,842
5.2	8,043	1,537	9,580	4,887	1,063	5,950
5.3	1,752	335	2,087	1,060	233	1,293
TOTAL	---	---	166,323	---	---	103,868

TABLE 1–46 Land and Water Surface Usable for Recreation in the Great Lakes Basin, 1970 (thousands of acres)

PSA	Land	Great Lakes	Inland Lakes	Total
1.1	5,300.0	325.0	506.0	6,131.0
1.2	2,100.0	481.0	116.0	2,697.0
2.1	1,300.0	245.0	251.0	1,796.0
2.2	122.4	124.0	69.0	315.4
2.3	80.0	69.0	106.0	255.0
2.4	2,200.0	451.0	228.0	2,879.0
3.1	1,691.0	178.0	111.0	1,980.0
3.2	11.3	137.0	24.0	172.3
4.1	68.1	151.0	40.0	259.1
4.2	24.0	59.0	26.0	109.0
4.3	33.7	69.0	15.0	117.7
4.4	146.5	96.0	1.0	243.5
5.1	94.5	38.0	10.0	142.5
5.2	159.5	51.0	170.0	380.5
5.3	211.0	77.0	32.0	320.0
TOTAL	13,542.0	2,551.0	1,705.0	17,798.0

The land and water surfaces usable for recreation in the Basin are shown in Table 1–46. No new information was collected for this study, and the data on water and land used for recreation were compiled from a number of sources. These data have a number of limitations:

(1) No information was available on the amount of existing recreation lands used for sightseeing, driving and walking for pleasure, and attending outdoor games and concerts.

(2) Information on the recreational opportunities provided by local government was inadequate.

(3) Data on private recreational opportunities were incomplete in many of the States in the Basin.

(4) Some States did not provide fully updated information, so other less accurate inventory data had to be used.

(5) The inclusion of water acreages in the supply base was somewhat arbitrary. It was assumed that 80 percent of all inland water surface acreages and 50 percent of the Great Lakes water surface within two miles of the shoreline are available for recreation.

The Basin has quite large areas of land and water suitable for recreation, but it also has large numbers of people who need recreational opportunities. The characteristics which provide the opportunities are generally in the northern part of the Basin, while the population concentrations are

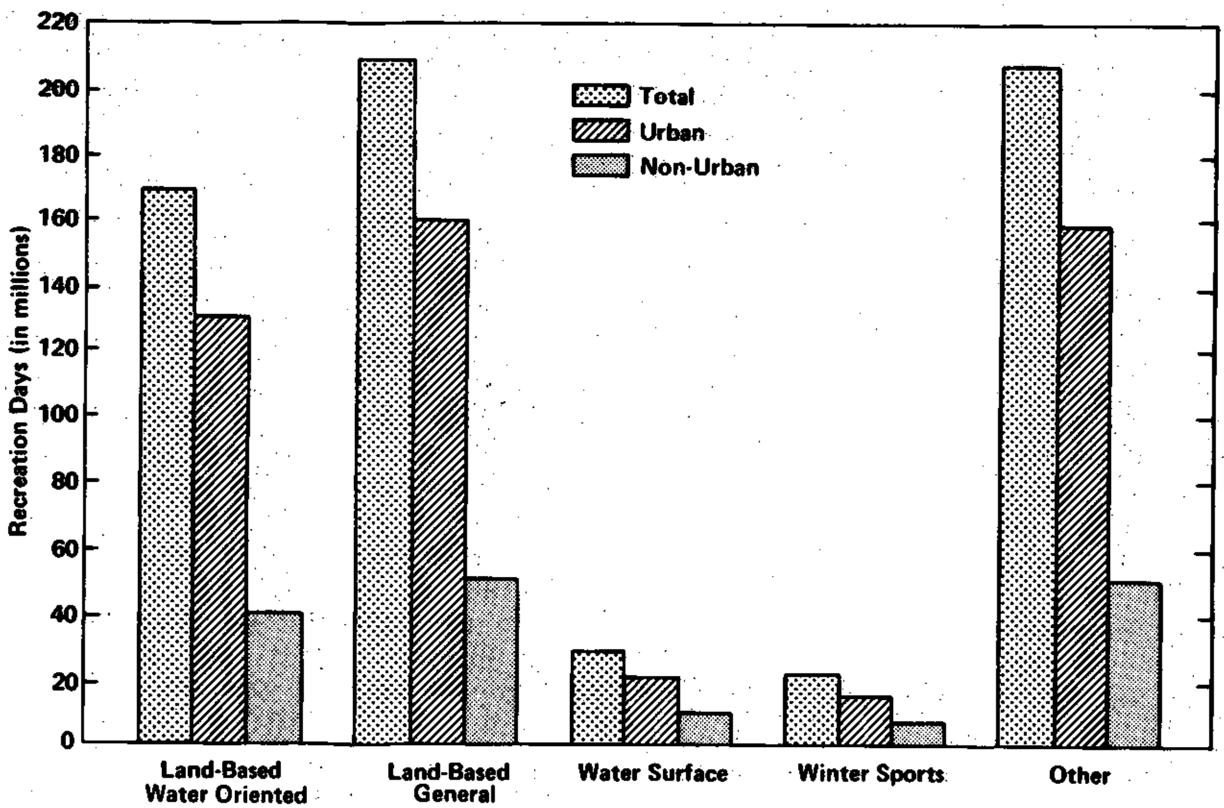


FIGURE 1–19 Total Urban and Non-Urban Annual Requirements by Major Activity Group (1970)

generally in the southern portion. This imbalance presents one of the problems of resource use.

5.3 Problems

The Resource Problems Matrix for the Great Lakes Basin and the five Lake basins, Table 1–47, identifies the locations and make-up of the critical problems of the Basin. For the Basin as a whole, no problem is classified as severe or demanding immediate attention. A number are of major concern and potentially serious. In local areas some need immediate attention.

The problems identified with mining water withdrawals are primarily related to the return of process wastewater to a Lake and to shoreline land use rather than to the withdrawals themselves.

Thermal power cooling is not a major problem at this time, but it may be potentially serious. Today, power plant siting requires study and individual site analysis, and has attracted widespread public concern.

Wastewater discharges, both municipal and industrial, now constitute problems in nearly all parts of the Basin. In the Lake Erie basin they demand immediate attention, and elsewhere early remedial measures will avoid potential trouble. As noted above, waste discharges from the mining industry are more serious than any problem of water withdrawal for that industry.

There are problems related to water-oriented outdoor recreation in many parts of the Basin. In general they occur because the areas of recreation opportunity are not near the population concentrations. There are also some specific conflicts in land use, notably along lakeshores and in areas where restrictions to access preclude the use of high-quality land for recreation.

The problems relating to sport and commercial fishing, recreational boating, and commercial navigation involve principally the management of resources and development of facilities, but these are by no means simple problems, and some introduce direct conflicts in uses. The need to coordinate the commercial and sport fishery has been mentioned. Facilities are identified in the specific areas where they are needed. Elimination of pollution in lakes and streams is recognized. Not so apparent is the need to consider fish and wildlife interests in connection with lake level control. High lake levels, which increase erosion and flooding, normally benefit fish and wildlife habitat. The overall impact must be considered.

There are problems in many parts of the Basin regarding land use. These stem largely from a lack

TABLE 1–47 Great Lakes Basin, Resource Problems Matrix

Resource Use Category	Great Lakes Basin					Lake Superior					Lake Michigan					Lake Huron					Lake Erie					Lake Ontario				
	Overall	Open Waters	Urban	Rural	Interface	Overall	Open Waters	Urban	Rural	Interface	Overall	Open Waters	Urban	Rural	Interface	Overall	Open Waters	Urban	Rural	Interface	Overall	Open Waters	Urban	Rural	Interface	Overall	Open Waters	Urban	Rural	Interface
WATER WITHDRAWALS																															
MUNICIPALLY SUPPLIED	1	–	1	–	–	–	–	–	–	–	1	–	2	–	–	1	–	1	–	–	–	–	–	–	–	–	–	–	–	–
SELF-SUPPLIED INDUSTRIAL	1	–	1	–	–	1	–	–	1	–	1	–	1	–	–	1	–	1	–	–	1	–	1	–	–	–	–	–	–	–
RURAL DOMESTIC & LIVESTOCK	1	–	–	1	–	1	–	–	1	–	1	–	–	1	–	1	–	–	1	–	1	–	–	1	–	1	–	–	1	–
IRRIGATION	1	–	–	1	–	1	–	–	1	–	1	–	–	1	–	–	–	–	–	–	1	–	1	1	–	2	–	–	2	–
MINING	2	–	–	1	2	2	–	2	1	2	1	–	–	–	–	1	–	–	1	–	1	–	–	1	1	2	–	–	1	2
THERMAL POWER COOLING	1	–	–	1	1	–	–	–	–	–	1	–	–	1	–	–	–	–	–	–	1	–	–	–	1	2	–	–	2	2
NON-WITHDRAWAL WATER USES																															
MUNICIPAL WASTEWATER DISCHARGES	2	–	2	2	1	1	–	1	–	–	2	–	2	–	–	1	1	2	–	1	3	–	3	2	3	2	–	2	1	1
INDUSTRIAL WASTEWATER DISCHARGES	2	–	2	1	1	1	–	–	–	–	2	–	2	–	–	2	1	2	1	1	3	–	2	2	–	2	–	1	1	1
HYDROELECTRIC POWER	1	–	–	1	–	1	–	–	1	–	1	–	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
WATER ORIENTED OUTDOOR REC.	2	–	2	2	2	1	1	1	–	1	2	–	3	1	2	1	–	1	1	1	2	–	2	2	2	3	–	2	2	3
SPORT FISHING	1	–	2	1	1	1	1	–	1	–	1	–	2	1	–	1	1	1	1	1	2	–	2	2	2	1	–	–	–	1
RECREATIONAL BOATING	1	2	2	1	2	1	2	–	–	–	1	1	2	1	2	1	–	–	1	1	1	1	2	–	2	1	2	1	–	1
COMMERCIAL FISHING	1	1	–	–	–	1	1	–	–	–	1	1	–	–	–	1	1	–	–	–	1	1	–	–	–	–	–	–	–	–
COMMERCIAL NAVIGATION	1	–	2	–	1	1	1	2	–	1	1	–	1	–	1	1	–	1	–	–	1	–	–	–	1	2	–	2	–	–
RELATED LAND USES & PROBLEMS																															
LAND USE	2	–	3	2	3	2	–	2	1	3	2	–	2	2	2	3	–	–	3	3	1	–	3	2	2	2	–	3	2	1
AGRICULTURAL LAND TREATMENT	1	–	–	1	–	1	–	–	1	–	1	–	–	1	–	1	–	–	1	–	2	–	–	2	–	1	–	–	2	–
CROPLAND DRAINAGE	1	–	–	2	1	1	–	–	1	1	1	–	–	2	–	1	–	–	1	–	2	–	2	2	1	1	–	–	2	–
FOREST LAND TREATMENT	1	–	–	1	–	1	–	–	1	–	2	–	–	1	–	1	–	–	1	–	–	–	–	–	–	1	–	–	1	–
SHORELAND EROSION	1	–	–	–	2	1	–	–	–	1	2	–	–	–	2	1	–	–	–	2	1	–	–	–	1	1	–	–	–	1
STREAMBANK EROSION	1	–	–	1	–	1	1	–	1	–	1	–	–	2	–	1	–	–	1	–	1	–	–	2	–	2	–	3	1	–
FLOOD PLAINS	2	–	2	2	1	1	–	1	1	–	1	–	2	2	1	1	–	1	1	–	2	–	3	3	3	2	–	3	3	–
WILDLIFE MANAGEMENT	2	–	2	2	3	1	–	1	1	1	1	–	1	1	1	1	–	–	1	3	3	–	3	3	2	2	–	3	2	3
AESTHETIC & CULTURAL	1	–	2	1	1	1	–	1	1	1	1	1	2	1	1	1	–	–	1	1	2	–	2	1	2	1	–	–	1	1
OUTDOOR RECREATION	2	–	2	1	–	2	–	–	–	–	1	–	2	1	1	1	–	–	1	–	2	–	2	1	2	3	–	3	2	3

Legend:
- 3 Severe--Demands immediate attention
- 2 Moderate--Of major concern; potentially serious
- 1 Minor--Not considered a serious problem
- – Problem is insignificant or not known

of adequate planning to insure that land is used for the purpose for which it is best suited. Degradation also occurs because of overuse of land for housing, recreation, mining, or many other purposes. The most crucial areas are the land-water interface along the lakeshores and streambanks. Damage in the flood plain and erosion and flood damage along the shore are manifestations of these problems that must be attacked vigorously and soon.

Wildlife management is another field in which there are a few critical areas, primarily related to preservation of high-class habitat. Some of these are marshes and wetlands along the shores of the Lakes.

5.4 Projected Resource Needs and Opportunities

Requirements, or future demands upon the resources, were projected for 22 resource use categories under the general headings of Water Withdrawals, Nonwithdrawal Water Uses, and Related Land Uses. These are discussed in Section 3.

When the supply (1970 base) is subtracted from the requirements, the needs are obtained. The projected needs for resource use by time period are shown in Table 1–25.

In the resource use categories of existing water surface acreage for recreation activities, irrigation, agricultural land treatment, cropland drainage, and forest land treatment, the term needs is not strictly appropriate. Opportunities is a better term than needs.

Needs or opportunities were calculated for each of the 15 river basin groups (or planning subareas, as appropriate) and added to obtain a total for the Basin in each category.

5.4.1 Water Withdrawals

Needs have been developed along conventional lines, with reasonable consistency among various parts of the Basin. There are no particular problems. Adequate supplies are available, and in many cases, there is a choice among sources to meet a particular need. It should be noted in using the data in Table 1–25 that the withdrawal rates for irrigation and mining are seasonal rather than annual. Thus, the tabulated rates of withdrawal cannot be added to obtain total annual quantities.

For thermal power cooling, the quantities represent a mix of cooling types split between the Case I and Case II assumptions. Case I is all flow-through except plants known to be supplemental; Case II is all supplemental except plants known to be flow-through.

5.4.2 Nonwithdrawal Water Uses

Quantities of municipal wastes to be treated are shown as needs. The degree of treatment is not identified in Table 1–25 and is not uniform throughout the Basin for the Normal Framework. Secondary treatment is a general requirement, with tertiary treatment and 90–percent phosphate removal required in specified locations.

Industrial waste treatment quantities will decrease from the present through 2000 and then will increase to slightly above present quantities by 2020. The early decrease is caused by process changes and increased in-plant treatment and reuse, coupled with increasing reliance on municipal waste treatment facilities for processing plant waste discharges.

Water needs for hydroelectric power production are not instream uses for conventional plants; rather they are withdrawal and return uses for pumped storage plants. The Ludington, Michigan, plant began operations just after the base year, and needs are shown for 1980. Pumped storage installations are anticipated in the Lake Ontario basin in both the later time periods, with needs as shown.

Water-oriented outdoor recreation needs, stated in terms of recreation days, increase for all parts of the Basin except in the Lake Superior basin and northern Lake Ontario basin, where existing supply is in excess of future requirements. These are prime recreation areas and the automatic transfer of needs, because of the mobility of persons seeking recreation, will tend to wipe out the excess. Land needs are considered in Subsection 5.4.3.

Needs for the sport fishery occur both in the Great Lakes and in inland lakes and streams. To some extent some transfer between the two can be effected, but most anglers prefer one or the other.

Recreational boating needs occur both in the Great Lakes and in inland lakes and streams. The large extent of water surface in the Lakes gives the appearance of an adequate supply of boating water, but much of the area is too far from shore for safe operation of small boats. In addition facilities are needed to create safe conditions that will permit meeting some of the needs. Some additional inland water surface is desirable, but better management and improved access are needed.

Needs for the commercial fishery have not been evaluated. Management of the commercial fishery will be based on programs compatible with the sport fishery.

An expansion of commercial navigation is projected in terms of tonnage handled. This is translated into harbor and port requirements and other physical changes in the system.

5.4.3 Related Land Uses and Problems

For several of the resource use categories in this group, opportunities rather than needs are shown in Table 1–25. These also relate closely to the existing situation, which is described in Subsection 5.2.3.

There are an estimated 20.5 million acres of agricultural land that could benefit from some form of conservation treatment. This acreage includes 6.2 million acres on which drainage systems are needed to develop and maintain high production.

Forest land presents similar opportunities to maintain high quality forest, sustain continuous timber production, and continue multiple use through appropriate land treatment measures.

About 10 percent of the Great Lakes shoreline has been protected against erosion, but more than 30 percent may have been subject to this form of damage in the base year (1970), with still greater amounts subject to erosion when lake levels are higher.

Along streambanks there are more than 10,000 miles subject to erosion damage, but only part of the total can be protected economically.

Flooding and flood damage must be alleviated in extensive urban and rural areas.

To meet the needs of hunters and those who are interested in bird-watching, animal photography, and other nonconsumptive wildlife pursuits, an extensive increased area must be managed effectively for wildlife habitat. In some areas this will be a primary use, and in others it will be a secondary, but recognized and planned, use.

The treatment of aesthetic and cultural needs is qualitative at this time with the hope that specific areas and features will be developed and preserved as a natural part of resource use and conservation.

The land presently used for water-oriented outdoor recreation has not been identified and quantified. However, estimates have been made of the amount of land required to meet needs for intensive and extensive types of development in order to meet recreation day needs.

5.5 Normal Framework

This subsection provides an analysis of the NOR Framework for the Great Lakes Basin. (PRO is considered in Subsection 5.6.) This subsection considers each of the resource use categories individually and describes the framework. In some cases these elements are selections made for the Basin as a whole from a consideration of Basinwide issues. In other cases, the elements were selected for each individual river basin group, and the framework for the Basin with respect to this element consists of a summation of the selections made. In addition to the narrative, there is a tabular presentation of statistical information in Section 12 about the entire Great Lakes Basin, and also about the individual Lake basins, river basin groups, and States. Sections 6–10 provide more detailed textual information on each Lake basin. A revision of the table from Annex E containing the program selections for the Great Lakes Basin is included (Table 1–26).

For the details of the selection of the programs for the individual river basin groups, specific sections of this appendix should be consulted. For details relating to any particular resource use category, the appropriate resource appendix should be used. The issues considered and the resolution of these issues are discussed in Annex D of this appendix. (See Introduction for availability of Annex D.)

5.5.1 Water Withdrawals

5.5.1.1 Municipally Supplied

An overriding consideration in the selection of programs was to provide adequate municipally supplied water to meet the needs projected for the time period. For the Normal Framework, about 85 to 90 percent of the need is expected to be met by withdrawals from the Great Lakes. Ground-water sources supply the next largest amount, followed by reservoir storage and inland lakes and streams. There is no problem in meeting the needs at any point. However, in some places where present supplies are from ground water and large increases in need were developed, it was necessary to go to the Great Lakes at a greater cost than that incurred in providing the present supply from relatively local sources. The Lake Michigan Plan Area presents special problems because such a large proportion of the population, particularly in the Chicago area, lives outside the drainage basin. Although some of the needs for municipal water are supplied by sources related to the Upper Mississippi River Basin, there is a large net export of water from the Great Lakes Basin to the Upper Mississippi River Basin for municipal use in this area.

5.5.1.2 Self-Supplied Industrial

By far the largest amount of self-supplied industrial water is furnished from the Great Lakes, particularly in the period 2000 to 2020. Programs have been selected to provide water from inland lakes, streams, and ground water as well as from the Great Lakes. In 1980 about half the supply comes from the Great Lakes, and considerably more of the supply comes from other surface supplies than from ground water. By 2020 nearly 75 percent comes from Great Lakes sources with the other relationships about the same. No reservoir storage is projected for self-supplied industrial water.

The situation in the Chicago area is unusual because much of the planning subarea is in the Upper Mississippi Basin. A large portion of the needs are met from local supplies, principally ground water. This differs from the municipal water supply in Chicago, most of which comes from the Great Lakes Basin. Thus, the needs computed for the entire PSA 2.2 are substantially reduced by transferring some of the needs to the Upper Mississippi Basin. To the extent that needs are met in the Great Lakes Basin, programs have been selected to provide water from Lake Michigan.

5.5.1.3 Rural Domestic and Livestock

Water for these purposes is nearly always supplied from a nearby source, and programs selected involve both surface- and ground-water sources, with the latter three to four times as large as the former. In the Chicago area some water is provided from the Upper Mississippi Basin to serve the needs projected for the Great Lakes Basin.

5.5.1.4 Irrigation

Inland surface-water and ground-water sources together supply almost ten times as much as Great Lakes sources, and ground water provides significantly more than surface sources. A very small amount is projected to be obtained from reservoir storage. All opportunities for irrigation are met. In the Milwaukee-Chicago-Gary area there is some adjustment of needs and supply in the three affected States between the Upper Mississippi Basin and the Great Lakes Basin.

5.5.1.5 Mining

Here, as in irrigation, the inland surface- and ground-water supplies are utilized far more heavily than the Great Lakes. Ground water plays a much more important part than does surface water in mining use. A very small portion is expected to be obtained from reservoir storage. All needs are met. Water from the Upper Mississippi Basin meets needs in the Great Lakes Basin for mining use.

5.5.1.6 Thermal Power Cooling

All needs in all time periods are met by use of water from the Great Lakes for this purpose.

5.5.2 Nonwithdrawal Water Uses

5.5.2.1 Municipal Wastewater Discharges

Programs have been selected to provide treatment for all municipal wastes adequate to meet the requirements of the Federal Water Pollution Control Act before the 1972 Amendments. The effect of the 1972 Amendments was less in the Great Lakes Basin than in many other parts of the country because of the higher standards already imposed in the Basin to protect the quality of the Lakes. In general, these standards required secondary treatment with 80-percent phosphate removal in all cases and advanced waste treatment with higher degree of phosphate removal at points where specific requirements were imposed. Also, treatment of flows from combined sewers was generally a part of the requirement to be met.

The quantities of waste to be treated shown in the tables of needs were developed by the Water Quality Work Group and are contained in Appendix 7, *Water Quality*. These quantities are shown for both NOR and PRO. The costs, however, are based on different methodologies for the two frameworks. For NOR the methodology is that contained in Appendix 7. Costs developed and reported in 1967 and 1969 by the Federal Water Quality Administration and updated to 1970 by indexing have been applied to the quantities of waste to be treated on a planning subarea basis. They include all operations from interceptor sewers through the treatment plant, including secondary treatment, phosphorous removal, and advanced waste treatment where required. Estimates are based on a study of the requirements in each planning subarea. Replacement costs under this procedure are included with capital costs rather than with O&M costs.

A discussion of the assumptions and the programs and their estimated costs for PRO are given in Subsection 5.6.2.

5.5.2.2 Industrial Wastewater Discharges

The frameworks provide for adequate facilities to treat industrial wastewater discharges not handled through municipal plants. Because of changes in technology, increased recycling of water within a plant, and an increasing reliance on municipal waste treatment plants, the projected amounts to be treated decrease from the present to 1980 and 2000 and then increase by the year 2020. Treatment is adequate in the Normal Framework to meet all the requirements of the Federal Water Pollution Control Act prior to the 1972 Amendments.

5.5.2.3 Hydroelectric Power

The number of locations in the Basin where conventional hydroelectric plants can profitably be installed is extremely limited. There are a number of places where pumped storage is a feasible way of meeting part of the power requirements, and plants to accomplish this are included in the frameworks. All needs for power generation are met. Hydroelectric power carries that share of the load for which it is suited, both in terms of power and energy.

5.5.2.4 Sport Fishing

Programs to meet the needs for a sport fishery are largely nonstructural, involving legislative and institutional changes. Some public acquisition of land and water is involved, and information must be collected and disseminated. Needs ranging up to 10 percent of the total are met by the use of multipurpose reservoirs. Unmet needs amount to between 8 percent and 18 percent depending on the time period. There are a few opportunities in some parts of the Basin to develop a fishery which will more than meet the projected needs and will assist in alleviating shortages in other areas. The few opportunities which do exist have not been specifically identified.

The sport fishery involves both inland waters and the Great Lakes. In both cases part of the problem is accessibility, ownership, and availability of the water, and part is the management of the fishery itself. Techniques that will be utilized on inland waters are cleaning up of polluted streams and lakes; stocking, managing, and controlling species; and providing access. On the Great Lakes there are some access problems, but the principal problems occur in the management of the fishery, including stocking, substitution of species, elimination of undesirable species, resolution and management of the relationship between sport fishery and commercial fishery, and similar related programs.

5.5.2.5 Recreational Boating

Recreational boating shares some characteristics with the sport fishery. In both cases needs exist and are met on inland waters and the Great Lakes, and to some extent, programs can be introduced which will induce persons to choose one or the other for satisfying the desire for this kind of recreation.

About 60 percent of the recreational boating needs have been met, based on the generalized criteria used to estimate capacity and the economic and demographic data used to project requirements. If safe, uncrowded boating opportunities are desired, the opportunities to provide increased boating capacity on the Great Lakes and on inland lakes and streams are limited. On the Great Lakes, potential capacity is about 130 percent of existing capacity, and on inland lakes and streams this figure is about 110 percent.

5.5.2.6 Commercial Fishing

At the present time the sport fishery is more valuable to the Great Lakes Basin than the commercial fishery, in terms of both the number of people affected and the economic value to the States. It is therefore anticipated that the commercial fishery will be managed to complement the sport fishery, and that programs will be adopted to use the commercial fishery for removal of undesirable species, harvesting of excesses, and similar functions. The control of sea lamprey and the monitoring and control of the alewife will be continued. In addition, the States will act individually, conjointly through whatever agreements can be practicably made, and with the assistance of the Federal government, to provide ways in which commercial fisherman can be licensed, or contracts can be let for specific fishing operations. Eventually, commercial fishing can only be properly managed on a lakewide basis with agreements among Great Lakes States, the Province of Ontario, and other responsible agencies.

5.5.2.7 Commercial Navigation

Commercial navigation is both a localized and a Basinwide operation. The broad expanses of the Lakes themselves and the confines of the connecting channels serve the Basinwide needs of navigation and transport. The individual ports at which cargoes are loaded and unloaded are focal points of the interface between land and water transportation. In the Normal Framework, programs include the maintenance of navigation improvements such as dredging of harbors and connecting channels, the maintenance of navigation aids, etc. Programs also provide for harbor improvements by creating 31-

foot depths in Silver Bay, Duluth-Superior, and Taconite Harbors in Lake Superior; in the connecting channels in Lake Superior and Sault Ste. Marie; in Escanaba, Chicago, Milwaukee, and Indiana Harbors; and in the connecting channels in Lake Michigan, including the Straits of Mackinac. These improvements will permit the use of the new supercarriers for handling iron ore from Lake Superior to the Lake Michigan ports.

5.5.3 Related Land Uses and Problems

5.5.3.1 Agricultural Land Treatment

A great deal of the agricultural land in the Great Lakes Basin will profit from conservation measures of various sorts, such as those now being applied in most areas on a limited scale. Programs adopted for the Normal Framework contemplate continuation of the present rate of treatment. It would not be feasible to treat all of the land that could profit from treatment. In fact, less than half of the land is treated; about 9 percent in the first time period, 26 percent in the second time period, and 37 percent in the final time period. This includes consideration of the land treated in the Upper Mississippi River Basin in the vicinity of Chicago.

5.5.3.2 Cropland Drainage

Opportunities for effective drainage treatment exist on a considerable amount of cropland, either as the sole conservation practice, or in conjunction with other practices. Some of this land will remain in crops, and, if drained, the same crops can be raised on it at lower cost, or higher-value crops can be raised. Other land, which may go into urban development, will need to be drained in order to provide suitable areas for development. Not all of the opportunities for drainage are accepted in the Normal Framework. The amount treated ranges from 7 percent in the first time period to a total of 24 percent in the final time period. The drainage programs include some effected on land in the Upper Mississippi River Basin.

5.5.3.3 Forest Land Treatment

As with agricultural land treatment and cropland drainage, there are far more opportunities for forest land treatment than can be feasibly accepted. The needs met or opportunities accepted amount to about 10 percent in the first time frame, 28 percent in the second, and 51 percent at the end of the study period. A small amount of treatment done in the Upper Mississippi River Basin is included.

5.5.3.4 Shoreland Erosion

The programs selected for the Normal Framework provide for treatment of the critical erosion areas that were determined in 1970 at the rate of 20 percent in the first 10 years, 40 percent in the next 20 years, and 40 percent in the last 20 years. All critical erosion areas are treated by various structural methods that are appropriate. None of the noncritical areas are treated.

5.5.3.5 Streambank Erosion

Not all the erosion areas, even those classified as severe, are treated in the period of study, but programs have been selected that will accomplish as much as is believed feasible. To some extent, the problem of correcting erosion on private land makes it impracticable to attempt to meet all of the needs. About 5 percent, 16 percent, and 27 percent of the total needs or opportunities for correcting streambank erosion are met in the three time periods.

5.5.3.6 Flood Plains

Programs for reducing floods and flood damage in both urban and rural areas involve both structural and nonstructural methods. Reservoirs are used in a few cases to reduce flood peaks, and stream channel improvements are also utilized. In addition, land use changes, including new zoning, legislative and institutional changes, and education in the proper use of the flood plains are all utilized. About 93 percent of the urban damages and 56 percent of the rural damages are alleviated at the end of the study period.

5.5.3.7 Wildlife

The ability to meet the needs for wildlife resources varies widely over the Basin. Both hunting and such nonconsumptive uses as bird-watching, photography, and nature study are involved. It is possible to meet the needs in some areas through management of the existing habitat. In other places this is difficult and may become impossible as land use changes occur. The programs selected involve public acquisition of additional land, changes in land use treatment of some areas to improve the habitat, legislative and institutional changes to control the use of the land, provision of access for hunters and other users, and changes in the availability of some species for hunting.

Both the ability to meet needs and the relationship between habitat area and user days may vary over the Basin. The percentage of habitat needs met decreases from 40 percent to 35 percent over the time period to 2020. However, more effective management results in an increase from 15 percent to 38 percent of the user-days being met.

5.5.3.8 Aesthetic and Cultural Resources

No programs have been specifically proposed in the Normal Framework, but the needs for corridor and shoreline development, which are expressed in Appendix 22, *Aesthetic and Cultural Resources*, have first priority in enhancing the aesthetic and cultural values in the Basin. This work should have a priority as high as any other work in the programs. There are individual sites which should also be examined carefully for early acquisition, preservation, or governmental control.

5.5.3.9 Outdoor Recreation

It is impossible to meet all the projected needs for water-oriented outdoor recreation at any of the three target dates. The unmet needs range between 35 percent and 55 percent for the three time periods. About 8 to 10 percent of the Basin's total projected needs are met in the Chicago area by programs developed in the Upper Mississippi River Basin. Meeting the outdoor recreation needs involves acquisition of additional land; development of some of this new land and some presently utilized land for more intensive recreational uses; development of additional water surface through the use of multipurpose reservoirs; and acquisition, zoning, and development of access to existing water. There are publicly owned areas in all parts of the Basin that can be made available for outdoor recreation use. The land needed for intensive development could be provided by these areas. Where there are opportunities to do so, recreation facilities are developed beyond the needs of the particular area, because it is recognized that existing and future travel patterns will enable persons to travel to areas where attractive recreational opportunities exist.

5.5.4 Statistical Tables

Table 1–26 shows the various programs selected for each resource use category, and the needs which are met, unmet, exceeded, or transferred. This table originally appeared in Annex E. The data has been revised to conform to final selections. Tables 1–190 through 1–192 in Section 12 show Great Lakes Basin needs, outputs, and percents needs met; capital costs; and operation, maintenance, and replacement costs for the Normal Framework.

5.6 Proposed Framework

A second framework, the Proposed (PRO) Framework, was developed in an effort to recognize preferences of Basin residents regarding the future of parts of the Basin, and to reflect State policies and programs. The NOR Framework did not do this. In an area as large as the Great Lakes Basin, with a wide range of population densities, employment opportunities, recreational resources and other factors, no uniform opinion is held as to the optimum programs for the Basin.

The Proposed Framework was developed following a series of public meetings at which Basin residents were encouraged to express their views. The selections made in NOR were used as a base for discussion, and the total range of possible conditions developed for limited growth and accelerated growth objectives gave an opportunity for considering desirable changes from NOR.

State, regional, and local policies with respect to population and economic growth do not differ greatly from those of OBERS projections on which the NOR Framework is based. The general attitude is that slower population growth is likely, and a slower rate of economic growth may be desirable. No new projections were made, but where alternatives were available for meeting needs and solving problems, those emphasizing environmental quality and reflecting slower rates of population increase and economic growth were selected.

For most resource use categories there are no quantitative changes in the Basin total from NOR. In a few instances changes were made in one or more of the river basin groups. The 15 separate river basin groups were then summed to achieve the Basin total. In the case of commercial navigation there is no quantitative difference in the programed traffic, but the elements selected for development are based on a systemwide approach to the development of this mode of transportation.

The specific emphases related to various resource use categories are described for PRO in comparison with NOR, and in those instances where outputs differ in magnitude or timing, the quantification is shown.

5.6.1 Water Withdrawals

In only a few instances do program selections for water withdrawals under the PRO Framework differ from those under the NOR Framework. Needs are the same except for thermal power cooling, discussed below. Municipal water supplies, self-supplied industrial water, and rural domestic and livestock supplies are furnished through similar program selections. An emphasis on educating the public to use water resources more sparingly, providing that the public health, welfare, economy, and social well-being of the inhabitants are not adversely affected, is part of the PRO Framework.

Crop irrigation needs in the area around Cleveland, Ohio, are not met in PRO, and mining needs there are met only for the period to 1980. Because other uses of the land are given higher priority, water is not supplied for these two purposes. Additional provisions relating to mineral lands are discussed in Subsection 5.6.3.

For thermal power cooling, the PRO Framework is predicated on individual site selection and determination of the most suitable method of cooling, either flow-through or some form of supplemental cooling. Needs for cooling water could be greater or smaller than in NOR. It is generally assumed that more supplemental cooling would be used, with fewer withdrawals, greater consumptive use, and higher capital and operating costs. This might not be the case, however, if site selection for flow-through cooling were undertaken seriously. Because of these uncertainties, no quantification of PRO as differing from NOR is shown.

5.6.2 Nonwithdrawal Water Uses

Needs for nonwithdrawal water uses in PRO are the same as in NOR. However, some assumptions regarding program selection in PRO result in significantly higher costs than those in NOR.

The same quantities of municipal and industrial wastes are treated under PRO as under NOR. However, because of the changes in Federal grant authority under the Federal Water Pollution Control Act Amendments of 1972 and more accurate information as to required treatment plants and costs, a different methodology for estimating costs was used in PRO, and the costs are considerably higher. These costs are based on the need surveys made pursuant to the 1972 Amendments and are not specifically related to the waste treatment quantities shown. However, since both costs and waste treatment quantities were derived from the same basic projections of population and waste treatment, the relationship is believed well within the accuracy of the estimates.

The estimates for PRO have been extracted from those developed by the States and the U.S. Environmental Protection Agency in the 1973 Survey of Needs for Municipal Wastewater Treatment Facilities.

Survey data were collected through questionnaires completed for each existing facility, each facility under construction, and each proposed facility within communities with populations of 10,000 or more. States were permitted to sample smaller communities. Questionnaires were reviewed by the State for completeness, consistency of data with State plans, priorities and schedules, and reasonableness of projections of needed size and cost. The questionnaires were also reviewed by the EPA for basic eligibility under the Federal Water Pollution Control Act Amendments of 1972 (P.L. 92–500), eligibility for inclusion in the 1973 Survey, reasonableness of size of facility, reasonableness of cost of project, and consistency of data with other factors, such as permit stipulations, water quality standards, etc.

The survey was designed with the expectation that it will be continuously updated through planning studies, revised State construction priority lists, grant applications and awards, reports on completed facilities, and other data. Such updating will serve well as an indication of trends of costs, needs, improvements, etc., in the treatment of wastewater in the Basin and nationwide.

The questionnaire provided information on existing and required treatment levels, flows, and costs for each category of needs which each facility may require. The survey grouped the many types of needs into five major categories:

(1) needs required to achieve secondary treatment

(2) needs required to achieve more stringent treatment than secondary, where this could be justified

(3) needs for infiltration/inflow analyses and rehabilitation or correction of sewers

(4) needs for construction of new collector and interceptor sewers

(5) needs for separation of combined sewers and treatment of storm waters where justified.

Some of these categories were further divided into component subparts. A summation of needs as defined in these five categories is used for the costs in PRO through 1982. This includes both the cost of updating facilities to current standards and the cost of facilities required for population growth. Costs beyond 1982 are estimated as described below. Wastewater flows requiring treatment have not been revised from previous estimates. It is noted, however, that flow volumes may, in fact, vary considerably among planning subareas and from NOR to PRO. Variation in flow may be induced by sewer separation, treatment of combined sewer flows, and correction of infiltration/inflow problems. With stringent new legislation and deadlines for meeting water quality standards, such improvements are becoming standard.

As noted in Subsection 5.5.2.1, the costs for NOR included interceptors and treatment plants. Under the effective provisions of the Federal Water Pollution Control Act Amendments of 1972, Federal grant programs are available for the five categories listed above in the needs survey. Costs for PRO include all elements from sewers through the treatment plants, including separation of combined sewers. The only element not included is separate storm-water control. The result, in terms of cost estimates, is that far more elements are being included in PRO than in NOR, and since the information is more accurate and up-to-date, the costs are higher. The unit cost of $300 per capita for investment was used to estimate the cost of facilities required due to population increase. The replacement cost of facilities, based on a 20-year life span, is included with operation and maintenance under PRO rather than with capital costs. The unit cost for operation and maintenance, $10 per capita per year, includes all of the operating costs.

The result of the inclusion of far more facilities and assumptions of higher unit costs is a higher total cost for wastewater treatment in PRO, including both capital and OM&R costs over the same period 1970 to 2020. This increase is roughly three times the costs in NOR for the same period.

Programs in PRO are the same as in NOR for hydroelectric power, sport and commercial fishery, and recreational boating. Water-oriented outdoor recreation is discussed in Subsection 5.6.3.

For commercial navigation, more extensive deepening of connecting channels and harbors is included in PRO than was the case in NOR. Additional elements are channel improvements, including a lock and dam in the St. Clair River and deepening that channel to 34 feet, and dredging the Detroit River and other channels; deepening to 31 feet the harbors of Marquette, Calumet, Port of Indiana, Detroit, Toledo, Sandusky, Lorain, Cleveland, Conneaut, Erie, and Buffalo, and channel dredging and structure modification in St. Lawrence Seaway.

The following extension of the navigation season is also included in PRO:

(1) six weeks extension for the following segments:

(a) from western Lake Superior, through the Soo Locks and St. Marys River, and to southern Lake Michigan

(b) through the St. Clair and Detroit Rivers and Lakes St. Clair and Erie

(c) through the Welland Canal into Lake Ontario

(2) four weeks through the St. Lawrence River system.

5.6.3 Related Land Uses and Problems

A number of recommendations are included in the PRO Framework relative to more effective management and use of land. Many do not have costs attached. The following are general recommendations:

"That additional studies be made at the State level, leading to the development and adoption of a comprehensive land use policy for the Great Lakes Region." (The cost of these sudies will not be stated).

"That studies be made in order that land use decisions can be based on adequate information relative to the physical land base for suitable uses, resulting in improved land use policies and permitting water resource planning to complement land use objectives." (The cost of these studies will not be stated.)

"That State-approved local control ordinances be established directed toward the control or treatment of runoff and sediment reduction on urban and rural lands. State-established regulations would prevail if local regulations are not implemented by July 1, 1977." (consistent with Federal Water Pollution Control Act Amendments of 1972).

"That the States should set time limits for local entities to manage and develop policies, objectives, programs and implementation techniques for flood plain regulations. If the local entities do not meet the time limits, the States should then manage and regulate the flood plains according to State statutes."

"That adequate sums of money be allocated to manage and control flood plain lands considering the cost may be allocated to both flood plain damage alleviation, outdoor recreation and other uses of the flood plain."

With respect to mineral deposits, PRO recommends: "That as part of the planning programs, particularly in urbanizing areas, due consideration be given to the preservation for possible future utilization of known mineral deposits."

With respect to reclamation of mined lands PRO recommends: "That those previously mined lands that have a significant adverse effect on the environment be reclaimed. The extent to which a specific mined area is to be reclaimed would have to be decided on a case by case basis. Restoration of lands affected by current and future mining operations should be the responsibility of the landowner and/or operator. States that have not already done so should be encouraged to institute legislation to require restoration of lands as part of all future mining activities. The general principle supported in the Proposed Framework is that the land be reclaimed to abate pollution sources and to provide the opportunity for appropriate future land uses. When location and topography are suitable, high priority consideration should be given to the opportunities of using mined lands for future recreation and open space."

Agricultural land treatment would, under the NOR Framework, be applied by year 2020 to about 37 percent of the land suitable for such treatment. In PRO the rates were selected for a higher rate of treatment, with drainage eliminated in certain areas that are not now highly productive. The area treated by 2020 would be about 76 percent of the land suitable for treatment.

Cropland drainage under NOR would be applied by year 2020 to 24 percent of the land having a wetness problem. Under PRO the land providing high agricultural production would be drained to the extent of 42 percent of the total having a wetness problem.

Forest land conservation under the NOR Framework includes programs that treat 14 million acres, or about 50 percent of the 28 million acres needing treatment. PRO provides for treatment of 22 million acres or more than 75 percent of the total. In both cases some areas are provided with multiple treatment programs.

Of the total shoreline of the Great Lakes, 1,192.6 miles were subject to erosion in 1970. Three terms are used to identify the extent of erosion hazard of shore areas. High risk erosion connotes physical conditions of erodible shore coupled with a high probability of lake conditions that will cause such erosion. Critical erosion includes both the high risk of erosion and the existence of high value economic or recreational resources. Noncritical erosion means that there is a high risk of erosion, but high value economic or recreational resources do not exist. NOR protected all the shoreline subject to critical erosion in 1970, which amounted to 203.9 miles or 17 percent of the total. With higher lake levels and other changes in conditions in 1973, a much larger portion suffered erosion damage or was susceptible to such damage, but a complete inventory for the Basin is not available. However, for the shoreline in Michigan, a total of 715 miles was classed in 1973 as high risk erosion mileage along Lakes Superior, Michigan, and Huron. This compares with 104 miles classed in 1970 as subject to critical erosion and 479 miles classed as subject to noncritical erosion for a total of 583 miles. No quantification of more effective treatment is shown for PRO than for NOR, but it is apparent that programs 50 percent to 100 percent more extensive should probably be considered.

Streambank erosion protection is provided in NOR for the 2,945 bank miles subject to severe erosion. This is 27 percent of the total of 10,934 bank miles having some erosion. The same rate of treatment and total protection is provided for in PRO.

In flood plain management, the adopted programs for PRO are the same as for NOR, and costs are also the same. Through education, emphasis on flood plain zoning, use of flood plains for recreation and other activities which have low vulnerability to flood damage, and similar means, it is expected that the rate of increase in flood damage costs due to increasing property values can be slowed or reversed.

Wildlife management programs in NOR met 35 percent of the habitat needs and exceeded the user-day needs. In PRO the same programs are included, but there is particular emphasis on acquisition of high-quality habitat including all wetlands.

No specific programs for aesthetic and cultural values were included in NOR. A few features were identified, and the same concepts emphasized as in the priorities given in Appendix 22, *Aesthetic and Cultural Resources,* for the five Lake basins. PRO recommends that the zone concept be implemented at higher levels and more rapidly, and that specific feature and site identification and study be emphasized and acquisition follow as appropriate.

There is the same amount of outdoor recreation programed in PRO as in NOR and the same output. Both depend heavily on the private sector for a large part of the total development. In PRO, however, the emphasis is on governmental input to urban-oriented recreation and on efforts to interest private developers in providing facilities removed from urban centers. These facilities would require greater travel, but they would also provide the highest quality recreation. Public funds should be used with the following priorities:

(1) urban recreation developments and acquisition and retention of unique and natural areas of regional significance

(2) developments on land now publicly owned

(3) other developments, to the extent that public funds are available for investment in urban lands. They may be used where feasible to assist the following:

(a) acquiring flood plain land in rapidly urbanizing areas

(b) clearing flood plains of damage-prone uses and making them available for recreation use.

5.6.4 Statistical Tables

Section 12 contains Table 1–193, which gives needs, outputs, and percent of needs met for PRO; Tables 1–194 and 1–195 list capital costs and operation, maintenance, and replacement costs. These tables indicate by italics where PRO entries differ from NOR.

Table 1–196 compares land treatment programs.

5.7 NOR and PRO Framework Costs

Table 1–197 in Section 12 lists the total costs (capital plus OM&R) for NOR and PRO for the periods 1971–1980 and 1971–2020.

Section 6

LAKE SUPERIOR BASIN

6.1 The Study Area

Statistical information about the Lake Superior basin and its subdivisions, River Basin Groups 1.1 and 1.2, and the counterpart Plan Area 1, subdivided into Planning Subareas 1.1 and 1.2 is given in Section 1. A map of the area is shown in Figure 1–20.

6.1.1 Human Characteristics

The population density in the United States portion of the Lake Superior basin is low, about 31 people per square mile. According to the 1970 census, 529,500 people reside in the area. Three of the 17 counties, St. Louis County, Minnesota; Douglas County, Wisconsin; and Marquette County, Michigan, account for 330,000 people, or 63 percent of the total population. Other population data are in Table 1–10.

The basin residents are only a small portion of the people who use the natural resources in the area. Nonresidents significantly swell the area's population during the hunting and vacation seasons. Resort and second-home seasonal uses add significantly to the number of part-time residents in the area. With better means of transportation and the advent of snowmobiling as a sport, the nonresident uses are increasing yearly in both numbers and duration. The estimated effect of this nonresident population influx is a more than twofold increase in basin population during parts of the year.

6.1.2 Water Resources

On the average, surface runoff is about 8 to 10 inches per year over the basin. There are hundreds of surface streams, typically short and fast with erratic seasonal flows. The principal river is the St. Louis, which has a drainage area of about 3,700 square miles, with a portion of the stream length forming part of the Minnesota-Wisconsin boundary. A portion of the Wisconsin-Michigan boundary is formed by the Montreal River, one of the smaller streams draining an area of about 281 square miles. Other principal rivers are the Bad River in Wisconsin and the Ontonagon River in Michigan.

The basin contains approximately 58,000 acres of inland lakes more than 40 acres in size, with many more smaller lakes dotting the region. Lake Gogebic is the largest inland lake in the area, with a water surface area of 8,700 acres. Seventeen reservoirs have been constructed in the region, several of which are located near Duluth. The largest is on the Cloquet River, Minnesota, containing 171,400 acre-feet of storage.

Since 1921, the level of Lake Superior has been regulated by control works in the St. Marys River above the rapids at Sault Ste. Marie. From 1957 to the base year of the study, 1970, the range of elevation of Lake Superior from extreme low to extreme high has been about 2.4 feet. The maximum range from highest monthly mean to lowest monthly mean for the period 1860 to 1970 was 3.83 feet. In addition to precipitation and runoff, Lake Superior receives water by importation via the Long Lake-Ogoki hydroelectric projects located in Canada. This diversion averages nearly 5,000 cfs of water which formerly flowed north to the Hudson Bay. The average annual outflow from Lake Superior through St. Marys River is about 74,500 cfs.

The Lake Superior basin has a poor to fair potential for ground-water supplies, but locally there are good aquifers. The best aquifers are in sand and gravel deposits, especially in the east end of the Upper Peninsula of Michigan, in the headwaters of the St. Louis River Basin of Minnesota, and in the headwater areas of Wisconsin. Elsewhere the bedrock is predominantly Precambrian igneous, metamorphic, and sedimentary rock, with a 25- to 400-foot thick glacial drift cover providing limited ground water.

The quality of surface waters is generally high, with localized areas receiving substantial amounts of domestic and industrial wastes. The lower St. Louis River is of poor quality, with numerous instances of oxygen depletion occurring in the past. Most of the tributaries to Lake Superior in the Wisconsin portion, and some in Michigan, produce considerable quantities of sediment. The biological, chemical, and physical characteristics of Lake Superior waters are generally of excellent quality,

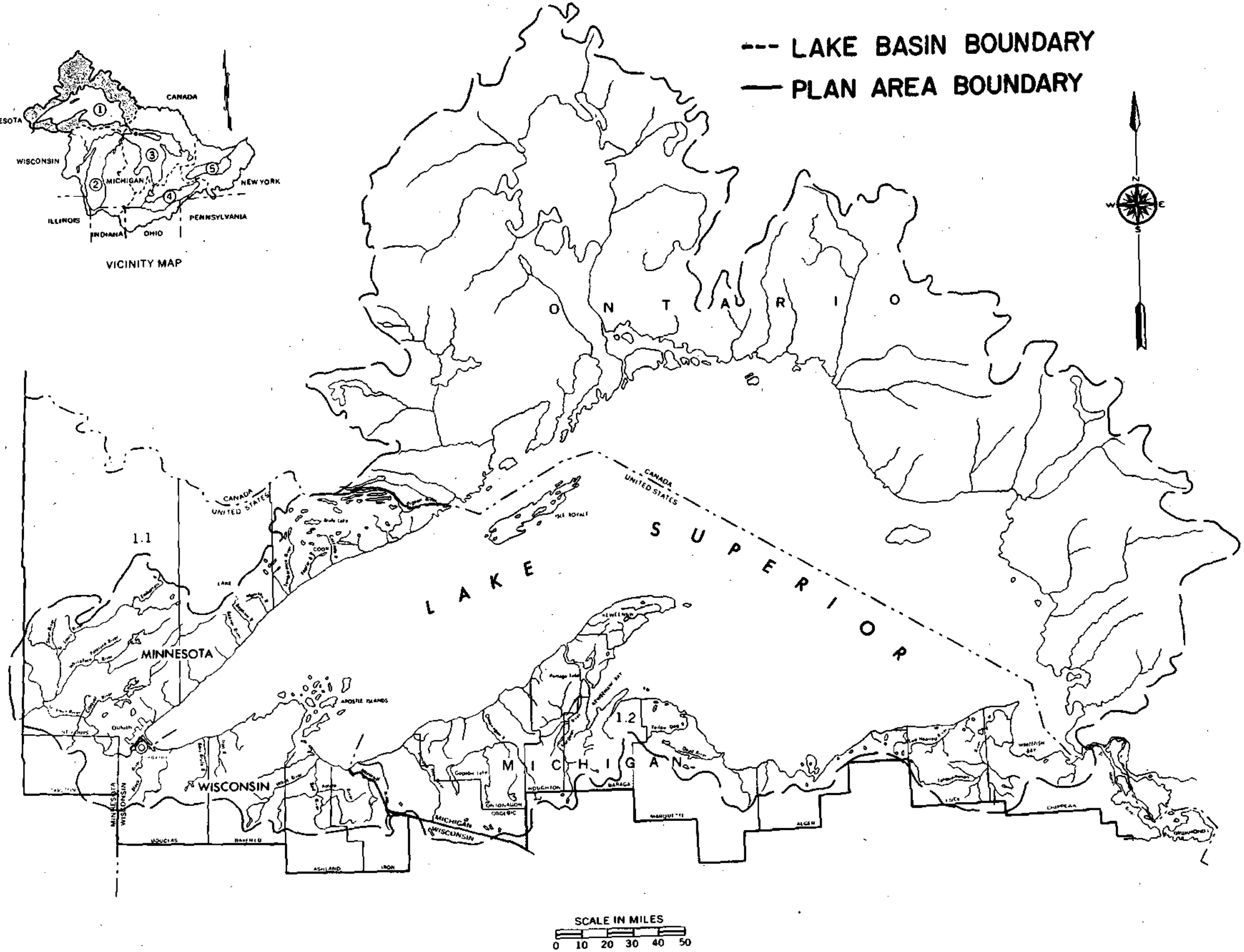


FIGURE 1-20 Plan Area 1, Lake Superior

except for localized areas. Generally, good-quality ground water is available, except for highly mineralized water occurring in a few areas, particularly in the Superior Slope and Apostle Islands complexes, the Keweenaw Peninsula area, and in the headwaters of the Tahquamenon complex.

6.1.3 Land and Other Natural Resources

With the exception of Michigan's Huron and Porcupine Mountains, the ridges of the Keweenaw Peninsula, and the steep slopes northeast of Duluth, the Lake Superior basin is typified by either rounded hills with deep-cut valleys or level to gently undulating plains.

The soils of the area are fairly low in natural fertility and were formed under coniferous or mixed coniferous forest covers. Those in the western part of the basin belong to somewhat poorly drained soil associations; whereas those in the Michigan and Wisconsin portion include better-drained sandy loams, sandy clays, and sandy clay loam tills.

Overall land use in the Lake Superior basin seems fairly consistent with its soil capabilities and is outlined in Section 1. Figure 1–21 shows land use in Plan Area 1 and PSAs 1.1 and 1.2.

The proportion of land in agriculture is the lowest of any of the basins (Tables 1–48, 1–49, 1–50). The most important agricultural products are potatoes, cloverseed, and dairy products, although such fruits as apples, blueberries, cranberries, and strawberries are grown along the southern shores of Lake Superior.

On the other hand, the proportion of land in forest is the highest of any of the basins. (Tables 1–48, 1–49, 1–50). Hardwood forests of beech, birch, maple, and aspen typify the Michigan-Wisconsin areas of the basin. Intermixed hardwood and softwood forests characterize the Minnesota portion. Second growth jack, red, and white pine, along with spruce and fir, typify these softwood forests.

Mineral commodities presently produced in the basin include clay, iron ore, peat, sand and gravel, silver, copper, and crushed stone (gabbro and basalt). Current reserves of iron ore are considered to be 988 million tons measured, 6.9 billion tons indicated and inferred, and 40.6 billion tons potential. Reserves of titaniferous iron, anorthosite, and copper, silver, and nickel sulfides are also available, but commercial exploitation is currently uneconomical.

The Lake Superior basin abounds in outstanding natural resources and aesthetically pleasing areas. There are more inland lakes per square mile than in any of the other basins, and hundreds of clear streams. Bogs, swamps, sand dunes, waterfalls, and a number of forest types comprise some of the major features in the area. The presence of a variety of wildlife forms including moose, whitetail deer, and the timber wolf, along with ruffed grouse, woodcock, and a wide variety of songbirds and waterfowl, provide abundant hunting and aesthetic opportunities. Sport fishing is both widespread and diversified. Brook, brown, and rainbow trout, along with smallmouth bass and northern pike, make up the majority of the sport catch, although introduction of coho, pink, and chinook salmon in Lake Superior has provided additional opportunities. One of the basin's great assets is the 912-mile Lake Superior shoreline. A number of outstanding recreational areas are found near or along this shoreline, including the Apostle Islands complex, the newly created Pictured Rocks National Lakeshore, Tahquamenon Falls, and the famous Isle Royale National Park.

6.1.4 Problems

Socioeconomic problems in the Lake Superior basin are serious. Over the past decade, the region

TABLE 1–48 Land Use, Lake Superior Plan Area, 1966–67 (in thousands of acres)

PSA and State	Total Land Area	Urban Built-Up	Resource Base: Cropland	Pasture Range	Forest Land	Other	Total
PSA 1.1							
Minnesota	6,579.9	162.5	258.3	62.0	5,981.5	115.6	6,417.4
Wisconsin	2,893.6	122.0	171.8	37.5	2,373.4	188.9	2,771.6
PSA Total	9,473.5	284.5	430.1	99.5	8,354.9	304.5	9,189.0
PSA 1.2							
Michigan	6,441.8	137.8	262.8	65.8	5,909.6	65.8	6,304.0
TOTAL	15,915.3	422.3	692.9	165.3	14,264.5	370.3	15,493.0

TABLE 1–49 Actual and Projected Land Use, Lake Superior Plan Area (thousands of acres)

Land Use	Actual 1966-67	Implied Change 1966-67 to 1980	Projected 1980	Implied Change 1980-2000	Projected 2000	Implied Change 2000-2020	Projected 2020
Lake Superior							
Total land area[1]	15,915.3	---	15,915.3	---	15,915.3	---	15,915.3
Total urban and built-up	422.3	0.7	423.0	8.8	431.8	18.1	449.9
Total nonurbanized land	15,493.0		15,492.3		15,483.5		15,465.4
Resource Base:							
Cropland	692.9	(*)[2]	692.9	(0.4)	692.5	(0.8)	691.7
Pasture	165.3	(*)	165.3	(0.1)	165.2	(0.2)	165.0
Forest Land	14,264.5	(0.7)	14,262.8	(8.0)	14,254.8	(16.6)	14,238.2
Other Land	370.3	(*)	370.3	(0.3)	370.0	(0.5)	369.5
Total[3]	15,493.0	(0.7)	15,492.3	(8.8)	15,483.5	(18.1)	15,465.4

Source: Developed by Economic Research Service, U.S. Department of Agriculture, East Lansing, Michigan.

[1]Total land area = total area - water area, and is assumed constant for projection periods.
[2]Bracket figures represent urban depletions for 1967-1980, 1980-2000, and 2000-2020. (*) indicates < 50 ac. depletion.
[3]Detail may not add to total due to rounding.

has experienced high unemployment, low incomes, and significant outmigration of workers. Although total personal income reached over $1,620 million in 1969, the per capita income of $3,037 lags far behind the Great Lakes Region average of $3,802.

The major economic problems relate to a decline in markets for forest and mineral products as well as to marginal agricultural activity. A decline in the commercial fishing industry brought about by sharply reduced catches of valuable fish species is a contributory factor. Generally inadequate transport facilities, combined with a commercial navigation industry that is closed down for three months of the year, further complicate these problems.

Municipal water supply systems throughout the area are generally in need of replacement. Lack of population and economic growth has meant minimum expansion and little modernization for many decades.

Water quality is generally excellent throughout the basin. Some localized areas such as the St. Louis River basin, however, suffer from both municipal and industrial wastes. Mining wastes also present problems in some areas. One of the more serious problems is in the Superior Slope complex along the northern Lake Superior shoreline.

Overall, the heavy forest cover and lack of agricultural activity keep erosion from becoming a serious basinwide problem. Lack of conservation treatment practices in some agricultural and forest lands, however, results in runoff, erosion, and sedimentation problems. Topography and erodibility factors contribute to these problems, especially in the western portions of Wisconsin where geologically young red clay soils encourage massive erosion and sedimentation. Although stream bank erosion is widespread throughout the basin, it reaches serious proportions in only a few localized areas. The same can be said of shoreline erosion, with only scattered portions of Lake Superior being subject to critical erosion.

Severe climate, adverse topography, long distances to markets, and poor drainage in some areas prevent these lands from reaching their potential for food and fiber production. These factors, plus the poor productivity of most of the area's soils, effectively restricts agricultural activities. In this respect, the Michigan land portion of this basin is the area in the Great Lakes Basin that has no Class I lands, i.e., those lands most suitable for agricultural activities. There are flooding problems based on natural soil and cover conditions in some areas. Except for the rural Sturgeon River basin area in Michigan's western section, the only serious flooding problems are in a few urbanized areas.

The low productivity which typifies many of the area's lakes and streams creates some problems with respect to fish abundance. The declining value of wildlife habitat in some areas brought about by the changing forest cover is posing definite local threats to the abundance of deer and grouse. Limited access to inland lakes, coupled with inaccessibility of many stretches of the Lake Superior shoreline, sets certain limits on resource use.

Problems of land use, particularly in terms of competition for shoreline areas, are evident in the areas near the major cities. Because of the increasing influx of seasonal residents, speculative land developers, and mining activity, some of these land use problems are acute.

A summary of the resource problems to be found in the Lake Superior basin is shown on Table 1–51.

6.1.5 Existing Resource Use and Development

The Lake Superior basin is the most extensively forested area in the Great Lakes Basin, with

TABLE 1–50 Actual and Projected Land Use, Lake Superior Plan Area by PSA (thousands of acres)

Land Use	Actual 1966-67	Implied Change 1966-67 to 1980	Projected 1980	Implied Change 1980-2000	Projected 2000	Implied Change 2000-2020	Projected 2020
PSA 1.1							
Total land area[1]	9,473.5	---	9,473.5	---	9,473.5	---	9,473.5
Total urban and built-up	284.5	.7	285.2	7.8	293.0	14.9	307.9
Total nonurbanized land	9,189.0		9,188.3		9,180.5		9,165.6
Resource Base:							
Cropland	430.1	(*)[2]	430.1	(.4)	429.7	(.7)	429.0
Pasture	99.5	(*)	99.5	(.1)	99.4	(.2)	99.2
Forest Land	8,354.9	(.7)	8,354.2	(7.0)	8,347.2	(13.5)	8,333.7
Other Land	304.5	(*)	304.5	(.3)	304.2	(.5)	303.7
Total[3]	9,189.0	(.7)	9,188.3	(7.8)	9,180.5	(14.9)	9,165.6
PSA 1.2							
Total land area[1]	6,441.8	---	6,441.8	---	6,441.8	---	6,441.8
Total urban and built-up	137.8		137.8	1.0	138.8	3.2	142.0
Total nonurbanized land	6,304.0		6,304.0		6,303.0		6,299.8
Resource Base:							
Cropland	262.8		262.8	(*)	262.8	(.1)	262.7
Pasture	65.8		65.8	(*)	65.8	(*)	65.8
Forest Land	5,909.6		5,909.6	(1.0)	5,908.6	(3.1)	5,905.5
Other Land	65.8		65.8	(*)	65.8	(*)	65.8
Total[3]	6,304.0		6,304.0	1.0	6,303.0	(3.2)	6,299.8

Source: Developed by Economic Research Service, U.S. Department of Agriculture, East Lansing, Michigan.

[1]Total land area = total area - water area, and is assumed constant for projection periods.
[2]Bracket figures represent urban depletions for 1967-1980, 1980-2000, and 2000-2020. (*) indicates < 50 ac. depletion.
[3]Detail may not add to total due to rounding.

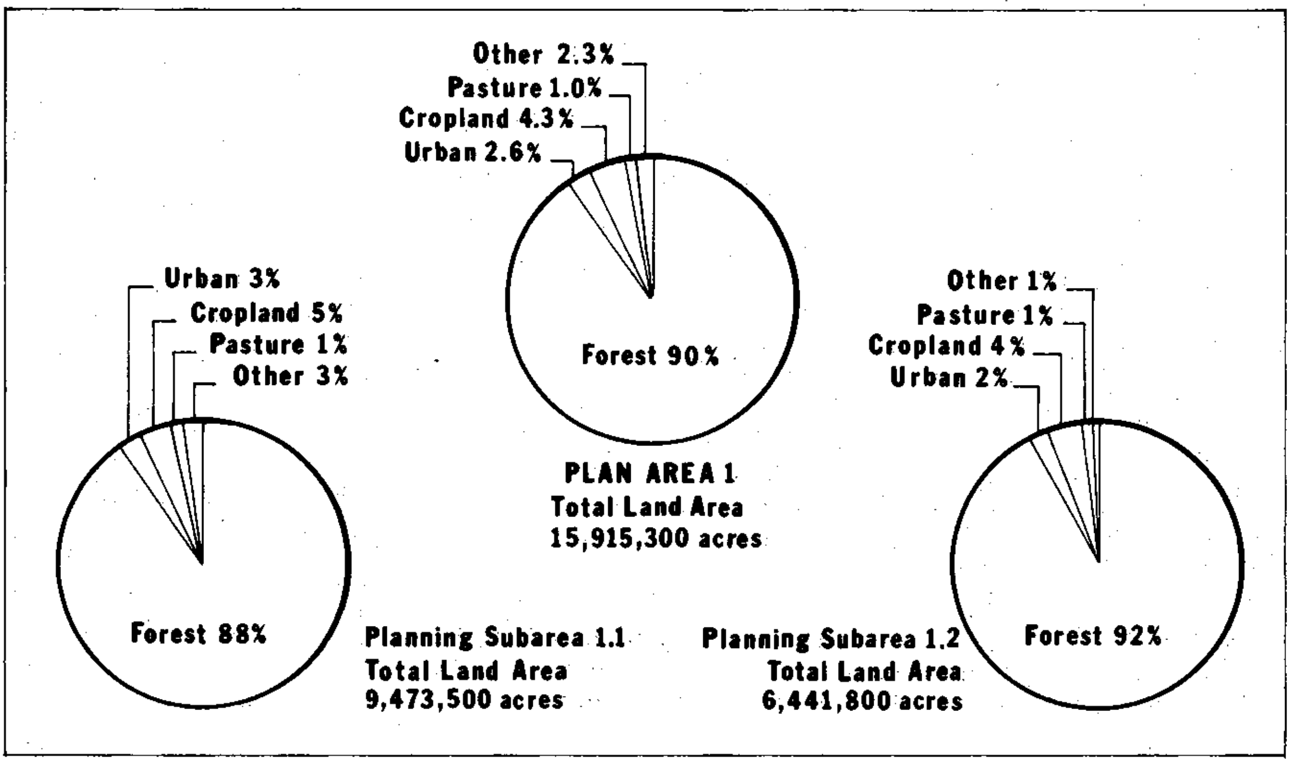


FIGURE 1–21 Land Use in the Lake Superior Basin

TABLE 1-51 Lake Superior Basin, Resource Problems Matrix

	LAKE SUPERIOR BASIN 1.0																	
		West River Basin Group 1.1																
				Superior Slope Complex			St. Louis River Basin			Apostle Islands Complex			Bad River Basin			Montreal Complex		
Resource Use Category	Overall	Overall	Open Waters	Urban	Rural	Interface	Urban	Rural	Interface	Urban	Rural	Interface	Urban	Rural	Interface	Urban	Rural	Interface
WATER WITHDRAWALS																		
MUNICIPALLY SUPPLIED	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	1	-
SELF-SUPPLIED INDUSTRIAL	1	1	-	-	1	-	-	1	-	-	1	-	-	1	-	-	1	-
RURAL DOMESTIC & LIVESTOCK	1	1	-	-	1	-	-	1	-	-	1	-	-	1	-	-	1	-
IRRIGATION	-	-	-	-	-	-	-	1	-	-	-	-	-	1	-	-	-	-
MINING	1	1	-	1	1	-	1	1	-	-	-	-	-	-	-	-	-	-
THERMAL POWER COOLING	-	-	-	-	-	1	1	1	-	-	1	-	-	-	-	-	-	-
NON-WITHDRAWAL WATER USES																		
MUNICIPAL WASTEWATER DISCHARGES	1	1	-	-	-	-	2	2	1	-	-	-	1	-	1	1	-	-
INDUSTRIAL WASTEWATER DISCHARGES	1	1	-	-	-	1	3	1	1	-	-	-	1	-	1	-	-	-
HYDROELECTRIC POWER	1	1	-	-	-	-	1	1	-	-	-	-	-	-	-	1	-	-
WATER ORIENTED OUTDOOR REC.	1	1	1	-	-	1	1	1	1	-	1	1	-	1	1	-	-	1
SPORT FISHING	1	1	1	-	1	-	2	1	2	-	1	-	1	-	-	1	-	-
RECREATIONAL BOATING	1	1	2	-	-	2	-	-	-	-	-	1	-	-	-	-	-	-
COMMERCIAL FISHING	1	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
COMMERCIAL NAVIGATION	1	1	1	1	-	1	1	-	1	-	-	1	-	-	1	-	-	1
RELATED LAND USES & PROBLEMS																		
LAND USE	2	2	-	1	-	3	2	1	1	-	2	2	-	2	-	-	2	-
AGRICULTURAL LAND TREATMENT	1	1	-	-	-	-	-	1	-	-	1	-	-	1	-	-	1	-
CROPLAND DRAINAGE	1	1	-	-	-	-	-	2	1	-	1	1	-	1	2	-	-	-
FOREST LAND TREATMENT	1	1	-	-	1	-	-	1	-	-	1	-	-	1	-	-	1	-
SHORELAND EROSION	1	1	-	-	-	1	-	-	1	-	-	2	-	-	1	-	-	1
STREAMBANK EROSION	-	1	-	-	-	-	-	1	-	-	2	-	-	2	-	-	2	-
FLOOD PLAINS	1	1	-	-	-	-	1	2	1	1	-	-	-	1	-	-	1	-
WILDLIFE MANAGEMENT	1	1	-	1	1	1	1	1	-	-	1	-	-	1	-	-	1	-
AESTHETIC & CULTURAL	1	1	-	1	-	1	1	-	2	1	-	1	-	1	-	-	-	-
OUTDOOR RECREATION	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-

Legend:
3 Severe--Demands immediate attention
2 Moderate--Of major concern; potentially serious
1 Minor--Not considered a serious problem
- Problem is insignificant or not known

13,308,900 acres of commercial forest land. Present income in payrolls of forest-based industries is about \$55 million (estimated 1970), with employment at about 11,000. About 12,500 are employed in mineral production, with value added estimated at more than \$625 million. Almost 70 percent of the nation's production of iron ore comes from the Lake Superior region. About 6,000 people were employed in agriculture, forestry, and fisheries in 1970. The recreational uses and development in the Lake Superior basin are substantial. In 1964, it was estimated that there were 1.4 million visitations to the area, with \$50 million spent by tourists. Detailed data and evaluations on existing economic and demographic conditions may be found in the various functional appendixes for the Great Lakes Basin Framework Study, and particularly in Appendix 19, *Economic and Demographic Studies.* A picture of present natural resource development gives an indication of the needs which have been

TABLE 1–51 (continued) Lake Superior Basin, Resource Problems Matrix

LAKE SUPERIOR BASIN 1.0

East River Basin Group 1.2

Overall	Open Waters	Porcupine Mt. Complex: Urban	Porcupine Mt. Complex: Rural	Porcupine Mt. Complex: Interface	Ontonagon River Basin: Urban	Ontonagon River Basin: Rural	Ontonagon River Basin: Interface	Keewenaw Peninsula Complex: Urban	Keewenaw Peninsula Complex: Rural	Keewenaw Peninsula Complex: Interface	Sturgeon River Basin: Urban	Sturgeon River Basin: Rural	Sturgeon River Basin: Interface	Huron Mountain Complex: Urban	Huron Mountain Complex: Rural	Huron Mountain Complex: Interface	Grand Marais Complex: Urban	Grand Marais Complex: Rural	Grand Marais Complex: Interface	Tahquamenon River Basin: Urban	Tahquamenon River Basin: Rural	Tahquamenon River Basin: Interface	Sault Complex: Urban	Sault Complex: Rural	Sault Complex: Interface
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
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1	-	2	1	-	2	1	-	-	-	-	-	2	-	1	-	-	-	-	-	-	-	-	-	-	-
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1	-	-	-	-	1	-	-	1	1	1	1	1	-	-	1	-	-	-	1	-	-	1	-	-	1
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

met in the past as well as an indication of the direction for future resource development.

6.1.5.1 Water Withdrawals

Because of low population and limited development of industry, agriculture, and electric power, the Lake Superior basin has the lowest total water withdrawal of the five Lake basins. The mining industry uses large quantities of water to process taconite and other iron ores. Pulp and paper mills in this area also use tremendous amounts of water. In 1970 it was estimated that 1,300 million gallons per day were withdrawn from ground water, inland lakes and streams, and Lake Superior for all uses.

Municipal water supplies served 382,900 persons (73 percent of the total population) in 1970 (Table I–52). Most of the larger municipalities are located near Lake Superior. As a consequence, more than half the total water supply comes from the Lake (Table I–53).

Industrial water supplies from private sources come primarily from surface water supplies (Table I–54). The value added by manufacturing was about $382 million in 1970.

Ground water, supplemented by some inland lakes and streams, is the primary source of water

TABLE 1–52 Municipal Water Supply Development, Lake Superior Plan Area (mgd)

		1970 Average Demand			
PSA	State	Domestic and Commercial	Municipally Supplied Industrial	Total	Source Capacity
1.1	Minnesota	18.1	7.6	25.7	49.6
	Wisconsin	5.2	1.2	6.4	24.1
	Michigan	1.0	---	1.0	1.5
1.2	Michigan	13.8	1.5	15.3	23.0
TOTAL	---	38.1	10.3	48.4	98.2

TABLE 1–53 Water Sources for Municipal Water Supplies, Lake Superior Plan Area, 1970 (mgd)

			Water Source		
PSA	State	Source Capacity	Great Lakes	Inland Lakes and Streams	Groundwater
1.1	Minnesota	49.6	38.3	0.2	11.1
	Wisconsin	24.1	5.5	1.2	17.4
	Michigan	1.5	---	0.5	1.0
1.2	Michigan	23.0	13.1	1.6	8.3
TOTAL	---	98.2	56.9	3.5	37.8

supplies for rural domestic, livestock, spray water, and rural nonfarm uses (Table I–55).

Irrigated cropland and golf courses cover about 1,700 and 1,800 acres respectively (Table I–56). Not much demand for crop irrigation has been experienced in this area, but some orchards, potatoes, and vegetables are irrigated. Inland lakes and streams and ground water have been the source of supply.

In 1968, approximately 59,000 acres of land were under active mineral production, with the bulk of land required for mining activity centered around the Mesabi Iron Range in Minnesota and the iron ore ranges in Marquette County, Michigan. Water was used in the production of iron ore, sand and gravel, copper, and crushed limestone (Table I–57). Lake Superior furnished the major portion of the water withdrawals, with the largest quantity being diverted for the Silver Bay taconite plant (Table I–58).

As of December 31, 1970, electric power generation facilities of 10 megawatts or more within the Lake Superior basin consisted of eleven thermal plants and three hydroelectric plants. All fourteen installed power plants and two more scheduled plants are privately or municipally owned, varying in type and capacity. The basin's electrical power development is shown in Table I–59.

With a total installed capacity of about 790 megawatts, net power generation from the basin exceeded 3.9 billion kilowatt hours of electricity in 1970. All condenser cooling systems operating in 1970 were of the flow-through type.

TABLE 1–54 Industrial Water Supply Development, Lake Superior Plan Area, 1970 (mgd)

			Self-Supplied	
PSA	State	Gross Water Requirements[1]	Withdrawals	Consumptive Use
1.1	Minnesota	153	68	5
	Wisconsin	95	26	2
	Michigan	---	---	--
1.2	Michigan	104	32	4
TOTAL		352	126	11

[1]Partially supplied by recirculation.

6.1.5.2 Nonwithdrawal Water Uses

In terms of requirements for treatment of wastewater discharges, there were about 44.6 mgd of municipal effluents and about 55.2 mgd of industrial effluents in the basin in 1970. The Lake Superior basin falls under the jurisdiction of the Federal-State conference on Lake Superior. Major pollution problems are traceable to effluents from mining and forest products industries, and to the lack of tertiary or, in some cases, secondary treatment by both public and private wastewater disposal systems. Because of the variance in treatment (or no

TABLE 1-55 Rural Water Supply, Lake Superior Plan Area, 1970 (mgd)

PSA	State	Developed Source Capacity	Consumptive Use
1.1	Minnesota	5.2	1.5
	Wisconsin	2.3	0.6
1.2	Michigan	5.0	1.2
TOTAL		12.5	3.3

TABLE 1-56 Irrigation Water Supply, Lake Superior Plan Area, (base year) estimated

	Agriculture			Golf Courses		
		Withdrawal (mgd)			Withdrawal (mgd)	
PSA	Acres	100-Day Season	Annual	Acres	100-Day Season	Annual
1.1	---	---	---	1,650	6.1	1.7
1.2	1,733	2.6	0.7	150	0.7	0.2
TOTAL	1,733	2.6	0.7	1,800	6.8	1.9

TABLE 1-57 Minerals Water Supply, Lake Superior Plan Area, 1968, estimated (mgd)

		New Water Intake		
PSA	Total Water Requirements[1]	Seasonal	Annual Average	Consumptive Use[2]
1.1	871	--	542	42
1.2	67	34	30	12
TOTAL	938	--	572	54

[1]New water intake plus recirculated (seasonal)

[2]Annual average

TABLE 1-58 Source of New Water Used by Mineral Industries, Lake Superior Plan Area, 1968, estimated (mgd)

New Intake	May-October	Average for 365 Days
Streams	5.4	5.4
Lake Superior	534.3	530.0
Other Lakes	26.7	26.7
Ground Water	1.0	1.0
Mines	9.1	9.1
TOTAL	576.5	572.2

treatment) for point sources of wastewater such as industry or municipal outfalls, and complexities associated with nonpoint sources such as agricultural or mining areas, an accurate summary of the status of wastewater treatment cannot be made. Table I-60 indicates the 1970 level of municipal and industrial wastewater discharges.

The single largest United States source of industrial effluent comes from Reserve Mining Company taconite plant at Silver Bay, Minnesota, which for several years has discharged approximately 67,000 long tons of taconite tailings into Lake Superior daily. As a result of a suit filed by the Department of Justice in behalf of EPA and joined by several States, the discharge into the lake is to be stopped and onland disposal instituted.

The many opportunities for sport fishing in the area are dominated by coldwater species. Fishing access, a continuing sea lamprey problem in Lake Superior, low productivity and poor wintering habitat of some inland waters, and depletion of some species are problems. Current fishery programs involve proper protection and improvement of natural resources, direct manipulation of fish populations, maintenance plantings, and continuing control of the sea lamprey. Table 1-61 illustrates the situation as of about 1970.

Recreational boating is somewhat limited by a short season and a deficiency of sheltered areas on Lake Superior for smaller craft. However, because of abundance of water acreage and high quality boating, demands are steadily increasing, largely through use by nonresidents (Table 1-62). Increased sport fishing as a result of introduction of coho salmon is increasing the demand for harbor facilities.

Commercial fishing activities are carried on to a limited extent in open Lake Superior waters. Both Wisconsin and Michigan restricted commercial fishing to limited entry as of 1970. During the period 1965-1969, the average annual value of six commercially important species was about $983,000 and average annual catch about 7,343,000 pounds.

In 1970, approximately 105 million tons of commerce moved through the locks on St. Marys River, which connects Lake Superior to Lake Huron. The

TABLE 1-59 Electric Power Development, Lake Superior Plan Area

	Type and Capacity (MW)				
PSA	Hydro-electric	Internal Combustion	Fossil Steam	Total	Steam-Electric Water Withdrawal (mgd)
1.1	88	15	389	492	311.9
1.2	42	40	215	297	203.8
TOTAL	130	55	604	789	515.7

TABLE 1-60 Municipal and Industrial Wastewater Flows, Lake Superior Plan Area, 1970

PSA	State	mgd Municipal	Industrial
1.1	Minnesota	23.5	31.5
	Wisconsin	9.2	--
1.2	Michigan	12.0	23.7
TOTAL	---	44.7	55.2

commercial navigation season is considered to average 240 days. Ten commercial harbors are located on Lake Superior, and major commodities moved are iron ore, coal, and grain.

6.1.5.3 Related Land Uses and Problems

In 1970, the agricultural land that needed treatment amounted to 472,900 acres consisting of cropland, pasture, and other land (Table 1-63). Approximately 314,700 acres, about 45 percent of all cropland, is now receiving adequate land conservation treatment and management. Drainage limitations also exist in the Lake Superior Plan Area as shown in Table 1-64.

Land treatment and management for the 14,254,500 acres of forest land, 21 percent of which is in national forest ownership, is provided through programs by the U.S. Forest Service under the national forest system and Federal-State Cooperative Forestry; by State and county agencies; by private owners and industry; and by the soil and water conservation districts. Current forest land treatment and management programs have contributed to the adequate treatment and acceptable management levels of 7,784,000 acres of national, State, county and private forest land in the region, or 54 percent of the total forest land.

Some shore erosion protection measures have been provided by the Corps of Engineers under its beach erosion control authority, but mostly private shore property and commercial interests have constructed seawalls, riprapping, and cribbing on scattered reaches of the shoreline. The use and ownership of Lake Superior shoreland and that of the St. Marys River are shown in Table 1-40. Table 1-65 indicates status of the Lake Superior shoreline as of 1970.

Streambank erosion is severe in some of the tributaries to Lake Superior. Besides being detrimental to water quality, erosion hastens the loss of existing land and agricultural and urban improvements (Table 1-66). Property owners desiring to install streambank erosion control measures may

TABLE 1-61 Sport Fishery Uses, Lake Superior Plan Area, 1970

PSA	State	Ponded Waters (acres)	Fishing Licenses Resident	Non-Resident	Angler Days
1.1	Minnesota	562,526	94,163	38,851	3,107,000
	Wisconsin	69,696	17,189	16,275	1,284,000
1.2	Michigan	145,535	34,007	19,053	2,701,000
TOTAL	---	777,757	145,359	74,179	7,092,000

TABLE 1-62 Recreational Boating Development, Lake Superior Plan Area, 1969

PSA	State	Lake Superior Harbors[1]	Access Sites[2]	Total No. of Boats	Total Boat Days in Use
1.1	Minnesota	7	130	34,000	1,759,000[3]
	Wisconsin	7	276	33,400	
1.2	Michigan	23	26	20,600	512,000
TOTAL	----	37	432	88,000	2,271,000

[1]Duluth-Superior counted only in Minnesota

[2]May include both inland lakes and streams

[3]Total for PSA 1.1

be furnished with technical assistance by the U.S. Forest Service, Soil Conservation Service, and Corps of Engineers.

There are only two major existing structural flood control projects: one on Ball Park Creek at Bayfield, Wisconsin, constructed by the Corps of Engineers, and another on Mission Creek at Fond du Lac, constructed by the State of Minnesota. There are numerous channel improvements, including floodwalls, channel straightening, and related flood control measures, which have been constructed by local governments and private interests. Flooding caused nearly a million dollars in damages in 1970 (Table 1–67).

TABLE 1–63 Agricultural Land Treatment Needs, Lake Superior Plan Area, 1970 (thousands of acres)

PSA	Cropland	Pasture Land	Other Land	Total
1.1	187.9	75.9	53.8	317.6
1.2	100.3	49.7	5.3	155.3
TOTAL	288.2	125.6	59.1	472.9

TABLE 1–64 Drainage Limitations in the Lake Superior Plan Area (thousands of acres)

PSA	Total Land Area	Agricultural Land	Drainage Problems Severe	Drainage Problems Some
1.1	9,473.5	530	37	39
1.2	6,441.8	326	55	15
TOTAL	15,915.3	859	92	54

Over 97 percent of the 15.9 million acres in the Lake Superior basin is classified as wildlife habitat. More than 94 percent of this total, or approximately 14.3 million acres, is forested. Ninety-three percent of the habitat shown in Table 1–68 is considered huntable.

The area of the land resource base, made up of the farmland and forest land, and reported in Table 1–17, is based on 1966–1967 measurements and estimates. Habitat is based on 1960 information and estimates. In some instances changes in land use result in habitat being recorded as greater than the corresponding land base in the planning subarea or State.

Figure 1–22 reflects the present availability and use of waterfowl habitat. Over 61,000 acres of shoal areas exist with one-half of this total important as nesting, resting, and feeding areas.

Much of the existing habitat is of generally low quality. This is reflected by the basin's wildlife species, which are generally lower in density and more specialized than those found elsewhere in the Great Lakes Basin.

In an inventory of outstanding, unusual, and significant aesthetic and cultural values in the Lake Superior basin, more than 500 items in 26 categories were identified. Environmental systems of the Lake Superior basin in most critical need of planning attention are identified in Appendix 22, *Aesthetic and Cultural Resources*. They include shore zones, buffer zones, and linkage corridors.

The United States portion of the Lake Superior basin is the least urbanized of the five Great Lakes basins. For this reason, its resources have been

TABLE 1–65 Lake Superior Shoreline Conditions, 1970 (miles)

PSA	State	Total Shoreline	Subject to Erosion: Critical	Subject to Erosion: Noncritical	Subject to Erosion: Protected	Subject to Flooding	No Problem
1.1	Minnesota	174.9	0.5	10.9	0	0	163.5
	Wisconsin	156.3	13.0	93.8	0.5	11.8	37.2
	Michigan	5.0	0	0	0	0	5.0
	Total	336.2	13.5	104.7	0.5	11.8	205.7
1.2	Michigan	575.8	15.2	23.2	4.9	0	532.5
	Total	575.8	15.2	23.2	4.9	0	532.5
TOTAL	---	912.0	28.7	127.9	5.4	11.8	738.2

TABLE 1–66 Streambank Erosion in the Lake Superior Basin, 1970

PSA	State	Bank Miles of Damage: Severe	Bank Miles of Damage: Moderate	Annual Damages ($): Land Loss	Sedimentation	Other	Total
1.1	Michigan	33	131	13,300	3,500	15,900	32,700
	Wisconsin	121	197				
1.2	Michigan	317	631	112,300	95,200	12,400	219,900
TOTAL	---	471	959	125,600	98,700	28,300	252,600

TABLE 1–67 Estimated Flood Damages, Lake Superior Basin, 1970

		Annual Damages ($)		Estimated Acres in Flood Plain	
RBG	State	Urban	Rural	Urban	Rural
1.1	Minnesota	79,000	49,400	120	112,322
	Wisconsin	241,800	5,000	938	19,547
1.2	Michigan	385,000	217,600	4,721	55,160
TOTAL	---	705,800	272,000	5,779	187,029

TABLE 1–68 Wildlife Habitat in the Lake Superior Plan Area, 1960

			Farm Habitat		Forest Habitat		
PSA	State	Total Land Area (acres)	Acres	% of Total Land	Acres	% of Total Land	Total Habitat (acres)
1.1	Minn. & Wisc.	9,473,500	816,500	8	8,511,300	90	9,327,800
1.2	Michigan	6,441,800	346,200	5	5,831,800	91	6,178,000
TOTAL	---	15,915,300	1,162,700	7	14,343,100	90	15,505,800

NOTE: The area of the land resource base, made up of the farmland and forest land, and reported elsewhere, is based on 1966-1967 measurements and estimates. Habitat is based on 1960 information and estimates. In some instances changes in land use result in habitat being recorded as greater than the corresponding land base in the PSA or State.

relatively little affected by urbanization. This basin is rich in clusters of resources features that have helped to make it a prime attraction to recreationists and casual visitors.

The outdoor recreation resources in this area are exceptional. Outstanding recreational features include Isle Royale National Park, portions of the Boundary Waters Canoe Area, the 219,000-acre Voyageurs National Park, the beaches of Whitefish Bay, dunes and cliffs of the Pictured Rocks National Lakeshore, the 56,000-acre Apostle Islands National Lakeshore area, Tahquamenon Falls, the Big-Sea-Water Recreation Area, the Huron and Porcupine Mountains, and a segment of the North Country Trail. The proposed Grand Portage National Monument comprising 12,644 acres, extending along 28.7 miles of Lake Superior shoreline, and encompassing fourteen offshore islands, will be an additional attraction. Extensive forests, abundant inland lakes and streams, and over 900 miles of Lake Superior shoreline provide a quality resource base for outdoor recreation.

Much of the area's terrain and the long winter, provides an excellent setting for the winter sports enthusiast. More than 1,000 acres have been developed for skiing and sledding activities, and there are over 250 miles of snowmobile trails in the Michigan portion of the basin.

Table 1–69 shows land and water surface available for recreation. The total land area in the basin designated in 1970 for recreation, 7.4 million acres, is nearly half the total land area of the basin and constitutes more than half the total designated recreation land in the Great Lakes Basin. Approximately 6 million acres are national, State, and county forests.

Portions of more than 6.4 million additional acres of public forest land in the basin have a potential for new recreational development. Of this total, about 2.8 million acres are in national forest, about 1.7 million acres are State forest, and about 1.9 million acres are owned by county and local governments. Also available for hunting, fishing, and other general recreational activities are thousands of acres of lands owned by paper, mining, and power companies.

Hundreds of inland lakes containing some of the highest-quality waters east of the Mississippi are scattered throughout the area. The inland surface waters available for recreation far surpass those

TABLE 1–69 Land and Water Surface Usable for Recreation in the Lake Superior Plan Area, 1970 (thousands of acres)

PSA	Land	Lake Superior	Inland Lakes	Total
1.1	5,300	325	506	6,131
1.2	2,100	481	116	2,697
TOTAL	7,400	806	622	8,828

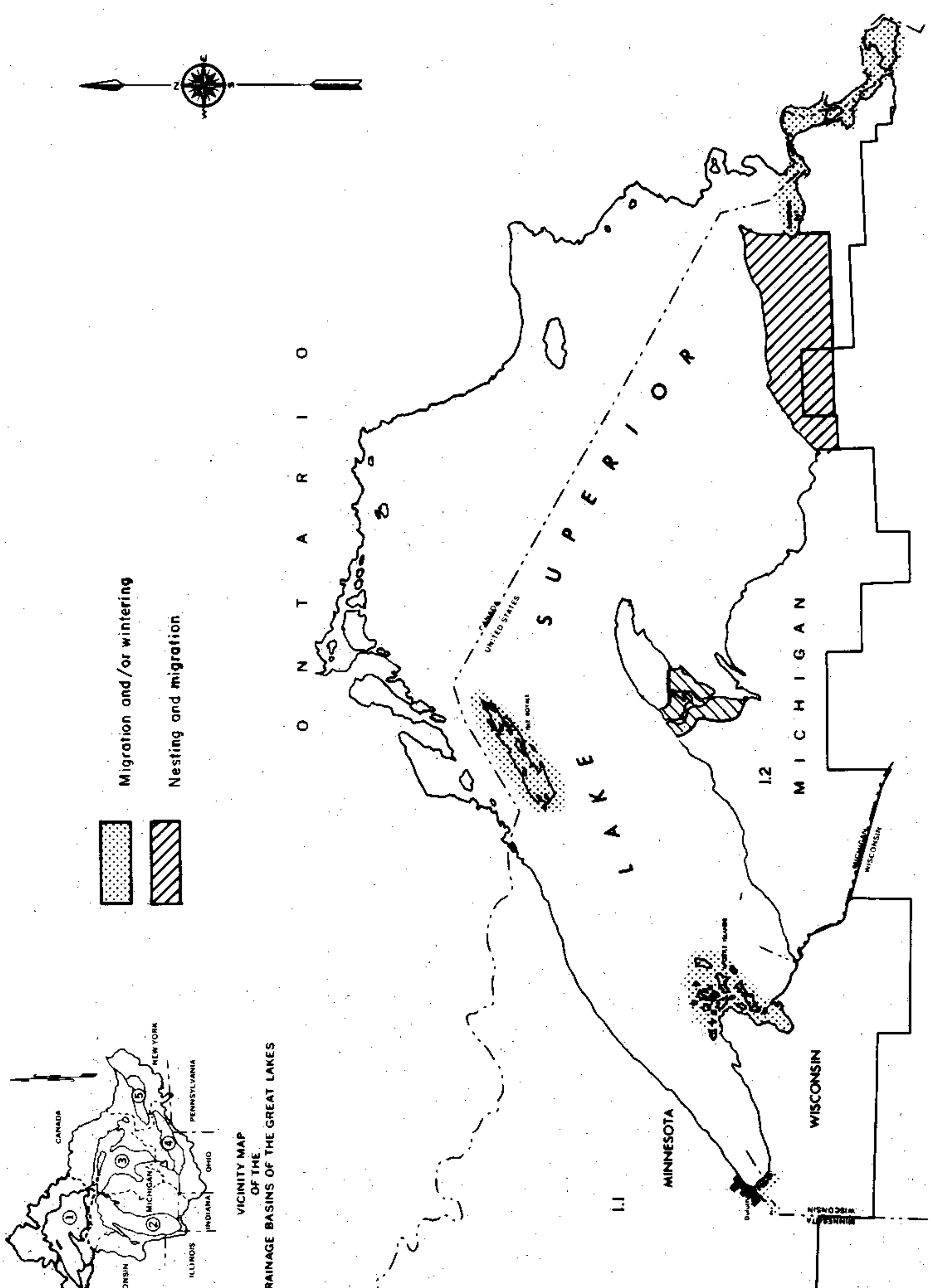

FIGURE 1-22 Primary Waterfowl Use Area, Plan Area 1

found in any other Lake basin, and constitute fully 30 percent of all such waters in the Great Lakes Basin.

Principal rivers of the area include the Black, Ontonagon, Presque Isle, Tahquamenon, Two Hearted, Dead, Sturgeon, Montreal, and St. Louis. The first five have been identified for possible inclusion in a State scenic or natural rivers system. Over 500 miles of canoe trails have been developed in the Minnesota and Wisconsin portions of the basin. Many of the lakes also provide excellent opportunities for canoeing in wilderness settings.

The 912-mile Lake Superior shoreline is probably the basin's finest recreational asset. It is unquestionably one of the most picturesque of any in the Great Lakes Basin. Along its length can be found 170 miles of public beaches (Table 1–70). Many of the area's outstanding features can be found along this shoreline.

The existing developed supply of total recreational facilities is shown in Section 12 in Table 1–198. This table also shows projected needs and outputs from the Proposed Framework for the Lake Superior basin developed from the frameworks for RBG 1.1 and RBG 1.2.

6.2 Frameworks for River Basin Group 1.1

6.2.1 Summary

Under a normal growth condition, the 1970 population of 345,155 in PSA 1.1 would increase to about 475,000 at year 2020. Total employment is estimated to increase to 177,300 in 2020 as compared to 117,956 at the 1970 level. An approximate 50 percent decrease by 2020 of employment in agriculture, forestry, and fisheries is projected, with mining expected to recover to about the 1960 level (20 percent above 1970) and manufacturing and other employment to increase 50 percent.

The western Lake Superior basin will experience continued recreational development (national parks, recreation and wilderness areas, and trails; and State parks and recreation areas) because of the availability of resources.

Tables 1–238, 1–239, and 1–240 in Section 12 summarize the Normal Framework and costs.

6.2.2 The Area

The study area, located in the northwest portion of the Great Lakes Basin, drains more than 9,200 square miles of Minnesota, Wisconsin, and Michigan land bordering the northwestern shore of Lake Superior (Figure 1–23). Statistics are included in tables in Section 1.

6.2.3 Projected Resource Needs and Problems

The projected needs for resources by time level are shown on Table 1–238 in Section 12.

6.2.3.1 Water Withdrawals

The total water withdrawal needs to 2020 are estimated at an additional 2190 mgd. The base year water withdrawals were about 995 mgd. About 93 percent of the additional water withdrawal need is for thermal power cooling and 5 percent is for rural domestic and livestock, irrigation, and mining. Municipal water supply and self-supplied industrial withdrawals each account for about 1 percent of the additional water to be withdrawn.

6.2.3.2 Nonwithdrawal Water Uses

There are many problems within the river basin group that cause degradation and restriction of uses. These will continue to have deleterious effects in the future. They include adequacy and operation characteristics of municipal waste treatment plants; collecting and intercepting sewers; industrial outfalls; combined sewers; steam power

TABLE 1–70 Amount, Ownership, and Recreational Potential of Great Lakes Beaches, Lake Superior Plan Area (in acres)

	Publicly Owned Beaches			Privately Owned Beaches				
	Usable			Open to Public		Not Open To Public		
PSA	Open to Public	Restricted	Not Usable	With Charge	Without Charge	Potential for Development	Little/No Potential	Total
1.1	34.7	0	0.1	7.3	0	0	8.5	50.6
1.2	127.3	0.5	0	0	9.6	0	23.1	160.5
TOTAL	162.0	0.5	0.1	7.3	9.6	0	31.6	211.1
%	76.7	<1	<1	3.5	4.5	0	15.0	

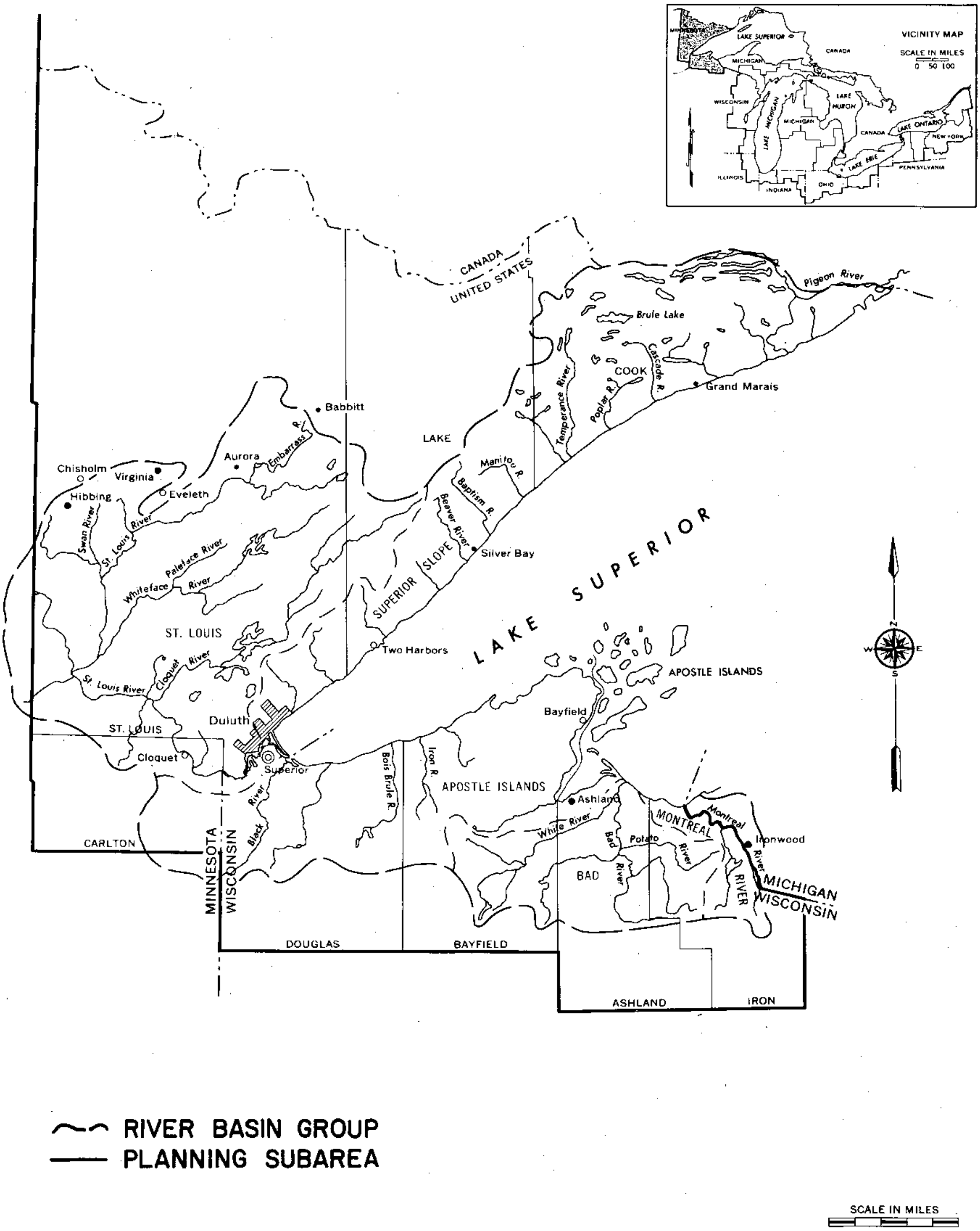

FIGURE 1–23 Lake Superior West, Planning Subarea 1.1

plants; fertilizers and pesticides from agriculture and land runoff; dredging and redeposition of bottom sediments in open water; and phosphorus and nitrogen inputs into the streams.

Corrective programs have been initiated to upgrade water quality throughout the river basin group. Municipal programs to meet water quality standards have been hampered by failure of the Federal government to meet its commitment to share in the cost of the construction of the plants. There is a need to implement programs for the reduction of agricultural wastes, nutrients, sediments, insecticides, and herbicides.

Problems related to fish habitat and fishing in this area are lack of fishing access, presence of the sea lamprey in Lake Superior, low productivity, low quality of wintering habitat in some inland waters, and depletion of some species.

One of the main problems in this area is that some of the existing inland waters are overused at the present time for recreational boating. The lack of stream improvement, lack of maintenance, and periodic low flows limit small boat opportunities and the amount of canoeing on some inland waters. The influx of nonresident boats into the area is extremely high each season and is steadily increasing. Table 1–71 shows recreational boating use in PSA 1.1 in 1970 and projects future needs.

In addition to making water surfaces available to boaters, it is necessary to provide berthing facilities, launching sites, access, and navigational aids.

The volume of waterborne commerce handled at ports in River Basin Group 1.1 is among the largest in the Great Lakes. This topic is discussed in Section 5 in relation to the Great Lakes Basin and in Subsection 6.4, Lake Superior Intrarelationships.

6.2.3.3 Related Land Uses and Problems

There are an estimated 834,100 acres of agricultural land, consisting of cropland, pasture, and other land, in this planning subarea. Approximately 40 percent of the cropland is presently idle, and this is projected to increase to 65 percent by 2020. Nearly 50 percent of the cropland is now being used for forage production, and this is projected to decrease to less than 30 percent in 2020. Agriculture is marginal at present and is projected to decline further in the future.

TABLE 1–71 Use and Projected Needs for Recreational Boating, PSA 1.1

	1000 Boating Days	
Category	Great Lakes Waters	Inland Waters
1970 Use	40	1,719
1980 Needs	103	147
2000 Needs	124	273
2020 Needs	151	399

The following are some of the problems associated with agriculture and forestry:

(1) low productivity resulting from a combination of relatively poor soils and a short growing season

(2) lack of adequate markets

(3) poor accessibility

(4) improper management and use of agricultural and forest lands. This is detrimental to economic growth and environmental enhancement.

(5) a lack of conservation treatment practices on agricultural and forest lands resulting in increased runoff and some erosion and sedimentation.

Forest land is predicted to decrease due to highway, power line, reservoir, urban, recreational, and industrial developments. Unless strong action is undertaken to halt the accelerating deterioration of natural environment, rehabilitation of the forested land will be very costly, if not impossible. Some other major problems in this area are how to secure good management for private forest lands and how to protect and establish trees and shrubs in areas surrounding urban and built-up areas.

There are 118.2 miles of Lake Superior shoreline with erosion problems in this river basin group, with 13.5 miles subject to critical erosion and 104.7 miles subject to noncritical erosion. The total shoreline in this area is 336.2 miles, of which 0.5 miles are protected.

Along streams which drain areas of less than 400 square miles, there are 313 bank-miles subject to moderate streambank erosion damage, and 154 miles subject to severe damage. The annual damage is estimated at $32,700 per year, principally due to land losses. For streams draining more than 400 square miles, there is an annual estimate of 15 bank miles of moderate streambank erosion with negligible damage. Most of this damage is from sedimentation. See also Table 1–66. The greatest streambank erosion problem in this area is the high erosion in northwestern Wisconsin that mostly occurs on private land. It is difficult both from a financial and a persuasive point of view to implement streambank erosion programs. To reduce erosion and sedimentation, more regulation is needed in highway, urban, and suburban construction programs and in logging.

The land in the southeast part of the river basin group, from Duluth to the northern part of Ashland County, Wisconsin, has high erosion and sedimentation rates, and local damage to cropland and land in other uses is common. Sedimentation from the entire area is estimated at 102,000 tons per year.

The greatest flood damages in this river basin group occur in the urban area, although the agricultural lands are also subject to considerable damage. The major problems are encroachment on the natural flood plain areas, the lack of local flood plain zoning and regulation, constricted river reaches, inadequate channel capacity, or a combination of these causes. About one-third of the average annual urban damages occur in the Bad River drainage area, and three-fourths of the average annual rural damages occur in the St. Louis River basin.

There appears to be an adequate supply of land and wildlife habitat to satisfy normal needs. There is a shrinking resource base. Wildlife habitat land is being allocated to other uses, and in some cases land is not managed as well as it could be for multiple uses including wildlife conservation. An additional acute problem, particularly in the St. Louis River basin, is the need for preservation or protection of the remaining wetlands in the area. A large portion of the inland wetland area still remaining in the Great Lakes Basin is found in this river basin group.

Existing aesthetic and cultural values have been summarized previously in Subsection 6.1. The major problem is the need to preserve outstanding values. In Planning Subarea 1.1 such cities as Duluth, Hibbing, and Virginia, Minnesota, and Superior and Ashland, Wisconsin, face some urban expansion. By the year 2020 it is estimated that 307,900 acres will be devoted to urban use, an increase of 23,400 acres over the 1966–67 figures. Environmental buffer zones immediately adjacent to the edge of the expanding urban centers are in need of study and planning attention to insure proper use of their inherent significant resources. Environmental corridors merit consideration in this area. At the present time, institutional arrangements and funding are not available to meet these objectives. The Lake Superior shore is important enough to warrant immediate steps for preservation.

The land acreage available for recreation in this planning subarea is about 5.3 million acres. Of this total, more than 4.1 million acres are in national, State or county forests. There are nearly 127,000 acres of Indian lands. State and local parks contain more than 40,000 acres. The total acreage of the Great Lakes and inland waters amounts to more than 690,000 acres.

An analysis of the recreational demand and supply for each of the target years indicates that no need exists for additional acreage through year 2020 for several activities, and only moderate needs for the remaining activities. However, this is a somewhat distorted conclusion because it was not possible to quantify the directional patterns of travel in the methodology used for estimating requirements. The actual situation, as indicated by studies made by the States of Wisconsin and Minnesota, is that there is very heavy travel north from the urbanized area around Chicago and Milwaukee, as well as from outside the Basin, to make use of the extremely desirable recreation areas in the Lake Superior basin. Not only does the direction of travel influence the requirements in this area, but the quality of the recreation experience has led people to drive farther than they normally would, and farther than was considered in the methodology.

Thus, the needs for the target years for almost all forms of recreation are believed to be understated. In considering the entire Great Lakes Basin, the process of framework formulation takes into account transfer of needs from one area to another. This is not normally done in considering a single river basin group. However, because of the availability of the State studies, the frameworks developed for River Basin Group 1.1 have been expanded beyond those required to meet the needs determined in the Outdoor Recreation Work Group methodology. These frameworks have endeavored to meet the needs as they are conceived after consideration of all the information available but without formally transferring the needs. Table 1-238 in Section 12, shows a summary of the extensive and intensive land needs and program outputs.

A significant part of the need is to serve urban residents, and presently undeveloped portions of existing recreation areas in or near urban centers could be developed to meet this need in part.

In addition to the general problems of meeting recreation needs, particularly where large numbers of persons come from outside the area, there are some specific problems related to unique high-quality recreational opportunities. The principal one is in the Boundary Waters Canoe Area. Most of the visitors to this area enter at only six of the 78 access points. The result is that the wilderness areas near these six access points receive excessively heavy use, and the beauty of the wilderness in the vicinity is being threatened with severe degradation. On the other hand, many other areas receive little or no use. No immediate solution is apparent, but solutions are being sought.

Large areas of potentially desirable recreational land have been disturbed in connection with the extensive mining of iron ore in the Minnesota portion of the area. The large open-pit excavations and huge piles of spoil detract from the aesthetic qualities of the area.

6.2.4 Alternative Frameworks

Two alternative frameworks are presented for this river basin group. The Normal Framework does not reflect coordination for the Lake basin or the Great Lakes Basin.

The Proposed Framework contains the recommendations of the Commission in an effort to reflect the views of the people of the basin and the policies and programs of the States. To some extent, the Proposed Framework reflects coordination in its formulation among a number of river basin groups, both in the Lake basin and in the Great Lakes Basin as a whole.

6.2.4.1 Normal Framework (NOR)

The Normal Framework is based on meeting quantified needs and solving identified problems to the maximum practicable extent consistent with subobjectives and criteria discussed in Section 2 of the appendix. The program outputs and costs are summarized in Tables 1–238, 1–239, and 1–240, which are in Section 12.

(1) Water Withdrawals

Generally, the water withdrawal problems are not serious, and all quantified needs are met. Large quantities of water for thermal power cooling and self-supplied industrial uses, including mineral processing, will probably come from Lake Superior. Municipal and industrial supplies will be provided by expanding ground-water sources, but after the year 2000 these systems will place increased reliance on inland lakes and streams. A large regional water supply system for the Duluth area, and a similar system for Marquette, Michigan, will take water from Lake Superior. As an alternative, reservoir storage should be considered in Marquette County, Michigan, to meet needs after the year 2000. Rural domestic and livestock requirements are met from ground-water sources, while irrigation needs are met from either ground-water sources or inland lakes and streams, depending on the particular location and the availability and cost factors.

(2) Nonwithdrawal Water Uses

All waste treatment needs are met by municipal or self-supplied industrial facilities, using conventional methods. Between 1970 and 1980, several locations in the Minnesota portion of the river basin group are expected to add tertiary treatment facilities to comply with water quality standards, and additional locations will require this between 1980 and 2020. There are relatively small quantities of waste which may need advanced treatment in the Wisconsin area, and these have not been evaluated, but there should be no problem with meeting the standards. Litigation to halt discharge of taconite waste into Lake Superior is nearing a conclusion, and this matter is not included in the NOR Framework program.

Water-oriented outdoor recreation is discussed under related land uses and problems.

All sport fishery needs are met by programs which include intensive management of reclaimed trout lakes; management of other lakes for other species; introduction of salmon and steelhead into Lake Superior; spawning run development; management and stocking of the stream fishery waters; and continued vigilance against the sea lamprey.

Recreational boating needs are met on both Lake Superior waters and inland waters. During the first ten years the needs are greater on Lake Superior, but by 2020 the needs on inland waters will have increased beyond those on the Lake Superior waters. Programs for Lake Superior include berthing facilities, launching sites, navigational aids, and habors of refuge. On inland waters the programs primarily provide launching sites, access, and some berthing facilities, in addition to making increasing amounts of water available to the public for boating. Because it is probable that boaters will come into the area in numbers above those indicated by the needs, the programs go further than simply meeting the needs and provide facilities for a surplus of boating days over the period.

Commercial navigation programs include essentially a continuation of present practices, namely, the maintenance of the existing systems of harbors and channels, including the containment of all polluted dredge spoil. Expansion of the total system to include a longer navigation season or provision for larger ships is discussed in Section 5 and Subsection 6.4. In RBG 1.1 Silver Bay, Duluth-Superior and Taconite Harbors will be improved.

(3) Related Land Uses and Problems

For the treatment of agricultural land and forest land, the programs consist of a continuation of present practices of conservation, drainage of the agricultural land, and land treatment on the forested land. Not all the opportunities for enhancement of these lands have been accepted.

The 13.5-mile section of Lake Superior shore which is subject to critical erosion will be treated during the projection period using conventional methods of structural protection. The 104.7-mile section of the shore subject to noncritical erosion is not treated under the programs.

Streambank erosion is severe on about one-third of the total bank-mileage subject to erosion, and this severe portion is treated under the programs by conventional structural methods.

Flood damages in urban areas are eliminated on about half the area before 1980 by structural programs. Programs in later years also involve structural measures but rely also on land use changes, treatment, and institutional changes. About 80 percent of the total urban land affected is protected in the total time period. Rural treatment is almost entirely by structural methods, and eliminates flood damage on about 40 percent of the land affected.

Wildlife management opportunities in the river basin group are such that the quantified needs for habitat can be more than met by treatment of land to improve its habitat capabilities and by some public acquisition. User-day needs for both hunters and nonconsumptive users are not met.

Aesthetic and cultural needs were not quantified, and no specific programs adopted.

Outdoor recreation needs for the total period are more than met by existing facilities, but as pointed out in the discussion in Subsection 6.2.3.3, there are believed to be markedly greater needs than projected. In addition, because of the opportunities for development, programs have been adopted to provide facilities which would permit meeting needs transferred from other river basin groups and other Lake basins. The principal means by which this is accomplished is by changes in land use: lands particularly adapted to recreation are utilized for this rather than for other purposes. Multiple use is also a possibility in some cases. For the intensively developed land, public acquisition of the major portion of the land will be required with some use changes on land already devoted to public use.

(4) Framework Outputs and Costs

Tables 1–238, 1–239, and 1–240 in Section 12, provide information on needs, outputs, percent of needs met, and capital and OM&R costs for the NOR Framework.

6.2.4.2 Proposed Framework (PRO)

A specific objective of the Proposed Framework for River Basin Group 1.1 is to maintain and preserve a high-quality environment while enhancing employment opportunities. The PRO Framework recognizes population growth somewhat lower than that of the NOR Framework. A lower projection is consistent with the recently observed downward trend in the fertility rate.

The PRO Framework provides for improvement in the regional economy by expansion of the recreational industry, expansion of the extractive minerals industry, and commercial harbor development. It does not include dependence on the expansion of the power industry as a basis for economic development (particularly if the power is to be exported to other areas). It is important to increase employment possibilities within RBG 1.1 so that outmigration of the population can be reduced or eliminated.

(1) Water Withdrawals

Differences with respect to water withdrawals in the PRO Framework as compared to the NOR have not been evaluated, but they are considered minor for a framework analysis. It should be noted that the NOR assessment of water withdrawals for the Minnesota portion of RGB 1.1 is in substantial agreement with the findings of the first assessment done by the State of Minnesota on water and related land resources.

(2) Nonwithdrawal Water Uses

In addition to the NOR recommendations for the treatment of municipal and industrial wastewater, the PRO Framework includes meeting the Federal Water Pollution Control Act Amendments of 1972 and a specific recommendation that alternative means be found of disposing mining and ore processing tailings. This is being handled by litigation.

With regard to fishing opportunities, the PRO Framework emphasizes the expansion of commercial fishing opportunity as a basis for improved employment. Such a recommendation may well conflict with existing State policies, which generally seek to expand sport fishing opportunity as a basis for growth of the recreation and tourist sectors of the economy. In any event, the PRO Framework recommends acceleration of fish management programs and a resolution of any conflict between sport and commercial emphasis in such management efforts.

The PRO Framework includes an endorsement of the expansion of the port facilities at Duluth and Superior as set forth by the Seaway Port Authority of Duluth. Attention should also be given to the expanded development of related land transit systems (highways and rail) to enhance the effectiveness of the Duluth port facilities. In order to maintain environmental quality while these expansions are undertaken, the PRO Framework includes a provision to require treatment of all shipping wastes. This would necessitate adequate port facilities for such treatment and uniform regulations throughout the Great Lakes. The Framework also advocates a 31-foot depth navigation system and extension of the navigation season. Silver Bay, Duluth-Superior and Taconite Harbors are mentioned in connection with this. There is more complete discussion in Subsection 5.5.2.7 and Subsection 6.4.

(3) Related Land Uses

The PRO Framework recommends the development of comprehensive land use plans for the entire RBG 1.1 area. Particular attention should be given to the establishment of criteria for the development of natural resources (specifically dealing with mining and lumbering practices) and for the use of shoreland areas. In related land transit systems, attention should be given to the air pollution problems of taconite dust from open railroad cars.

The PRO Framework includes specific recommendations on agricultural and forest land treatment programs. The difference between the NOR Framework and the PRO Framework programs is shown in Table 1–328 of Section 12. The PRO Framework provides an accelerated program for all agricultural and forest land treatment needs to be met by the year 2020. The accelerated agricultural land treatment programs include only conservation practices. PRO includes no cropland drainage programs.

Shoreland erosion was viewed by many as being a considerably more serious problem than is suggested in the NOR Framework. The higher lake levels of 1973, even though slight for Lake Superior, did increase the damage, but the difference has not been determined for this area. The PRO Framework recommends that the schedule for controlling shore erosion be accelerated so that such erosion is controlled by the year 1990. Furthermore, a re-evaluation of shore erosion problems should be made so that several areas (particularly those with red clay problems) could be reclassified in order to receive adequate protection. Shoreland management plans are recommended for all Great Lakes shores by 1980 for protection and preservation of shoreland integrity and uniqueness.

The PRO Framework places greater emphasis on flood plain zoning and regulation than on structural measures as a means of reducing flood damages. The impact of flooding damages is reduced by flood insurance.

In the PRO Framework wildlife habitat, particularly wetlands, should be protected from drainage.

The PRO Framework contains several recommendations relative to outdoor recreation. Outdoor recreation should be broadly based in River Basin Group 1.1 in order to be attractive to a variety of out-of-basin recreationists. While some wilderness recreational opportunity should be preserved, major emphasis should be much broader so that recreation may provide substantial enhancement of the regional economy. The PRO Framework also provides for the expansion and improvement of the highway transportation network. This is essential for easy movement and improved access for recreationists. Since Lake Superior is one of the region's greatest recreational assets, the PRO Framework provides for improved public access to shore areas. While much of the outdoor recreation opportunity will be provided for through government expenditures, private developments will also be important to the growth of the recreational sector of the economy. The PRO Framework emphasizes the need for specific criteria to insure that such developments do not endanger the high-quality natural environment which is one of the greatest assets of RBG 1.1.

(4) Framework Outputs and Costs

Tables 1–241, 1–242, and 1–243 in Section 12 provide information on needs, outputs, percent of needs met, and capital and OM&R costs for the PRO Framework, indicating by italics where they differ from the NOR. Table 1–328 compares land treatment programs.

6.2.4.3 NOR and PRO Framework Costs

Table 1–343 in Section 12 lists the total costs (capital plus OM&R) for the NOR and PRO Frameworks for the periods 1971–1980 and 1971–2020.

6.3 Frameworks for River Basin Group 1.2

6.3.1 Summary

Under a normal growth condition in Planning Subarea 1.2, the 1970 population of 188,384 would increase to about 193,800 at year 2020. Total employment is estimated to increase to 74,200 in 2020 as compared to 53,862 at the 1970 level. An approximate 73 percent decrease by 2020 of employment in agriculture, forestry, and fisheries is projected, with a slight decrease in mining employment and increase of 30 percent in manufacturing and other employment.

The southern Lake Superior basin will have continued recreational development (national parks, recreation and wilderness areas, and trails; and State parks and recreation areas) because of the availability of resources. Table 1–244 in Section 12 summarizes the needs, needs satisfied, and percent needs met for the Normal Framework. Capital costs are summarized in Table 1–245, also in Section 12, and operation, maintenance, and replacement costs in Table 1–246.

6.3.2 The Area

River Basin Group 1.2 is located in the northwest portion of the Great Lakes Basin and encompasses 7,756 square miles of Michigan and Wisconsin land bordering the southern shore of Lake Superior (Figure 1–24).

Trades and services, particularly in the recreational field, play a key role in the economic structure of the area. Mineral production, associated industries, and forestry products are also important to the economy. Iron ore and copper deposits found primarily in the western portion of the region in the Gogebic and Marquette iron ranges are among the area's most valuable natural resources. Manufacturing activity in RBG 1.2 is largely oriented toward these natural resources.

Generally, the area is characterized by decreasing population, except for a few of the larger urban areas, such as Marquette. Over the past decade, the population in this planning subarea has experienced high unemployment and low income. There has been a significant outmigration of workers.

6.3.3 Projected Resource Needs and Problems

The projected needs for resource use by time level are shown on Table 1–244 in Section 12. Where needs can be quantified, they are not discussed in the text unless special conditions warrant such discussion.

6.3.3.1 Water Withdrawals

The total water withdrawal needs to 2020 in RBG 1.2 are estimated at an additional 1,015 mgd. The base year water withdrawals were about 294 mgd. About 86 percent of the additional water withdrawal need is for thermal power cooling, 5 percent for self-supplied industrial withdrawals, and 8 percent for mining, with the remainder for rural domestic and livestock and irrigation needs. Generally, the water withdrawal problems are not serious. Large quantities for both self-supplied industrial needs, including water for mineral processing, and for thermal power cooling will probably come from Lake Superior.

Consumptive use of municipal water is projected at 1.5 mgd, 2.1 mgd, and 2.4 mgd by 1980, 2000, and 2020, respectively. The water resources available are adequate to meet all future water requirements. Although most communities and municipalities do not face problems of supply, there are problems in updating the systems, particularly in providing the necessary distribution and treatment facilities. In some cases intercommunity cooperation might help to solve mutual problems.

Consumptive use of self-supplied industrial water is projected at 5 mgd, 15 mgd, and 30 mgd by 1980, 2000, and 2020, respectively.

There is a lack of available water of suitable quality at certain locations. Periodic surveys of water-use patterns are needed to keep abreast of discharge and recirculated water-use changes.

Future large generating stations must be able to comply with established water quality criteria if a flow-through cooling method is used. Failure to arrive at environmental standards will continue to cause delays in the construction of needed generating facilities. Historically, supplemental cooling has been used only in areas of limited water availability. Re-evaluation of use of supplemental cooling will result from the desire to limit thermal discharges. Supplemental cooling systems involve higher capital costs, higher operating costs, and more evaporation loss than flow-through cooling, but the amount of withdrawal is much less.

6.3.3.2 Nonwithdrawal Water Uses

Industrial wastewater discharges not connected with municipal wastewater treatment facilities are expected to increase only slightly in the future due to a trend in industry to provide more recirculation and also to make more extensive use of municipal plants.

Corrective programs have been initiated to upgrade water quality throughout the river basin group. Michigan is initiating a program for the control of soil erosion and sedimentation. Construction by municipalities of facilities to meet water quality standards has been hampered by the failure of the Federal government to meet its commitments to share in the construction costs. There is a need to implement programs for the reduction of agricultural wastes, nutrients, sediments, insecticides, and herbicides.

Problems in RBG 1.2 related to fish habitat and fishing are lack of fishing access, the presence of sea lamprey in Lake Superior, low productivity of area waters, poor wintering habitat of some inland waters, and depletion of some species.

In addition to making water surfaces available to boaters, it is necessary to provide berthing facilities, launching sites, access, and navigational aids. One of the main problems in this area is inadequate access to many inland lakes. The lack of stream improvement, lack of maintenance, and periodic low flows limit small boat opportunities and the amount of canoeing on some inland waters. The influx of nonresident boats into the area is extremely high each season and is steadily increasing. Table 1–72 shows recreational boating use in PSA 1.2 and projects future needs.

The principal cargo shipped over the lake is iron ore from Marquette. Marquette receives large amount of coal, and both Marquette and Ontonagon receive considerable amounts of petroleum products and miscellaneous items. Continued provisions must be made for containment of all polluted dredge spoil and maintenance of the existing systems of harbors and channels. This topic is consid-

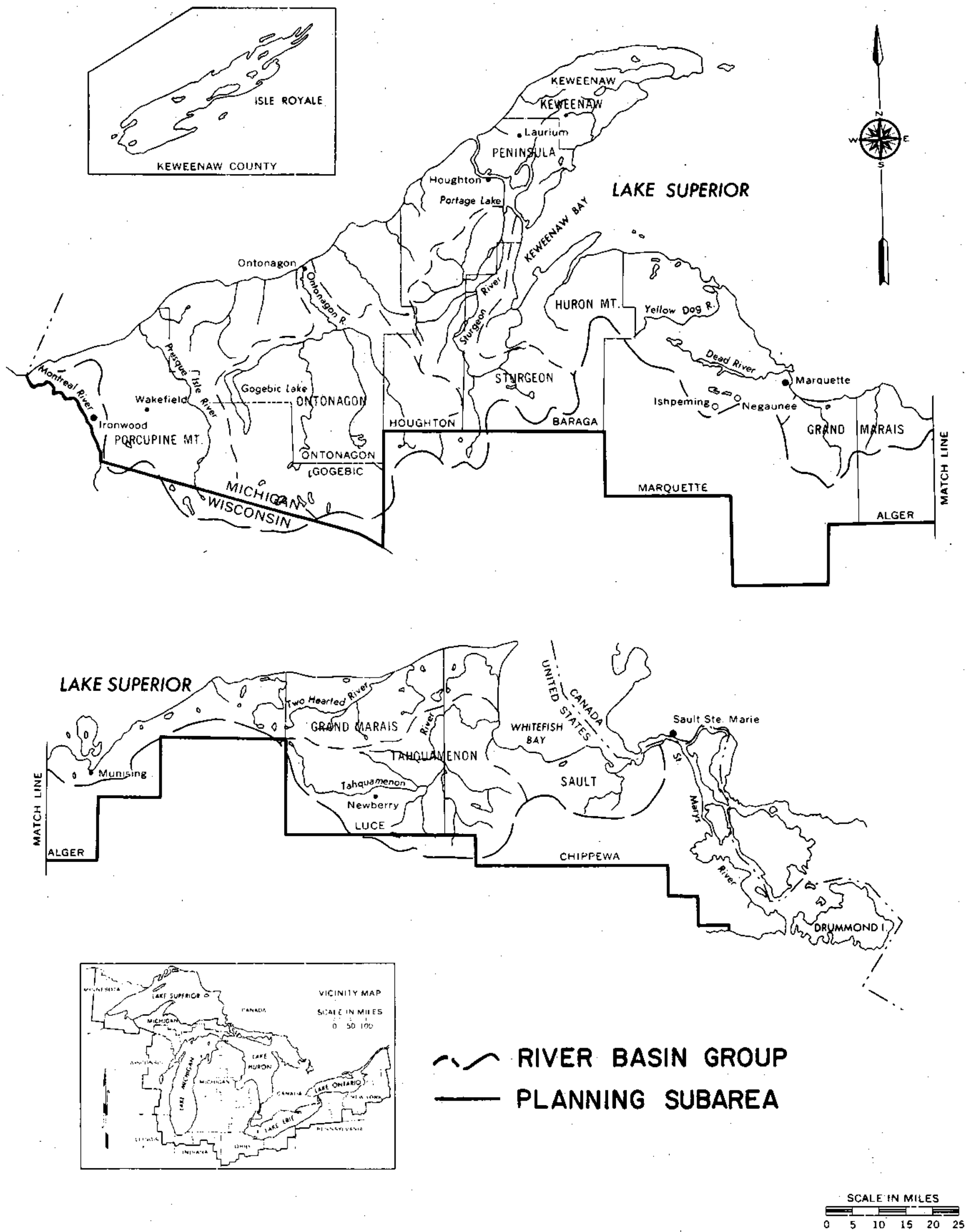

FIGURE 1-24 Lake Superior East, Planning Subarea 1.2

ered overall in Subsection 5.5.2.7 and in Subsection 6.4.

6.3.3.3 Related Land Uses and Problems

Approximately 40 percent of the cropland is presently idle, and this is projected to increase to 65 percent by 2020. Nearly 50 percent of the cropland is now being used for forage, and this is projected to decrease to less than 30 percent in 2020. Only small quantities of high-value cash crops are raised in the area. Agriculture is marginal at present and is projected to decline further in the future.

TABLE 1–72 Use and Projected Needs for Recreational Boating, PSA 1.2

	1000 Boating Days	
Category	Great Lakes Waters	Inland Waters
1970 Use	79	433
1980 Needs	34	0
2000 Needs	33	27
2020 Needs	33	3

There are approximately 105,000 acres of agricultural land on which production is presently reduced or limited by excess water in the soil profile. About one-third of this is cropland needing drainage. The following are some of the problems associated with agriculture and forestry:

(1) low productivity resulting from a combination of relatively poor soils and a short growing season

(2) lack of adequate markets

(3) poor accessibility

(4) improper management and use of agricultural and forest lands. This is detrimental to economic growth and environmental enhancement.

(5) a lack of conservation treatment practices on agricultural and forest lands, resulting in increased runoff and some erosion and sedimentation.

Forest land will probably decrease due to highway, power line, urban, recreational, and industrial developments. Unless strong action is undertaken to halt accelerating deterioration, rehabilitation of the forested land will be very costly, if not impossible. Some other major actions needed in this area are implementation of management procedures in private forest lands and protection and establishment of trees and shrubs in areas surrounding urban and built-up areas.

The total shoreline in this area is 575.8 miles, of which 4.9 miles are protected, 15.2 miles are subject to critical erosion, and 23.2 miles are subject to noncritical erosion.

Along streams which drain less than 400 square miles, there are 591 bank-miles subject to moderate streambank erosion damage and 315 miles subject to severe streambank damage. The annual damage is estimated at $219,900 per year, principally due to land losses. For streams draining more than 400 square miles, there are an estimated 42 bank-miles of severe streambank erosion with about $12,000 damage annually. Most of this damage is from sedimentation. The greatest streambank erosion problem in this area is on private land in the Keweenaw and Grand Marais complexes. It is difficult to organize and finance streambank erosion programs. More regulation of highway construction and logging is needed to reduce erosion and sedimentation. Erosion control is needed on 103,000 acres, where an estimated 82,600 tons of sediment per year originate.

Table 1–244 in Section 12 gives estimates of areas subject to flooding and of annual losses. The major problems are encroachment on the natural flood plain areas and the lack of local flood plain zoning and regulation, coupled with constricted river reaches and inadequate channel capacity. Major urban damages occur in the Ontonagon River basin and Sturgeon River basin. The latter basin accounts for 94 percent of the rural average annual damages.

Table 1–244 estimates future needs for wildlife user-days and acreage. There appears to be an adequate supply of land and wildlife habitat to satisfy the needs for NOR growth conditions in spite of a shrinking resource base. Wildlife habitat land is being allocated to other uses. Some farming practices leave little habitat on the land, and drainage, stream modification, and urban encroachment have contributed to the reduction of habitat. An acute problem, particularly in the Ontonagon River basin, is the need for preservation or protection of the remaining wetlands in the area. To meet the projected needs of the next 50 years, an additional 50,000 acres should be considered for wildlife management and habitat development.

Existing aesthetic and cultural values are summarized in Subsection 6.1. The major problem is the need to preserve outstanding values. Cities such as Ironwood, Houghton, and Marquette face urban expansion. Environmental buffer zones immediately adjacent to the edges of the expanding urban centers need study and planning attention to insure proper use of their significant inherent resource features. Environmental corridors merit consideration in this area. At the present time, institutional arrangements and funding are not available to meet these objectives.

This river basin group contains some of the highest-quality recreational resources in the Great Lakes Basin. Examples are Tahquamenon Falls, Pictured Rocks, the Huron and Porcupine Mountains, the proposed North Country Trail, and Isle Royale National Park.

The gross land area available for recreation is about 2.1 million acres, of which more than 1.8 million acres of forest land are in State and national forests. Isle Royale National Park contains 134,000 acres of wilderness, and State and local parks and water access areas contain 128,000 acres, of which 122,000 acres in three parks are wilderness. The inland water areas contain about 116,000 acres.

An analysis of the recreational demand and supply for each of the target years indicates that no need exists for additional acreage through year 2020 for several activities, and only moderate needs for the remaining activities. However, as discussed in Subsection 6.2.3.3, this conclusion is somewhat distorted because it was not possible to quantify the directional patterns of travel in the methodology used for estimating requirements. Subsection 6.2.3.3 discusses the findings of studies made by Wisconsin and Minnesota and explains how this additional information altered the frameworks developed for RBG 1.1. The same also applies to RBG 1.2.

6.3.4 Alternative Frameworks

Two alternative frameworks are presented for this river basin group. The Normal (NOR) Framework reflects a normal growth objective, based on needs derived from the OBERS projections. It meets these needs to the maximum extent practicable within the river basin group. The Normal Framework for this river basin group does not reflect coordination for the Lake basin or the Great Lakes Basin.

The Proposed (PRO) Framework, contains the recommendations of the Commission in an effort to reflect the views of the people of the basin. To some extent, it reflects coordination in the development of the Framework among a number of river basin groups, both in the Lake basin and in the Great Lakes Basin as a whole.

6.3.4.1 Normal Framework (NOR)

The Normal Framework is based on meeting quantified needs and solving identified problems to the maximum practicable extent consistent with the subobjectives and criteria discussed in Section 2 of the appendix. The program outputs and costs for RBG 1.2 are summarized in Tables 1–244, 1–245, and 1–246 which are found in Section 12.

(1) Water Withdrawals

Generally, the water withdrawal problems for RBG 1.2 are not serious, and all quantified needs are met. The 1970 source supply for municipal water is greater than the projected withdrawals for 2020, so no quantified needs are shown. However, rehabilitation and replacement of the facilities will be necessary through the entire period, and it may be that communities will wish to combine facilities in order to get the advantages of larger-scale construction. The NOR Framework suggests that some regulatory storage may be utilized in the rebuild facilities. The water required for self-supplied industrial purposes and for thermal power cooling will be obtained from Lake Superior. About half the water for mining use will be obtained from Lake Superior under the programs selected, with most of the other half being obtained from inland lakes and streams. Rural domestic and livestock water will normally come from local ground-water supplies at the point of need. Irrigation supplies will come either from ground water or from inland lakes and streams, depending on the availability at the point of need and the comparative cost. It is estimated that about half will come from each source. Some storage may be involved.

(2) Nonwithdrawal Water Uses

The Normal Framework program to meet water quality standards will generally provide a minimum level of secondary waste treatment to remove at least 90 percent of the organic material and about 80 percent of the phosphates from municipal wastes. Because of the unique importance and sensitive ecological balance of Lake Superior and its vulnerability to relatively low levels of nutrient input, additional programs of advanced waste treatment may be important for some of the municipalities and industries that discharge or drain into the Lake. Industrial wastewater discharges will be increasingly treated in municipal plants, but full treatment to meet the water quality standards, including necessary advanced treatments, will be expected in any plants which treat their own wastes. Programs for agricultural waste treatment are not included, but the effects of fertilizers and pesticides from agriculture and land runoff require additional study.

Water-oriented outdoor recreation is discussed under related land uses and problems.

All sport fishery needs are met by programs which include primarily public acquisition of access and nonstructural legislative and institutional changes. These will include fish management programs on inland lakes and streams and in the Great Lakes; stocking programs; the control of sea lamprey; and related types of programs.

Recreational boating needs are met both on Lake Superior waters and inland waters. Programs for Lake Superior include berthing facilities, launching sites, navigational aids, and harbors of refuge. On inland waters, the programs primarily provide launching sites, access, and some berthing facilities. Increased efficiency in the use of available water surface is paramount, and there will probably be an actual reduction in the total amount of water available on inland lakes and streams over the 50-year period.

Commercial navigation programs include a continuation of present practices, namely, the maintenance of the existing systems of harbors and channels, including the containment of all polluted dredge spoil. Expansion of the total system to include a longer navigation season and accommodation for larger ships is discussed in Subsection 5.5.2.7 and Subsection 6.4.

(3) Related Land Uses and Problems

For the treatment of agricultural land and forest land, the programs consist of a continuation of present practices of conservation and drainage of the agricultural land, and appropriate treatment on the forested land. Not all the opportunities for enhancement of these lands can be accepted because the benefits do not justify the costs.

The 15.2 miles of shoreline subject to critical erosion are treated during the projection period, using conventional methods of structural protection, but none of the 23.2 miles subject to noncritical erosion are treated.

Streambank erosion is severe on about one-third of the total bank-mileage subject to erosion, and this severe portion is treated under the program by conventional structural methods.

Flood damages in urban areas are eliminated on about one-fourth of the area for each of the time periods by conventional structural methods, and increasingly from 1980 to 2020 by legislative and institutional changes. However, not all of the needs can be met during the projection period. In rural areas, the total acreage protected is about one-third of that subject to flooding. About one-half of the protection comes from structural measures, and the other half from legislative and institutional changes.

Wildlife management opportunities in the river basin group are such that the quantified needs for habitat can be more than met. Programs would rely heavily on public acquisition and management of land to improve its habitat capabilities. While numerical user-days do not appear to be met, it is believed that the use of habitat by hunters and other users at different times of the year will result in meeting practically all these needs.

Outdoor recreation programs have been adopted to provide facilities which will permit meeting needs transferred from other river basin groups and Lake basins. The principal means is by changes in land use, in which lands particularly adapted to recreation are utilized for this rather than for other purposes. Multiple use is also a possibility in some cases. For the intensively developed land, public acquisition of the major portion of the land will be required, with some changes on land already devoted to public use.

(4) Framework Outputs and Costs

Section 12 contains Tables 1–244, 1–245, and 1–246 which provide information on needs, outputs, percent of needs met, and capital and OM&R costs for the NOR Framework.

6.3.4.2 Proposed Framework (PRO)

A specific objective of the Proposed Framework for River Basin Group 1.2 is to maintain and preserve a high quality environment while enhancing employment opportunities. The PRO Framework considers population growth to be somewhat lower than that in the NOR Framework. A lower projection is consistent with the recently observed downward trend in the fertility rate.

While the PRO Framework provides for improvement in the regional economy by expansion of the recreational industry and the extractive minerals industry, it does not include dependence on the expansion of the power industry. The power generating capacity of River Basin Group 1.2 should be increased only to meet the needs created within the area itself and not for export purposes. The PRO Framework recommends that efforts be made to reduce the per capita use of electric energy. While the PRO Framework does recommend that some industrial expansion take place in order to provide greater employment opportunities, it is important that new industries be as nondamaging as possible to the environment. It is important to provide employment opportunities in RBG 1.2, so that outmigration can be reduced or eliminated.

(1) Water Withdrawals

There are no differences with respect to water withdrawals in the PRO Framework as compared to the NOR Framework.

(2) Nonwithdrawal Water Uses

The PRO Framework includes programs to comply with the Federal Water Pollution Control Act Amendments of 1972 as early as possible. This would result in a higher order of treatment in a shorter time than that which would occur in the NOR Framework.

The PRO Framework includes recommendations to accelerate fish management programs, particularly those that would increase sport fishing opportunities. Fish management programs should emphasize coldwater species over warmwater species. The generally high water quality of the area allows many excellent coldwater species to flourish. This is not the case in many other river basin groups where lower water quality and different climatic conditions are found. The PRO Framework recognizes this rather unique fishing opportunity by continuing to emphasize the propagation of coldwater species.

The PRO Framework recommends the acceleration of development of small boat harbors. The establishment of such facilities at locations like Grand Marais is important to the growth of the recreation sector of the economy.

Because of pollution from untreated ship wastes, the PRO Framework includes a recommendation for the treatment of all such wastes. Treatment of ship wastes is an important environmental safeguard that should be established to insure that cost-efficient deep-draft navigation, which the Great Lakes Basin Commission has endorsed, may be realized within the context of a quality environment. Adequate port facilities for such treatment are required as well as uniform regulations throughout the Great Lakes system. Improvement of Marquette Harbor is included in the PRO Framework. Subsection 5.5.2.7 and Section 6.4 contain discussion of expansion of the total system.

(3) Related Land Use

The PRO Framework includes a recommendation for the development of comprehensive land use plans. Such planning is being initiated by the State of Michigan at the present time. That effort is endorsed. It is particularly important to include criteria for the development of natural resources (particularly mining and lumbering) and for the use of shoreland areas. The PRO Framework recommends programs of shoreland management which recognize the Great Lakes shoreland as a unique natural resource. This includes developmental setbacks for all shoreland areas unless public benefits can be shown to outweigh public disadvantages.

Both agricultural and forest land treatment programs are substantially greater in the PRO than in the NOR Framework. The differences between the two frameworks are shown in Table 1–329 in Section 12. The PRO Framework provides for accelerated treatment for all agricultural land (exclusive of drainage) to be accomplished by the year 2020. PRO forest land treatment programs will also meet all of the needs by the year 2020. A further PRO recommendation with respect to forest lands is that forest land use practices provide for the joint commercial and recreational use of those lands. This recommendation with respect to forest lands is that forest land use practices provide for the joint commercial and recreational use of those lands. This recommendation is important for maintaining the recreational opportunities in RBG 1.2, particularly since the great majority of the land is forested.

In terms of meeting shoreland erosion needs, the PRO Framework recommends that the surface elevation of Lake Superior be maintained at levels which will minimize shore property damage, in addition to including NOR programs for shoreland protective measures. Stabilization of lake levels is important so that recreational development can take place near the shoreline without being subject to either flooding or erosion. Shoreland management plans are recommended for all Great Lakes shores by 1980 in order to protect and preserve shoreland integrity and uniqueness.

With regard to flood plain management, the PRO Framework includes a recommendation that zoning take precedence over structural measures. Zoning will allow flood plains to be used for recreational purposes, and the maintenance of streams in a free-flowing state will enhance recreational potential. Flood insurance provides a supplementary way of reducing the impact of flood damage.

Wetland areas should be fully protected under the PRO Framework. This is an essential recommendation because of the importance of wetlands to the propagation of wildlife. Abundant wildlife in RBG 1.2 is a significant element of the appeal of the river basin group to both hunters and wildlife observers.

The PRO Framework contains several recommendations relative to outdoor recreation. Outdoor recreation should be broadly based in RBG 1.2 in order to be attractive to a variety of recreationists from outside the basin. The major emphasis should be on broad and variable outdoor recreational opportunities to provide substantial enhancement of the regional economy. The PRO Framework also recommends a transportation system that will improve access to major recreational areas. This is essential in order to facilitate easy movement of recreationists within the area. Since Lake Superior is one of the region's greatest recreational assets, the PRO Framework provides for improved public access to shore areas. While much of the outdoor recreational opportunity will be provided through government expenditures, private developments will also be important to the growth of the recreational sector of the economy. The PRO Framework emphasizes the need for specific criteria to insure that such developments do not endanger the high-quality natural environment.

(4) Framework Outputs and Costs

Section 12 contains Tables 1–247, 1–248, and 1–249, which provide information on needs, outputs, percent of needs met, and capital and OM&R costs for the PRO Framework, indicating by italics where they differ from the NOR Framework. Table 1–329 compares land treatment programs.

6.3.4.3 NOR and PRO Framework Costs

Table 1–344 in Section 12 lists the total costs (capital plus OM&R) for the NOR and PRO Frameworks for the periods 1971–1980 and 1971–2020.

6.4 Lake Superior Intrarelationships

Various lakes uses, such as commercial navigation, recreational boating, and sport and commercial fishing, as well as such parameters as water quality and levels and flows, frequently cross political boundaries. While these activities are usually land based, or at least heavily influenced by land-based activities, their nature is such that it is useful to view them within the context of Lake Superior itself in addition to viewing them in the context of specific river basin groups.

6.4.1 Commercial Navigation

The Great Lakes Basin Commission has endorsed the following policy guidelines with respect to commercial navigation:

> To the extent technically feasible, economically justified, and environmentally acceptable, the Great Lakes Basin Commission favors the maintenance of efficient, low cost, deep draft navigation and the provision of incremental improvements to the navigation system in the Great Lakes and St. Lawrence Seaway, including connecting channels, shipping and receiving harbors, compensating works, additional locks, canals, dams, and extensions of the navigation season.

The terms "economically justified" and "environmentally acceptable" are of particular importance in the case of Lake Superior. The somewhat economically depressed nature of the Lake Superior region and the importance of commercial navigation to the regional economy make it likely that any improvement in the navigation system of the Great Lakes would be economically justified with respect to the Lake Superior region. The advent of supercarriers (730 ft. to 1000 ft. long) will increase the competitive advantage of Lake Superior iron ores over eastern Canadian ores. This is because the Welland Canal is not sufficiently large to accommodate new supercarriers that would otherwise carry ores from eastern Canada to inland ports such as Chicago. The deepening of commercial harbors to 31 feet in several major ports would allow large ships to load more fully. The possibility of extension of the navigation season could well increase the region's economic stability by reducing the rather high rate of seasonal unemployment.

At the same time, such improvements, if realized, must be developed with adequate environmental safeguards in order to insure that recreational uses (another major economic sector of the region) of the Lake will not be impaired. Recreational use could be impaired, for example, if adequate criteria are not established for the safe disposal of polluted dredge spoil and for the treatment of all shipping wastes. Failure to establish these criteria could easily contribute to the degradation of Lake water or be detrimental to the quality of shoreland areas.

6.4.2 Recreational Boating

A program providing for the establishment of new small-boat harbors is essential to the expansion of recreational boating opportunity throughout Lake Superior. The introduction of coho salmon in Lake Superior, and the restocking of other salmonid species such as lake trout, have improved the sport fishery considerably, concurrent with the expansion of recreational boating. Since the nature of boating activity is such that rather large distances are frequently covered, it is essential that a system of small boat harbors be developed. Lake Superior experiences frequent storms which are often severe. This increases the need for adequate harbors of refuge. While the shoreline is not always amenable to the construction of such facilities (due to its rocky character), there are enough sites to provide harbors an average of 15 to 20 miles apart. Improvements in the system of communicating weather conditions to boaters are also important if the harbors are to be used with greatest effectiveness.

6.4.3 Commercial and Sport Fishery

It is only in recent years that sport fishing has outstripped the once-substantial commercial fishing industry in Lake Superior. At the present time, sport fishing brings about four times as much income to the region as does commercial fishing. It is expected that this trend will continue.

Lake Superior is an oligotrophic lake with relatively few fish species. In a simple ecosystem such as this, the abundance of one species can have an immediate and dramatic effect on the survival, growth, and/or abundance of another. Furthermore, recent research has indicated that the fish of oligotrophic lakes are much more likely to concentrate contaminants such as mercury and persistent pesticides than fish found in eutrophic lakes. Given this delicate ecological balance in Lake Superior, it becomes of utmost importance to have intensive and intelligent fish management programs.

Various stocking programs involving primarily salmonid species have provided revitalization of fishing opportunities in Lake Superior. These programs are carried out by the States of Minnesota, Wisconsin, and Michigan. Since fish often move freely throughout the lake, it would be desirable to have greater coordination among the States of the fish stocking efforts in order to avoid duplication and potential overstocking.

Given the relatively large number of salmonid species in Lake Superior, it is important to continue lamprey control programs. If such programs are not carried out in all portions of Lake Superior, the efforts of fish managers in some areas will be nullified by the continued availability of lamprey habitat in other areas.

While direct coordination of management efforts is essential to maintain the quality of the Lake Superior fishery, it is also important to prevent the degradation of Lake Superior by the introduction of pollutants. The potential importance of sport fishing and the delicate nature of Lake Superior (in terms of the susceptibility of fish to pollutants) may justify even more stringent water quality standards for municipal and industrial discharges than now exist.

6.4.4 Water Quality

Lake Superior is not only the largest of the Great Lakes, it is also the cleanest. The importance of maintaining the Lake in this state cannot be overemphasized. The Lake is much colder than the other Great Lakes, and so its assimilative capacity is lower. Since the processes by which various types of pollutants are broken down proceed more slowly in Lake Superior, it is more susceptible to degradation by such pollutants. Lake Superior provides a source of clean water to the downstream Lakes. The pollution problem of Lake Erie might be considerably worse if it were not for the clean water available from Lake Superior.

Due to water circulation patterns, the apparently localized sources of pollution can affect other uses throughout the entire Lake area. Because of the delicate nature of Lake Superior, it behooves users to take steps to preserve the high water quality of the Lake by thoroughly treating all shipping wastes, by the containment of dredge spoil, and by compliance on the part of the municipal and industrial dischargers with Federal water quality standards. The disposal of mine tailings in the Lake has been ordered stopped through litigation.

6.4.5 Levels and Flows

The level and outflow of Lake Superior has been regulated since 1921. It is presently being regulated under rules established by the International Joint Commission in 1949 (and modified in 1955). Any change that would affect the level of Lake Superior would have implications for many users throughout the Lake. Of regional significance are proposals to store additional waters temporarily in Lake Superior to alleviate flooding conditions on downstream Lakes during periods of above-normal lake levels. Principal uses that would be affected include commercial navigation, power, and shore property utilization. There are trade-offs and conflicts in connection with lake level regulation for these uses. For example, a scheme to maximize commercial navigation opportunities would not necessarily complement one to generate power. Nor would either of them necessarily be consistent with a scheme designed to minimize erosion on the shoreline of Lake Superior, or with a scheme to maintain waters at specific levels to enhance wildlife and aesthetic and cultural values. Changes in the regulation of Lake Superior levels are being considered with maximum regional benefits to all the Great Lakes in mind. Regional adjustments in shore property damages, power generation, commercial navigation, and recreational boating are being considered. The PRO Framework recommends that any shore property damages, erosion problems, or other detrimental effects to the Lake Superior area should be compensated for when Regional (Great Lakes system) benefits are maximized. The International Great Lakes Levels Board of the International Joint Commission has recently conducted a study of possible change in regulation of the levels of the Great Lakes. The final report was made public in August 1974.

Section 7

LAKE MICHIGAN BASIN

7.1 Study Area

This basin is the only Great Lakes basin lying entirely within the boundaries of the United States. The entire area drains to the Straits of Mackinac, the natural outlet for the basin. There is also a man-made diversion from the basin at Chicago. Statistical information on the Lake Michigan basin and its river basin groups, and the counterpart plan area and PSAs, is given in Section 1. A map appears in Figure 1–25.

It is apparent from a study of the map and the statistical information that special consideration must be given to the Chicago metropolitan area in terms of water resource planning for the basin. Much of the metropolitan area lies in the Upper Mississippi River Basin rather than in the Lake Michigan basin, and yet it is because of the location on the Lake that the population increases and economic growth of the area have been so great. It is impossible to exclude consideration of the Chicago area in an analysis of either the Upper Mississippi River Basin or the Great Lakes Basin. For this reason, both the Upper Mississippi River Comprehensive Basin Study and the Great Lakes Basin Framework Study include this area. Six counties in Illinois are involved. Each study recognizes that certain elements of the study area are related primarily to one or the other of the basins, and in determining requirements, needs, and programs for meeting needs, the capabilities of the two areas have been taken into account, on a rational basis where possible, and arbitrarily in a few cases. There is no double counting in the final result. The details of handling the various resource use categories with respect to the overlapping consideration in the two studies are discussed in Subsection 7.3, Frameworks for River Basin Group 2.2.

Plan Area 2, Lake Michigan, constitutes nearly 40 percent of the Great Lakes Region. In several respects, including land use patterns, land use problems, and population concentrations, the Lake Michigan study area falls into northern and southern portions divided by a line running approximately through Milwaukee, Wisconsin, and Muskegon, Michigan. PSAs 2.1 and 2.4 are mostly north of this line and PSAs 2.2 and 2.3 mostly south. The northern portion of the area is over 50 percent forested. Here, the agricultural areas are relatively small, but specialized and significant. There are relatively small urban centers. This area is used throughout the year for recreational purposes as a retreat from population and industrial concentrations. In contrast, the southern portion of the planning subarea is largely cropland and highly urbanized with minor contributions from forest and pasture lands. This area is heavily industrialized, heavily populated, and in places heavily polluted.

7.1.1 Human Characteristics

Plan Area 2, Lake Michigan, had the largest population of the five plan areas in 1970, with about 46 percent of the Regional population. The population density of 296 persons per square mile is the greatest in the Great Lakes Region.

Out of the 86 counties located in the Lake Michigan Plan Area, four of the counties—Cook in Illinois, Milwaukee in Wisconsin, Lake in Indiana, and Kent in Michigan—have 56 percent of the total population. The 1970 population census showed 11,187,000 persons, or 83 percent of the area's total population of 13,517,000, living in urban areas including 13 SMSAs (see Tables 1–10, 1–11, 1–12, and 1–13). Battle Creek, Michigan was designated an SMSA after the 1970 data were compiled.

The basin has a distinct contrast in population distribution. The southern half is highly urbanized and also highly diversified in agricultural activities. The northern half is more devoted to development and utilization of recreational resources. Nonresidents significantly swell the population of the northern portion during the hunting and vacation seasons. Better means of transportation and rising incomes have increased resort and second home seasonal use and added significantly to the part-time residents in the area. Snowmobile use attracts people to stay for extended periods in the area during the winter.

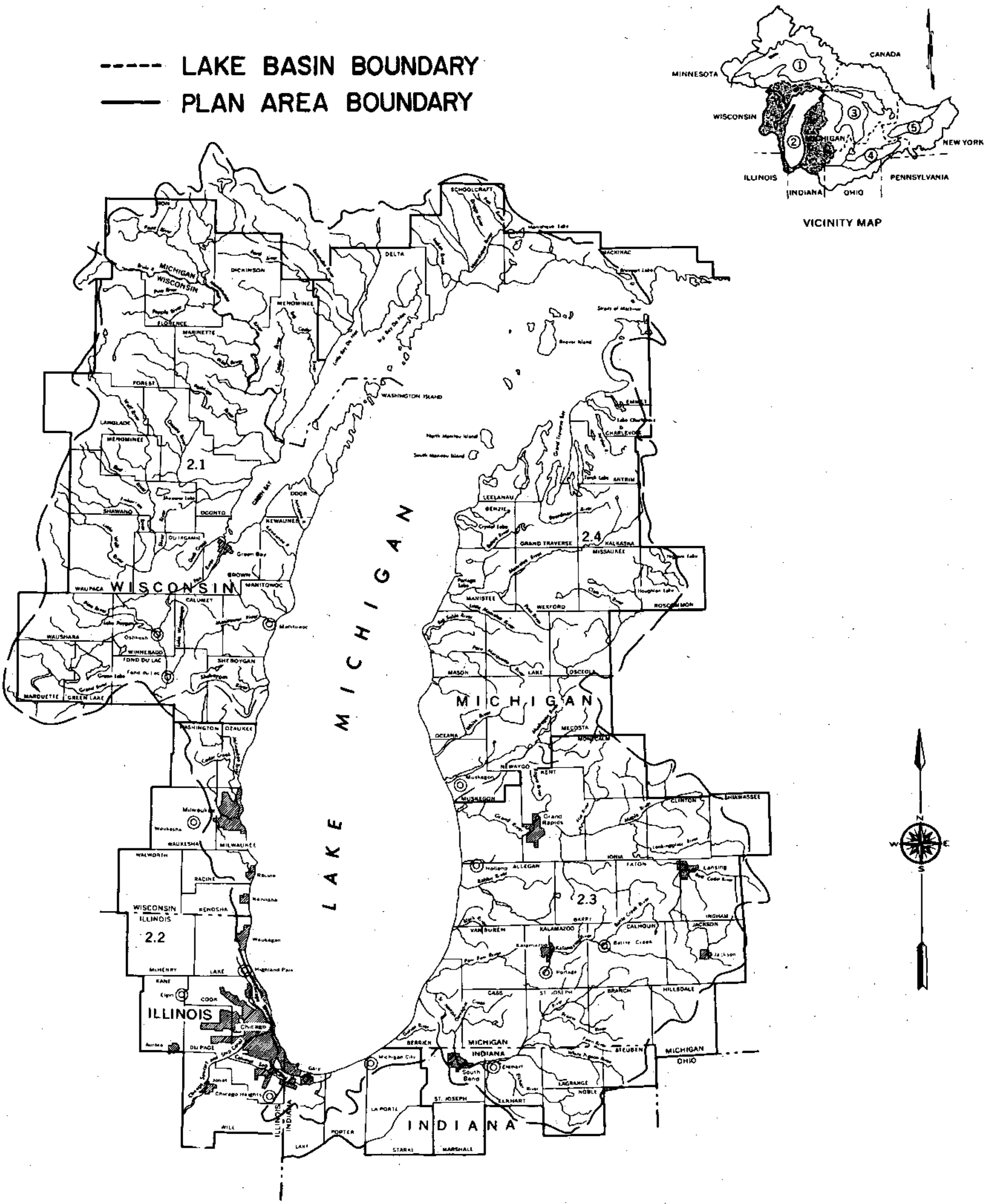

FIGURE 1–25 Plan Area 2, Lake Michigan

7.1.2 Water Resources

An abundant supply of generally high-quality water comes from surface and subsurface sources in the Lake Michigan basin (see Subsection 1.4.3). Average annual runoff in the basin is about 10 inches. The river systems of the basin are products of glacial moraines and are typically short with limited drainage basins. Even so they are among the longest in the Basin. Many of the rivers of northern Wisconsin and Michigan have their sources in or flow through national or State forest lands, while southern area streams generally originate in or flow through agricultural and urban areas.

Subsurface water resources occur in both unconsolidated sediment aquifers and bedrock aquifers in the Lake Michigan basin, providing the greatest ground-water supply of any Great Lakes basin. The glacial drift contains many high-producing aquifers, particularly in the Lower Peninsula of Michigan. The western shore of Lake Michigan is underlain by high-producing bedrock aquifers.

Areas of poor ground-water yield are relatively scarce and of small areal extent, mainly occurring in the Precambrian areas of northern Wisconsin and the Upper Peninsula of Michigan, and in the Ottawa River in the Lower Peninsula. Highly saline water is present at shallow depths in the bedrock formations of Michigan's Lower Peninsula and in extremely deep wells in northern Indiana. Overlying aquifers in the glacial drift provide good freshwater sources, however. The saline water is a source of potential contamination to the overlying aquifer.

7.1.3 Land and Other Natural Resources

Soils of the Lake Michigan basin include sandy and gravelly soils in northern Michigan and Wisconsin, lightly colored loams and clay loams in eastern Wisconsin, and variable sands and clay soils in Michigan, Indiana, and Illinois. Most of the soils are quite acid and low in organic matter. Poor drainage is a problem in central Wisconsin, as well as northern Indiana, eastern Illinois, and southern Michigan.

From north to south the extent of land in forests decreases. Most of the northern one-third is forested. The Upper Peninsula of Michigan and the northeastern section of Wisconsin are both covered extensively by northern hardwoods and conifers with aspen stands appearing in great numbers, and numerous bogs. The northern Lower Peninsula of Michigan is 70 percent forested, with coniferous species and aspen dominating the landscape. Tables 1–73, 1–74, and 1–75 provide information on land use in the Lake Michigan basin.

The southern sections of the basin are primarily agricultural with only 10 to 17 percent left in forest land. Deciduous species were the dominant original cover of these areas. Most of the remaining forest cover of this area is in farm woodland. Figure 1–26 illustrates the land uses.

Land use patterns and statistics, though suggestive, do not completely reflect the highly urbanized areas which characterize the southern portion of the Lake Michigan basin. It is projected that urban built-up areas will gain, primarily at the expense of cropland. Tables 1–74 and 1–75 summarize these projections. The land use changes are many and complex. Unfortunately, uniformly reliable data on current land use and management activities in the region are deficient. As urban expansion, new seasonal developments in the northern portion of the basin, and pressures for additional developments along the shorelines increase, more governmental units will be faced with a need for expanded land use planning.

Mineral deposits found in the basin are reflections of its sedimentary origin and subsequent glaciation. Iron is found principally in the northwestern Michigan section of the basin while stone and sand and gravel are principal minerals in most of the basin. Oil, gas, salt, and gypsum deposits occur primarily in Michigan. Marl is also found in southern Michigan and northern Indiana. Northern Illinois produces peat in significant quantities.

Wildlife habitat and resources vary from north to south with changes in land use and climate. Farm game, deer, and small game animals like squirrels, rabbits, fox, skunks, and raccoon are located in the basin's interior, but the shoreline and bays are the most valuable wildlife areas. The shores of Lake Michigan serve as protection and sustenance for many permanent as well as migratory waterfowl and other bird species. Big game animals including white-tailed deer and black bear are found in the northern reaches of Wisconsin and Michigan.

The northern portion of the basin has excellent fish habitat for northern pike, walleyes, largemouth bass, smallmouth bass, trout and muskellunge. In addition, perch, bluegill, crappie, and various sunfishes are also found throughout the basin lakes and streams. Other common species include catfish, rock bass, white bass and the less desirable sheepshead, carp, bowfin and gar. Migrations and spawning runs of walleyes, white bass, sturgeon, smelt, and suckers provide seasonal recreational opportunities for fishermen in many streams tributary to Lake Michigan.

In Lake Michigan itself, fishing for lake trout, walleyes and whitefish has been important in the

TABLE 1–73 Land Use, Lake Michigan Plan Area, 1966-67 (thousands of acres)

PSA and State	Total Land Area	Urban Built-Up	Resource Base: Cropland	Pasture Range	Forest Land	Other	Total
PSA 2.1							
Michigan	1,889.8	52.0	133.6	21.7	1,664.5	18.0	1,837.8
Wisconsin	8,120.9	412.0	3,182.8	335.0	3,452.0	739.1	7,708.9
PSA Total	10,010.7	464.0	3,316.4	356.7	5,116.5	757.1	9,546.7
PSA 2.2							
Illinois	2,367.3	678.0	1,249.6	98.7	93.0	248.0	1,689.3
Indiana	1,174.3	122.8	722.3	55.7	90.6	182.9	1,051.5
Wisconsin	1,670.5	409.7	871.5	83.0	157.1	149.2	1,260.8
PSA Total	5,212.1	1,210.5	2,843.4	237.4	340.7	580.1	4,001.6
PSA 2.3							
Indiana	1,580.4	156.4	1,031.3	106.8	140.1	145.8	1,424.0
Michigan	7,375.0	662.1	4,343.5	352.6	1,564.6	452.2	6,712.9
PSA Total	8,955.4	818.5	5,374.8	459.4	1,704.7	598.0	8,136.9
PSA 2.4							
Michigan	8,094.2	414.8	1,481.5	351.8	5,434.3	411.8	7,679.4
TOTAL	32,272.4	2,907.8	13,016.1	1,405.3	12,596.2	2,347.0	29,364.6

past in both the sport and commercial fisheries. With the invasion of the sea lamprey and, more recently the alewife, into the Lake, fish populations have undergone some major changes. The successful introduction of the coho and chinook salmon has added new dimensions to the basin's fishery resource.

Forested land, large expanses of dunes and beaches, and hundreds of inland lakes provide many opportunities for outdoor recreation activities in the Lake Michigan basin. The forests are particularly significant in the northern part of the basin, especially in the northern one-third; which is 90 percent forest. Approximately 40 percent of the forest land in Michigan's Upper Peninsula is publicly owned, as is 35 percent in the northern Lower Peninsula.

Lake Michigan has some of the finest beaches on the Great Lakes, particularly along its eastern shore. Over one-third of the area of the beaches is publicly owned, and an additional equal amount is privately owned but has some potential for public use. Lake Michigan islands provide an excellent base for recreational use. Within this region there

TABLE 1–74 Actual and Projected Land Use, Lake Michigan Plan Area (thousands of acres)

Land Use	Actual 1966-67	Implied Change 1966-67 to 1980	Projected 1980	Implied Change 1980-2000	Projected 2000	Implied Change 2000-2020	Projected 2020
Lake Michigan							
Total land area[1]	32,272.4	---	32,272.4	---	32,272.4	---	32,272.4
Total urban and built-up	2,907.8	658.8	3,566.6	903.2	4,469.8	788.2	5,258.0
Total nonurbanized land	29,364.6		28,705.8		27,802.6		27,014.4
Resource Base:							
Cropland	13,016.1	(446.7)	12,569.4	603.3	11,966.1	513.6	11,452.5
Pasture	1,405.3	(38.1)	1,367.2	51.7	1,315.5	44.5	1,271.0
Forest Land	12,596.3	(88.9)	12,507.4	134.2	12,373.2	136.4	12,236.8
Other Land	2,347.0	(85.1)	2,261.9	114.0	2,147.9	93.7	2,054.2
Total[2]	29,364.6	(658.8)	28,705.8	903.2	27,802.6	788.2	27,014.4

Source: Developed by Economic Research Service, U.S. Department of Agriculture, East Lansing, Michigan.

[1]Total land area = total area - water area, and is assumed constant for projection periods.
[2]Detail may not add to total due to rounding.
[3]Bracketed figures reporesent urban depletions for 1967-1980, 1980-2000, and 2000-2020.

TABLE 1-75 Actual and Projected Land Use, Lake Michigan Plan Area by PSA

Land Use	Actual 1966-67	Implied Change 1966-67 to 1980	Projected 1980	Implied Change 1980-2000	Projected 2000	Implied Change 2000-2020	Projected 2020
PSA 2.1							
Total land area[1]	10,010.7	---	10,010.7	---	10,010.7	---	10,010.7
Total urban and built-up	464.0	23.0	487.0	43.2	530.2	53.3	583.5
Total nonurbanized land	9,546.7		9,523.7		9,480.5		9,427.2
Resoure Base:							
Cropland	3,316.4	(8.0)[2]	3,308.4	(15.0)	3,293.4	(18.5)	3,274.9
Pasture	356.7	(.9)	355.8	(1.6)	354.2	(2.0)	352.2
Forest Land	5,116.6	(12.3)	5,104.2	(23.2)	5,081.0	(28.6)	5,052.4
Other Land	757.1	(1.8)	755.3	(3.4)	751.9	(4.2)	747.7
Total[3]	9,546.7	(23.0)	9,523.7	(43.2)	9,480.5	(53.3)	9,427.2
PSA 2.2							
Total land area[1]	5,212.1	---	5,212.1	---	5,212.1	---	5,212.1
Total urban and built-up	1,210.5	515.7	1,726.2	671.5	2,397.7	504.9	2,902.6
Total nonurbanized land	4,001.6		3,485.9		2,814.4		2,309.5
Resource Base:							
Cropland	2,843.4	(366.4)	2,477.0	(477.2)	1,999.8	(358.8)	1,641.0
Pasture	237.4	(30.6)	206.8	(39.8)	167.0	(29.9)	137.1
Forest Land	340.7	(43.9)	296.8	(57.1)	239.7	(43.0)	196.7
Other Land	580.1	(74.8)	505.3	(97.4)	407.9	(73.2)	334.7
Total[3]	4,001.6	(515.7)	3,485.9	(671.5)	2,814.4	(504.9)	2,309.5
PSA 2.3							
Total land area[1]	8,955.4	---	8,955.4	---	8,955.4	---	8,955.4
Total urban and built-up	818.5	105.0	923.5	159.7	1,083.2	196.7	1,279.9
Total nonurbanized land	8,136.9		8,031.9		7,872.2		7,675.5
Resource Base:							
Cropland	5,374.8	(69.4)[2]	5,305.4	(105.5)	5,199.9	(129.9)	5,070.0
Pasture	459.4	(5.9)	453.5	(9.0)	444.5	(11.1)	433.4
Forest Land	1,704.7	(22.0)	1,682.7	(33.5)	1,649.2	(41.2)	1,608.0
Other Land	598.0	(7.7)	590.3	(11.7)	578.6	(14.5)	564.1
Total[3]	8,136.9	(105.0)	8,031.9	(159.7)	7,872.2	(196.7)	7,675.5
PSA 2.4							
Total land area[1]	8,094.2	---	8,094.2	---	8,094.2	---	8,094.2
Total urban and built-up	414.8	15.1	429.9	28.8	458.7	33.3	492.0
Total nonurbanized land	7,679.4		7,644.3		7,635.5		7,602.2
Resource Base:							
Cropland	1,481.5	(2.9)	1,478.6	(5.6)	1,473.0	(6.4)	1,466.6
Pasture	351.8	(.7)	351.1	(1.3)	349.8	(1.5)	348.3
Forest Land	5,434.3	(10.7)	5,423.6	(20.4)	5,403.2	(23.6)	5,379.6
Other Land	411.8	(.8)	411.0	(1.5)	409.5	(1.8)	407.7
Total[3]	7,679.4	(15.1)	7,664.3	(28.8)	7,635.5	(33.3)	7,602.2

Source: Developed by Economic Research Service, U.S. Department of Agriculture, East Lansing, Michigan.

[1]Total land area = total area - water area, and is assumed constant for projection periods.
[2]Bracket figures represent urban depletions for 1967-1980, 1980-2000, and 2000-2020.
[3]Detail may not add to total due to rounding.

are several areas that possess high recreational value which has warranted recent authorization for acquisition. These include Sleeping Bear Dunes National Lake Shore, Michigan, Indiana Dunes National Lake Shore, Indiana, and the Ice Age National Scientific Reserve in Wisconsin. A portion of the Wolf River, Wisconsin, has been designated part of the national wild and scenic river system, and a number of other rivers are being considered for addition to this system or as part of State wild, scenic, or recreational rivers systems.

Although there are hundreds of inland lakes in the Lake Michigan basin, the shores of many of them, particularly in the southern part of the region have been developed heavily with residences and summer cottages. These lakes have beach areas that probably total thousands of acres. Their water surface area is approximately 811,000 acres.

TABLE 1–76 Lake Michigan Basin, Resource Problems Matrix

LAKE MICHIGAN BASIN 2.0																																										
SE River Basin Group 2.3																	NE River Basin Group 2.4																									
		St. Joseph Basin			Black River Complex			Kalamazoo Basin			Ottawa Complex			Grand River Basin					Muskegon River Basin			Sable Complex			Manistee River Complex			Traverse Complex			Seul Choix[5] Complex			Manistique Complex			Bay de Noc Complex			Escanaba River Basin		
Overall	Open Waters	Urban	Rural	Interface	Urban	Rural	Interface	Urban	Rural	Interface	Urban	Rural	Interface	Urban	Rural	Interface	Overall	Open Waters	Urban	Rural	Interface	Urban	Rural	Interface	Urban	Rural	Interface	Urban	Rural	Interface	Urban	Rural	Interface	Urban	Rural	Interface	Urban	Rural	Interface	Urban	Rural	Interface
1	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	1	1	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1	-	1	-	1	-	-	-	-	-	-	-	-	-	-	-	1	1	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-
1	-	1	1	-	-	1	-	-	-	-	-	1	-	1	1	-	1	-	-	1	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1	-	-	-	1	1	1	1	2	2	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1	-	1	-	-	-	-	1	1	-	-	-	-	-	1	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	1	-
1	-	-	-	-	-	1	1	1	1	-	-	-	-	-	-	-	1	-	-	1	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2	2	2	-	1	1	-	2	2	-	1	2	-	2	2	-	-	1	-	1	-	-	-	-	-	1	-	-	2	-	-	-	-	-	1	-	-	1	-	-	1	-	-
2	-	2	-	-	-	-	-	2	-	-	-	-	-	2	-	-	1	-	1	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	1	-	-	2	-	-
1	-	1	1	-	-	-	-	-	1	-	-	-	-	1	1	-	1	-	2	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1	-	1	1	1	1	1	1	2	2	1	1	1	1	2	1	-	1	-	1	-	-	-	-	-	-	-	-	-	1	-	-	-	2	-	-	-	-	-	1	-	-	-
2	1	1	1	-	1	2	-	2	2	-	1	1	-	2	2	1	1	-	1	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-
2	1	2	2	1	-	1	2	2	1	-	-	1	2	2	1	1	1	1	-	-	1	-	-	1	-	-	1	-	-	1	-	-	1	-	-	1	-	-	1	-	-	1
1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1	-	1	-	1	-	-	-	-	-	-	-	-	-	1	-	1	1	-	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-	-	-	-	-	-	-	1	-	1
2	-	1	2	1	-	3	3	-	2	1	-	2	3	1	2	1	2	-	-	3	3	-	3	3	-	2	2	-	2	2	-	1	1	-	1	1	-	-	2	1	1	1
2	-	-	2	-	-	1	-	-	1	-	-	1	-	-	2	-	1	-	-	2	-	-	1	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-
1	-	-	1	-	-	2	-	-	1	-	-	2	-	-	2	-	1	-	-	1	-	-	-	-	-	-	-	-	-	-	-	1	-	-	2	-	-	1	-	-	1	-
1	-	-	-	-	-	-	-	-	-	-	-	1	-	-	1	-	1	-	-	1	-	-	1	-	-	1	-	-	2	-	-	1	-	-	1	-	-	1	-	-	1	-
2	-	-	-	2	-	-	3	-	-	1	-	-	1	-	-	1	2	-	-	-	2	-	-	2	-	-	2	-	-	1	-	-	1	-	-	-	-	-	-	-	-	-
2	-	-	2	-	-	1	-	-	2	-	-	1	-	-	2	-	1	-	-	2	-	-	1	-	-	2	-	-	-	-	-	-	-	-	1	-	-	-	-	-	2	-
1	-	1	2	-	1	-	-	1	2	-	1	-	-	2	2	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	2	-	-	-
1	-	1	2	-	-	1	-	1	1	-	-	1	-	1	2	-	1	-	1	1	-	-	1	-	-	1	-	-	1	-	-	1	-	-	1	-	-	1	-	-	1	-
1	1	1	1	2	1	-	1	1	-	1	1	-	1	1	-	1	1	-	1	-	1	1	-	-	1	-	1	1	-	-	-	-	-	-	-	1	-	-	-	1	-	1
1	-	1	1	1	1	1	1	2	2	1	1	1	1	2	1	-	1	-	1	-	-	-	-	-	-	-	-	-	1	-	-	-	2	-	-	-	-	-	1	-	-	-

7.1.4 Resource Problems

In the Lake Michigan basin proper, the following problem items are of major concern, and recognition should be given to their potential severity.

(1) municipal wastewater discharge
(2) industrial wastewater discharge
(3) land use
(4) shoreland erosion

These conditions indicate an urgent need for land use management in all areas. Wastewater treatment and erosion prevention for shorelines and streambanks are also of concern. Problems matrix for the Lake Michigan basin is shown on Table 1–76.

7.1.5 Existing Resource Use and Development

7.1.5.1 Water Withdrawals

Water is withdrawn from inland lakes, streams, ground water, and Lake Michigan itself to meet requirements of the following uses: municipally supplied water, self-supplied industrial, rural domestic and livestock, irrigation including cropland and golf courses, mineral production, and thermal power plants. As of 1970 approximately 13,770 million gallons of water per day (mgd) were withdrawn in the Lake Michigan basin for these purposes. Except for minor terminal-type reservoirs in a few locations, most of the water is withdrawn directly from the sources for use. Generally, there are adequate water resources in quantity as well as quality for these functions. In terms of quantity, Lake Michigan serves as the principal source of water withdrawals in the basin. Approximately 11,440 mgd were withdrawn as of 1970 from the Lake.

In 1970, about 10,519,000 persons in the Lake Michigan Plan Area were served by central water systems. About 7,554,000 persons were served from Lake Michigan; 175,000 were served by inland lakes and streams; and 2,790,000 were served by ground-water sources. Municipal water supply development and sources are summarized on Tables 1–77 and 1–78.

Industry in the Lake Michigan Plan Area utilized about 25 percent of the total water withdrawn by municipal systems in 1970, as illustrated on Table 1–77. Particularly heavy water uses occur in the area of major population concentrations in the Chicago and Indiana portions of PSA 2.2. Purification treatment is generally required of all surface water supplies, while ground-water supplies are disinfected and often receive some type of corrective treatment, such as softening and iron removal.

TABLE 1-76 (continued) Lake Michigan Basin, Resource Problems Matrix

Resource Use Category	LAKE MICHIGAN BASIN 2.0																																
		NW River Basin Group 2.1																											SW River Basin Group 2.2				
					Menominee Complex			Menominee Basin[2]			Peshtigo River Basin			Pennsaukee Complex			Oconto River Basin			Suamico Complex			Fox River Basin			Cheboygan Complex[3]					Chicago[4] Complex		
	Overall	Overall	Open Waters--GB[1]	Open Waters	Urban	Rural	Interface	Urban	Rural	Interface	Urban	Rural	Interface	Urban	Rural	Interface	Urban	Rural	Interface	Urban	Rural	Interface	Urban	Rural	Interface	Urban	Rural	Interface	Overall	Open Waters	Urban	Rural	Interface
WATER WITHDRAWALS																																	
MUNICIPALLY SUPPLIED	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	1	-	-	2	-	3	-	1
SELF-SUPPLIED INDUSTRIAL	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1	1	-	2	-	1
RURAL DOMESTIC & LIVESTOCK	1	-	-	-	-	-	-	-	1	-	-	1	-	-	-	-	-	-	-	-	-	-	-	1	-	-	1	-	1	-	-	2	-
IRRIGATION	1	1	-	-	-	1	-	-	1	-	-	1	-	-	-	-	-	1	-	-	-	-	-	1	-	-	1	1	-	-	-	-	-
MINING	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1	2	-
THERMAL POWER COOLING	1	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	2	1	1
NON-WITHDRAWAL WATER USES																																	
MUNICIPAL WASTEWATER DISCHARGES	2	2	1	-	1	-	-	1	-	-	1	-	-	-	-	-	1	-	-	1	-	-	2	-	-	2	-	-	1	1	2	-	1
INDUSTRIAL WASTEWATER DISCHARGES	2	2	1	-	1	-	-	1	-	-	2	-	-	-	-	-	1	-	-	2	-	-	2	-	-	2	-	-	2	1	3	-	1
HYDROELECTRIC POWER	1	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-
WATER ORIENTED OUTDOOR REC.	2	1	1	-	-	-	2	-	-	1	-	-	1	-	-	-	-	-	-	-	-	-	-	1	1	-	-	-	2	2	3	2	3
SPORT FISHING	1	-	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	2	2	3	2	2
RECREATIONAL BOATING	1	1	-	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	1	1	1	2	2	1	2	2	3
COMMERCIAL FISHING	1	-	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-
COMMERCIAL NAVIGATION	1	1	-	-	-	1	1	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	1	1	-	1	-	1
RELATED LAND USES & PROBLEMS																																	
LAND USE	2	2	-	-	-	-	2	-	1	2	-	2	1	-	2	1	-	2	1	-	1	1	1	2	1	1	2	2	3	-	3	3	3
AGRICULTURAL LAND TREATMENT	1	2	-	-	-	1	-	-	2	-	-	1	-	-	-	-	-	1	-	-	1	-	-	2	-	-	1	-	-	-	-	1	-
CROPLAND DRAINAGE	1	2	-	-	-	1	-	-	1	-	-	1	-	-	1	-	-	1	-	-	1	-	-	1	-	-	1	-	1	-	-	1	-
FOREST LAND TREATMENT	2	1	-	-	-	1	-	-	1	-	-	1	-	-	1	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-
SHORELAND EROSION	2	1	-	-	-	-	1	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	2	-	-	-	2
STREAMBANK EROSION	1	2	-	-	-	1	-	-	2	-	-	2	-	-	1	-	-	1	-	-	1	-	-	2	-	-	1	-	1	-	-	1	-
FLOOD PLAINS	1	1	-	-	-	-	-	1	1	-	1	1	1	-	-	1	-	1	1	-	-	1	2	2	1	1	-	-	1	-	2	1	-
WILDLIFE MANAGEMENT	1	1	-	-	-	1	-	-	1	-	-	1	-	-	1	-	-	1	-	-	1	-	1	1	-	-	1	-	2	-	1	3	2
AESTHETIC & CULTURAL	1	1	1	-	1	-	-	1	-	-	1	-	-	1	-	-	1	-	-	1	-	-	1	1	1	1	1	-	2	-	2	2	2
OUTDOOR RECREATION	1	1	-	-	-	-	2	-	-	1	-	-	1	-	-	-	-	-	-	-	-	-	-	1	1	-	-	-	2	-	2	2	2

[1]The full name of this area is Open Waters--Green Bay
[2]The full name of this area is the Menominee River Basin
[3]The full name of this area is the Cheboygan-Green Bay Complex
[4]The full name of this area is the Chicago-Milwaukee Complex
[5]The full name of this area is the Seul Choix-Groscap Complex

Legend:
3 Severe--Demands immediate attention
2 Moderate--Of major concern; potentially serious
1 Minor--Not considered a serious problem
- Problem is insignificant or not known

TABLE 1-77 Municipal Water Supply Development, Lake Michigan Plan Area (mgd)

PSA	State	1970 Average Demand: Domestic and Commercial	1970 Average Demand: Municipally Supplied Industrial	Total	Source Capacity
2.1	Michigan	4.2	0.9	5.1	7.7
	Wisconsin	48.5	39.2	87.7	284.3
2.2	Wisconsin	128.6	82.5	211.1	733.8
	Illinois	1,084.5	252.4	1,336.9	1,843.9
	Indiana	63.5	33.3	96.8	183.0
2.3	Indiana	33.6	11.6	45.2	145.7
	Michigan	132.6	88.2	220.8	331.1
2.4	Michigan	32.7	6.4	39.1	58.7
TOTAL	---	1,528.2	514.5	2,042.7	3,588.2

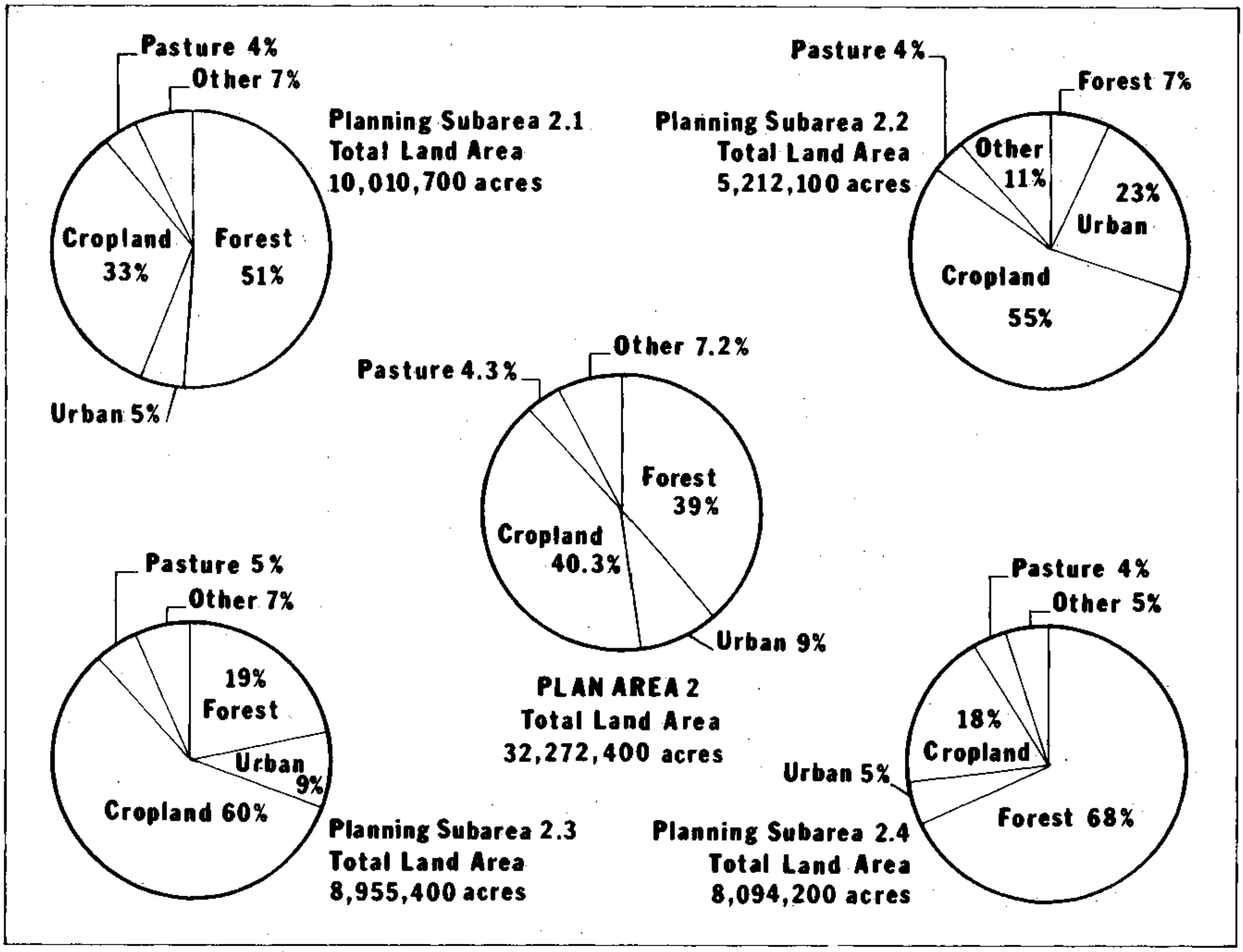

FIGURE 1–26 Land Use in the Lake Michigan Basin

TABLE 1–78 Water Sources for Municipal Water Supply, Lake Michigan Plan Area, 1970 (mgd)

PSA	State	Source Capacity	Water Source: Great Lakes	Water Source: Inland Lakes and Streams	Water Source: Groundwater
2.1	Michigan	7.7	1.8	1.9	4.0
	Wisconsin	284.3	78.8	76.4	129.1
2.2	Wisconsin	733.8	664.6	---	69.2
	Illinois	1,843.9	1,566.0	---	277.9
	Indiana	183.0	146.8	1.1	35.1
2.3	Indiana	145.7	---	---	145.7
	Michigan	331.1	139.1	---	192.0
2.4	Michigan	58.7	34.6	5.3	18.8
TOTAL	---	3,588.2	2,631.7	84.7	871.8

In 1967, the Lake Michigan Plan Area accounted for about 47 percent of the total value added by manufacturing for the entire Great Lakes Region. It also used approximatley 54 percent of total manufacturing water withdrawals. It is estimated that about 95 percent of the water self-supplied by manufacturers is taken from surface water supplies, primarily from Lake Michigan. The remainder is obtained from company-owned wells. Table 1–79 contains data on industrial water supply development.

Inland lakes and streams and ground water are the primary sources of rural water supplies for domestic, livestock, spray water, and nonfarm uses in the region. Table 1–80 shows developed source supply and consumptive use for the rural water supply in 1970.

In 1970 an estimated 344 mgd of water were supplied over a 100-day season to irrigate 21,590 acres of golf courses and 133,726 acres of high-value cropland in the Lake Michigan basin (Table 1–81). This is an annual average 94 mgd. Some of the high-value crops irrigated were potatoes, vegetables, orchards, and sod. Inland lakes and streams and ground water are the major water sources.

Water for primary mineral production is supplied principally from inland lakes and streams and ground water (Table 1–82). Information on minerals water supply in 1968 is shown in Table 1–83.

As of December 31, 1970, the 55 electric power generation plants of 10 megawatts capacity or more within the Lake Michigan basin included 34 fossil-fueled steam, 9 gas turbine, 5 hydroelectric, 5 internal combustion, and 2 nuclear-fueled steam electric plants. Table 1–84 provides information on electric power development. Plants that in 1970 were scheduled for construction had a total capacity of 9,530 megawatts and consisted of one pumped storage, 1,872 megawatts; six nuclear-fueled steam plants, 6,943 megawatts; two fossil-fueled steam plants, 681 megawatts; and one gas turbine plant of 34 megawatts. Virtually all condenser cooling systems operating in 1970 were of the flow-through type.

TABLE 1–79 Industrial Water Supply Development, Lake Michigan Plan Area, 1970 (mgd)

PSA	State	Gross Water Requirements[1]	Self-Supplied Withdrawals	Self-Supplied Consumptive Use
2.1	Michigan	1,079 [2]	9	1
	Wisconsin		311	36
2.2	Wisconsin	11,605 [2]	258	16.2
	Illinois		1,348	99.5
	Indiana		3,184	278.6
2.3	Indiana	1,260 [2]	48	5
	Michigan		406	42
2.4	Michigan	201	90	7.7
TOTAL		14,145	5,654	486

[1]Partially supplied by recirculation

[2]Figure is total for PSA

TABLE 1–80 Rural Water Supply, Lake Michigan Plan Area, 1970 (mgd)

PSA	State	Developed Source Capacity	Consumptive Use
2.1	Michigan	9.0	4.4
	Wisconsin	38.5	19.1
2.2	Wisconsin	28.1	7.2
	Illinois	39.8	10.2
	Indiana	19.7	5.1
2.3	Indiana	14.5	4.3
	Michigan	67.8	19.9
2.4	Michigan	16.8	4.8
TOTAL		234.2	75.0

7.1.5.2 Nonwithdrawal Water Uses

Some of the more serious water quality problems in Lake Michigan itself exist in the Green Bay area, southern Lake Michigan, and in the Grand Traverse Bay area. Major pollution problems are traceable to the effluents from forest products industries in the northern portion of the basin, to the lack of tertiary treatment, and in many cases, secondary treatment, in both public and private wastewater disposal systems, and to drainage from agricultural, urbanized, and natural lands. Because of the variance in treatment (or no treatment) for point sources of wastewater, and the complexities of nonpoint sources, a summary of the exact status of wastewater treatment cannot be made. The following stream segments are reported by the States to have priority for correction of water quality deficiencies:

(1) River Basin Group 2.1

(a) Fox (Green Bay) River—from upper dam at Appleton to Green Bay

(b) Green Bay—southeast from navigation channel and southeast from north line of Brown County

(2) River Basin Group 2.2

(a) Honey Creek—Milwaukee County, Wisconsin

(b) Indian Creek—Milwaukee County, Wisconsin

(c) Kinnickinnic—Milwaukee County, Wisconsin

TABLE 1-81 Irrigation Water Supply, Lake Michigan Plan Area, 1970, estimated

	Agriculture			Golf Courses		
		Withdrawal (mgd)			Withdrawal (mgd)	
PSA	Acres	100-Day Season	Annual	Acres	100-Day Season	Annual
2.1	28,282	49.5	13.6	4,700	22.1	6.0
2.2	14,689	26.7	7.3	12,100	56.9	15.6
2.3	62,956	117.7	32.2	4,600	21.6	5.9
2.4	27,799	48.9	13.4	190	0.9	0.3
TOTAL	133,726	242.8	66.5	21,590	101.5	27.8

TABLE 1-82 Source of New Water Used by Mineral Industries, Lake Michigan Plan Area, 1968, estimated (mgd)

New Intake	April-November	Average for 365 Days
Streams	16.0	11.7
Lakes	9.6	7.4
Ground Water	15.9	10.7
Mines	4.0	3.3
Purchased	0.3	0.3
Other	0.1	0.1
TOTAL	45.9	33.5

TABLE 1-83 Minerals Water Supply, Lake Michigan Plan Area, 1968, estimated (mgd)

		New Water Intake		
PSA	Total Water Requirements[1]	Seasonal	Annual Average	Consumptive Use[2]
2.1	16.5	2.6	2.2	1.4
2.2	38.0	21.9	16.0	0.6
2.3	28.7	16.3	10.9	0.3
2.4	6.6	5.1	4.4	0.1
TOTAL	89.8	45.9	33.5	2.4

[1]New water intake plus recirculated (seasonal)

[2]Annual average

(d) Menomonee River—Milwaukee County, Wisconsin below confluence with Honey Creek

(e) Milwaukee River—Milwaukee County, Wisconsin, downstream from North Avenue Dam

(f) South and Menomonee Canal and Burnham Canal—Milwaukee County, Wisconsin

(g) Underwood Creek—Milwaukee County, Wisconsin

(h) Pike River—Racine County, Wisconsin

(i) Calumet River—Indiana

(j) Deep River—Indiana

(k) Little Calumet River—Indiana

(3) River Basin Group 2.3

(a) Upper Pigeon Creek—Indiana

(b) Turkey-Baugo Creeks

(c) Upper Elkhart River—Indiana

(d) Lower Elkhart River

(e) Little Elkhart-Lower Pigeon River

(f) St. Joseph River—main stem

(g) Red Cedar River—Michigan, East Lansing to confluence with Grand River

(h) Kalamazoo River—Michigan, Comstock to Kalamazoo County-Allegan County line including Portage Creek below Cork Street, Kalamazoo

(i) Battle Creek—Michigan, Charlotte to ten miles downstream

(j) St. Joseph River—Michigan, Hillsdale to Jonesville

(k) Grand River—Michigan, Jackson to Ingham County line and Lansing to Grand Ledge

(4) River Basin Group 2.4—none reported

TABLE 1-84 Electric Power Development, Lake Michigan Plan Area

	Type and Capacity (MW)					
PSA	Hydro-electric	Internal Combustion and Gas Turbine	Fossil Steam	Nuclear Steam	Total	Steam Electric Water Withdrawal (mgd)
2.1	150	47	989	524	1,710	669
2.2	---	283	6,125	---	6,408	3,208
2.3	36	217	2,116	---	2,369	1,079
2.4	87	67	616	75	845	471
TOTAL	273	614	9,846	599	11,332	5,427

TABLE 1–85 Municipal and Industrial Wastewater Flows, Lake Michigan Plan Area, 1970

PSA	State	mgd Municipal	Industrial
2.1	Michigan	4.7	9.0
	Wisconsin	87.7	310.0
2.2	Wisconsin	211.1	321.0
	Illinois	7[1]	20
	Indiana	113.6	2,953.0
2.3	Indiana	71.9	25.8
	Michigan	170.0	220.0
2.4	Michigan	27.0	82.3
TOTAL	---	693	3,941

[1]Work is underway to cease discharging to Lake Michigan, and divert out of the Basin.

The growth of algae due to nutrients has caused nuisance conditions in locations on the southern end of Lake Michigan. This problem can be partially relieved by adequate treatment facilities. Sedimentation, thermal input, watercraft discharge, and oil spills detract from the water quality of the Lake. The Lake Michigan basin falls under the jurisdiction of the Federal-State conference on Lake Michigan.

Table 1–85 shows the 1970 municipal and industrial wastewater flows discharging into Lake Michigan drainage.

Except during extreme flood conditions, the City of Chicago and State of Illinois divert the natural drainage from about 810 square miles of the Lake Michigan basin and waste flows from the Chicago area into the Illinois River, to keep from burdening the Lake with the waste contents of those waters. Under the limitations set by the U.S. Supreme Court for water diversion from the Lake Michigan watershed by the State of Illinois, total withdrawal is limited to an average over a five-year accounting period of 3,200 cubic feet per second (cfs), or 2,068 mgd. This includes pumpage for municipal and industrial water supply and diversion for navigation and waste assimilation purposes.

Wastewater from the City of Hammond, Indiana, and the area it serves is also normally diverted from the Lake Michigan drainage area to the Upper Mississippi River Basin. Occasionally the Grand Calumet River reverses and flows into Lake Michigan.

Current fisheries programs involve protection and improvement of natural resources, direct manipulation of fish population, maintenance planting, and some indirect continuing control of the sea lamprey. While both sport and commercial fisheries are affected in Lake Michigan, the latter is subordinated to the former at the present time. Occasionally the alewife die-off creates problems along the beaches of Lake Michigan. However, the alewife population is a source of food for predators. Table 1–86 illustrates the current situation as of about 1970.

Because of the large numbers of boaters, many areas, particularly in the southern portion of the Lake Michigan basin, are overcrowded. Table 1–87 illustrates the existing development of recreational boating in the basin.

There are 29 Federal commercial harbors and 7 private commercial harbors on Lake Michigan. Total traffic handled, including receipts and shipments, is over 100 million tons annually. The com-

TABLE 1–86 Sport Fishery Uses, Lake Michigan Plan Area, 1970

PSA	State	Ponded Waters (acres)	Fishing Licenses Resident	Non-Resident	Angler Days (1000)
2.1	Michigan	35,427	10,472	9,848	110
	Wisconsin	278,102	176,617	48,548	10,900
2.2	Wisconsin	37,963	180,016	30,801	1,229
	Illinois	30,364	273,520	1,267	1,617
	Indiana	4,826	60,638	3,615	320
2.3	Indiana	27,871	66,914	7,932	834
	Michigan	104,756	242,417	58,821	4,566
2.4	Michigan	285,565	129,846	51,359	8,678
TOTAL	---	804,874	1,140,440	212,101	28,254

TABLE 1-87 Recreational Boating Development, Lake Michigan Plan Area, 1969

PSA	State	Lake Michigan Harbors	Access Sites	Total No. of Boats	Total Boat Days in Use
2.1	Michigan	2[1]	25	161,000	4,440,000[3]
	Wisconsin	32[2]	590		
2.2	Wisconsin	6	0	97,400	1,280,000[3]
	Illinois	17	0		
	Indiana	7	0		
2.3	Indiana	0	40	120,600	3,516,000
	Michigan	9	130		
2.4	Michigan	23	257	121,800	3,543,000
TOTAL	---	96	1,042	500,800	12,779,000

[1]Menominee Harbor counted only in Michigan

[2]Nine harbors on Lake Winnebago also have access to Lake Michigan

[3]Total for PSA

TABLE 1-88 Agricultural Land Treatment Needs, Lake Michigan Plan Area, 1970 (thousands of acres)

PSA	Cropland	Pasture Land	Other Land	Total
2.1	1,702.3	269.6	253.5	2,225.4
2.2	1,800.5	147.0	222.7	2,170.2
2.3	3,060.6	351.3	127.6	3,539.5
2.4	632.1	263.0	122.9	1,018.0
TOTAL	7,195.5	1,030.9	726.7	8,953.1

TABLE 1-89 Drainage Limitations in the Lake Michigan Plan Area (thousands of acres)

PSA	Total Land Area	Agricultural Land	Drainage Problems Severe	Drainage Problems Some
2.1	10,010.7	3,680	276	461
2.2	5,212.1	3,077	161	331
2.3	8,955.4	5,822	314	586
2.4	8,094.2	1,834	121	58
TOTAL	32,272.4	14,413	872	1,436

mercial and industrial development around the southern end of the Lake has built up largely on the base of water transport.

7.1.5.3 Related Land Uses and Problems

Of the 32.3 million acres of land in the area, about 13 million were cropland in 1970. Conservation measures have been applied to much of the agricultural land with the assistance of the Department of Agriculture's Soil Conservation Service, which acts through local soil and water conservation districts. Land still not included in conservation programs and which could profit from such programs is listed in Table 1-88.

A significant part of the benefits from land treatment measures comes from preventing erosion and the resulting transport and deposition of sediment. Besides being detrimental to water quality, erosion hastens the loss of existing land and natural resources, agricultural improvements, and urban development. Particularly intense erosion conditions occur in southern portions of River Basin Group 2.1 due to intensified agriculture and intense rainfall. River Basin Group 2.3 suffers from significant amounts of erosion and sedimentation due to the presence of highly erodible soils, slopes and other relief characteristics, relatively intense rainfall, and extensive cultivation of cropland. Estimated gross erosion rates range from about 2 tons per acre in the northern edge of this area to more than 6 tons in the southwestern part. In RBG 2.4 erosion and sedimentation rates are the highest in the western parts of the planning subarea. Significant reasons for this are the concentration of fruit farming along the western shore areas and the present management practices of clean cultivation during much of the growing season.

Approximately 2.3 million acres of agricultural land in the Lake Michigan basin have a drainage

TABLE 1–90 Approximate Forested Land Area and Ownership, Lake Michigan Plan Area (thousands of acres)

Area	National	State, County, and Private
PSA 2.1	763.0	4,296
PSA 2.2	---	337
PSA 2.3	4.0	1,703
PSA 2.4	992.5	4,504
TOTAL	1,759.5	10,840

problem (Table 1–89). This is only about 7 percent of its drainage area, but the total acreage is second only to Lake Erie basin in total acres of drainage problems. Nearly 900,000 acres of cropland and pastureland have a severe problem with no drainage improvements installed; there are also approximately 1.4 million acres of land with a drainage problem on which some drainage improvements have been installed. These installations have not been maintained and are not adequate to provide the needed drainage for cropland.

Drainage limitations not only affect agricultural production potential, but also may limit urban growth in the Lake Michigan basin. In ten of the SMSAs in the Lake Michigan basin, the portions which are not yet in an urban built-up category have moderately wet soils that would create problems for future development. These soils will need internal and supplementary drainage in order to be developed for urban purposes. Generally speaking, the majority of the SMSAs located in the Lake Michigan basin have wetness problems on 30 percent to 45 percent of their nonurban lands.

Approximately 39 percent, or 12.6 million acres, of the study area is forest. From north to south, the extent of land in forest decreases, from nearly complete forest cover in the north to farm woodland in the south.

Portions of five national forests are located within the Lake Michigan basin. The total gross area within national forest boundaries in the basin is 3.2 million acres (Table 1–90).

Conservation and treatment that consist of reforestation, forest stand improvement, grazing control, erosion control, improved harvesting, urban forestry, and multiple land-use planning, are presently considered to be adequate over 4.4 million acres, or 41 percent of the non-Federal forest lands in the Lake Michigan basin. Forest land treatment practices are also extensive on national forests and other Federal lands, but no estimate is available of the percentage which is considered to be adequately treated at present.

Of the 1,362 miles of Lake Michigan shoreline, about 590 miles were classed in 1970 as subject to erosion (Table 1–91). Estimates for 1973 conditions are greater. For the State of Michigan about 450 miles were classed as "high risk" in 1973, compared with 80 miles critical and 300 miles noncritical in 1970. (Critical erosion implies economic consequences great enough to warrant protective measures. High risk connotes probability of occurrence.) Structural protective measures have been provided by the U.S. Army Corps of Engineers under its authority for beach erosion control, and by private and commercial shore property owners.

At present the use and development of the shorelines in northwestern Indiana and eastern Illinois are largely commercial and industrial. This use gives way to permanent and seasonal residential development north to an approximate line from Frankfort, Michigan, to Sturgeon Bay, Wisconsin. From this line northward, including the Upper Peninsula of Michigan, the shoreline has less development, with agricultural and forest lands predominating. Distribution of shoreland use and

TABLE 1–91 Lake Michigan Shoreline Conditions, 1970 (miles)

PSA	State	Total Shoreline	Subject to Erosion: Critical	Subject to Erosion: Noncritical	Subject to Erosion: Protected	Subject to Flooding	No Problem
2.1	Michigan	61	0	39.0	0	22.0	0
	Wisconsin	315	0	98.6	20.4	62.4	133.6
	Total	376	0	137.6	20.4	84.4	133.6
2.2	Wisconsin	92	26.0	47.6	18.4	0	0
	Illinois	65	10.5	0	54.5	0	0
	Indiana	45	13.0	9.6	22.4	0	0
	Michigan	23	0	23.0	0	0	0
	Total	225	49.5	80.2	95.3	0	0
2.3	Michigan	85	38.6	45.2	1.2	0	0
2.4	Michigan	676	42.0	194.4	45.1	56.3	338.2
TOTAL	---	1,362	130.1	457.4	162.0	140.7	471.8

TABLE 1-92 Streambank Erosion in the Lake Michigan Basin, 1970

		Bank Miles of Damage		Annual Damages ($)			
PSA	State	Severe	Moderate	Land Loss	Sedimentation	Other	Total
2.1	Wisconsin Michigan	151 9	875 323	27,000	4,700	28,000	59,700
2.2	Wisconsin Illinois Indiana	8 7 3	27 36 10	15,000	800	15,300	31,100
2.3	Indiana Michigan	46 257	267 495	35,700	13,400	15,900	65,000
2.4	Michigan	554	722	34,900	10,900	32,800	78,600
TOTAL	---	1,035	2,755	112,600	29,800	92,000	234,400

TABLE 1-93 Estimated Flood Damage, Lake Michigan Basin, 1970

		Estimated Average Annual Damages ($)		Estimated Acres in Flood Plain	
RBG	State	Urban	Rural	Urban	Rural
2.1	Michigan	191,560	31,801	1,571	55,228
	Wisconsin	2,143,450	1,167,406	12,069	592,727
2.2	Wisconsin	280,500	191,650	2,198	54,386
	Illinois	---	---	---	---
	Indiana	8,419,180	38,700	2,200	3,865
2.3	Indiana	397,800	28,000	3,413	14,956
	Michigan	2,542,830	1,961,690	46,222	266,332
2.4	Michigan	98,800	147,132	3,235	112,592
TOTAL		14,074,120	3,566,379	70,908	1,100,086

ownership for each of the four States bordering Lake Michigan is shown in Table 1-40.

Table 1-92 shows the extent of streambank erosion problems in the Lake Michigan basin.

About 1.1 million acres of urban and rural flood plain in the basin are subject to over $17 million of average annual damages, based on 1970 conditions of economic development (Table 1-93).

There are few major Federal flood control projects within the Lake Michigan basin. Measures which characterize the flood protection throughout the Lake Michigan basin include channel diversions, channel improvements, levees and floodwalls, institutional measures, and land treatment areas. Major flood damage protection measures have been instituted in all river basin groups in the Lake Michigan basin except RBG 2.4.

Nearly 90 percent of the Lake Michigan region is considered capable of supporting wildlife (Table 1-94). A high percentage of the habitat area is considered huntable, and much is used by both hunters and nonhunters.

Lake Michigan shoreland includes approximately 175,000 acres of shoals and wetlands. Some 140,000 acres are considered to be extremely important fish and wildlife habitat.

While the open waters of the Lake are used primarily as waterfowl resting areas, shoals and marshes are used for resting, nesting and feeding. The Lake Michigan basin is one of the most important basins in the production of waterfowl in the Great Lakes Basin. Figure 1-27 indicates primary waterfowl areas of the shoreline and wetland regions over the basin.

In an inventory of outstanding, unusual, and significant aesthetic and cultural features in the Lake Michigan basin, 1,400 items in 27 categories were identified. Environmental systems of the Lake Michigan basin in most critical need of planning attention are identified in Appendix 22, *Aesthetic and Cultural Resources.* They include buffer zones, shore zones, and linkage corridors. The projected increase in urban development through 2020 makes it urgent that immediate planning attention

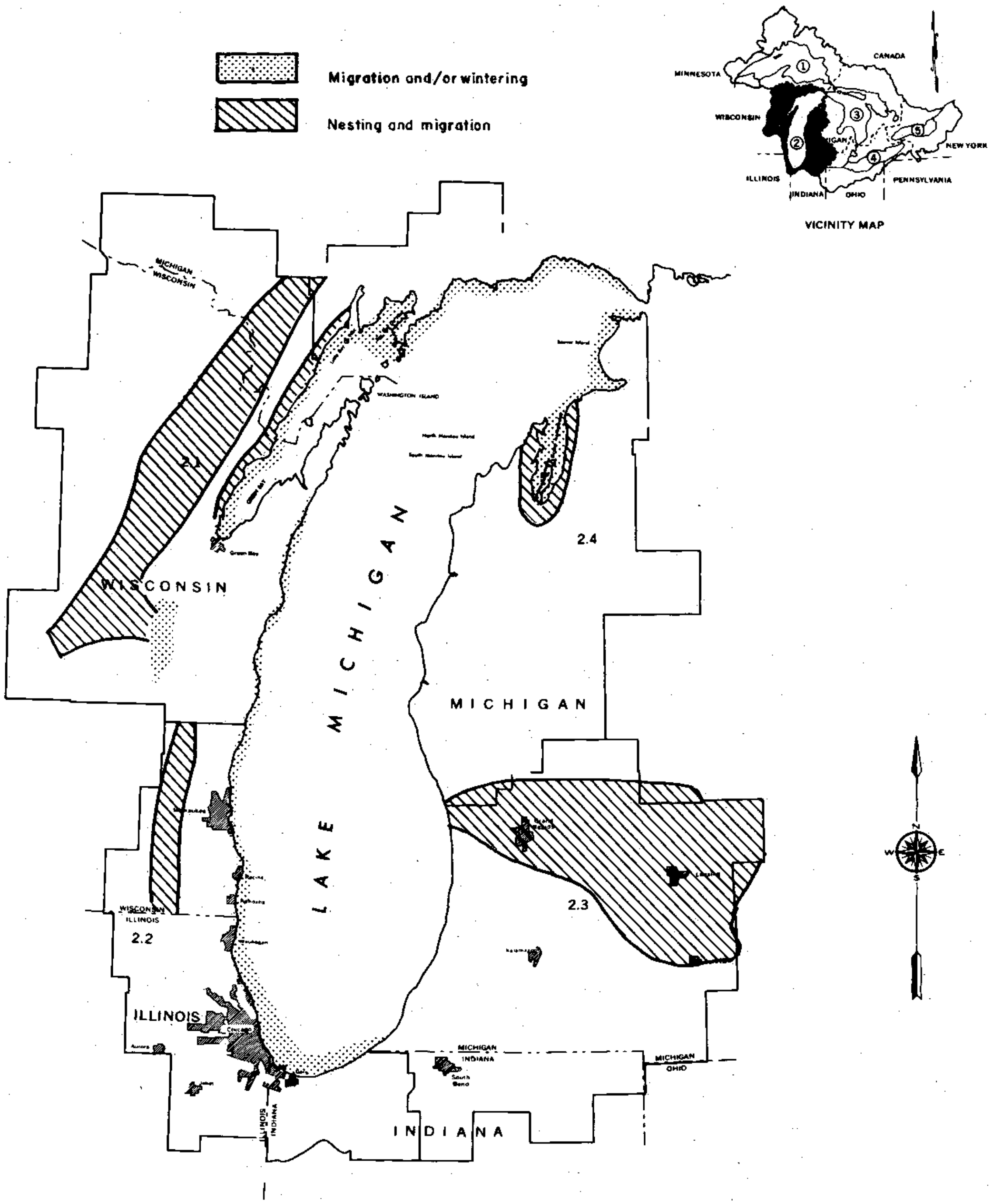

FIGURE 1–27 Primary Waterfowl Use Area, Plan Area 2

be given to all river basin groups in the Lake Michigan basin, particularly RBG 2.2 and RBG 2.3.

Forested lands, large expanses of dunes and beaches, and hundreds of inland lakes are the natural foundations on which much of the Lake Michigan basin's outdoor recreation activities are built.

The forest environment is a significant factor in the basin's recreational attraction. More than four

TABLE 1-94 Wildlife Habitat in the Lake Michigan Plan Area, 1960

PSA	State	Total Land Area (acres)	Farm Habitat Acres	Farm Habitat % of Total Land	Forest Habitat Acres	Forest Habitat % of Total Land	Total Habitat (acres)
2.1	Michigan	1,889,800	179,800	10	1,641,500	87	1,821,300
	Wisconsin	8,120,900	4,044,500	50	3,370,500	42	7,415,000
2.2	Illinois	2,367,300	1,466,500	62	148,100	6	1,614,600
	Indiana	1,174,300	846,800	72	131,000	11	977,800
	Wisconsin	1,670,500	1,232,900	74	158,900	10	1,391,800
2.3	Indiana	1,580,400	1,249,900	79	145,000	9	1,394,900
	Michigan	7,375,000	5,216,900	71	1,081,500	15	6,298,400
2.4	Michigan	8,094,200	1,701,700	21	5,905,900	73	7,607,600
TOTAL	---	32,272,400	15,939,000	49	12,582,400	39	28,521,400

NOTE: The area of the land resource base, made up of the farmland and forest land, and reported elsewhere, is based on 1966-1967 measurements and estimates. Habitat is based on 1960 information and estimates. In some instances changes in land use result in habitat being recorded as greater than the corresponding land base in the PSA or State.

TABLE 1-95 Amount, Ownership, and Recreational Potential of Great Lakes Beaches, Lake Michigan Plan Area (acres)

	Publicly Owned Beaches			Privately Owned Beaches				
	Usable			Open to Public		Not Open to Public		
PSA	Open to Public	Restricted	Not Usable	With Charge	Without Charge	Potential for Development	Little/No Potential	Total
2.1	137.5	3.9	0.8	0	0	64.2	223.6	430.0
2.2	570.2	72.4	53.9	26.8	0	202.6	116.6	1,042.5
2.3	215.5	0	0	0	0	426.6	198.9	841.0
2.4	293.1	0	0	0	0	497.3	121.0	911.4
TOTAL	1,216.3	76.3	54.7	26.8	0	1,190.7	660.1	3,224.9
%	37.7	2.4	1.7	0.8	0	36.9	20.5	

million acres of forest lands are publicly owned, with nearly two million acres in national forests, 1.6 million acres in State forests, and one-half million acres owned by local governments. From north to south, the extent of forested land decreases, from about 90 percent in the northern one-third to less than 20 percent in the southern sections. About 40 percent of the forest land in Michigan's Upper Peninsula is publicly owned, while in the northern Lower Peninsula, about 35 percent of the forest is in public ownership.

Lake Michigan has some of the finest beaches on the Great Lakes, particularly along its eastern shore. Of the total of over 3,100 acres, about 1,200 acres are publicly owned and available for use, and an additional 1,200 acres in private ownership have some development potential for public use (Table 1-95).

Islands in Lake Michigan that provide an excellent base for recreational use and development include (1) the Green Bay Islands, containing more than 22,000 acres of land in the northern part of the Lake, (2) North and South Manitou Islands, included as part of the Sleeping Bear Dunes National Lakeshore, and (3) the Beaver Islands, an eight-island area which is approximately one-third publicly owned.

There are several areas within this basin possessing such high recreational value that they were recently authorized for acquisition by Congress. Areas presently being acquired include Sleeping Bear Dunes National Lakeshore (Michigan), and Indiana Dunes National Lakeshore (Indiana). The Ice Age National Scientific Reserve in Wisconsin has been authorized. Acquisition is a State responsibility. Portions of the Wolf River (Wisconsin) and the Pere Marquette River (Michigan) have been designated as components of the National Wild and Scenic Rivers System. Other rivers in the Lake Michigan basin being considered for designation as wild, scenic, or recreational rivers by either the Federal or State governments include the Little Manistee, Manistee, Pine, Escanaba, Whitefish, Manistique, and Muskegon in Michigan; the Pike, Pine, Wolf, Brule, and Popple Rivers in Wisconsin; the Fox River in Illinois; and the Elkhart in Indiana.

In spite of the extensive recreational resources in the Lake Michigan basin, there are also many problems associated with recreation here. In the

TABLE 1-96 Land and Water Surface Usable for Recreation in the Lake Michigan Plan Area, 1970 (thousands of acres)

PSA	Land	Lake Michigan	Inland Lakes	Total
2.1	1,300.0	245.0	251.0	1,796.0
2.2	122.4	124.0	69.0	315.4
2.3	80.0	69.0	106.0	255.0
2.4	2,200.0	451.0	228.0	2,879.0
TOTAL	3,702.4	889.0	654.0	5,245.4

heavily urbanized area the tendency is for the recreational land to be converted to uses which produce greater income and remove it from the recreation category, thus further depleting the recreational opportunities in this area where they are so badly needed. This problem is accentuated by the fact that the recreation business is affected quickly and sharply by changes in the economic situation so that it is relatively unstable, and a lowering of the general economic level of the region and the nation reduces to an even greater extent the stability of the recreation industry.

Furthermore, the proximity of the recreation facilities just north of the heavily urbanized areas means that these are quickly overcrowded on weekends and holiday periods by persons moving into them from the cities. The population of the Chicago urban complex flows up both sides of Lake Michigan into the recreation areas farther north, saturating all of the immediately adjacent area on the way, and the population of the heavily urbanized Detroit area floods into the northern part of Michigan.

The latter situation is also affected by the fact that while the north and south interstate highway system is developed through the Lower Peninsula of Michigan, the feeder roads into the recreation areas on both sides, particularly toward the Lake Michigan side, are not highly developed. Traffic problems on these roads are almost as great as the problems at recreation facilities themselves.

Although there are hundreds of inland lakes in the Lake Michigan basin, the shores of many, especially in the southern part of the basin, have been heavily developed for permanent and summer residence. These lakes contain an undetermined amount of beach area that probably measures into the thousands of acres.

Land and water available for recreation use in the Lake Michigan basin are shown in Table 1-96. The land is in public ownership, under Federal, State, county, and local governments.

Planning Subarea 2.1 contains large tracts of public forest lands and many inland lakes. Lake Winnebago, Wisconsin's largest inland lake, lies in the southern portion of the area. In addition, some of the recreational resources are of national significance.

Within the boundaries of Planning Subarea 2.2, there are five standard metropolitan statistical areas, including Chicago, the largest city in the Great Lakes Basin, Gary-Hammond-East Chicago, Kenosha, Milwaukee, and Racine. Amid this highly urbanized setting are found recreation resources which, because of their proximity to millions of people, are quite significant. The many inland lakes in Wisconsin's portion, the dunes along southeastern Lake Michigan, and the Lake Michigan shoreline form the major elements of the area's recreation resource base.

Planning Subarea 2.3 contains many miles of picturesque Lake Michigan shoreline, numerous lakes, and several outstanding recreation areas, including the Waterloo Recreation Area, Yankee Springs Recreation Area, and the Allegan State Forest.

Planning Subarea 2.4 possesses many high-quality recreation areas, including Sleeping Bear Dunes, Grand Traverse Bay, and the adjacent shoreline. Large areas of public forest lands are also located here, including the Manistee and Hiawatha National Forests, and a number of State forests. The Big Bay de Noc area of the Upper Peninsula is important both as a waterfowl area and as an area of significant aesthetic values.

The existing developed supply of recreation areas is shown in Section 12 on Table 1-204. This table also shows projected needs and outputs from the Proposed (PRO) Framework for the Lake Michigan basin developed from the frameworks for RBGs 2.1, 2.2, 2.3, and 2.4.

7.2 Frameworks for River Basin Group 2.1

7.2.1 Summary

Under normal growth conditions the 1970 population of 1,005,023 in PSA 2.1 is projected to increase to 1,527,000 by year 2020. Total employment is estimated to increase from 371,022 in 1970 to 672,400 in 2020. Agriculture, forestry, and fisheries are expected to decrease nearly one-half in the 50-year period. Mining will increase about 50 percent but remain minor, and manufacturing is expected to increase nearly 65 percent. Services and other industries will more than double. Tables 1-250, 1-251, and 1-252 (found in Section 12) summarize the Normal (NOR) Framework and costs.

The northwest portion of the Lake Michigan basin will continue to have recreational development to take advantage of the natural resources of the area.

The population is just over half urban, and the proportion will no doubt increase, following national and Basinwide trends. There are two SMSAs in the river basin group—Green Bay, and Appleton-Oshkosh, both in Wisconsin. Together they contain about 43 percent of the population of the PSA.

The availability of water has not been a bar to any development for which other factors were favorable, but the quality of water is seriously degraded in the streams below some of the industries, particularly food processing, beverages, chemicals, paper products, and primary metals. This is particularly true along the lower Fox River, but a similar problem exists along the Oconto, Peshtigo, and Menominee Rivers.

The Normal Framework provides for correcting conditions which have caused the degraded water quality, by alleviating flood damages, providing land treatment and drainage, and providing shoreland protection. These are corrective measures. NOR also provides for increased recreational opportunities, expansion of recreational boating, enhancement of fish and wildlife habitat for improved conservation in these fields, and the provision of water supplies for all uses to meet the needs of a balanced development.

7.2.2 The Area

River Basin Group 2.1 lies in the northwest portion of the Lake Michigan basin in the States of Michigan and Wisconsin. It includes four river basins and four complexes made up of smaller basins. The planning subarea includes three counties in Michigan and twenty counties in Wisconsin (See Subsection 1.2).

Topographically, the area is rolling to hilly, with moderate relief, but some isolated hilly to mountainous areas of high relief occur in Iron and Dickinson Counties, Michigan, where the elevations range from 1,000 to 2,000 feet above sea level. Drainage is generally from northwest to southeast, but the Fox River in its lower reach runs in a northeasterly direction into Green Bay.

Four general areas associated with land types are the heavily populated commercial-industrial complex in the area around Oshkosh and Green Bay; the intensively farmed area in the southern and eastern part of the river basin group; the largely forested, heavily used recreation area in the northern and western portion; and Door County, east of Green Bay, a heavily used recreation area with very shallow soil cover and potential ground water pollution problems due to the creviced limestone.

The area has a continental climate with extremes of heat and cold in the summer and winter. Growing season ranges from about 80 days in the northwest to 160 days in the southeast. Precipitation averages about 28 to 32 inches per year. Runoff averages 10 to 15 inches annually. Snow covers the ground in practically all the winter months, and most streams are ice covered from late November until late March. Surface-water supplies and ground-water supplies are both abundant.

The most prevalent minerals in the river basin group are nonmetallic: sand, gravel, clay, and limestone. These are used for building and road construction. In Iron and Dickinson Counties, Michigan, there are deposits of iron ore which have been and are presently being mined. The reserves, both metallic and nonmetallic minerals, are believed to be great.

Seven counties in the heavily forested, lightly populated area north of Green Bay lost population between 1960 and 1970. The heavily populated counties in the Green Bay-Lake Winnebago area all had a considerable increase in population, and the planning subarea showed a net gain over all.

The area is shown in Figure 1–28. Statistical information about the river basin group and planning subarea is given in Section 1.

7.2.3 Projected Resource Needs and Problems

Future demands or requirements upon the resources were projected in Section 3.

Needs determined for resource uses by time level are shown on Table 1–250 on Section 2. Where needs can be quantified, they are not discussed in the text unless special conditions warrant such discussion.

Problems in RBG 2.1 relate primarily to the impact of people on land and water. Waste treatment facilities have not kept pace with growth, and stream quality has been degraded.

Increasing amounts of sediment and nutrients are being added to the streams and lakes from urban growth, highway construction, improperly maintained streambanks and lakeshores, and agricultural activities adjacent to the streams or lakes. The popularity of many of the lakes for recreation and permanent home sites has caused lake pollution and pollution of the ground-water aquifers.

Fish and wildlife habitat has been destroyed through expansion of industrial and urban development, by changes in land use, and by the deteriorated water quality from wastes put into the streams. This water quality deterioration has expanded also to Lake Michigan itself, principally in the Green Bay area.

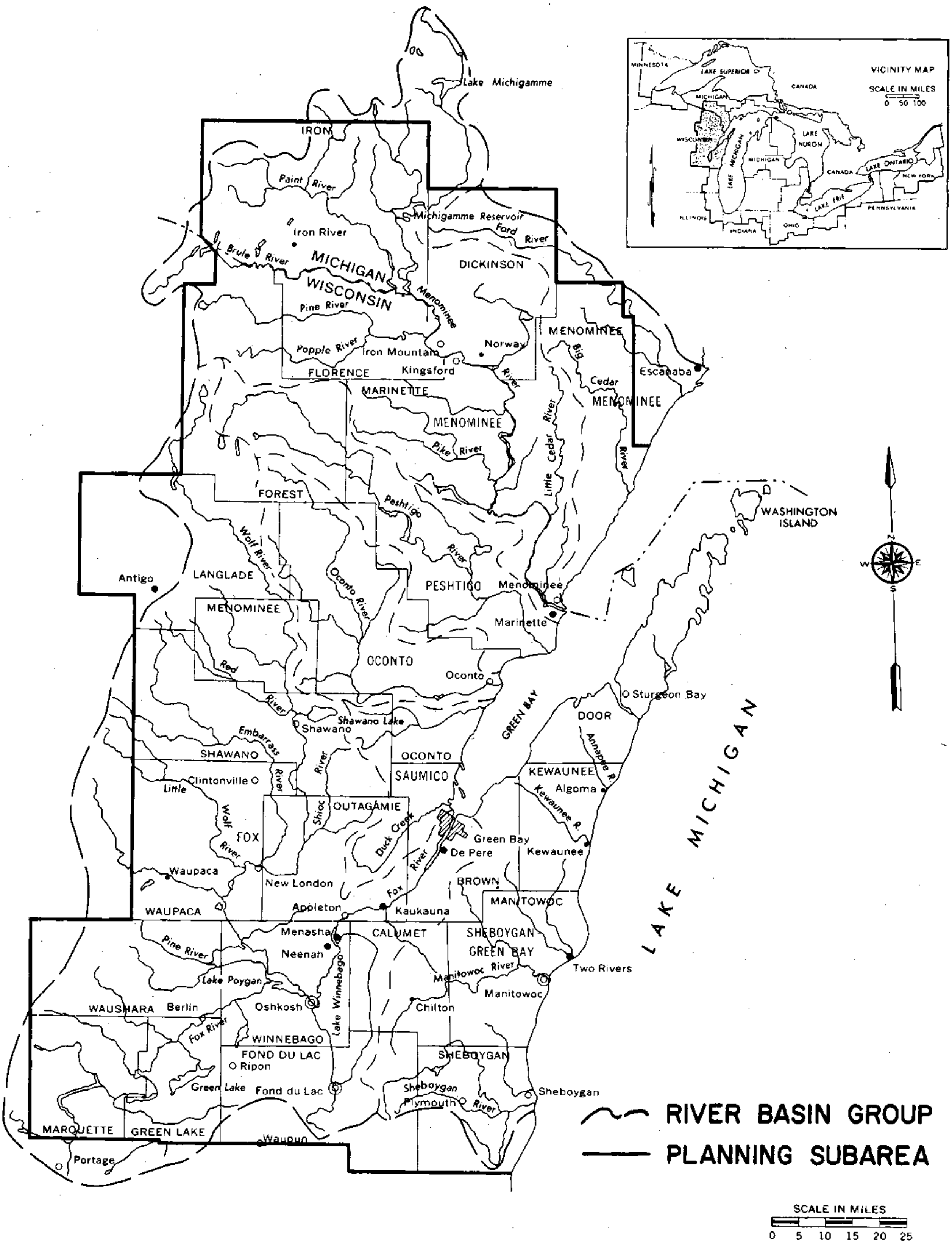

FIGURE 1–28 Lake Michigan Northwest, River Basin Group 2.1

TABLE 1–97 Use and Projected Needs for Recreational Boating, PSA 2.1

Cateogry	1000 Boating Days Great Lakes Waters	Inland Waters
1970 Use	330	4,110
1980 Needs	450	300
2000 Needs	600	1,020
2020 Needs	780	2,010

7.2.3.1 Water Withdrawals

The needs in the water withdrawal category have been developed along conventional lines, and no particular problems exist. Adequate water sources are available. In many cases there is an opportunity for choice among sources to meet a particular need.

7.2.3.2 Nonwithdrawal Water Uses

The problem of unsatisfactory water quality points up the most significant aspect of nonwithdrawal water uses, that of the need for treatment of wastewater, both municipal and industrial. There are no peculiar problems associated with this need, except that industries such as wood pulp or food products generate very high oxygen demand in the wastes. Techniques for adequate treatment are available. Of the over 30 hydroelectric developments in RBG 2.1, only 2 plants are over 10 megawatts in capacity. No additional installations are anticipated.

The river basin group has a wealth of water area and outdoor recreational opportunities, but it has the usual problems involving competing land use, pollution, and questions of recreational development or preservation and protection. None of these is unusual. The inland lakes and upland streams provide high quality fisheries, but the deteriorated water quality in the lower reaches of the rivers prevents fisheries from developing in this area. This is one of the problems which must be resolved. The high-quality recreational boating in the area induces a large number of people to come in from outside, adding to the already high concentration of local boaters. Table 1–97 shows recreational boating use in PSA 2.1 and projects future needs. There are opportunities for additional development on inland waters, including the portion of the Fox River between Lake Winnebago and Green Bay, which was initially improved in the interest of commercial navigation and which may now be available for recreational boating. Development of suitable facilities along the Lake Michigan shore is also a possible solution. The commercial fishery is faced with the usual problems in the Great Lakes: the question of management alternatives, the competition for riparian lands where shore-based facilities could be established, and the need for technological improvement in fishing gear and processing techniques. The basic question is the way in which commercial fishing will be handled as part of the total fishery management in the Great Lakes Basin.

Commercial navigation will be influenced by the overall treatment of this resource throughout the Great Lakes Basin. The major receipt in the area has been coal, and the principal shipments have been lumber, newsprint, pulp, and paper. It is not anticipated that changes in the size of ships or the length of navigation season will significantly affect this area.

7.2.3.3 Related Land Uses and Problems

No peculiar problems exist in the area. The maintenance of the soil resource in the agricultural area requires constant surveillance, and treatment measures are needed. There are areas where excess water on the surface or in the soil profile is a problem, and drainage will alleviate this problem and permit increased crop production at lower production costs.

The long-term trend in forest land is toward a declining acreage, as forest land gives way to highways, power lines, reservoirs, and urban, recreational, and industrial developments. The challenge is to satisfy increasing demand for goods and services from a declining forest resource base. All of the acreage now available will be needed in the future. Management efforts and forest land treatment must be intensified.

Shoreline erosion is not a serious factor in the river basin group. Streambank erosion does present some problems, but losses are relatively small. Flooding may occur at any time, but generally the major floods are the result of rain and/or snow melt on frozen or nearly saturated ground. A few intense summer storms have caused destructive floods. Overbank flooding is also caused by ice jams. Conditions vary among the different streams, and both structural and institutional measures must be considered.

The loss of wildlife habitat to urban and resort development is a significant problem in the river basin group, as it is throughout most of the Great Lakes Basin.

There is a wealth of opportunity for outdoor recreation, and a great diversity of recreational resources. There are no particular problems associated with development, but the acquisition and management of the resource is a major undertaking.

7.2.4 Alternative Frameworks

Two alternative frameworks are presented for this as for other river basin groups. The Normal Framework does not reflect coordination of solutions to meet needs outside the RBG 2.1 in the Lake Michigan basin or the Great Lakes Basin.

The Proposed Framework contains the recommendations of the Commission in an effort to reflect the views of the people of the basin, and the policies and programs of the States. To some extent, it reflects coordination in the development of the Framework among a number of river basin groups, both in the Lake Michigan basin and in the Great Lakes Basin as a whole.

7.2.4.1 Normal Framework (NOR)

NOR is based on meeting quantified needs and solving identified problems to the maximum practicable extent consistent with subobjectives and criteria discussed in Section 2 of the appendix. The program outputs and costs are summarized in Section 12 in Tables 1–250, 1–251, and 1–252.

(1) Water Withdrawals

In NOR the principal elements of municipal water supply include ground-water development, a pipeline to the Great Lakes for a regional water supply, and the development of water systems to provide intake from inland lakes and streams. All needs are met.

Self-supplied industrial water needs are met by increasing amounts of water from the Great Lakes, inland lakes and streams, and ground-water sources over the 50-year period. The largest single source is the Great Lakes, but in each time frame less than half the total requirement is met from this source. Inland lakes and streams are utilized slightly more than ground water.

Mineral industry water needs are fully met in NOR, about half from inland lakes and streams and half from ground water.

Irrigation needs are met initially from inland lakes and streams and ground water, with a possibility that by 2020 about 20 percent of the needs may be met from the Great Lakes, and 40 percent each from inland lakes and streams and ground water. Reservoir storage may be provided in all time periods.

Thermal power cooling needs are met by siting plants on the shore of Lake Michigan and providing a mix of flow-through and supplementary cooling systems.

(2) Nonwithdrawal Water Uses

Municipal waste treatment plants will meet effluent requirements established prior to the Federal Water Pollution Control Act Amendments of 1972, including phosphate removal, throughout the entire period. Advanced waste treatment needs are indicated for the portions of the Fox River, the Oconto River, and the Peshtigo River, where problems revolve primarily around paper mill wastes. Industrial wastewater discharges will also be treated to meet effluent requirements. Regional treatment of wastewater is not anticipated but might be considered for the latter part of the 50-year period.

Water requirements for hydroelectric power production in existing plants will be met. No additional plants are projected.

Water-oriented outdoor recreation will be discussed in connection with related land uses and problems.

The fishery is adequate to meet needs through 1980. Degraded water quality in the lower portions of the streams has eliminated much sport fishery. Adequate waste treatment may permit a rebuilding of this habitat. In addition, management of the fishery through stocking, introduction of predators for forage species, physical and chemical removal of unwanted fish, and provision of adequate access to the water are programs included in NOR which will meet the needs in all periods of the study.

Recreational boating needs are met in NOR by acquisition of critical areas and by more efficient use of the existing water. There is an adequate supply of water surface available. Around the inland lakes and streams access and launching sites must be developed, and on Lake Michigan navigational aids and harbors of refuge are needed to permit use of the extensive water surface available beyond Green Bay, which is already heavily used.

Commercial fishery and commercial navigation are discussed in Subsection 7.6, which deals with Lake Michigan intrarelationships. No specific navigation improvements are included in NOR.

(3) Related Land Use and Problems

Agricultural land treatment will be carried out through conventional methods throughout the 50-year period on 43 percent of the acres which could benefit from treatment.

Agricultural drainage will be carried out by group action on 34 percent of the land adversely affected by drainage conditions during the 50-year period.

Forest land treatment will be applied to 66 percent of the land that could profit from treatment. Improved management practices, technical assistance, and consulting services will materially help to preserve and enhance the forest environment.

Shoreline erosion is not a serious factor, as there is no critical erosion area in the river basin group under 1970 conditions. No programs are included in NOR.

Streambank erosion occurs in isolated areas and only a minimum program to correct 11 percent of the mileage in the 50-year period has been included. This accounts for roughly 30 percent of the damages.

Both structural and nonstructural measures are included in flood plain management in NOR, and at the end of the 50-year period, about 67 percent of the urban affected area is expected to be taken care of, accounting for 75 percent of the average annual damages. Rural area affected is much larger, and the results of treatment much less, so that a much smaller percent of the area and of the average annual damages is taken care of.

Wildlife habitat is faced with continual reduction, but this trend is alleviated by purchase and management, and acreage needs are met. The user-day needs appear not to be met, but this problem is believed exaggerated because actually the hunters and non-consumptive users will use the same area at different times.

About 75 percent of water-oriented outdoor recreation-day needs can be met in the 2020 period. This will require that 70 percent of the "intensive-use" land be developed and arrangements made for the use of 90 percent of the "extensive-use" land. Acquisition and development of several thousand acres in selected areas will be necessary over the entire time period to provide a constantly growing base of land and associated water for this form of outdoor recreation.

(4) Framework Outputs and Costs

Section 12 contains Tables 1–250, 1–251, and 1–252, which provide information on needs, outputs, and percent needs met, and capital and OM&R costs.

7.2.4.2 Proposed Framework (PRO)

The economic growth and population base for PRO are not numerically different from NOR. However, the States recognize as a major problem the population imbalance between the northern and southern areas of RBG 2.1.

There is continuing economic decline and outmigration from the northern part of the basin, with increasing concentration of economic activity and population in the southern part.

PRO does not specifically recommend future social and economic policies or programs to influence the rate of growth and/or distribution of people in the river basin group. However, it has estimated the water and related land programs needed to support growth rates generally associated with regional economic development objectives. This is interpreted in the Normal Framework as representing an extension of trends in the demand for water and land resources.

The environmental quality problems addressed indicate that the restoration of a very high level of water quality, the development and conservation of recreational opportunities, the reduction of rural and urban flooding, improvements to fish and wildlife resources, and a balanced level of development, supported by funding as necessary by Federal, State, and local levels, need top priority if the objectives of the public in the area are to be achieved.

PRO quantification differs from NOR in only a few elements. These are shown in Section 12 on Tables 1–253, 1–254, and 1–255.

(1) Water Withdrawals

All needs are met in PRO as in NOR with the same program selections. The environmental aspects of power plant siting are given more weight, but there is no identified difference in quantity or cost of water.

(2) Nonwithdrawal Water Uses

Wastes will be treated in both municipal and industrial treatment plants to meet the requirements of the Federal Water Pollution Control Act Amendments of 1972. Quantities of waste to be handled are the same for PRO as for NOR. Treatment costs will be greater. For other non-withdrawal water uses the needs are met for PRO the same as for NOR. A sport fishery balanced between coldwater and warmwater species is programed, and there is emphasis on meeting needs near urban areas.

(3) Related Land Uses and Problems

Needs for related land uses and problems are the same as in NOR, but they are met to a greater extent in PRO. All of the agricultural land which can profit from the treatment will be treated, and the drainage program will be nearly doubled. All of the forest land that can profit from treatment will be treated. Table 1–330 in Section 12 compares land treatment programs for NOR and PRO.

Shoreline treatment may be greater in PRO because of higher lake levels and critical reaches in RBG 2.1, but no quantities are shown. Shoreland management plans for all areas are urged.

Severe erosion reaches of streambanks will be treated in PRO as in NOR. There will be greater emphasis on flood plain management in the reduction of flood damage under PRO. Wildlife management programs are the same for PRO as for NOR.

PRO will meet all water-oriented outdoor recreation needs. It is assumed that approximately 60 percent of the outdoor recreation needs will be met with public funds (Federal, State, and local), and it is further assumed that the remainder will be met either by private funding or not at all, and that the priorities for the use of public funding will be

(a) urban recreation developments, and acquisition and retention of unique and natural areas of regional significance

(b) developments on lands now publicly owned

(c) other developments.

It is assumed that to the extent public funds are available for investment in urban lands, they may be used where feasible to assist in acquiring flood plain land in the rapidly urbanizing areas in the southern portion of the basin, in clearing flood plains of drainage-prone uses, and in making them available for recreational use.

(4) Framework Outputs and Costs

Section 12 contains Tables 1-253, 1-254, and 1-255, which provide information on needs, outputs, percent needs met, and capital and OM&R costs for PRO, indicating by italics where they differ from NOR.

7.2.4.3 NOR and PRO Framework Costs

Table 1-345 in Section 12 lists the total costs (capital plus OM&R) for NOR and PRO for the periods 1971-1980 and 1971-2020.

7.3 Frameworks for River Basin Group 2.2

7.3.1 Summary

RBG 2.2 is the most highly urbanized area in the entire Great Lakes Basin. The Chicago-area megalopolis lies on the hydrologic divide between Lake Michigan and the Illinois River, which is a part of the Upper Mississippi River Basin, covering portions of southeast Wisconsin, northeast Illinois, and northwest Indiana. This concentration of people and industries generates tremendous requirements for water and related land resources. Not all purposes are compatible; for example, recreational development competes with industrial expansion for use of the Lake Michigan shoreline.

In some areas, explicit choices have been made. The City of Chicago with the State of Illinois chose to protect its water supply in Lake Michigan by diverting about 810 square miles of the natural Lake Michigan drainage area to the Illinois River. The Metropolitan Sanitary District of Greater Chicago constructed the diversion system and maintains it. The U.S. Supreme Court has set a limit for water diversion from the Lake Michigan watershed by the State of Illinois. Under present conditions, the total withdrawal, including pumpage for municipal and industrial water supply and diversion for navigation and waste assimilation purposes, is limited to 3,200 cubic feet per second (cfs), or 2,068 million gallons per day (mgd). Wastewater discharges from the City of Hammond, Indiana, and the area it serves are also normally diverted from Lake Michigan to the Upper Mississippi River Basin. (Occasionally the Grand Calumet River reverses and flows to Lake Michigan.)

The most severe problems in River Basin Group 2.2 are meeting the future water quantity requirements and maintaining or improving the present water quality. To formulate alternative futures for RBG 2.2, it is not only necessary to consider the various subobjectives and criteria, but also imperative to consider the availability of the resources in the adjacent basin. The recently completed Upper Mississippi River Comprehensive Basin Study (UMRCBS) facilitates such consideration.

In the formulation of the Normal Framework, it has been assumed that the present dependence on Lake Michigan for water supply will continue in the future. Ground water will be used where it is available.

With respect to nonwithdrawal uses, the Normal Framework is designed to meet the water quality standards existing in the base year, 1970. The PRO Framework meets the higher standards of the Federal Water Pollution Control Act Amendments of 1972. Neither water-oriented outdoor recreation needs nor recreational boating needs can be met within RBG 2.2. The requirements for commercial navigation can be met.

Related land problems stem, in many cases, from improper or mismanaged land use. Regulation of development on the flood plain and the shoreland will be necessary if damages are to be reduced in the future. Some structural remedies have been proposed to alleviate existing conditions. There is little agricultural land within the boundary of RBG 2.2, and hence these treatment programs are small. The Normal Framework does not propose satisfying much of the wildlife and recreation needs because opportunities simply do not exist in the area. Table 1-256, in Section 12, lists the needs, outputs, and percent of needs met for the Normal Framework for RBG 2.2. The two tables following (Table 1-257 and Table 1-258) show costs.

In referring to the summary table, it should be noted that needs shown are for the planning subarea or river basin group, depending on the particular resource category and the methodology of the work group. However, programs for meeting the needs are for the river basin group. When the outputs do not match the needs, it is often because needs have been transferred between Great Lakes and Upper Mississippi River Basins. These transfers are explained in the text and are also

TABLE 1-98 Comparison of Areas of Planning Subarea 2.2 and River Basin Group 2.2

State	Acres PSA	Acres RBG
Illinois	2,401,300	39,000
Indiana	1,194,200	426,000
Michigan	0	106,000
Wisconsin	1,720,300	821,000
TOTAL	5,315,800	1,392,000

incorporated into the appropriate tables of Annex E. See the Introduction for availability of Annex E.

7.3.2 The Area

The area covers the southwest part of Lake Michigan and lies within portions of Wisconsin, Illinois and Indiana. PSA 2.2 includes seven counties in Wisconsin, six counties in Illinois, and four counties in Indiana. Of these 17 counties only Ozaukee and Milwaukee Counties in Wisconsin lie wholly within RBG 2.2. In fact, six counties lie wholly within the Upper Mississippi River Basin. See Table 1–98 for a comparison of the areas of PSA 2.2 and the RBG 2.2.

The 1970 population of Planning Subarea 2.2 was 9,492,823, with 18.5 percent in Wisconsin, 73.5 percent in Illinois, and 8 percent in Indiana. Needs for many of the resource categories are based on planning subarea populations when, in fact, most of these people neither live within the Great Lakes Basin nor rely on its resources.

Figure 1–29 shows the areal extent of Planning Subarea 2.2 and River Basin Group 2.2. Section 1 contains data about the area.

7.3.3 Projected Resource Needs and Problems

Future demands upon the resources, or requirements, were described in Section 3. Needs determined for resource uses by time period are shown in Table 1–256 of Section 12. Because of the dual consideration of six Illinois counties in the Upper Mississippi River Comprehensive Basin Study (UMRCBS) and the Great Lakes Basin Framework Study, adjustment of needs was incorporated into the framework formulation process to avoid double-counting. Details are discussed below.

7.3.3.1 Water Withdrawals

The total water withdrawal needs to the year 2020 are projected to be over 31,500 mgd. The base year withdrawals totaled almost 10,000 mgd. The 2020 need is made up of about 80 percent for thermal power cooling, 13 percent for self-supplied industries, 6 percent for municipally supplied water users, and the remainder for rural domestic and livestock, irrigation, and mining uses.

Except for thermal power cooling, water withdrawal amounts were computed for the 17 county PSA 2.2. Basically, this same area was analyzed in the UMRCBS. The UMRCBS satisfied a portion of these needs for the Great Lakes Basin which does not "double-count" the requirements associated with the Milwaukee-Chicago-Gary-Hammond complex.

(1) Municipally Supplied Water

Plan formulation for the UMRCBS supplied part of the need from available resources, primarily ground water resources in the Illinois River basin. In view of the shortage of sufficient ground water and the existing interbasin transfers, the study transferred over 1,000 mgd of the 2020 need to GLBFS to be supplied from Lake Michigan. If water withdrawals from Lake Michigan to supply areas outside the basin are continued, some of the future industrial self-supplied water needs would be shifted to municipally supplied sources. The net result of these adjustments was to increase municipally supplied water withdrawal needs for 2020 from 1,768 mgd to 1,921 mgd.

(2) Self-Supplied Industrial Water

These needs were also considered by both studies. Again, needs were programed for satisfaction where the resources were available. Slightly over 1,000 mgd of the 2020 need were converted to municipal supply and transferred to GLBFS. Shifts were made to account for more industrial use of municipally supplied water in the future. Self-supplied industrial use needs were transferred from GLBFS to UMRCBS, with the net result a decrease in self-supplied industrial water withdrawal needs in GLBFS for 2020 from 4,020 mgd to 1,986 mgd.

(3) Rural Domestic and Livestock Water

This category of need is closely related to geographic location. Water is seldom transported great distances for rural uses. Therefore, to avoid duplication of needs in both regions, a simplistic approach was used. This approach resulted in 80 percent of these rural needs being programed as part of the UMRCBS and the other 20 percent to be considered in the GLBFS. This reduced the 2020 need for rural domestic and livestock water withdrawals from 27.3 mgd to 5.5 mgd.

(4) Irrigation Water

There are vast differences in projections for irrigation water between the UMRCBS and the GLBFS. A partial explanation is the inclusion of

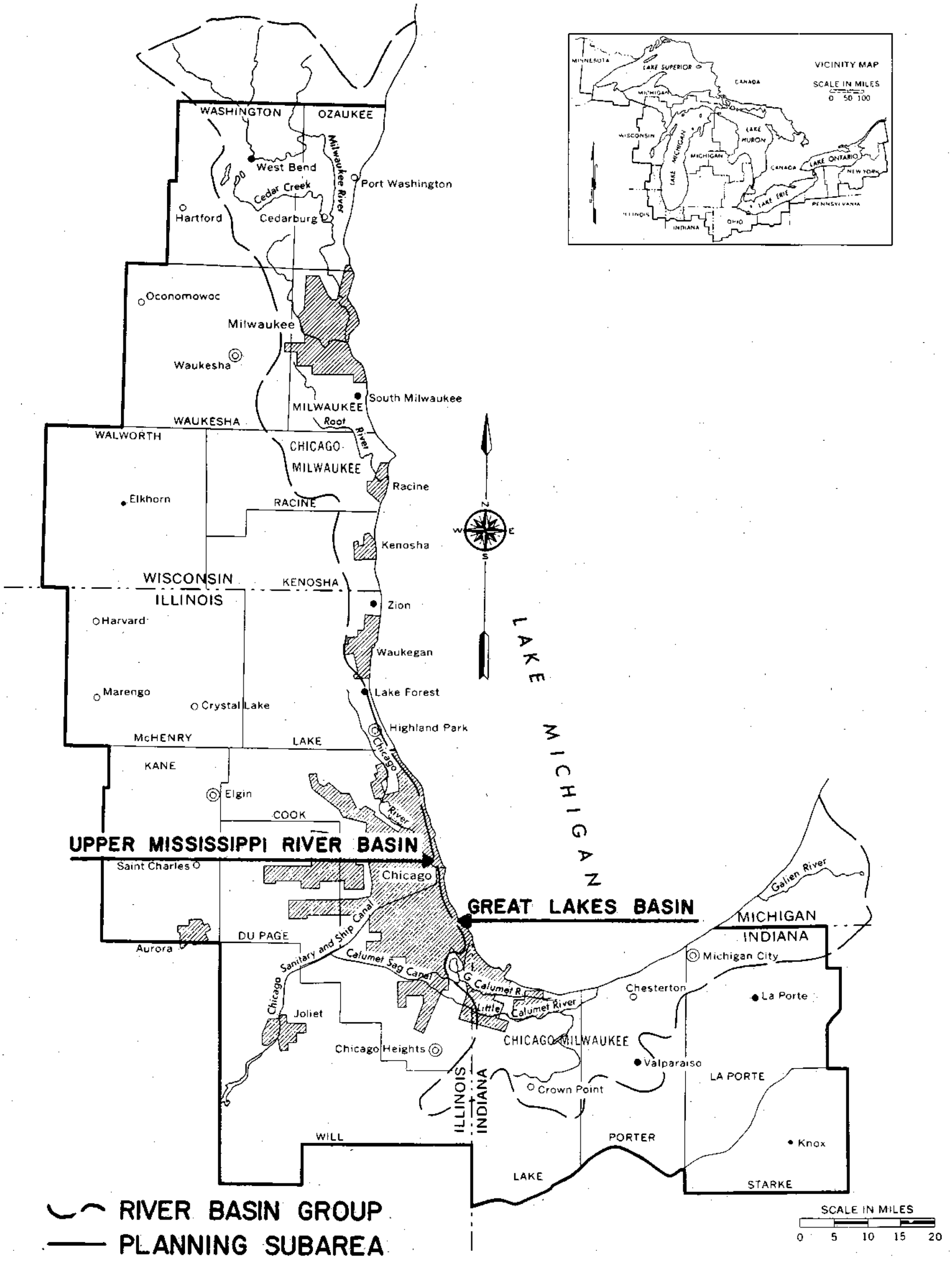

FIGURE 1–29 Lake Michigan Southwest, River Basin Group 2.2

golf course irrigation in the irrigation category of the GLBFS. The UMRCBS, on the other hand, considered these withdrawals as municipally supplied. Recognizing these differences and the magnitude of the amounts involved, the simplistic 80 percent-20 percent split of needs was used. This reduced the 2020 need for irrigation water withdrawals from 454 mgd to 91 mgd.

(5) Mining Water

The only area not duplicated by the UMRCBS in computing mining water withdrawal needs was Ozaukee and Milwaukee Counties in Wisconsin. The adjustment made for this resource category was based on an analysis of the distribution of present water use by commodity (i.e., sand and gravel, stone, coal, and other) and site locations. The result of this analysis indicated that 92 percent of the mining water required by PSA 2.2 would be obtained from sources within the Illinois River basin. Therefore, the need for mining water withdrawals was reduced from 140 mgd to 11.2 mgd for the year 2020.

(6) Thermal Power Cooling Water

The Power Work Group adjusted the requirements for both the UMRCBS and the GLBFS to eliminate duplication. This was part of the procedure used to prepare Appendix 10, *Power*.

7.3.3.2 Nonwithdrawal Water Uses

(1) Wastewater Discharges

There are no significant waste discharges into Lake Michigan from the Illinois portion of RBG 2.2, except for the North Shore Sanitary District, which is under order to divert its effluent from Lake Michigan. No municipal discharges are anticipated in the future. There are small industrial waste discharges to the Lake.

The Indiana portion of RBG 2.2 is the most highly industrialized area of the State with five of the nation's major steel plants, four major oil refineries, and other heavy manufacturing and chemical industries. Wastewater discharges from the Hammond, Indiana, area into the Upper Mississippi River Basin are not considered as part of this study. In 1970 about 340,000 Indiana people were served by municipal treatment plants which handled wastewater flows attributable to the Lake Michigan basin of 114 mgd. In addition the 1970 industrial wastewater flows were about 3,000 mgd into Lake Michigan basin. By the year 2020, municipal flows could reach 334 mgd, and industrial flows could reach 4,000 mgd. Between 1970 and 1980 advanced wastewater treatment (advanced biological treatment, physical-chemical treatment, or land treatment) is needed at Gary, East Chicago, Crown Point-Hobart, Valparaiso, and Michigan City to meet Indiana water quality standards. After 1980, Portage, Indiana, will need advanced wastewater treatment.

There are numerous manufacturing establishments and a substantial dairying activity in the Wisconsin portion of RBG 2.2. In 1970 about 1,500,000 Wisconsin people were served by municipal treatment plants which handled wastewater flows of 211 mgd. In addition, industrial flows in 1970 were about 3,274 mgd. By the year 2020, municipal flows could reach 1,049 mgd. Current advanced wastewater treatment needs have been identified on the Milwaukee River below Campbellsport, Kewaskum, and West Bend to the mouth of the river at Milwaukee, on the Pike River below Sturtevant, and on the Menomonee River below Menomonee Falls.

(2) Water-Oriented Outdoor Recreation

In 1970 Planning Subarea 2.2 generated 26.7 percent of the Great Lakes Basin's total acreage requirements for water-oriented outdoor recreation. However, PSA 2.2 could provide only 1.8 percent of the Basin's supply. The total recreation requirement for PSA 2.2 was 170.3 million recreation days, with the water-oriented recreation requirement at 44.5 million recreation days. By the year 2020 these requirements are projected to be nearly 500 million and 135 million recreation days, respectively.

As discussed previously, the PSA 2.2 needs must be reduced to RBG 2.2 needs to avoid overlap. A detailed breakdown of needs was not feasible. However, provisions were made in the plan formulation process to take credit for needs met by UMRCBS. This is in effect a transfer of needs and so appears in Annex E tables (see Introduction).

(3) Sport Fishing

The projected sport fishery requirements by 2020 are over 30,000,000 angler days. After an analysis of existing supply, the 2020 need for PSA 2.2 was set at 17,263,000 angler days. The UMRCBS satisfied 8,105,000 angler days. Thus, the Great Lakes Basin's portion of the requirements is 9,158,000 angler days. The Fish Work Group transferred requirements to areas of supply outside RBG 2.2 and further reduced these requirements. With a capacity given at 3,166,000 angler days, need has been stated at 4,434,000 angler days for the year 2020. In summation, needs for sport fishing have been adjusted to consider the existing resources capability (supply), the existing resource capability of other river basin groups within the Great Lakes Basin (intrabasin transfers), and the existing and potential resource capability of the adjacent areas of the Upper Mississippi River Basin (interbasin transfers).

Problems associated with sport fishing include water quality degradation, lack of public access,

TABLE 1–99 Use and Projected Needs for Recreational Boating, PSA 2.2

Category	1000 Boating Days Great Lakes Waters	Inland Waters
1970 Use	768	512
1980 Needs	282	102
2000 Needs	429	203
2020 Needs	588	321

and a reduction of spawning area brought about by the filling of shoreline marsh areas. There is a specific need to develop a comprehensive, cooperative management plan.

(4) Recreational Boating

In 1968 there was an average of over 1.5 registered boats per 100 persons in PSA 2.2. This does not include canoes, sailboats, and small craft located in the area, the numbers of which are unknown. RBG 2.2 experiences only a moderate influx of nonresident boaters because of the limited area of inland waters and the excessive pressure on the resource base from local boaters. See Table 1–99 for recreational boating use in PSA 2.2 and projected future needs.

The resident fleet in the Planning Subarea is projected to grow from 180,000 boats in 1968 to 336,000 by the year 2020. It has been estimated that 90 percent of the demand for resident boats over 30 feet long and 50 percent of the demand for the remainder of the resident fleet plus the present nonresident demand are being satisfied in River Basin Group 2.2.

The waters of Lake Michigan are not considered safe for boats less than 20 feet in length. Recreational boating generally occurs in the vicinity of the 30 commercial and recreational harbors which offer refuge.

Inland lakes are heavily used. Canoeing is not widely pursued because of the high degree of area development and the poor water quality. Needs have been identified with the Upper Mississippi River Basin and RBG 2.2 as appropriate. For the latter there are estimated to be 588,000 boat days for Lake Michigan and 321,000 boat days for inland lakes and streams in 2020.

(5) Commercial Navigation

Major harbors located in RBG 2.2 include Port Washington, Milwaukee, Oak Creek, Port of Chicago (Chicago Harbor and Calumet Harbor and River), Indiana Harbor, Buffington Harbor, Gary Harbor, and Port of Indiana (Burns Waterway). They handle a significant part of the Great Lakes traffic, as shown in Table 1–100.

TABLE 1–100 Traffic Handled by Major Harbors in RBG 2.2 as Percent of Great Lakes Total

Commodity	% of Great Lakes Total Received	Shipped
Iron Ore	33	--
Coal	8	13
Limestone	22	--
Grain	--	15
General Cargo	36	45
Other Traffic	33	33

Commerce shipped and received in 1970 amounted to 55.5 million tons of bulk commodities and 6.6 million tons of general cargo. By 2020 commerce is expected to reach 117.5 million tons of bulk commodities and 13.4 million tons of general cargo.

Strong port promotional policies and favorable action to reduce discriminatory rail rates could substantially increase the area's share of grain exports and general cargo. At the present time, an extension of the navigation season and improvements to facilitate handling the 1,000-foot vessels are under consideration.

7.3.3.3 Related Land Uses and Problems

Approximately 2,170,200 acres of agricultural land, cropland, and pasture in PSA 2.2, on which conservation practices have not been applied, would benefit from such practices. About 526,700 of these acres are in RBG 2.2.

An inventory of soil wetness in PSA 2.2 has been made, and it is estimated that 442,400 acres of agricultural land have a drainage problem. Of this amount, RBG 2.2 has 66,600 acres in Wisconsin, none in Illinois, and 40,800 acres in Indiana, for a total of 107,400 acres.

There is a shortage of well-drained soil conditions in the nonurban land that is expected to become urban land. Some drainage will be necessary before such urban expansion can occur. Drainage systems are needed on 21,600 acres for the removal of excess surface and internal water. There are about 340,700 acres of forests in Planning Subarea 2.2. The opportunity exists to program for forest land treatment on 212,000 acres in order to realize important conservation. About 51,400 of these acres are in RBG 2.2, the balance in the Upper Mississippi River Basin.

There are 49.5 miles of shoreline in this river basin group subject to critical erosion and 80.2

miles subject to noncritical erosion. There is no problem of overlap with the Upper Mississippi River Basin. There are no flooding problems associated with the shorelands.

There are 91 bank-miles in this planning subarea subject to moderate or severe streambank erosion damage, of which 12 miles are in RBG 2.2. The total estimated 1970 annual damages in PSA 2.2 resulting from streambank erosion are $32,200.

In this river basin group the greatest flood damages occur in the urban areas. The average annual damages in urban areas are estimated at nearly $9 million in 1970 and are projected to increase to $13 million by 1980 and $56 million by 2020. Similar figures for rural areas are $230,000 in 1970 and projections of $297,000 by 1980 and $679,000 by 2020. The urban area subject to flooding is on the order of 5,000 acres, and the rural area subject to flooding is on the order of 55,000 acres. There is no overlap of these estimates into the Upper Mississippi River Basin.

In 1970 there were about 384,100 hunters in Planning Subarea 2.2. There is a need to plan for 670,900 hunters by 1980 and over one million hunters by 2020. The wildlife demand is about 50 percent consumptive use, or hunting, and 50 percent nonconsumptive use, or observing, photographing, and otherwise enjoying wildlife. One of the greatest problems in this area is the need to set aside and protect areas having considerable value for either feding grounds or other wildlife habitat use. From the standpoint of preserving wildlife opportunities, optimum human population levels have already been exceeded.

If all of the hunter-day needs are to be satisfied in this planning subarea under the assumptions used in the study, an additional 1,383,600 acres above the 1970 supply of 1,344,680 acres of huntable land will be needed by 1980. This figure will increase to 4,406,400 acres by 2020. About 25 percent of the total planning subarea acreage was suitable for hunting in 1970. By 1980, 50 percent will be needed, and by 2020 there will not be sufficient land. For this reason intra- and interbasin transfers of needs are programed to meet about 25 percent of the planning subarea need.

The existing aesthetic and cultural values in RBG 2.2. have been referred to in Subsection 5.1.5.3. The major problems are

(1) the need to preserve outstanding values

(2) industrial and residential use of shoreline which competes with preservation of aesthetic values

(3) inadequate funds for land acquisition.

7.3.4 Alternative Frameworks

Two alternative frameworks are presented for this as for other river basin groups. The Normal Framework does not reflect coordination of solutions to meet needs outside the river basin group in the lake basin or the Great Lakes Basin.

The Proposed Framework, on the other hand, contains the recommendations of the Commission in an effort to reflect the views of the people of the basin, and the policies and programs of the States. To some extent, it reflects coordination in the development of the framework among a number of river basin groups, both in the lake basin and in the Great Lakes Basin as a whole.

7.3.4.1 Normal Framework (NOR)

NOR is based on meeting quantified needs and solving identified problems to the maximum practicable extent consistent with subobjectives and criteria discussed in Section 2 of the appendix. Section 12 contains the program outputs and costs which are summarized in Tables 1–256, 1–257, and 1–258.

(1) Water Withdrawals

There is adequate water from Great Lakes sources to meet water withdrawal needs up to and beyond 2020. The development of Great Lakes source capacity is the program selected in NOR to satisfy all of the needs for municipally supplied water, self-supplied industrial water, and water for thermal power cooling. Rural domestic and livestock needs and water for mineral production are all expected to be satisfied by the development of ground-water sources that are adequate to do this. Irrigation needs, including golf courses, will be satisfied primarily by water from inland lakes and streams and from ground water.

Programs are included to initiate research to bring about process modification and recirculation which would reduce the overall amount of water withdrawals and would bring about advances in technology which would have the same results.

(2) Nonwithdrawal Water Uses

The NOR Framework includes programs to provide municipal wastewater treatment facilities to handle the need for treating quantities of waste discharges. In addition to the basic requirements of secondary treatment and 80 percent phosphorus removal throughout the river basin group, there will be 10 locations needing advanced waste treatment by 1980 and one more between 1980 and 2000, in order to meet the water quality criteria as of 1970.

The cost of the advanced waste treatment is included in the investment costs. No data are available on the cost of industrial waste treatment in this area. Municipal facilities handle a substantial portion of the industrial wastewater. NOR includes a recommendation for implementation of the regional waste treatment concept.

Fishery management programs in NOR include land acquisition for access and habitat protection on inland water areas. This program, coupled with future additional stocking from a new warmwater hatchery, is estimated to satisfy angler-day needs. It should be emphasized that the NOR Framework does not at the present time have specific programs to provide substantial new opportunities for new access facilities in the urbanized areas. Information on the potential and the corresponding costs of additional fishery opportunity development in these urbanized areas is not available.

NOR includes programs to satisfy most of the boating-day needs in all of the time periods. The additional development will be on Lake Michigan. Recreational boating on inland areas is already at a saturated level.

Commercial fishing is discussed in Subsection 7.6, Lake Michigan Intrarelationships.

Commercial navigation is also discussed in subsection 7.6. Specific investments in RBG 2.2 included in NOR for commercial navigation are

(a) dock improvement in Lake Calumet
(b) rebuilding of the bulkhead at Navy Pier
(c) dock and wharf improvement at Milwaukee
(d) additional dredging at the Milwaukee, Chicago, and Indiana harbors.

(3) Related Land Use and Problems

The programed agricultural land treatment in NOR is essentially a continuation of ongoing programs at a level that has been followed in the past.

Programs for drainage of cropland have been selected to include the on-farm drainage measures included in the land treatment needs at a current program rate of installation. The drainage measures are tiling, field ditching, and other field drainage. Drainage improvement is also needed on urban development areas. The amount of such drainage and locations where it will be needed have not been determined except by standard metropolitan statistical areas.

The forest land treatment program for NOR provides forest land treatment at a higher level than merely a continuation of the past trend.

The shoreland erosion program included in NOR would treat the critical erosion areas by the year 2020.

The streambank erosion program would provide treatment by 2020 of all the streambank mileage in RBG 2.2 subject to severe erosion.

The resource most directly involved in reducing flood damages is people. Damages would be less if settlement patterns and land use patterns had been substantially different from what they were and still are. All of the program elements considered in the framework formulation process for reducing or preventing flood damages have some merit. Estimates of benefits (damages reduced or acres protected) and costs were available for structural solutions such as channel modification, reservoirs, levees, floodwalls, and other protective works. Estimates of damage reduction, acres protected, and costs have also been made for some nonstructural programs.

Regulated use of flood plains to achieve substantial reduction of flood damages in the urban areas is an essential feature of the NOR Framework. Institutional reduction measures are appropriate throughout almost all of the river basin group in the areas adjacent to the main stem and the principal tributaries.

NOR includes channel modification to reduce damages caused by a structural flood control project for the Milwaukee River main stem, the Little Calumet River, and damages in numerous upstream watersheds.

NOR, if fully implemented and funded, and fully supported by the residents of the basin, would eliminate almost all of the average annual flood damages by the year 2020.

For wildlife management, NOR includes a continuation of ongoing budgeted programs by State agencies for habitat management, enforcement, and research. In addition to land acquisition, NOR includes recommendations for continuing wildlife research conducted by State-supported universities and private investments in wildlife management.

NOR provides that features with outstanding, unusual, and significant aesthetic and cultural values be acquired in the early-action period and conserved for the benefit of future generations.

NOR provides for meeting a portion of the recreational needs. In each of the time periods, existing public lands currently undeveloped are to be developed more intensively while maintaining a setting as natural as possible. The NOR Framework also provides that on class 2 recreational areas (areas designated as general outdoor recreational areas which are subject to substantial development for a wide variety of specific recreational uses including unique natural areas), all existing publicly owned lands consisting largely of State and regional parks and forests should be developed to their optimum capacity to provide additional recreational opportunity.

NOR also provides for

(a) additional access sites in suitable places on Lake Michigan
(b) reclaiming polluted beach areas along the Lake shore in and near urban areas
(c) the preservation of areas of significant cultural, historical, or biological interest

(d) continuing activity by the private sector to develop quality recreational facilities for golfing, skiiing, camping, swimming, picnicking, and other recreational facilities which the private sector can develop effectively.

Even with the transfer of needs to the Upper Mississippi River Basin, NOR falls far short of satisfying the recreation-day needs in this planning subarea. The remaining needs may be satisfied elsewhere in the Great Lakes Basin, or changes in activity preference may reduce some of the estimated future demands.

(4) Framework Outputs and Costs

Section 12 contains Tables 1–256, 1–257, and 1–258 which provide information on needs, outputs, percent of needs met, and capital and OM&R costs for NOR.

7.3.4.2 Proposed Framework (PRO)

State, regional, and local policies with respect to population and economic growth do not deviate greatly from those of the OBERS projections on which NOR is based. The general attitude is that slightly slower population growth is likely, and a slower rate of economic growth may be desirable. No new projections were made, but where alternatives were available for meeting needs and solving problems, those selected emphasized environmental quality coupled with slower rates of population and economic growth. Without providing any quantitative information, PRO endorses conservation and wise use of natural resources, fostered by the use and development of government policies, incentives, and penalties. The specific emphases for PRO related to various resource use categories are described below, and where outputs differ from NOR in magnitude or timing, the quantification is shown.

(1) Water Withdrawals

PRO is the same as NOR in water withdrawal quantities. With emphasis on reduction in per capita use and a lower rate of population increase, it is anticipated that water withdrawals will be reduced. For thermal power cooling, specifically, PRO provides for consideration of the type of cooling on a site-by-site basis, with the implicit assumption that more supplemental cooling will be used than is provided for in NOR. In the extreme case this could reduce withdrawals for this purpose in PRO to about 4 percent of those in NOR, increase consumptive use by possibly 25 percent, and increase power costs by somewhat over 5 percent. Actual experience would no doubt result in changes less extreme than these.

(2) Nonwithdrawal Water Uses

In waste treatment, PRO meets the standards of the Federal Water Pollution Control Act Amendments of 1972, and higher costs are shown than for NOR. Problems associated with overflow from combined sewers will be corrected by 1977, or as soon thereafter as practicable.

The PRO Framework emphasizes the development of sport fishery in and near the urban areas, but information on the potential benefits and the corresponding costs of additional fishery opportunity development in these urbanized areas is not available.

The PRO Framework for recreational boating is the same as the NOR Framework.

Commercial fishing is discussed in subsection 7.6, which deals with Lake Michigan intrarelationships.

Commercial navigation is discussed in subsection 7.6 and more completely in Section 5, dealing with the entire Basin. In RBG 2.2 the harbors at Calumet and Port of Indiana would be deepened, and the navigation season would be extended for six weeks in this area.

(3) Related Land Use and Problems

The agricultural land treatment and cropland drainage programs are substantially greater in PRO than in NOR. With the pressures of urbanization upon prime agricultural land, particularly acute in the area, an accelerated program provides for treatment of 88 percent of the opportunity by 2020.

The forest land treatment program was given high priority in the NOR Framework because of the unusual conditions of urban forestry in RBG 2.2, and no additional emphasis is included in PRO. The comparison of these NOR and PRO programs is given in Section 12 on Table 1–331.

With the higher lake levels of 1973, areas of critical erosion that were not considered in NOR have become apparent along the Lake Michigan shore. PRO recommends protection for these areas. However, the mileage and costs are shown the same as NOR.

Streambank erosion programs are the same in PRO as in NOR.

The PRO Framework accomplishes the same flood damage reduction as NOR, but emphasizes the need for adequate expenditure of funds in managing flood plains and use of these lands for purposes less subject to high flood-related losses.

PRO has the same programs as NOR for wildlife management.

Aesthetic and cultural programs are the same for PRO as for NOR.

The PRO Framework recommends resource utilization that will meet water-oriented recreation needs to the maximum practicable extent. Numerically, the outputs are the same as NOR, but an additional recommendation is that priorities for the use of public outdoor recreation funds be given to developing facilities which meet urban needs, then to developing facilities on existing public lands, and, where feasible, to acquiring flood plain land in rapidly urbanizing areas, clearing flood plains of damage-prone uses, and making them available for recreation use.

(4) Framework Outputs and Costs

Section 12 contains Tables 1-259, 1-260, and 1-261 which provide information on needs, outputs, percent of needs met, and capital and OM&R costs for PRO, indicating by italics where they differe from NOR. Table 1-331 compares land treatment programs.

7.3.4.3 NOR and PRO Framework Costs

Table 1-346 in Section 12 lists the total costs (capital plus OM&R) for NOR and PRO for the periods 1971-1980 and 1971-2020.

7.4 Frameworks for River Basin Group 2.3

7.4.1 Summary

River Basin Group 2.3 is one of the most diversified of the river basin groups in the Great Lakes Basin. It has the most potential for conflicts among agricultural, urban, and recreational uses. It has a solid base in agriculture, containing the largest proportion of land in farms and the largest number of farms of any river basin group. It ranks first in acreage in fruits and commercial vegetables as well as in irrigated farms. Planning Subarea 2.3 has more Standard Metropolitan Statistical Areas than any other planning subarea, but it ranks fourth in total population. (As of the base year, 1970, PSA 2.3 had five SMSAs, but a sixth, Battle Creek, Michigan, has since been added.) Yet, the area has by far the most wetland acreage within a river basin group. Besides urban expansion potential and pressures upon recreational opportunities by nearby large metropolitan areas, there are pressures for land use changes on prime agricultural lands as well as wetlands. There are existing and emerging conflicts between agricultural practices and the preservation of wildlife and aesthetic and cultural values.

Local water sources may be a limiting constraint upon full development of some urban areas on a long-term basis. However, the areas such as South Bend and Elkhart, Indiana, and Jackson and Lansing, Michigan, can augment local supplies either through reservoir development or by obtaining supplies from Lake Michigan. (The latter two cities might also be served from Lake Huron.)

Major problems of erosion and sedimentation can be corrected or avoided through structural means, as well as through nonstructural means such as land management and local ordinances.

The framework developed under the normal growth projection for this river basin group provides for correction of conditions that have degraded water quality, alleviation of flood damages, treatment and drainage of land, and protection of shoreland. The framework also provides for the increase of recreational opportunities, expansion of commercial navigation and recreational boating, enhancement of fish and wildlife habitat, and the provision of water supplies for all uses to meet the needs of a balanced development.

The Proposed Framework is consistent with the Federal Water Pollution Control Act Amendments of 1972 and reflects a higher degree of wastewater treatment. Agricultural and forest land treatment and drainage measures are more extensive, and shoreland erosion measures reflect the high lake levels of 1973.

7.4.2 The Area

The study area of River Basin Group 2.3, located in the south-central portion of the Great Lakes Basin, drains the portions of Michigan and Indiana that border the southeastern shore of Lake Michigan.

The major tributary is the Grand River, which has a drainage area of 5,661 square miles. Besides the Grand, the principal streams are the Kalamazoo River and the St. Joseph River. The area includes five Standard Metropolitan Statistical Areas: South Bend, Indiana; and Grand Rapids, Jackson, Kalamazoo-Portage, and Lansing-East Lansing, Michigan. Battle Creek was designated subsequent to the 1970 census as a SMSA. The area is shown in Figure 1-30. Section 1 contains additional information.

7.4.3 Projected Resource Needs and Problems

Future demands upon the resources, or requirements, were projected in Section 3.

Needs determined for resource uses by time period are shown in Section 12 on Table 1-262. Where needs can be quantified, they are not discussed in the text, unless special conditions warrant such discussion.

The most serious problems in RBG 2.3 are those concerning land use, including problems of shore erosion. Other problem areas are treatment of wastes and overcrowded conditions for fishing, hunting, recreational boating, and other forms of outdoor recreation.

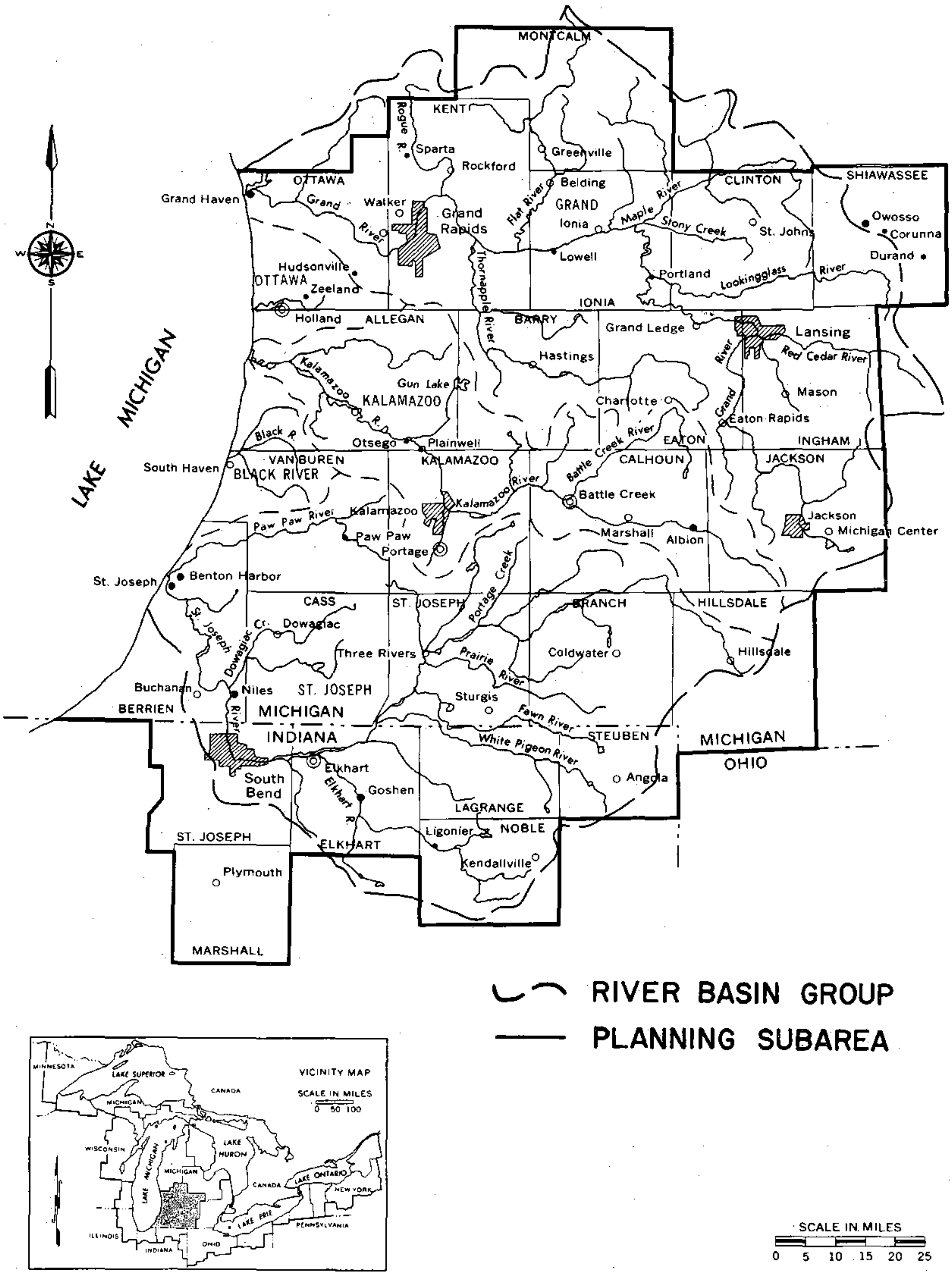

FIGURE 1–30 Lake Michigan Southeast, River Basin Group 2.3

7.4.3.1 Water Withdrawals

The total water withdrawal needs to 2020 are estimated at an additional 12,700 mgd, compared to base year water withdrawals of about 1,930 mgd.

Generally, water withdrawal problems are not serious. However, excessive lowering of groundwater level has been experienced in the Lansing area, and there is a possibility of local overdevelopment of ground water in this area. The critical areas of concern in future years for supplying municipal and industrial water requirements are in Lansing, Jackson, and South Bend, where alternatives such as interbasin conveyance of water, obtaining an adequate supply from Lake Michigan, or reservoir storage could be considered. One of the difficulties will be the financing of any large regional water supply system which might be considered for the Lansing area and possibly include the Jackson area. (This might be from Lake Huron rather than Lake Michigan.) Reservoir storage could be considered after 2000 to meet the projected demands in the Elkhart River basin, Indiana.

7.4.3.2 Nonwithdrawal Water Uses

There are no unusual circumstances relating to municipal or self-supplied industrial wastewater treatment. The proportion of industrial wastewater discharges treated by industry is expected to decrease somewhat in the future in view of a trend to provide more recirculation coupled with the trend for industry to have its waste treated in municipal plants.

Between 1970 and 1980 a number of locations in the river basin group, in both Indiana and Michigan, are expected to require advanced waste treatment facilities in order to comply with 1970 water quality standards. Additional locations in Michigan are expected to reach this stage after 1980.

There are many problems within RBG 2.3 that cause degradation and restriction of uses. These include problems with adequacy and operating efficiencies of municipal sewage treatment plants, collecting and intercepting sewers, industrial outfalls, combined sewers, steam power plants, fertilizers and pesticides from agriculture and land runoff, and redeposition in open water of dredged bottom sediments.

Corrective programs have been initiated to upgrade water quality throughout RBG 2.3. Implementation by municipalities of construction programs to meet water quality standards has been hampered by lack of Federal funding to meet cost sharing commitments. The State of Michigan has had to underwrite the Federal share. There is a need to develop and implement programs for the reduction of agricultural wastes, nutrients, sediments, insecticides, and herbicides.

There is a need for fish passage improvements, fish production through hatcheries, fish population control, fish habitat improvement and protection, and improved fishing access.

In addition to making more water surface available to boaters, it is necessary to provide berthing facilities, launching sites, boating access, and navigational aids.

One of the main problems in this area is inadequate access to many inland lakes. The lack of stream improvement and maintenance and periodic low flows limit small boat opportunities, especially those for canoeing, on inland waters.

Waterborne commerce handled at ports in RBG 2.3 is relatively small. Continued provision must be made for containment of all polluted dredged spoil and maintenance of the existing systems of harbors and channels.

7.4.3.3 Related Land Uses and Problems

Maintenance of this agricultural base requires constant surveillance, and treatment measures are needed. Included are lands with a wetness problem on which drainage is needed.

There is more cropland in this river basin group than in any other in the Great Lakes Basin. However, cropland is predicted to decrease under growing pressure to convert the land to other uses. Generally, these other uses reduce the amount of cover on the land and increase the amount of erosion and sedimentation.

Present forest land is predicted to decrease due to highway, power line, and reservoir construction, and urban, recreational, and industrial developments. Unless forest land treatment is undertaken to halt the accelerating deterioration of the natural environment, rehabilitation of the forest land will be very costly, if not impossible. Some other major problems in this area involve improved management of private forest lands and protection and establishment of trees and shrubs in areas surrounding urban and built-up areas.

The shoreline area of Lake Michigan in RBG 2.3 is one of the most severely eroding areas in the Great Lakes Basin. The shoreline consists of sand dunes and sand banks throughout the entire length, and is directly in the path of severe westerly storms and winds. The high lake levels of 1973 have created erosion conditions more severe than those shown in the tables.

Along streams in PSA 2.3 that have a drainage area of less than 400 square miles, 481 miles are subject to moderate streambank erosion damage, and 272 miles are subject to severe damage. The annual damage is estimated at $65,000. For streams draining more than 400 square miles, there are an estimated 312 bank-miles of severe streambank erosion with an estimated $26,400 worth of damage annually. The greatest problem in this area is the high erosion rates occurring principally on private land. To reduce erosion and sedimentation, more regulation of urban and suburban construction programs is needed.

The greatest flood damages in this river basin group occur in the urban areas, although the agricultural lands are also subject to considerable damage. The major problems are encroachment on the natural flood plain areas and the lack of local flood plain zoning and regulation. The flooding problems of many of the urban areas are the result of constricted reaches of the rivers, inadequate channel capacity, encroachment on the natural flood plain, or a combination of these causes. About one-half of the urban average annual damages occur in the Grand River basin.

There does not appear to be enough land and wildlife habitat in RBG 2.3 to satisfy the projected needs. The resource base is shrinking as wildlife habitat land is converted to other uses. Some farming practices leave little wildlife food and cover on the land. Drainage, stream modification, and urban encroachment have also contributed to the reduction of wildlife habitat. An acute problem in this area is the need for preservation or protection of the remaining wetlands in the area. A large portion of the inland wetland areas still remaining in the Great Lakes Basin is found in this planning subarea.

Existing aesthetic and cultural values have been summarized previously in Subsection 7.1. The major problem is the need to preserve outstanding values. Environmental buffer zones immediately adjacent to the edge of the expanding urban centers are in need of study and planning attention to insure proper use for their inherent significant resource features. Environmental corridors merit consideration in this area. At the present time, institutional arrangements and funding are not available to meet these objectives.

This planning subarea attracts many people from outside its boundaries for recreational purposes, especially for weekend and vacation uses. Table 1–101 shows recreational boating use in PSA 2.3 and projects future needs. Many of these people come from the Chicago and Detroit metropolitan areas and northern Indiana. The 1970 area's developed capacity for land-based water-oriented outdoor recreation must be more than doubled by 1980 and increased five-fold by 2020 if needs projected for normal growth are to be satisfied. Limited quantities of land are already in public ownership and could accommodate some additional recreational development. These areas include Allegan State Forest, Fort Custer, Waterloo, and Ionia recreation areas, all in Michigan, and several of the newer State parks.

TABLE 1–101 Use and Projected Needs for Recreational Boating, PSA 2.3

Category	1000 Boating Days	
	Great Lakes Waters	Inland Waters
1970 Use	978	2,538
1980 Needs	1,032	492
2000 Needs	1,422	1,182
2020 Needs	1,962	1,992

There are an additional 115,404 acres of State game and wildlife areas within the Michigan portion of Planning Subarea 2.3. In the not too distant future, it may be necessary to utilize these public lands more fully and provide some other types of compatible recreational opportunities for the general public in addition to hunting and fishing. Development of other recreational areas to meet the remaining needs in this subarea would involve the acquisition of new land for recreational development or the exportation of a part of the subarea's recreational requirements to areas further north.

7.4.4 Alternative Frameworks

Two alternative frameworks are presented for this as for other river basin groups. The Normal Framework does not reflect coordination of solutions to meet needs outside RBG 2.3 in the Lake basin or the Great Lakes Basin.

The second of the alternatives, the Proposed Framework contains the recommendations of the Commission in an effort to reflect the views of the people of the Basin and the policies and programs of the States. To some extent, it reflects coordination in the development of the Framework among a number of river basin groups in the Lake basin and in the Great Lakes Basin as a whole.

7.4.4.1 Normal Framework (NOR)

NOR is based on meeting quantified needs and solving identified problems to the maximum practicable extent consistent with subobjectives and criteria discussed in Section 2 of the appendix. The program outputs and costs are summarized in Section 12 on Tables 1–262, 1–263, and 1–264.

(1) Water Withdrawals

There are adequate water resources to meet water withdrawal needs with additional source capacity developed from the Great Lakes. Lake Michigan is the source considered in this framework. Self-supplied industry will continue to obtain a great share of its water from inland lakes and streams, with a little over 20 percent from ground-water sources. Rural domestic and livestock needs and much of the irrigation and mining needs will be satisfied from inland lakes and streams. About 30 percent of the rural domestic water supply and mining needs will be supplied from ground-water sources. It is estimated that the water for thermal power cooling generally will be supplied by Lake Michigan.

In the middle- and long-range time periods, regulatory storage, probably by reservoirs, will become increasingly important. All needs are met.

Land-use changes, process modification, and recirculation will have a considerable impact on the water withdrawal needs. Programs are included in NOR to initiate research to bring about process modification and recirculation, which would reduce the overall amount of water withdrawals. Additional advances in technology will also reduce amounts of withdrawal.

(2) Nonwithdrawal Water Uses

NOR includes both municipal and industrial waste treatment plants to meet water quality standards prior to the Federal Water Pollution Control Act Amendments of 1972. It also provides that there will be no degradation of water quality where existing water quality exceeds the standards. In addition to secondary treatment, there are a number of locations in RBG 2.3 in both States that will require advanced wastewater treatment by the year 1980. Additional facilities will be required before the year 2020.

No hydroelectric power development is planned in RBG 2.3.

Programs for developing the fishery in the river basin group are included in NOR to augment ongoing and existing programs in the area. These programs include fish passage improvements, fish production, fish hatcheries, fish population control, additional access to fishing areas, and fish habitat improvement and protection.

The recreational boating programs include additional marinas, harbors, and access points on Lake Michigan and marinas and inland lake and stream access points. In later time periods artificial impoundments may be created and used for boating. Much of the additional fishing demand will come from the South Bend, Chicago, and Detroit metropolitan areas.

Commercial fishery and commercial navigation are discussed in Subsection 7.6, which deals with Lake Michigan intrarelationships, and in Section 5. No specific navigation elements are included for this river basin group.

(3) Related Land Use and Problems

Both agricultural land treatment and cropland drainage are included in NOR. The forest land treatment is at a level that represents both the ongoing programs and the accelerated program.

NOR provides shoreline protection for the entire portion of the Lake Michigan shoreline subject to critical erosion. The noncritical reaches will not be protected.

NOR includes correction of streambank erosion by 2020 on all of the streambanks subject to severe erosion. None of the moderate streambank erosion would be treated.

NOR includes early-action programs to reduce urban and rural flood damages along all of the main streams and principal tributaries, utilizing both structural and nonstructural means. Use of both types of programs continues in the 1980–2000 and 2000–2020 periods.

For wildlife management, NOR includes acquisition and leasing of lands, development of streams, and the management of stocks of waterfowl and game. Wetlands are emphasized.

NOR provides for the development of outstanding and unusual significant aesthetic and cultural values. Many of these sites should be acquired in the early-action program (see Appendix 22, *Aesthetic and Cultural Resources*). Some of the most valuable wetland resources in the Great Lakes Basin are located in RBG 2.3. The wildlife program includes the acquisition and development of some of these areas. Additional areas would be considered in the aesthetic and cultural programs.

NOR includes additional recreational development to satisfy about 55 percent of the water-oriented outdoor recreation needs as they accrue during the planning period from 1970 to 2020. Programs to accomplish this include acquisition and development of river valleys for valley recreation areas, additional acquisition and development of about 6 miles of shoreline along Lake Michigan, acquisition and development of 8 regional parks during the 50-year period, acquisition and development of access segments along rivers and major tributaries for extensive recreation under the natural rivers act of the two States, and placing under contract and development an estimated 300,000 acres of wetlands under the Water Bank Act of 1970.

Only about half the outdoor recreation acreage requirements are met in the Normal Framework over the long term. The remaining needs for outdoor recreation will be met to a certain extent in the northern areas of the State of Michigan.

(4) Framework Outputs and Costs

Section 12 contains Tables 1–262, 1–263, and 1–264 which provide information on needs, outputs, percent of needs met, and capital and OM&R costs.

7.4.4.2 Proposed Framework (PRO)

PRO was formulated in consultation with State officials in order to reflect State policies and programs, as well as the desires of area residents.

State, regional, and local policies with respect to population and economic growth do not differ greatly from those of the OBERS projections used in NOR.

(1) Water Withdrawals

All elements in PRO are the same as in NOR, except that more individual attention is given to site selection and cooling process for thermal power plants. If the proportion of flow-through cooling is increased, the total withdrawal will be increased, but consumptive use will be less.

(2) Nonwithdrawal Water Uses

Quantities of waste to be treated are the same in PRO as in NOR, but PRO meets the higher standards of the Federal Water Pollution Control Act Amendments of 1972, so costs are greater. PRO also emphasizes the need for studies of methods of controlling nonpoint sources and agricultural wastes.

For sport fishing and recreational boating, the program selections for PRO are the same as for NOR.

Commercial fishery and commercial navigation programs are the same in PRO as in NOR, except for the general system programs for navigation, which may have minor effects on the river basin group.

(3) Related Land Use and Problems

Agricultural land treatment, cropland drainage, and forest land treatment are all programed for greater and more rapid accomplishment in PRO than in NOR. Comparison is shown in Table 1–332 of Section 12.

Shoreland erosion protection is programed for the same number of miles in PRO as in NOR. However, it is recommended that the greater amount of shore subject to critical erosion with recent high lake levels be provided with structural protection by 1980 and all shoreland be under management programs by that date.

Streambank erosion protection programs in PRO are the same as in NOR. The quantity of flood damage reduction is the same in PRO as in NOR, but there is more emphasis on flood plain management and other nonstructural measures.

PRO recommends an increase over NOR in the amount of wetlands acquired for wildlife management.

Aesthetic and cultural resource programs in PRO are the same as in NOR.

In water-oriented outdoor recreation, PRO will meet essentially the same proportion of needs as NOR. Emphasis will be on programs affecting urban areas, with reliance on the private sector to expand the development of areas away from the cities. Priorities for the use of public funding will be

(a) urban recreation developments and acquisition and retention of unique and natural areas of regional significance

(b) developments on lands now publicly owned

(c) other developments.

To the extent public funds are available for investment in urban lands, they may be used where feasible to assist in acquiring flood plain land in the rapidly urbanizing areas in the southern portion of the basin and in clearing flood plains of damage-prone uses and making them available for recreation use.

(4) Framework Outputs and Costs

Section 12 contains Tables 1–265, 1–266, and 1–267 which provide information on needs, outputs, percent of needs met, and capital and OM&R costs for PRO, indicating by italics where they differ from NOR. Table 1–332 compares the land treatment programs.

7.4.4.3 NOR and PRO Framework Costs

Section 12 contains Table 347 which lists the total costs (capital plus OM&R) for NOR and PRO for the periods 1971–1980 and 1971–2020.

7.5 Frameworks for River Basin Group 2.4

7.5.1 Summary

This river basin group is unique in having two land areas separated by Lake Michigan. Three counties in the planning subarea are located in the Upper Peninsula of Michigan and 18 counties in the Lower Peninsula. Together, these two sections constitute the shoreline of both sides of the northern part of Lake Michigan.

Looking at RBG 2.4 as a whole, there are no problems apparent which are severe enough to require immediate attention. Generally speaking, problems involve matters of land use, streambank erosion, flooding, and shoreline erosion. In a few cases, localized areas have problems of severe proportions, and many areas have problems of moderate magnitude. Water withdrawals and nonwithdrawal water uses are taken care of quite satisfactorily with the resources in the river basin group.

Because of its natural endowment and subsequent development, the area provides many high-grade recreational experiences, and the recreational opportunities will be enhanced under the framework adopted.

Agriculture in RBG 2.4 is quite specialized. In the northern counties dairy products, beef, berries, and potatoes, and some other vegetables are the principal products. In the counties of the Lower Peninsula, fruit and vegetable production are major enterprises, and three of the counties are the leading three counties nationally in the production of sour cherries. Dairy and livestock production are also important in the Lower Peninsula. Lumbering was at one time a major industry in both the Upper and Lower Peninsula portions of the river basin group. The current economy in the Upper Peninsula is still largely related to wood-using industries—pulp, paper, and wood products—and the same is true to some extent of the Lower Peninsula. Manufacturing is of very little importance in the Upper Peninsula, except for a few light industries. In the Lower Peninsula, some of the former sawmill towns have converted to general manufacturing and provide a wholesale-retail trade base. Recreation is an important part of the economy of the entire river basin group. In the Lower Peninsula three harbors are important in commercial navigation. This diverse economy influences the choice of elements in the NOR Framework. However, matters concerning maintenance of water quality; correction of land use, flooding, and erosion problems; and development of opportunities for recreational boating, sport fishing, and general outdoor recreation have loomed large in the programs adopted.

Table 1–268 in Section 12 shows needs, outputs, and percent of needs met under NOR. Tables 1–269 and 1–270, also in Section 12, show capital costs and operation, maintenance, and replacement costs.

The Proposed Framework is intended to reflect the policies of the State and local governments and the wishes of the residents of the area. The application of these policies does not result in projections of population or economic activity which differ from the OBERS projections. However, some local residents have expressed a desire for reduction in the rate of energy use, and increased attention to the environment.

The Proposed Framework is consistent with the Federal Water Pollution Control Act Amendments of 1972 and reflects a higher degree of wastewater treatment. Agricultural land treatment and forest land treatment are increased over NOR levels, but no cropland drainage is programed. Shoreland erosion programs reflect the high lake levels experienced in 1973.

7.5.2 The Area

Figure 1–31 shows the areal extent and the drainage pattern of River Basin Group 2.4 and also the counties included in the planning subarea. Statistical and descriptive information is in Section 1.

7.5.3 Projected Resource Needs and Problems

Needs for each time period are shown on Table 1–268 of Section 12. Where needs can be quantified, they are not discussed in the text, unless special conditions warrant such discussion.

7.5.3.1 Water Withdrawals

The needs in the water withdrawals category have been developed along conventional lines, and no particular problems are associated with them. Adequate water sources are available. In many cases there is an opportunity for choice among sources to meet a particular need.

7.5.3.2 Nonwithdrawal Water Uses

Municipal wastewater treatment requirements increase by about one-third in 1980, and by the year 2020 the total quantity to be treated is a little over three times that of the base year. At the same time, industrial wastewater discharges decrease from the base year to year 2000 and then increase between 2000 and 2020, but to an amount less than treated in the base year. The reduction in industrial treatment requirements is primarily due to the trend toward in-plant treatment and reuse of water so that water requirements are reduced.

Water requirements for hydroelectric power generation at the base year have not been quantified. Hydroelectric installed capacity was on the order of 10 percent of the total installed capacity, and generation was about 7 percent of the total power generated in the base year. Almost immediately thereafter, however, a large pumped storage plant at Ludington, Michigan, came into operation and became by far the largest single element in the generating system in the river basin group, accounting for about 75 percent of the total installed capacity and about 45 percent of the total power generated in RBG 2.4. The need for water for hydroelectric power use increased sharply from the base year to 1980 to serve this plant, but remained constant thereafter.

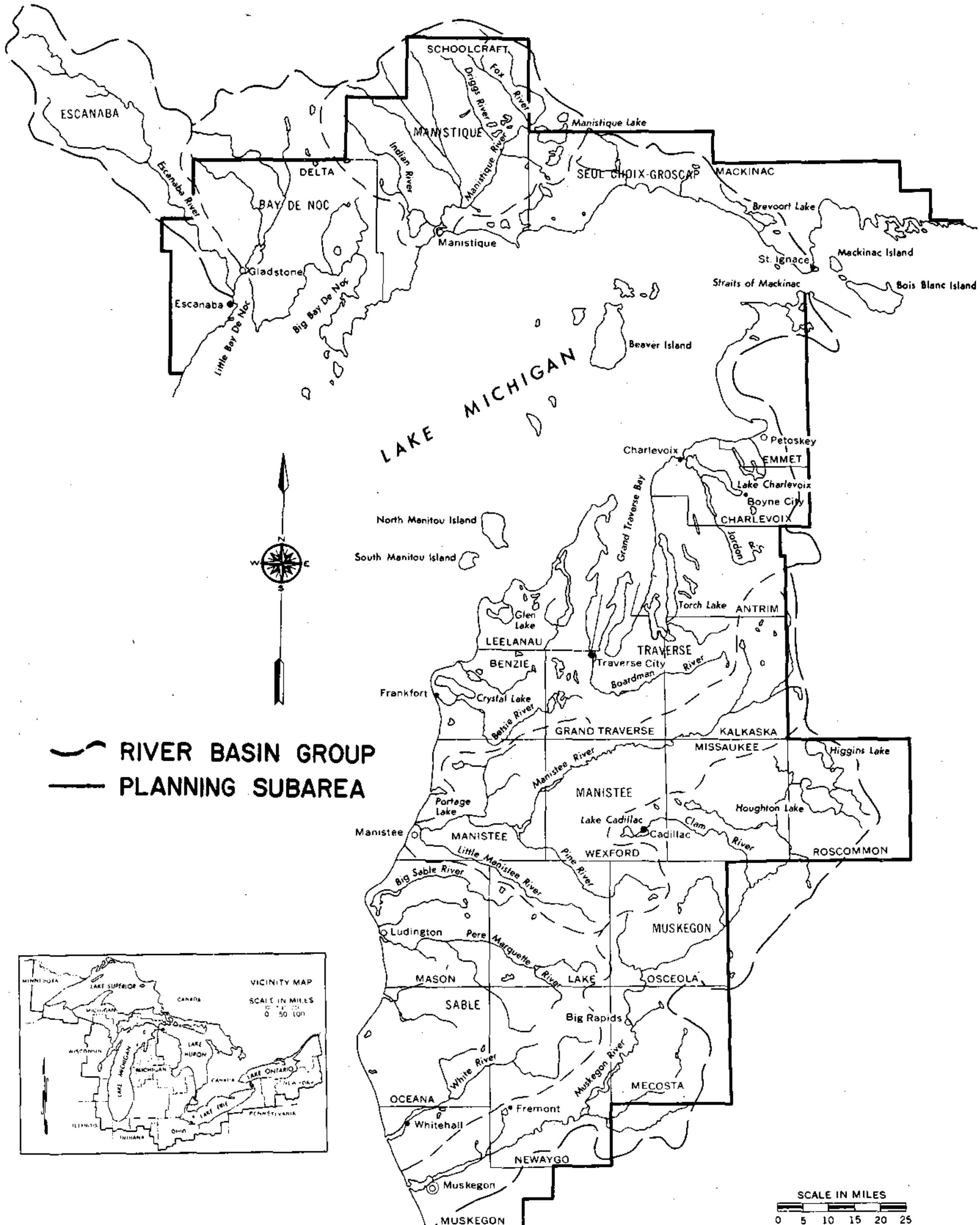

FIGURE 1-31 Lake Michigan Northeast, River Basin Group 2.4

TABLE 1–102 Use and Projected Needs for Recreational Boating, PSA 2.4

	1000 Boating Days	
Category	Great Lakes Waters	Inland Waters
1970 Use	969	2,574
1980 Needs	291	387
2000 Needs	417	798
2020 Needs	540	1,290

Problems adversely affecting the sport fishery are principally related to land use and result from erosion and sedimentation and the runoff from agriculture and other lands. This runoff contains nutrients, and in many cases, pesticides, herbicides, fungicides, and other chemicals, which pose a threat to the fishery resource and to the humans consuming the fish. Also in some areas where real estate developments are being carried out, tributary streams are dammed in connection with the development, reducing the amount of water available for the fish and also blocking the feeder streams used for spawning.

There is a quite high participation in boat ownership in this river basin group, with about 9.7 registered boats for every 100 residents. Possibly 10 percent of the total number of boats are not registered. There is also a very large amount of inland water available for boating, including lakes and streams which are suitable for boating and canoeing. Harbors and protective waters are relatively plentiful and well-spaced in Lake Michigan. The relationship between boating-day needs for Great Lakes and for inland waters is shown in Table 1–102. The adequate supply of inland lakes is relatively little used and principally requires access and launching sites to facilitate increased usage. Berthing facilities will also be required, particularlv on Lake Michigan.

No estimates of needs for commercial fishery have been made, and in general, this use of the resource is subordinated to sport fishery. These alternatives are considered for Lake Michigan and for the entire Great Lakes Basin in Subsections 5.2.2.8, 5.5.2.7, and 7.6.1.

There is no harbor in the river basin group which can be considered a major Great Lakes port. However, the nine principal harbors handle enough traffic to make commercial navigation a significant consideration in selecting frameworks for RBG 2.4. About 14 percent of the expected population of RBG 2.4 will be supported by this activity in 1980 and about 19 percent in 2020.

7.5.3.3 Related Land Uses and Problems

No peculiar land resource problems exist in RBG 2.4. The maintenance of the soil resource in the agricultural area requires constant surveillance, and treatment measures are needed. There are areas where excess water on the surface or in the soil profile is a problem, and drainage will alleviate this problem and permit increased crop production at lower production costs.

There is a long-term trend of declining forest land acreage because of encroachment by highways, power lines, reservoirs, and urban, recreational, and industrial developments. However, it is also expected that some idle cropland will probably revert to forest over a period of time. The challenge is to satisfy increasing demand for goods and services from a declining forest resource base. All of the acreage now available will be needed in the future. Management efforts and forest land treatment must be intensified.

Along the shoreline of the Upper Peninsula, there is no shoreland subject to critical erosion. However, along the Lower Peninsula, there are 42 miles subject to critical erosion and needing treatment.

Streambank erosion presents some problems, but losses are generally small.

The average annual damages due to flooding in urban areas are expected to be almost 4 times as great in year 2020 as in the base year. However, only slightly more acreage will be flooded. In rural areas the damages nearly double during this period, while the acreage remains essentially the same. There are no specific problems related to the flooding, but the urban area would profit most from any effective prevention.

The loss of wildlife habitat to urban and resort development is a significant problem in the river basin group. There are other problems, some related to the use of pesticides, which have proved to be persistent and are taking their toll of many rare and endangered species as well as the more common species. Habitat loss is also affecting certain species. The use of off-the-road vehicles and snowmobiles is creating wildlife management problems. However, because of the relatively sparse population, management practices will permit enhancement of this resource to a greater extent than in many parts of the Basin.

A number of resource types listed in Appendix 22, *Aesthetic and Cultural Resources*, relate to the establishment of corridors and buffer zones around and between population centers and along the shoreline and streams. Others relate to the acquisition and preservation of specific natural or cultural features, which should be identified at an early date and preserved by proper actions.

There is a wealth of opportunity for outdoor recreation, and a great diversity of recreational resources. There are no particular problems associated with development, but acquisition and management of the resource is a major undertaking. Uncontrolled and mismanaged development can degrade and destroy the resource.

7.5.4 Alternative Frameworks

Two alternative frameworks are presented for this as for other river basin groups. The Normal Framework does not reflect coordination of solutions to meet needs outside RBG 2.4 in the Lake basin or the Great Lakes Basin.

The second of these alternatives, the Proposed Framework, contains the recommendations of the Commission in an effort to reflect the views of the people of the basin and the policies and programs of the States. To some extent, it reflects coordination in the development of the framework among a number of river basin groups, in both the Lake basin and the entire Great Lakes Basin.

7.5.4.1 Normal Framework (NOR)

NOR is based on meeting quantified needs and solving identified problems to the maximum practicable extent consistent with subobjectives and criteria discussed in Section 2 of the appendix. The program outputs and costs for RBG 2.4 are summarized in Section 12 on Tables 1-268, 1-269, and 1-270.

(1) Water Withdrawals

Water withdrawal needs in River Basin Group 2.4 for NOR will be met in fairly conventional fashion. Municipal water requirements will be met principally by development of Great Lakes sources, with ground water the next largest source, and inland lakes and streams used in a relatively minor way. There is a possibility of reservoir development for municipal water supply. The industries which supply their own water have adequate source capacity through year 2000 by making use of techniques that are rapidly developing for recycling the water and withdrawing smaller amounts. Rural domestic and livestock water will principally come from ground-water supplies in the localities where it is needed. Some care will be needed, particularly in parts of the Upper Peninsula, to avoid attempting to develop wells in areas where yields are too low. Irrigation supplies will come from the best available source near the point of use, principally from ground water, but also from inland lakes and streams. Reservoir storage for irrigation is also a possibility. The needs for water for mining purposes will be met almost equally from ground-water sources and from inland lakes and streams, depending on the cheapest and most available source near the point of use.

The quantities of water required for thermal power cooling dictate that Lake Michigan receive first consideration as a source for this water, and the Normal Framework includes this as the source of the entire supply. No water above that presently provided will be needed for this purpose prior to the year 2000.

(2) Nonwithdrawal Water Uses

NOR provides for treating municipal wastes by conventional processes, including secondary treatment, and for 80 percent removal of phosphates. Advanced waste treatment is provided in those cases where it is needed to meet water quality standards. It is anticipated that regional waste treatment systems may prove desirable from an economic standpoint in certain areas.

Industrial waste treatment is also provided in conventional fashion. Based on projected quantities, no additional facilities are expected to be needed before year 2000. This is due to the increased in-plant recirculation of water and greater use of municipal facilities for treating industrial wastes. However, higher standards and new processes may require new plants. NOR meets effluent standards prior to the Federal Water Pollution Control Act Amendments of 1972.

The requirement for additional water for hydroelectric power production, which is shown as a need, is not in the strict sense a nonwithdrawal water use, as is the case with conventional hydroelectric plants. The need in question is for a pumped storage plant, located on the shores of Lake Michigan. This plant withdraws and returns the water on an almost daily basis, pumping from Lake Michigan to an elevated reservoir during the pumping cycle at the time of low demand on the power system, and releasing water from the reservoir to Lake Michigan during the generating cycle at the time of peak power demands. The supply is adequate for this purpose.

It is not possible to meet all the projected needs for additional angler-days for sport fishing. NOR includes proposals for land management that will improve the habitat and for other institutional changes. No acquisition of additional fishing water or fisherman access or any construction is contemplated in the framework.

There is adequate inland water to supply the needs for recreational boating through the projection period, and the Great Lakes water surface is adequate. However, additional access facilities and launching sites and similar facilities are required for inland waters, and berthing facilities are needed on Lake Michigan. By the end of the projection period, needs will be met.

Commercial fishing and commercial navigation are discussed in Section 5 and Subsection 7.6. Proposals for the improvement of Escanaba Harbor and the Straits of Mackinac are included in NOR.

(3) Related Land Use and Problems

Agricultural land treatment is included in NOR at essentially the same level as the program that has been followed in the past. About 42 percent of the land that could profitably use treatment for conservation benefits will be treated by the year 2020. Agricultural land drainage is included in NOR to the extent of 51 percent of the total needs.

About half of the forest land that could profit by treatment will be treated.

Twenty percent of the shoreland subject to critical erosion will receive protection in the first ten years, and an additional 40 percent will be treated in each of the remaining 20-year periods. No protection will be afforded reaches subject to noncritical erosion.

All of the streambank mileage subject to severe erosion will be treated, with 20 percent of this work done in the period to 1980, an additional 40 percent by 2000, and the balance by year 2020. None of the mileage subject to moderate erosion will be treated.

Programs for the alleviation of flood damage consist of both structural and institutional measures. Flood plain legislation and control should be instituted at the earliest practicable date and will increase in effectiveness, so that during the period 2000–2020 an estimated 75 percent of the average annual damages can be prevented through institutional means. Structural measures will begin as appropriate in the various locations and will supplement the institutional arrangements in preventing the remaining flood losses.

Wildlife management is provided for in NOR by continuation of ongoing programs including habitat management, enforcement, and research. Additional programs in the same fields will be carried out. These will more nearly meet the wildlife user-day needs than the hunting acreage needs, though neither will be fully met.

There is no specific provision in NOR for aesthetic and cultural programs, but the recognition of significant areas in RBG 2.4 that may be lost should lead to the protection and possible acquisition of these areas, and the development of buffer zones and corridors.

The area has great potential for water-oriented outdoor recreation, and programs have been selected for NOR that will provide surplus recreation days at all three target dates. Programs include development of the authorized Sleeping Bear Dunes National Lakeshore, acquisition and development of Lake Michigan shoreline, development of additional facilities in national forests, acquisition and development of regional parks, the development of about 50 miles of scenic river, and acquisition and development of about 100 miles of the proposed North Country Trail. The private sector will be urged to continue development of high-quality recreational facilities.

(4) Framework Outputs and Costs

Section 12 contains Table 1–268 which gives needs, outputs, and percent of needs met for the Normal Framework; Tables 1–269 and 1–270 list capital costs and operation, maintenance, and replacement costs.

7.5.4.2 Proposed Framework (PRO)

PRO was formulated in consultation with State officials in order to reflect State policies and programs as well as the desires of local residents.

State, regional, and local policies with respect to population and economic growth do not differ greatly from those of the OBERS projections. However, State data indicate that populations may be even lower than before projected.

PRO does not specifically recommend future social and economic policies or programs to influence the rate of growth or distribution of people in River Basin Group 2.4.

The environmental quality problems addressed indicate that the restoration of a very high level of water quality, development and conservation of recreational opportunities, reduction of rural and urban flooding, improvements to fish and wildlife resources, and a balanced level of development, supported by funding, as necessary, on the Federal, State, and local levels, are needed as top priority if the objectives of the public in the area are to be achieved.

PRO quantification differs from NOR in only a few elements. Comparative data are included where pertinent.

(1) Water Withdrawals

PRO is the same as NOR for all withdrawals. No water above that presently provided for thermal power cooling will be needed prior to the year 2000. PRO endorses the concept of encouraging reduction in the rate of growth of per capita use of power providing that the health, welfare, economy and social well-being of the inhabitants are not adversely affected. PRO also places more emphasis on environmental considerations in plant siting, and individual selection for each site of the appropriate cooling water system. If more supplemental cooling is introduced, the quantity withdrawn will be less, but there will be much more consumptive use.

(2) Nonwithdrawal Water Uses

In connection with waste treatment, PRO meets the requirements of the Federal Water Pollution Control Act Amendments of 1972, and higher costs are shown. PRO recommends full consideration of possibilities for waste treatment systems with on-land disposal. Major sources of pollution in the area are agricultural wastes, and PRO recommends attention to alleviating or treating these, including nonpoint sources.

The program for hydroelectric power production is the same for PRO as for NOR. PRO is the same as NOR for sport fishing and recreational boating.

(3) Related Land Use and Problems

PRO provides for treatment by year 2020 of all the agricultural land which can profitably use treatment for conservation benefits. No cropland drainage is included in PRO. The total forest land treatment will be about 60 percent of the opportunity. This is more than in NOR.

Treatment of shoreland against erosion should reflect the severe conditions of high lake levels of 1973. However, because data are not available, the quantities shown are the same as NOR.

For streambank erosion PRO is the same as NOR.

In flood plain management the numerical data for PRO are the same as for NOR. However, the Proposed Framework recommends that adequate sums of money be allocated to manage and control flood plain lands, with money allocated to both flood plain damage alleviation and to outdoor recreation and other uses of the flood plain.

The Proposed Framework includes the concept that the States should set a time limit for local entities to manage and develop policies, objectives, programs, and implementation techniques for flood plain regulations. If the local entities do not meet the time limits, the States should then manage and regulate the flood plains according to State statutes.

The Proposed Framework recommends the establishment of State-approved local control ordinances directed toward sediment reduction and the control or treatment of runoff on urban and rural lands. Consistent with Federal Water Pollution Control Act Amendments of 1972, State-established regulations would prevail if local regulations are not implemented by July 1, 1977.

The Proposed Framework for River Basin Group 2.4 includes the recommendation that additional studies be made at the State level leading to the development and adoption of a comprehensive land-use policy for the Great Lakes Region, including zoning to restrict flood plain usage, provisions for erosion control for urban and rural areas, and land-use decisions made on adequate information relative to the physical land base for suitable uses. This should result in improved land-use policies and permit water resources planning to complement land-use objectives.

Wildlife management programs in PRO are the same as NOR.

PRO has no specific provision for aesthetic and cultural programs, but recognizes the same elements as NOR.

PRO includes resource utilization that will meet all water-oriented outdoor recreation needs. It is assumed that approximately 60 percent of the outdoor recreation needs will be met with public funds (Federal, State, and local), and it is further assumed that the remainder will be met either by private funding or not at all. The priorities for the use of public funding will be:

(a) urban recreation developments and acquisition and restoration of unique and natural areas of regional significance

(b) developments on lands now publicly owned

(c) other developments.

To the extent public funds are available for investment in urban lands, they may be used where feasible to assist in acquiring flood plain land in urbanizing areas and in clearing flood plains of damage-prone uses and making them available for recreation use. The Proposed Framework emphasizes a need for specific criteria to insure that such recreational developments are consistent with the maintenance of a high-quality environment.

(4) Framework Outputs and Costs

Section 12 contains Table 1–271, which gives needs, outputs, and percent of needs met for PRO; Tables 1–272 and 1–273 list capital costs, and operation, maintenance, and replacement costs. These tables indicate by italics where PRO entries differ from NOR. Table 1–333 compares land treatment programs.

7.5.4.3 NOR and PRO Framework Costs

Table 1–348 in Section 12 lists the total costs (capital plus OM&R) for NOR and PRO for the periods 1971–1980 and 1971–2020.

7.6 Lake Michigan Intrarelationships

Various lake uses, such as commercial navigation, recreational boating, and sport and commercial fishing, and such parameters as water quality, levels and flows, and shore erosion, cross political boundaries. Although these activities and parameters have already been discussed for each river basin group, it will also be useful to discuss them in relation to the entire Lake Michigan basin.

7.6.1 Commercial Navigation

The importance of commercial navigation to most portions of the Lake Michigan basin is such that improvements in the navigation system are essential to the economic health of the region, and extension of the navigation season in other parts of the Great Lakes system is important to the ports on Lake Michigan itself. Consistent with these guidelines, the Normal Framework provides for enlargement of the Lake Superior-Lake Michigan system. Harbors at Escanaba, Chicago, and Milwaukee, and Indiana Harbor would be deepened to 31 feet, and constrictions in the Straits of Mackinac would be eliminated. Environmental quality must be maintained, and the disposal of dredge spoil is critical in this respect.

In PRO the harbors at Calumet and Port of Indiana would be deepened as part of the 31-foot system. The navigation season would be extended by six weeks through the Soo Locks, the St. Marys River, and to southern Lake Michigan.

7.6.2 Recreational Boating

The demand for recreational boating opportunities has increased markedly in the Lake Michigan basin. Small boat harbors are not always spaced closely enough for boaters to have ready access to a sheltered port. More berthing facilities are also needed at the harbors. Construction of new harbors and expansion of public access and existing facilities are needed in some areas. Because of heavy use in the southern portion of the basin, the boating opportunities in the northern portion are becoming more popular. New construction here is essential if the needs are to be met. Systems for providing weather information and other urgent messages to boaters must be developed and installed.

7.6.3 Sport Fishery

Sport fishing is rapidly growing throughout much of Lake Michigan. Opportunities are generally good except where water quality has been substantially degraded, as in the southern portion of the Lake.

Various programs by the States bordering the Lake for stocking salmonid species have revitalized fishing opportunities. Still greater coordination is desirable in order to avoid duplication and potential overstocking.

Because of the relatively large number of salmonid species in Lake Michigan, it is important to continue lamprey control programs throughout the Lake, in order to keep the efforts of fish managers in some areas from being nullified by the continued availability of lamprey habitat in other areas.

The periodic die-off of the alewife in recent years has caused a substantial problem in Lake Michigan. The reintroduction of salmonid species helps to control alewife populations.

Because many of the salmonid species are anadromous, it is important that sport fish management programs be coordinated with programs to protect the quality of the inland streams used by salmonid species for spawning.

7.6.4 Commercial Fishery

Many aspects relating to management of sport fishery also affect commercial fishery. The two have often been in conflict as to time, area, and species. Management concepts are being developed that will utilize a controlled commercial fishery as a management tool as well as an economic enterprise and will assist in developing and maintaining the sport fishery, which has impact on more people and is of more economic importance than the commercial fishery.

7.6.5 Water Quality

Much of Lake Michigan has excellent water quality. Furthermore, circulation patterns tend to contain the pollution in localized areas such as the southern portion of the Lake and Green Bay. The water quality of the Lake is threatened by many influences. In the southern portion there is substantial industrial development, while in the northern and eastern portions there is considerable agricultural development. Both of these can lower the water quality.

Another potential threat to water quality in the Lake comes from the anticipated increase in power generation. Lake Michigan is particularly suited for power generation because of the large power loads in the region and the abundant water for cooling purposes. At the present time, the States bordering on Lake Michigan are developing standards with respect to discharge of waste heat to the Lake. Some groups have expressed strong preferences for the use of supplemental cooling systems in power plants.

The degradation of water quality from activities associated with commercial navigation can be prevented through management of all shipping wastes and proper disposal of polluted dredge spoil.

It is difficult to overemphasize the importance of high quality water in meeting the needs of the large population on the shores of Lake Michigan. Furthermore, there is a real possibility of passing pollution thresholds in certain areas of the Lake. For these reasons, an expanded water quality monitoring program throughout the Lake is recommended. Such a program will provide information for wise water management and will assist in the enforcement of water quality standards and regulations.

7.6.6 Levels and Flows

Unlike Lake Superior or Lake Ontario, Lake Michigan is not a regulated Lake. Inflows, outflows, and the level of the Lake are almost exclusively a result of natural phenomena. The most significant manmade influence is the diversion to the Mississippi River through the Illinois River at the City of Chicago. This diversion is limited by the Supreme Court decree of 1967 to an annual average of 3,200 cubic feet per second (2068 mgd). Levels of the Great Lakes system are responsive to inflows and outflows in both the United States and Canada. A general discussion appears in Section 5.

Because of recent high lake levels, and the susceptibility of Lake Michigan shores to much greater erosion damage with only slightly higher levels, there have been proposals to increase the diversion at Chicago and lower the Lake by a small amount. Also, because the diversion occurs in the most polluted portion of Lake Michigan, advocates believe that increasing the diversion would serve to "flush out" the polluted end of the Lake. These proposals are among the many included in the overall studies of lake regulation.

Section 8

LAKE HURON BASIN

8.1 Study Area

The United States portion of Lake Huron and its drainage basin lies in the State of Michigan. More than half the Lake surface area and more than two-thirds of the drainage basin are in Canada. Principal inflow to Lake Huron is from Lake Superior and Lake Michigan. The Lake Huron drainage basin lies in portions of both the Upper and Lower Peninsulas of Michigan. However, the Lake Huron region (Plan Area 3.0), which is based on county boundaries for planning convenience, is only in the Lower Peninsula. (See Figure 1–32). For planning purposes, the Lake Huron basin (3.0) is divided into two river basin groups, (RBGs 3.1 and 3.2), with planning subarea economic counterparts, (PSAs 3.1 and 3.2). For a list of counties, river basins and complexes, and other data, see Section 1.

8.1.1 Human Characteristics

The Lake Huron plan area ranked fourth in population of the five plan areas in 1970, with 1,236,265 persons, about 4 percent of the regional population. This was an increase of 17 percent from the 1960 population of 1,056,577. The rate of increase was slightly higher in the northern part of the area than in the southern part, though the latter is by far the more populous. In the 11 northern counties only Alpena, Cheboygan, Iosco, Otsego, and Presque Isle Counties supported population centers large enough to be classified as urban. Of the remaining counties, four had less than 10,000 persons each. The urban population of the northern area was 26 percent of the total. The southern portion of the area shows a wide spread between sparsely settled Gladwin County, which has no urban population, and Genesee County, which has a population density of about 690 persons per square mile, the second most densely populated area in Michigan. Over 61 percent of the people in the southern portion live in urban areas. The Flint, Saginaw, and Bay City standard metropolitan statistical areas are all in the southern part. Major centers in the northern portion are Cheboygan, Rogers City, and Alpena. Additional statistics are given in Section 1.

The northern half of the Lake Huron basin is attractive because of its recreational resources, indicated by the approximately 20,700 seasonal vacation homes that are located in the area. The highest concentration of these homes is in the counties adjacent to Lake Huron and in the counties with large numbers of inland lakes. In addition to these seasonal vacation residents, thousands of tourists come to the area each year for recreation.

The economy in the southern portion of the basin is focused on intensive, heavy manufacturing, largely concentrated in the urban areas of Genesee, Saginaw, and Bay Counties, and in Midland County, which is the center of one of the largest chemical industries in the United States. Most of the population is in these four counties. Most of the other counties in the southern portion of the basin depend on resource base activities such as the prime agricultural land in the Thumb area and in the western part of the basin.

8.1.2 Water Resources

The Lake Huron basin has over 208,000 acres of inland lakes and approximately 8,000 miles of streams and rivers. The lakes range in size from 50,000 acres to small glacial ponds measuring one-tenth of an acre. The nature, availability, and quality of the water resource differ between the northern and southern parts of the basin. Streams in RBG 3.1 are typically short, with generally stable flows and small drainage areas. Water surface on inland lakes within PSA 3.1 exceeds 134,000 acres. Ground-water yields are estimated to range from over 700 mgd for the Au Sable River basin to less than 10 mgd in lacustrine deposits along the lakeshore. In general, most water in the glacial deposits is of good chemical quality, although it may be hard. Local areas, however, have very poor quality ground water, especially where bedrock containing highly mineralized water lies directly under glacial deposits.

In the northern part of the basin, water from lakes and streams and limited ground-water sources should be adequate to satisfy developing water needs. There are no extensive aquifers known to be capable of yielding large flows of ground water to individual wells. However, this

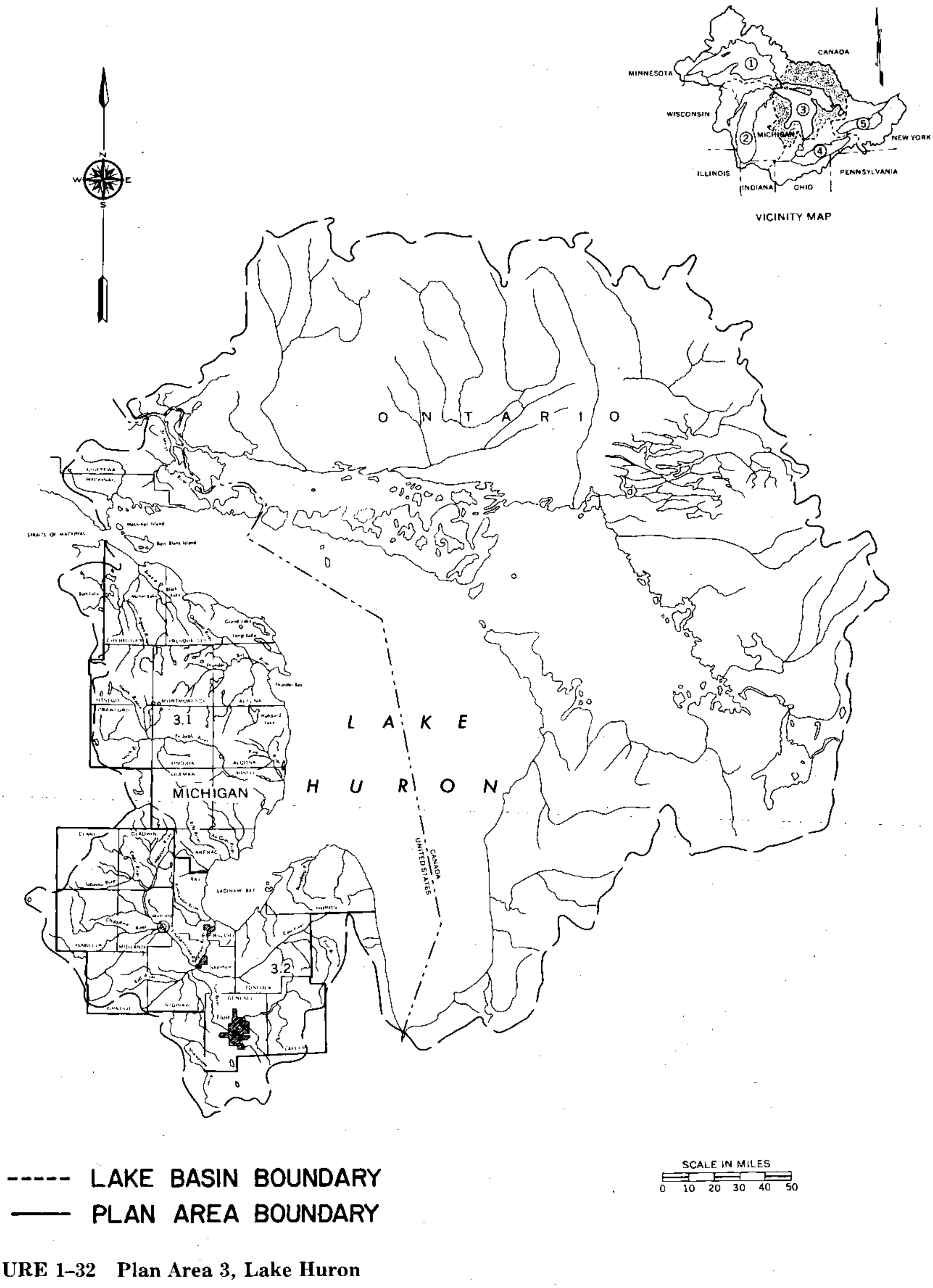

FIGURE 1–32 Plan Area 3, Lake Huron

area has an abundance of surface water resources. Though not generally long or steep, the streams drain over 6,700 square miles in the upper part of the basin. Relatively stable streams include the Au Sable, Black, and Rifle Rivers. The potential reservoir storage capacity is estimated to be about 76,000 acre-feet, if all adequate streams and lakes were developed for water supply. Potential increase in surface water yield from developing these resources is estimated at about 225 mgd. In spite of the overall limited potential for large ground-water resources, sustained yield of the ground-water resources in the planning subarea is estimated to be about 1945 mgd.

In the southern part of the basin the streams drain primarily agricultural land with extensive artificial drainage, and the urbanized areas of Flint and the Saginaw Valley. Flows are unstable and water quality is poor due to turbidity and municipal, industrial, and agricultural wastes. Inland lakes are not plentiful except near the headwaters, and surface resources are variable but generally poor in quantity and chemical quality. Flows of the lower Saginaw River are significantly affected by the raising and lowering of Saginaw Bay.

The two principal bedrock aquifers, the Grand River-Saginaw and the Marshall, locally yield large volumes of ground water, but over the aquifer area as a whole the yield would be moderate. In addition to the scarcity of large ground-water supplies, there is a problem of poor quality. Saline waters are often found at depths less than 100 feet either in the drift or in the bedrock. In general, poor water quality can be expected in the central basin area. Part of the poor water quality probably results from the natural migration of saline water upwards and outwards from the inner and deeper bedrock formations in the Michigan basin.

The surface waters of the Flint River basin constitute a limited source of supply for withdrawal uses. Although the City of Flint has developed the potential of the Flint River to a considerable degree, the principal supply is Great Lakes water purchased from the City of Detroit. Smaller communities depend upon ground water. The basin is relatively close to suitable supplies from Lake Huron and Saginaw Bay.

The quality of water in the main body of Lake Huron is excellent. Lake Huron waters are low in turbidity and moderate in hardness. Lake Huron is suitable for domestic water supply and will be kept so under present plans through the year 2020.

8.1.3 Land and Other Natural Resources

Soils in the Lake Huron basin vary widely from north to south. In the northern portion the podzol soils, those developed under cool, moist climate from siliceous parent material, cover most of the area. Typically, these soils are low in lime content, low in fertility, and subject to severe drainage restrictions.

The soils of the southern portion of the basin show little resemblance to the bedrock. Instead, their character is determined by differences in the glacial mantle. Deposits range from lacustrine clays to outwashes of nearly pure sand, and contain a large variety of mineral materials. In addition the actions of climate, cover, and topography working on the parent materials over a long time period have resulted in soils of great variety in terms of texture and soil profile development. Slightly over 50 percent of the total land base in the southern portion of the basin is subject to some drainage or flooding problem. About 24 percent of the cropland is subject to drainage problems and on half of this area these problems are severe.

The land resources of the basin are used for many diverse purposes. The low soil fertility in sections of the northern portion of the region and the large number of limestone outcrops along the Lake Huron shoreline have limited the potential for agriculture in that area. However, agriculture will continue to be important, particularly the production of potatoes, beef, and milk.

Distribution of uses of the total land area in the Lake Huron region and in the two planning subareas is shown in Figure 1–33.

Beech, birch, maple, and hemlock are the major forest trees covering the northern portion of the basin, parts of the middle portion, and the Lake Huron shore area. A wide band of jack, red, and white pine stretches across the central portion of the northern area of the basin, bordered by areas of spruce and fir to the south. In the southern portion of the basin, the species are aspen, birch, elm, ash, maple, and pine. These species are not of high quality for producing marketable saw logs. Consequently, the forest industry in the 11 counties of PSA 3.2 is primarily oriented to the production of pulpwood and Christmas trees, with only a limited amount of timber being used for manufacturing or other wood products.

The total built-up area of the northern portion of the plan area is less than 85,000 acres. The number of farms in this portion of the area has been declining for several years. Much of the land in the abandoned farms did not become part of any other farming enterprise, and the percentage of the total area in farms declined from 22.3 percent in 1959 to 19.7 percent in 1965, and to 16.1 percent in 1969.

The southern portion of the plan area contrasts with the northern portion in that 54 percent of the total land area is cropland. This area ranks high in

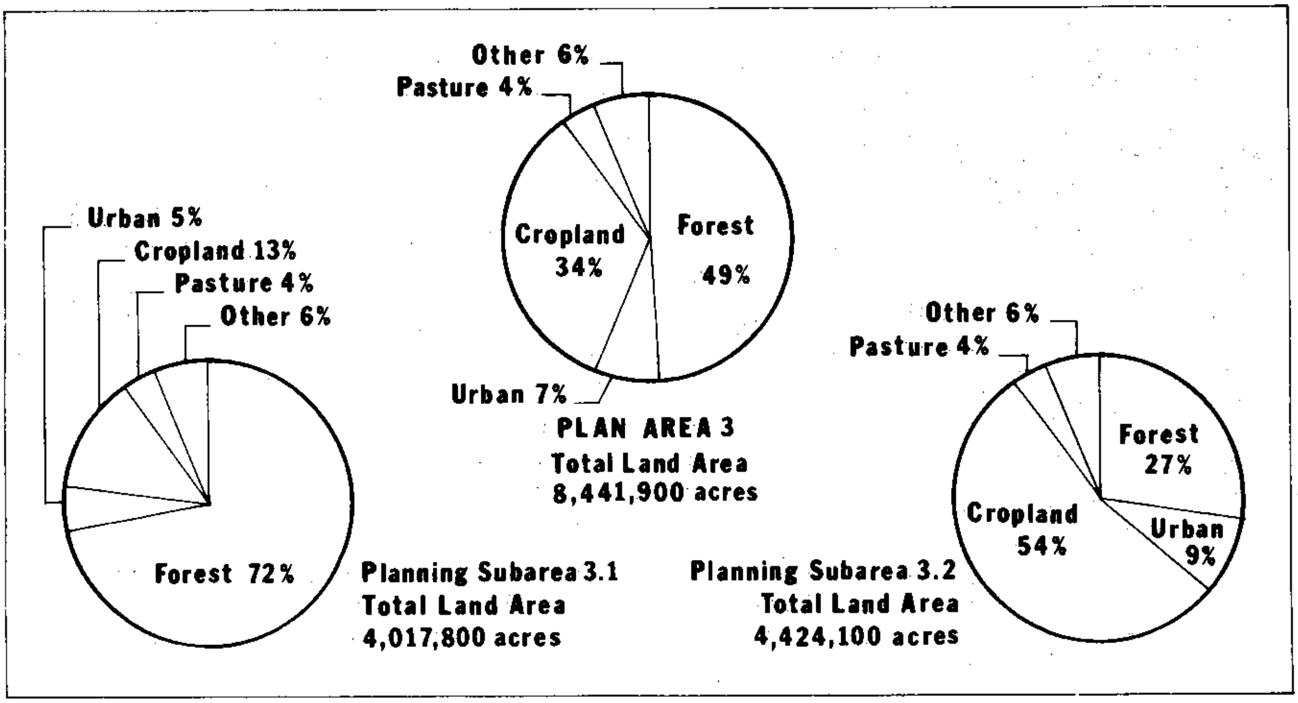

FIGURE 1–33 Land Use in the Lake Huron Basin

total value of farm products sold. Cash crops, grain, and other field crops predominate, with a value of slightly over $100 million annually. Livestock sales account for about 40 percent of the value of farm products sold. Important crops are dry beans, sugar beets, and potatoes. This planning subarea leads the Great Lakes Basin in dry field bean production and produces one-third of the field beans for the entire nation.

In the northern portion of the plan area, it is projected that by 2020 urban built-up areas will gain primarily at the expense of forest land, while in the southern portion the changes will be primarily at the expense of cropland. The reduction of the land base due to urban buildup in the northern portion amounts to only 32,800 acres, while in the south the shift is projected to be 180,100 acres. As urban expansion, new seasonal home development in all portions of the basin, and pressures for additional developments along the shoreline of Lake Huron materialize, more governmental units will be faced with the need for land use plans or revision of existing plans.

Mineral deposits found in the Lake Huron basin reflect the geology and sedimentation in the area and its subsequent glaciation. Minerals found in the northern portion include gypsum, petroleum and natural gas, sand and gravel, shale, and limestone. The minerals found in the southern portion include clay, peat, petroleum and natural gas, salt, sand and gravel, and limestone. In addition, cement and lime are manufactured from both local and imported raw materials, and bromine, calcium compounds, iodine, magnesium, and potash (salines) are extracted or manufactured from the natural brines. By far the most important mineral group is the salines.

Wildlife habitat and wildlife resources vary from north to south, with changes in land use and climate being important factors in the variation. The northern part of the plan area is characterized by large tracts of State and national forests. Human population densities are low and problems here are those of resource management. In the big game category, deer are the major species. There is also a small herd of elk in four northeast counties. Elk hunting was permitted in 1964 and 1965 but has not been permitted since then. Black bear hunting is permitted in limited areas of the northern Lower Peninsula.

Good habitat conditions provide the small game hunter with some of the best ruffed grouse and woodcock hunting in the State. Squirrel, varied hare, and cottontail rabbit make up the remainder of the small game population.

For the waterfowl hunter, many species of ducks and geese frequent the open waters of Lake Huron and the many inland marshes, lakes, rivers, and flooded areas.

The southern portions of the basin, particularly the Thumb and the Saginaw Valley, are renowned for pheasant hunting. Squirrel, rabbit, grouse, and raccoon are favorite targets of the upland game hunter, and fox hunting provides sport for man and dog. Many private land owners cooperate by allowing hunting on their land. However, the wildlife habitat has deteriorated lately. Clean farming practices, particularly in the Thumb on the east side of Saginaw Bay, have decreased nesting and winter cover for pheasant and reduced the pheasant food supply. In addition to the degradation of habitat, losses of habitat area are occurring from urban expansion. The construction of highways, subdivisions, and new utilities has taken a significant amount of land.

The northern portion of the area offers the sport fisherman an abundance of fishing opportunities. A wide variety of species, numerous large lakes, many miles of stream accessibility, and a rural natural environment influence large numbers of fishermen to travel fairly long distances to fish in this area.

In the lower portion of the basin, pollution from industrial, municipal, and agricultural development has in the past diminished the fishing quality in many of the major rivers and impoundments, particularly around Flint, Saginaw, Bay City, and Midland. Additional problems are serious erosion and siltation from both agriculture and urban construction. These require corrective action. Management for the valuable sports species and the removal of rough fish are also problems in this portion of the basin. Pollution of the rivers and impoundments in the past has discouraged many of the fishermen in this area and caused them to seek their recreation in Saginaw Bay or further north in the Great Lakes Basin. However, recent improvement in water quality and the newly planned impoundment of the Pine River offer hope for reestablishing valuable fish species within the southern portion of the basin.

The United States sector of Lake Huron itself may be divided into four general ecological areas, each of which has traditionally yielded a characteristic combination of fish species. In the large central basin, which extends from above Rogers City south to below Harbor Beach, were chubs and lake trout. The far northern straits were similar to the adjacent habitat of Lake Michigan and supported lake trout, whitefish, and suckers. The southern portion of Lake Huron yielded yellow perch, lake herring, walleye, and suckers near the shore and whitefish offshore. Saginaw Bay provided a highly productive habitat for yellow perch, smelt, walleye, lake herring, suckers, catfish, and carp.

Other than the appearance of carp and the near disappearance of sturgeon in the early 1900s, there were few major changes in the fish population of Lake Huron prior to 1930. However, there has been considerable change since then. Many of the species in the lake today were deliberately introduced or have entered the lake indirectly as a result of man's activities. Following the establishment of the sea lamprey in the 1930s, the lake trout and the whitefish population underwent rapid decline. This allowed the smelt and smaller chub population to increase in the 1940s and the alewife population to explode in the 1950s. Concurrently, the walleye and suckers started to decline in the 1940s, a trend which has continued to the present time. The lake herring population fell sharply in the 1940s and suffered an extreme decline to near insignificance in the 1950s and 1960s. Today, the alewife dominates the lake, while control of the sea lamprey is the major factor in permitting reestablishment of the high-value predator species. The successful introduction of the coho and chinook salmon have added new dimensions to the fishery resources of Lake Huron.

The Lake Huron region includes many of the elements which are important to the recreation resource base. Among these are more than 1.5 million acres of State and national forests, many inland lakes and rivers, and the beaches of Lake Huron. The northern half of the region is less heavily populated, and thus less developed, than the southern half and has the more extensive recreational opportunities. The southern half has almost equally good opportunities at its northern border, but these gradually give way to more highly populated areas toward the southern part of the basin. The lake plain circling Saginaw Bay lacks many natural resources necessary to provide varied recreational opportunities, yet the shoreline of the bay is marshy and supports large numbers of waterfowl and fish species.

The shores of many inland lakes have been developed with residences and summer cottages. While these lakes have many acres of beach, public use is limited by the lack of access sites. Of the more than 700 acres of beach along the western shore of Lake Huron, approximately 140 acres are publicly owned, but 13 acres are closed because of pollution. Another 50 acres may have potential for public use.

The Au Sable, Carp, Black, Ocqueoc, and Rifle Rivers have been identified as potential scenic or natural rivers by Michigan. The Tittabawassee, Shiawassee, Flint, and Cass Rivers and their tributaries offer a significant recreation resource base.

8.1.4 Resource Problems

Potentially severe problems in the Lake Huron

TABLE 1–103 Lake Huron Basin, Resource Problems Matrix

	LAKE HURON RIVER BASIN 3.0																	
		North River Basin Group 3.1																
			St. Marys Complex				Les Cheneaux C.				Cheboygan River				Presque Isle C.			
Resource Use Category	Overall	Overall	Overall	Urban	Rural	Interface	Overall	Urban	Rural	Interface	Overall	Urban	Rural	Interface	Overall	Urban	Rural	Interface
WATER WITHDRAWALS																		
MUNICIPALLY SUPPLIED	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
SELF–SUPPLIED INDUSTRIAL	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
RURAL DOMESTIC & LIVESTOCK	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
IRRIGATION	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
MINING	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
THERMAL POWER COOLING	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
NON–WITHDRAWAL WATER USES																		
MUNICIPAL WASTEWATER DISCHARGES	1	1	1	1	–	1	–	–	–	–	1	–	1	1	–	–	–	–
INDUSTRIAL WASTEWATER DISCHARGES	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
HYDROELECTRIC POWER	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
WATER ORIENTED OUTDOOR REC.	1	1	1	–	–	1	1	–	–	1	1	1	1	1	1	–	–	1
SPORT FISHING	2	2	–	–	–	–	–	–	–	–	1	–	2	1	1	–	1	–
RECREATIONAL BOATING	1	1	–	–	–	–	–	–	–	–	1	–	–	1	1	–	–	1
COMMERCIAL FISHING	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
COMMERCIAL NAVIGATION	1	1	–	–	–	–	–	–	–	–	1	1	–	–	–	–	–	–
RELATED LAND USES & PROBLEMS																		
LAND USE	3	3	–	–	–	–	–	–	–	–	3	–	3	3	3	–	3	3
AGRICULTURAL LAND TREATMENT	1	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
CROPLAND DRAINAGE	1	1	–	–	–	–	–	–	–	–	1	–	1	–	–	–	–	–
FOREST LAND TREATMENT	1	1	–	–	–	–	–	–	–	–	1	–	1	–	1	–	1	–
SHORELAND EROSION	–	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
STREAMBANK EROSION	1	1	–	–	–	–	–	–	–	–	1	–	1	–	–	–	–	–
FLOOD PLAINS	1	1	–	–	–	–	–	–	–	–	1	–	2	–	1	–	1	–
WILDLIFE MANAGEMENT	1	1	–	–	–	–	–	–	–	–	1	–	1	–	1	–	1	–
AESTHETIC & CULTURAL	1	1	1	–	–	1	1	–	–	1	1	–	1	1	1	–	–	1
OUTDOOR REC.–INTENSIVE	1	1	–	–	–	–	–	–	–	–	1	–	1	–	–	–	–	–
–EXTENSIVE	1	1	–	–	–	–	–	–	–	–	1	–	–	1	1	–	–	1

Legend: 3 Severe--Demands immediate attention
2 Moderate--Of major concern; potentially serious
1 Minor--Not considered a serious problem
– Problem is insignificant or not known

basin ranked in order of priority for providing solutions are: pollution from cities, pollution from industries, inadequate land-use planning, and sedimentation. There are other areas of major concern to which recognition must be given. These are flooding problems, economic growth, recreational opportunities, and other resource uses so intimately related to the water resource use as to demand recognition. A problems matrix for the basin is shown in Table 1–103.

River Basin Group 3.1 has a number of problems of major concern, reflecting changes over the past 30 years. Agriculture is no longer a dominant factor in the economy or the employment structure. There has been increased employment in the wholesale and retail trade, public administration, business and services, and miscellaneous activities. The increase in these categories is attributable in part to increased manufacturing activities, but an equally important factor has probably been the increase in tourist trade.

Population growth has not kept pace with growth in the State or the nation. Population change, migration, education, income, and the growth of em-

TABLE 1–103 (continued) Lake Huron Basin, Resource Problems Matrix

LAKE HURON RIVER BASIN 3.0																													
North River Basin Group 3.1																		Central River Basin Group 3.2											
Thunder Bay River Basin				Alcona Complex				Au Sable Complex				Rifle-Au Gres C.						Kawkawlin Complex				Saginaw River Basin				Thumb Complex			
Overall	Urban	Rural	Interface	Overall	Urban	Rural	Interface	Overall	Urban	Rural	Interface	Overall	Urban	Rural	Interface	Overall	Open Waters	Overall	Urban	Rural	Interface	Overall	Urban	Rural	Interface	Overall	Urban	Rural	Interface
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	1	1	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	1	1	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	1	-	1	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	1	-	1	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1	1	-	1	1	1	-	1	1	1	-	-	1	1	-	-	2	1	-	-	-	-	2	3	2	2	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	1	-	-	-	-	2	3	2	2	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1	1	1	1	1	-	-	1	1	1	1	1	1	1	-	1	1	-	1	-	-	1	1	-	2	-	1	-	-	1
1	-	2	1	1	-	1	-	1	-	2	1	1	-	1	-	1	1	1	-	1	1	1	1	1	1	1	-	1	-
-	-	-	-	1	-	-	1	-	-	-	-	1	-	-	1	1	-	1	-	1	1	1	-	1	1	1	-	1	1
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	1	1	-	-	-	-	-	-
3	-	3	3	3	-	3	3	3	-	3	-	3	-	3	3	2	-	3	-	3	3	3	3	3	3	3	-	3	3
-	-	-	-	-	-	-	-	1	-	1	-	1	-	1	-	1	-	1	-	1	-	1	-	1	-	1	-	1	-
1	-	1	-	1	-	1	-	-	-	-	-	1	-	1	-	1	-	-	-	-	-	1	1	1	-	-	-	-	-
1	-	1	-	1	-	1	-	1	-	1	-	1	-	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	2	-	-	2	-	-	-	-	2	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1	-	1	-	-	-	-	-	1	-	1	-	1	-	1	-	1	-	1	-	1	-	1	1	1	-	1	-	1	-
-	-	-	-	-	-	-	-	-	-	-	-	1	-	1	-	2	-	1	1	1	-	2	2	1	-	1	-	1	-
1	-	1	-	1	-	1	-	1	-	1	-	1	-	1	-	3	-	1	-	1	3	2	-	2	2	1	-	1	3
1	-	1	-	1	-	-	1	1	-	1	-	1	-	1	1	1	-	1	-	-	1	1	1	-	1	1	-	-	1
1	-	1	-	-	-	-	-	1	-	1	-	1	-	1	-	1	-	1	-	-	1	1	-	1	-	1	-	-	1
-	-	-	-	1	-	-	1	-	-	-	-	1	-	-	1	1	-	1	-	-	1	1	-	1	-	1	-	-	1

ployment opportunities are strongly interrelated. Certain segments of the area's population are disadvantaged because unemployment and underemployment are high, labor participation rate is low, out-migration of the young is high, in-migration of retirees is high, educational level is low, and vocational educational facilities are inadequate.

Problems in land use, particularly in the shoreline areas, are increasing because of the influx of seasonal residents, speculative land developers, and mining activities. Table 1–104 shows land use in the Lake Huron basin in 1966–67. Some of these land use problems are acute at the present time, and indications are that they will grow to be of major concern in the future. Table 1–105 indicates the implied changes to the land resource base for the three time frames for the Lake Huron basin. Table 1–106 provides the same information by PSA.

Water quality problems, although localized, are present throughout the Lake Huron basin. A number of stream reaches in RBG 3.1 are subject to pollution resulting from discharges of effluent from primary treatment plants, industrial waste discharge, and discharge of untreated and partially treated sewage. Such conditions are found in portions of the Pine, Rifle, Au Sable, Thunder Bay, and Cheboygan Rivers.

Water quality in the Au Gres and Tawas Rivers is generally good, with the exception of localized bacteriological problems due to the discharge of untreated and partially treated sewage and ef-

TABLE 1–104 Land Use, Lake Huron Plan Area, 1966–67 (thousands of acres)

PSA and State	Total Land Area	Urban Built-Up	Resource Base: Cropland	Pasture Range	Forest Land	Other	Total
PSA 3.1 Michigan	4,017.8	179.6	531.2	173.6	2,914.3	219.1	3,838.2
PSA 3.2 Michigan	4,424.1	389.0	2,370.0	185.2	1,194.7	285.2	4,035.1
TOTAL	8,441.9	568.6	2,901.2	358.8	4,109.0	504.3	7,873.3

TABLE 1–105 Actual and Projected Land Use, Lake Huron Plan Area (thousands of acres)

Land Use	Actual 1966-67	Implied Change 1966-67 to 1980	Projected 1980	Implied Change 1980-2000	Projected 2000	Implied Change 2000-2020	Projected 2020
Lake Huron							
Total land area[1]	8,441.9	---	8,441.9	---	8,441.9	---	8,441.9
Total urban and built-up	568.6	60.4	629.0	86.9	715.9	65.6	781.8
Total nonurbanized land	7,873.3		7,812.9		7,726.0		7,660.4
Resource Base:							
Cropland	2,901.2	(31.7)[2]	2,869.5	(46.1)	2,823.4	(32.4)	2,791.0
Pasture	358.8	(2.8)	356.0	(4.0)	352.0	(3.0)	349.0
Forest Land	4,109.0	(21.7)	4,087.3	(30.8)	4,056.5	(25.7)	4,030.8
Other Land	504.3	(18.7)	485.6	(6.0)	479.6	(4.5)	475.1
Total[3]	7,873.3	(60.4)	7,812.9	(86.9)	7,726.0	(65.6)	7,660.4

Source: Developed by Economic Research Service, U.S. Department of Agriculture, East Lansing, Michigan.

[1]Total land area = total area - water area, and is assumed constant for projection periods.
[2]Bracket figures represent urban depletions for 1967-1980, 1980-2000, and 2000-2020.
[3]Detail may not add to total due to rounding.

TABLE 1–106 Actual and Projected Land Use, Lake Huron Plan Area by PSA (thousands of acres)

Land Use	Actual 1966-67	Implied Change 1966-67 to 1980	Projected 1980	Implied Change 1980-2000	Projected 2000	Implied Change 2000-2020	Projected 2020
PSA 3.1							
Total land area[1]	4,017.8	---	4,017.8	---	4,017.8	---	4,017.8
Total urban and built-up	179.6	8.3	187.9	10.9	198.8	13.6	212.4
Total nonurbanized land	3,838.2		3,829.9		3,819.0		3,805.4
Resource Base:							
Cropland	531.2	(1.1)[2]	530.1	(1.5)	528.6	(1.9)	526.7
Pasture	173.6	(.4)	173.2	(.5)	172.7	(.6)	172.1
Forest Land	2,914.3	(6.3)	2,908.0	(8.3)	2,899.7	(10.3)	2,889.4
Other Land	219.1	(15)	218.6	(.6)	218.0	(.8)	217.2
Total[3]	3,838.2	(8.3)	3,829.9	(10.9)	3,819.0	(13.6)	3,805.4
PSA 3.2							
Total land area[1]	4,424.1	---	4,424.1	---	4,424.1	---	4,424.1
Total urban and built-up	389.0	52.1	441.1	76.0	517.1	52.0	569.1
Total nonurbanized land	4,035.1		3,983.0		3,907.0		3,855.0
Resource Base:							
Cropland	2,370.0	(30.6)	2,339.4	(44.6)	2,294.8	(30.5)	2,264.3
Pasture	185.2	(2.4)	182.8	(3.5)	179.3	(2.4)	176.9
Forest Land	1,194.7	(15.4)	1,179.3	(22.5)	1,156.8	(15.4)	1,141.4
Other Land	285.2	(3.7)	281.5	(5.4)	276.1	(3.7)	272.4
Total[3]	4,035.1	(52.1)	3,983.0	(76.0)	3,907.0	(52.0)	3,855.0

Source: Developed by Economic Research Service, U.S. Department of Agriculture, East Lansing, Michigan.

[1]Total land area = total area - water area, and is assumed constant for projection periods.
[2]Bracket figures represent urban depletions for 1967-1980, 1980-2000, and 2000-2020.
[3]Detail may not add to total due to rounding.

TABLE 1–107 Municipal Water Supply Development, Lake Huron Plan Area (mgd)

		1970 Average Demand			
PSA	State	Domestic and Commercial	Municipally Supplied Industrial	Total	Source Capacity
3.1	Michigan	6.2	0.8	7.0	10.5
3.2	Michigan	73.6	52.0	125.6	188.4
TOTAL	---	79.8	52.8	132.6	198.9

fluent from primary sewage treatment plants. Algal blooms are common occurrences in these areas.

Water in the Saginaw River (RBG 3.2) is of substandard quality throughout its entire length. Tributary inflows contribute sizeable waste loads, especially of chlorides and nutrients. The Flint River waters are degraded by eight municipal and institutional wastewater treatment plants, storm water overflows, tributary waste loads, and untreated or partially treated sewage discharges from outlying townships. The other rivers in the basin all have reaches of substandard quality due to quantities of dissolved solids, septic tank discharges, or industrial and agricultural waste discharges.

Streambank erosion and resulting sedimentation are moderately severe in this Lake basin, with over 1,700 bank miles subject to some erosion. Streambank erosion along rivers with less than 400 square miles of drainage area amounts to about 612 miles with severe erosion and 950 miles with moderate erosion. Streambank erosion along rivers and streams draining more than 400 square miles amounts to about 147 miles of streambank that are subject to erosion, with about one-third of that mileage subject to severe erosion. The average annual damages from land loss, sedimentation, and other degradation amounts to about $140,000 per year for the Lake basin.

Even though many of the rivers and the drainage areas in this Lake basin are small, there are flood problems. Flood overflows resulting from ice jams, and floods created by severe rainstorms, some of which may be extremely local, have caused damages to both urban and rural areas. Flooding problems in the northern portion of the Lake basin are relatively minor and generally local in nature. Areas affected have been farm lands, power facilities, and secondary roads and their drainage structures. Storms and prolonged rain have caused soil losses from cultivated fields.

In the southern part of the Lake basin, some flooding occurs almost every spring. The flood of March 1948 was one of the most severe. The areas subject to inundation in the Kawkawlin basin are the residential areas along both banks from Saginaw Bay to about 2.5 miles upstream and the crop areas located along the upper reach of the main stem and the lower reaches of the two branches of the Kawkawlin River. A steady development of land for residential purposes has taken place near the mouth of the Kawkawlin River. The trend shows no sign of abating, and property owners are reluctant to recognize the flood threat. Zoning restrictions against further development would help to prevent increased flood damages.

Wildlife habitat in the Lake basin is diverse. It includes the northern forests, active and fallow cropland, and some of the most valuable waterfowl marsh in the State of Michigan. Urban areas comprise a significant portion of the lower portion of the basin, and their associated problems have seriously degraded some of the wildlife habitat. Changes in forest succession are also occurring to some extent. The loss and degradation of wetland habitat around Saginaw Bay is one of the most critical wildlife resource problems. The bay and its extensive marsh complex is a nationally known waterfowl concentration area. The construction of a small boat channel, docks, and other marine facilities in the marsh area has adversely affected wildlife resources.

These conditions in the two river basin groups that make up the Lake Huron basin indicate the need for land use management in all areas.

8.1.5 Existing Resource Use and Development

8.1.5.1 Water Withdrawals

In the Lake Huron basin there are adequate water resources of satisfactory quality for water withdrawal functions. The approximate requirement in 1970 was 1,480 mgd. Lake Huron serves as the principal source of water in the basin, furnishing about 75 percent of the water withdrawn in 1970, with inland lakes and streams and ground water supplying the balance.

In 1970 about 766,000 persons in the Lake Huron

TABLE 1–108 Water Sources for Municipal Water Supply, Lake Huron Plan Area, 1970 (mgd)

			Water Source		
PSA	State	Source Capacity	Great Lakes	Inland Lakes and Streams	Groundwater
3.1	Michigan	10.5	5.0	-	5.5
3.2	Michigan	188.4	135.8	2.1	50.5
TOTAL	---	198.9	140.8	2.1	56.0

TABLE 1–109 Industrial Water Supply Development, Lake Huron Plan Area, 1970 (mgd)

			Self-Supplied	
PSA	State	Gross Water Requirements[1]	Withdrawals	Consumptive Use
3.1	Michigan	80	25	3
3.2	Michigan	815	515	31
TOTAL		895	540	34

[1]Partially supplied by recirculation

TABLE 1–110 Rural Water Supply, Lake Huron Plan Area, 1970 (mgd)

PSA	State	Developed Source Capacity	Consumptive Use
3.1	Michigan	6.8	2.0
3.2	Michigan	32.5	9.4
TOTAL		39.3	11.4

TABLE 1–111 Irrigation Water Supply, Lake Huron Plan Area, 1970, estimated

	Agriculture			Golf Courses		
		Withdrawal (mgd)			Withdrawal (mgd)	
PSA	Acres	100-Day Season	Annual	Acres	100-Day Season	Annual
3.1	650	1.0	0.3	600	2.4	0.7
3.2	10,300	17.9	4.9	460	1.7	0.5
TOTAL	10,950	18.9	5.2	1,060	4.1	1.1

basin, or 41 percent of the population of the northern portion and 65 percent of the population of the southern portion, were served by central water systems. The municipal water supply development and sources are summarized in Tables 1–107 and 1–108.

In the northern part of the basin, important manufacturing includes cement production, paper and paper products, and miscellaneous metal products. Industry used only about 11 percent of the total water withdrawn by municipal systems. The economy of the southern portion of the basin is focused on intensive heavy manufacturing activities, and industry used about 41 percent of the water withdrawn by the municipal systems in 1970, largely for processing and cooling. See Table 1–109.

Manufacturers who were supplied by their own systems, withdrew about 10 times as much water in 1970 as that obtained by those manufacturers who obtained their water from public water supplies. In general, wells are not expected to maintain a significant role as a source of new manufacturing water supplies because of the limited yields of the aquifers and the frequent occurrence of poor water quality.

Ground water is the primary source for rural domestic and livestock water, although inland lakes and streams supply small amounts. See Table 1–110.

In 1968 an estimated 23.0 mgd of water was supplied for a 100-day season to irrigate 1,060 acres of golf courses and 10,950 acres of high-value crops (Table 1–111). Some of the crops irrigated were potatoes, beans, vegetables, orchard, and sod. Inland lakes, streams, and ground water are assumed to have been the major source of supply. Wherever possible, ground water was used because the areas irrigated are often rather small and somewhat scattered, and the use of ground water is most economical.

Inland lakes, streams, and ground water are the major sources for the mineral industry for the Lake Huron basin. Table 1–112 indicates the total water required and the new water withdrawal in the

TABLE 1–112 Minerals Water Supply, Lake Huron Plan Area, 1968, estimated (mgd)

PSA	Total Water Requirements[1]	New Water Intake Seasonal	New Water Intake Annual Average	Consumptive Use[2]
3.1	22.1	20.9	14.0	1.7
3.2	10.8	3.9	2.6	0.0
TOTAL	32.9	24.8	16.6	1.7

[1]New water intake plus recirculated (seasonal)

[2]Annual average

TABLE 1–113 Source of New Water Used by Mineral Industries, Lake Huron Plan Area, 1968, estimated (mgd)

New Intake	April-November	Average for 365 Days
Streams	4.2	3.5
Lakes	9.6	9.6
Ground Water	2.4	1.6
Mines	1.3	1.3
Other	0.2	0.1
TOTAL	17.7	16.1

TABLE 1–114 Electric Power Development, Lake Huron Plan Area

PSA	Type and Capacity (MW) Hydro-electric	Internal Combustion and Gas Turbine	Fossil Steam	Nuclear Steam	Total	Steam Electric Water Withdrawals (mgd)
3.1	110	99	---	---	209	0
3.2	10	242	1,366	---	1,618	749
TOTAL	120	341	1,366	---	1,827	749

basin. Sources of new water used by the mineral industry in 1968 are estimated in Table 1–113.

As of December 1970, 11 electric power generating plants of 10 MW capacity or more within the Lake Huron basin include two hydroelectric, three gas turbine, two internal combustion, and four fossil-fueled steam plants. One gas turbine plant, one fossil-fueled plant, and two nuclear plants (at a single location) are scheduled to be in operation after 1970 with a total capacity of 2,016 MW. All condenser cooling systems operating in 1970 were the flow-through type. The basin's electric power development is shown in Table 1–114.

8.1.5.2 Nonwithdrawal Water Uses

For study purposes this category includes municipal and industrial wastewater discharges as well as nonwithdrawal uses of water. Although significant consumptive uses of water are not associated with these functions, demands are imposed upon the water resource.

Water quality is generally good throughout the upper portion of the basin, although there are localized reaches of substandard water quality receiving effluent of municipal primary treatment plants and/or industrial discharges. In the southern portion of the basin, the Saginaw River has suffered from poor water quality in recent years, partly because of inflows carrying sizeable waste loads of chlorides and nutrients.

The Saginaw River discharges considerable quantities of nutrients from industrial, municipal, and agricultural sources into Saginaw Bay, and excessive algal blooms in warm weather have occurred. The quality of the water in Saginaw Bay reflects the materials received from the Saginaw River and the smaller contributions from other tributaries. While the existing water quality of the bay as a whole is adequate to support all designated uses with moderate exceptions, the waters of the inner bay are substandard with respect to nutrients, and water quality along the western shore of Saginaw Bay north of Bay City is substandard because of the high coliform levels that occur at a limited number of beaches.

Water quality in a number of nearshore areas within the harbors and at the mouth of tributary streams is lower than that of Lake Huron proper. These areas include the Straits of Mackinac, Cheboygan Harbor, Rogers City Harbor, Thunder Bay, Harrisville Harbor, Oscoda Harbor, Harbor Beach, and Port Sanilac. In general, these areas receive waste loads from tributaries, municipal treatment plants, and industries, and experience slightly lower dissolved oxygen and slightly increased levels of total solids and other parameters. In almost all cases the concentration of phosphorus and nitrates is sufficient to support algal growth which, under certain conditions, could interfere with water uses.

The following stream segments are reported by the States to have priority for correction of water quality deficiencies:

(1) River Basin Group 3.1—none reported
(2) River Basin Group 3.2

TABLE 1–115 Municipal and Industrial Wastewater Flows, Lake Huron Plan Area, 1970

PSA	State	mgd Municipal	Industrial
3.1	Michigan	5.0	12.3
3.2	Michigan	80.0	453.0
TOTAL	---	85.0	465.3

(a) Flint River—Flint to Genesee County-Saginaw County line

(b) Shiawassee River—Linden to Genesee County-Shiawassee County line

(c) Shiawassee River—Owosso to ten miles downstream

(d) Tittabawassee River—Midland to Midland County-Bay County line.

Because of the variance in treatment or lack of treatment for point sources of wastewater, and complexities involved with nonpoint sources, a summary of the exact status of wastewater treatment cannot be made. Table 1–115 shows the 1970 municipal and industrial wastewater flows for the planning subarea.

The management objective of the State of Michigan for Lake Huron is to manage the waters in such a way as to achieve the maximum development of both sport and commercial fisheries. Sport fishery use in the Lake Huron plan area in 1970 is shown in Table 1–116. To achieve this goal, the State and Federal governments, as well as the Provincial government of Ontario, are conducting several programs on the Lake. Management measures under way include sea lamprey control, stocking of hatchery-reared salmon, habitat improvement and maintenance, regulation of fishing, and research. The sea lamprey control in the United States waters of Lake Huron is presently being carried out by the Bureau of Sport Fisheries and Wildlife under contract with the Great Lakes Fishery Commission.

About 129,600 boats were registered in 1968 for the Lake Huron region. While there are 23 boat harbors on the Lake Huron shoreline, the use of the Great Lakes waters is limited by the lack of suitable mooring places (Table 1–117). There are few mooring spaces available in the northern part of the basin.

Water resources management, protection, and facility development to increase the resource base are needed. In order to utilize the existing inland water base at the projected usage by the year 2000, it will be necessary to almost double the number of boating access sites. The extensive Great Lakes waters are more than adequate to accommodate the existing and projected boating use. However, additional harbors would greatly enhance the safety of this area for Great Lakes boaters and provide additional sheltered mooring waters at which to base a significant portion of the projected new recreational craft ownership.

There are four Federal and five private commercial harbors on Lake Huron. Total traffic handled

TABLE 1–116 Sport Fishery Uses, Lake Huron Plan Area, 1970

PSA	State	Ponded Waters (acres)	Fishing Licenses Resident	Fishing Licenses Non-Resident	Angler Days (1000)
3.1	Michigan	138,777	59,740	14,443	3,800
3.2	Michigan	29,575	106,606	3,466	2,343
TOTAL	---	168,352	166,346	17,909	6,143

TABLE 1–117 Recreational Boating Development, Lake Huron Plan Area, 1969

PSA	State	Lake Huron Harbors	Access Sites[1]	Total No. of Boats	Total Boat Days in Use
3.1	Michigan	16	146	49,800	1,431,000
3.2	Michigan	7	67	79,800	2,361,000
TOTAL	---	23	213	129,600	3,792,000

[1]May include both inland lakes and streams

TABLE 1–118 Agricultural Land Treatment Needs, Lake Huron Plan Area, 1970 (thousands of acres)

PSA	Cropland	Pasture Land	Other Land	Total
3.1	267.5	130.1	38.0	435.6
3.2	1,390.3	154.4	70.9	1,615.6
TOTAL	1,657.8	284.5	108.9	2,051.2

TABLE 1–119 Drainage Limitations in the Lake Huron Plan Area (thousands of acres)

PSA	Total Land Area	Agricultural Land	Drainage Problems Severe	Drainage Problems Some
3.1	4,017.8	696	85	59
3.2	4,424.1	2,555	387	339
TOTAL	8,441.9	3,251	472	398

(shipments and receipts) is about 32 million tons per year.

8.1.5.3 Related Land Uses and Problems

In a number of respects including land-use patterns, land-use problems, and population concentrations, the Lake Huron study area may be divided into northern and southern parts that approximate the division between the River Basin Groups 3.1 and 3.2. The situation in the Upper Peninsula portion of RBG 3.1 is similar to that in the Lower Peninsula portion, but when specific data on land are given, they are for PSA 3.1, which is in the Lower Peninsula only. As indicated earlier, Planning Subarea 3.1 is sparsely populated and supports limited manufacturing or industrial development. The region is heavily forested, with over 4.1 million acres of national, State, county, and private land under tree cover. In contrast, Planning Subarea 3.2 sustains a highly diversified manufacturing, trades, and services economy in the major cities of Flint, Saginaw, Bay City, and Midland, while its fertile soils support some of Michigan's best farm production.

In Subsection 8.1.4 is was pointed out that probblems in land use, particularly in the shoreline areas, are increasing because of the influx of seasonal residents, speculative land developers, and mining activities. This situation points to the need for a land use policy, implemented with controls such as zoning. Particularly with respect to problems which may develop from mining activities, it is important to recognize the importance of mineral deposits and to insure that these deposits are extracted in a manner consistent with a general land use policy that protects the adjacent areas.

Conservation treatment measures applied to agricultural land in the Lake Huron plan area have been accomplished with the assistance of the Soil Conservation Service of the Department of Agriculture, but a continuing program is needed (see Table 1–118).

Approximately 870,000 acres of agricultural land in the Lake Huron basin have a drainage problem (Table 1–119). This represents about 11 percent of the total land area with drainage problems in the Great Lakes Basin as a whole. The basin ranks fourth of the five Great Lakes basins in this respect. Some drainage improvement measures have been installed, but indications are that about 572,300 acres of cropland provide opportunity for drainage improvement either because drainage facilities have not been installed or because they have not been maintained and are not adequate to provide the drainage needed.

Drainage limitations not only affect agricultural production potential, but also may place limitations on urban growth. In the Saginaw-Bay City SMSA, which has a total nonurban base of about 711,800 acres, dry soils without wetness problems are scarce, estimated at only about 40,000 acres. The wet soils will need internal and supplemental drainage in order to be developed for urban purposes.

Portions of two national forests are located within the Lake Huron basin boundaries. These are the Hiawatha National Forest, which has a very insignificant amount of acreage in the basin, although none of it lies within the plan area; and the Huron National Forest, which has over 2,400,000 acres in the basin. Of the total forest land, 4,072,000 acres are considered commercial.

Conservation and treatment, which consists of reforestation, forest land improvement, controlled grazing erosion control, improved harvesting techniques,urban forestry, and multiple land-use management, is presently considered to be adequate on about 1,650,000 acres of the total forest land in the Lake Huron basin, excluding the national forest and other Federal lands. Forest land treatment practices are also extensive on these Federal lands, but no estimate is available of the area which is adequately treated.

Table 1–40 shows ownership and use of Lake Huron shorelands; Table 1–120 gives information on Lake Huron shoreland conditions. Although the shorelines are protected from westerly winds and are relatively free of areas of critical erosion, the amounts of erosion have increased markedly due to high water and severe winds in some areas over the last several years. Under 1973 conditions there are estimated to be over 100 miles of high risk erosion shoreline.

TABLE 1–120 Lake Huron Shoreline Conditions, 1970 (in miles)

RBG	State	Total Shoreline	Subject to Erosion Critical	Noncritical	Protected	Subject to Flooding	No Problem
3.1	Michigan	361.0	7.8	62.9	0	7.2	283.1
3.2	Michigan	204.0	0.2	91.5	0	67.7	44.6
TOTAL	---	565.0	8.0	154.4	0	74.9	327.7

TABLE 1–121 Streambank Erosion in the Lake Huron Basin, 1970

PSA	State	Bank Miles of Damage Severe	Moderate	Annual Damages ($) Land Loss	Sedimentation	Other	Total
3.1	Michigan	229	413	26,700	13,300	22,700	62,700
3.2	Michigan	397	670	43,400	14,400	21,700	79,500
TOTAL	---	626	1,083	70,100	27,700	44,400	142,200

TABLE 1–122 Estimated Flood Damage, Lake Huron Basin, 1970

RBG	State	Estimated Average Annual Damages ($) Urban	Rural	Estimated Acres in Flood Plain Urban	Rural
3.1	Michigan	29,600	214,100	733	39,315
3.2	Michigan	591,900	892,600	7,441	254,126
TOTAL		621,500	1,106,700	8,174	293,441

Streambank erosion in the Lake Huron region is widespread, with 1,709 miles of streambank subject to erosion (Table 1–121). The erosion is classified as slight, moderate, or severe in damage.

The annual damages resulting from all streambank erosion include those from land loss, sedimentation, loss of reservoir capacity, sediment damages to crops and cropland, and damages to culverts, bridges, and other facilities. Damages also occur as a result of the raw bank cuts that deface the natural beauty of the streams. This affects aesthetic values for canoeists and others. No economic value has yet been placed upon this aesthetic aspect.

The overall contribution of sediment from streambank erosion is a minor part of the total sediment resulting from all types of erosion in the basin. Erosion plays an important present and future role in degrading water quality. The effects on water quality are particularly noticeable in developing urban areas. Urban development leads to increased runoff because the house tops, parking lots, streets, and other hard surfaces do not allow water to soak in.

There are no major flood control projects within the Lake Huron basin. Protection measures including channel diversion, channel improvement, levees and floodwalls, land treatment measures, and institutional measures have been installed in nine areas. Table 1–122 estimates flood damage in the Lake Huron basin in 1970.

In the State of Michigan local authorities have the responsibility for defining the flood plain and specifying or establishing its limits, but few, if any, communities within the basin have effective land-use regulations for proper flood plain development. Some Statewide regulations on a broad basis fill in the gaps left by the local governments. Michigan Act 288 (Public Acts of 1967) of August 1, 1967, contains provisions to regulate the subdivision of land and to control residential building development within the flood plain areas. Michigan Act 245 of 1929, amended by Act 167 (Public Acts of 1968) of June 17, 1968, provides the Michigan Water Resources Commission with the power to implement the portion of the Act dealing with flood plain lands and to make regulations and orders for the prevention of harmful interference with the discharge and stage characteristics of streams.

Most of the land in Lake Huron basin is considered wildlife habitat and much of this is huntable land. Most of the habitat is used by both hunters and nonhunters. For the purposes of planning, the nonconsumptive users were estimated to equal the consumptive users in numbers. About 14,000 acres are considered to be areas of ecological significance in the Lake Huron basin. These include natural areas, beaches, dunes, harbors, and bays, shoals and marshes used for resting, nesting, and feeding. The Lake Huron basin is one of the most important basins in the Region for the production of waterfowl. Many of the streams and marshes are frequented by mallard, black, and teal ducks. Michigan's inland Thumb area also provides excellent nesting habitat for sizeable populations of waterfowl including the Canada goose, and further inland, the Saginaw area provides prime breeding and nesting habitat for various species of waterfowl. Particularly valuable are the Shiawassee State Game Area and the Shiawassee National

TABLE 1-123 Wildlife Habitat in the Lake Huron Plan Area, 1960

PSA	State	Total Land Area (acres)	Farm Habitat Acres	Farm Habitat % of Total Land	Forest Habitat Acres	Forest Habitat % of Total Land	Total Habitat (acres)
3.1	Michigan	4,017,800	762,000	19	3,023,000	75	3,785,000
3.2	Michigan	4,424,100	2,849,000	64	1,056,000	24	3,905,000
TOTAL	---	8,441,900	3,611,000	43	4,079,000	48	7,690,000

NOTE: The area of the land resource base, made up of the farmland and forest land, and reported elsewhere, is based on 1966-1967 measurements and estimates. Habitat is based on 1960 information and estimates. In some instances changes in land use result in habitat being recorded as greater than the corresponding land base in the PSA or State.

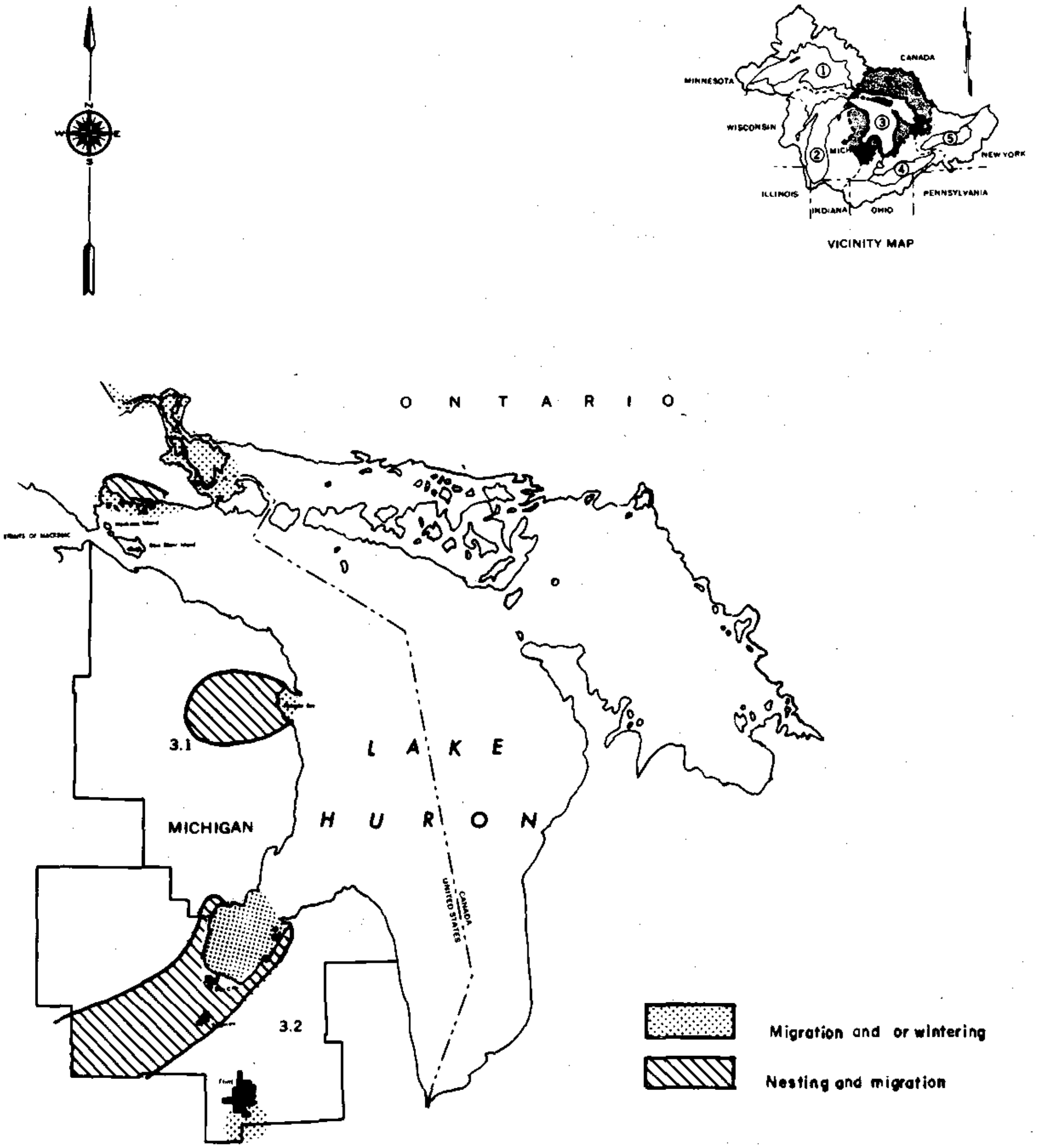

FIGURE 1-34 Primary Waterfowl Use Area, Plan Area 3

Game Area. Many other nesting areas are found in both Lapeer County and in the Grand Blanc area in Genesee County.

Table 1–123 shows the acreage of farm and forest game habitat by planning subareas in 1960. Figure 1–34 indicates primary waterfowl use areas along the shorelines and in the wetland regions.

In an inventory of outstanding, unusual, and significant aesthetic and cultural values in the Lake Huron basin, 229 items in 22 categories were recorded. Environmental systems of the Lake Huron basin which need planning attention most critically are linkage corridors, resource clusters, buffer zones, and shore zones, as described in Appendix 22, *Aesthetic and Cultural Resources.* The projected increase in urban development through the year 2020 makes prompt planning attention urgent to both planning subareas in this basin—particularly PSA 3.2.

The resource base in the Lake Huron basin has many pleasing aspects that relate to outdoor recreation. Included are more than 400,000 acres of national forests, nearly 1.2 million acres of State forest lands, many inland lakes, Lake Huron beaches, and the rivers. In the northern half of the basin, features include extensive forests, many lakes and streams, the last area of undeveloped Lake Huron shoreline, and a topography and climate conducive to winter sports.

In the southern half of the basin, river valleys or forests in the north and glacial moraines in the south support heavy recreational activities. Although not as aesthetically attractive as those in the northern half, these rivers have exceptional potential for recreational development because of close proximity to large population concentrations.

The Lake Huron region has many of the same problems which occur throughout the Great Lakes area with respect to outdoor recreation, but the region itself is so diverse that problems range widely in nature. In the northern part, where there are considerable forest, lake, and river resources, the economic situation is depressed, and there has not been adequate development of the resources by the private sector for public use. In addition, the highway system expedites travel north and south, but there are not enough feeder roads into the recreation areas. Recreational development is likely to increase at a rapid rate because of the influx of persons from the more crowded southern areas in the Lake Huron basin and the adjacent Lake Erie basin (particularly Detroit and environs), who will make use of the facilities of the northern part of the Lake Huron region.

The southern part of the Lake Huron region, on the other hand, has a very small area of land and water devoted to recreation, with an average of only 10.3 acres of all types of recreational land available per thousand people. This compares unfavorably with a recommended average of 10 acres of urban recreational areas, 15 acres of extra urban open space, and 65 acres of large parks, forests, and other open spaces per 1,000 people. It is unlikely that this standard can be met, and the present movement of population to the north for recreation purposes is likely to continue and to be accentuated.

Table 1–124 indicates the land and water surface currently available for recreation in the Lake Huron basin in 1970. Table 1–125 provides information on amount, ownership, and recreational potential of Great Lakes beaches in the plan area.

TABLE 1–124 Land and Water Surface Usable for Recreation in the Lake Huron Plan Area, 1970 (thousands of acres)

PSA	Land	Lake Huron	Inland Lakes	Total
3.1	1,691.0	178.0	111.0	1,980.0
3.2	11.3	137.0	24.0	172.3
TOTAL	1,702.3	315.0	135.0	2,152.3

8.2 Frameworks for River Basin Group 3.1

8.2.1 Summary

Nearly three-fourths of the land area in RBG 3.1

TABLE 1–125 Amount, Ownership, and Recreational Potential of Great Lakes Beaches, Lake Huron Plan Area (acres)

	Publicly Owned Beaches			Privately Owned Beaches				
	Usable			Open to Public		Not Open to Public		
PSA	Open to Public	Restricted	Not Usable	With Charge	Without Charge	Potential for Development	Little/No Potential	Total
3.1	83.4	0	0	0	23.5	46.6	357.8	511.3
3.2	43.6	0	13.1	0	0	0	157.2	213.9
TOTAL	127.0	0	13.1	0	23.5	46.6	515.0	725.2
%	17.5	0	1.8	0	3.3	6.4	71.0	

is forested and provides for some forest resource-oriented industry. The same is true of the mineral resource and its related industry. Agricultural employment is declining and trades and services are increasing.

River Basin Group 3.1 is part of the high-quality recreation area of Michigan, and an increasing part of the economy is related to this use of resources. Summer and winter recreation demands are met by a great diversity of recreational facilities. The future of outdoor recreation in this river basin group is very bright.

The availability of water has not been a constraint to any development for which other factors were favorable. However, the presently developed quantities of water are not adequate to meet all the needs projected for the future. Water quality is generally good, although there are localized reaches of substandard water quality. These substandard reaches receive the effluent of primary treatment plants or industrial discharges, seepage from septic tanks, the discharge of raw sewage into streams, and the naturally heavy silt load carried by some streams. During the navigation season the St. Marys River is degraded by vessel traffic, which has a tendency to concentrate the waste in the river because of the pumping of bilges and ballast or the discharging of sewage while in the river area. Water quality standards include secondary treatment as a minimum for all municipal wastes and an equivalent treatment for all industrial wastes. In addition, a minimum of 80 percent phosphorus removal is required. Advanced waste treatment is required in certain stream sectors and effluent disinfectant is necessary, particularly where recreational use of the receiving water is prevalent or desired.

The framework developed under the normal growth projections for this river basin group provides for water supplies for all uses to meet the needs of a balanced development and for correcting conditions which have degraded water quality. NOR provides for increased recreational opportunities, expansion of commercial navigation and recreational boating, enhancement of fish and wildlife habitat, alleviation of flood damages, land treatment and drainage, shoreline protection.

Section 12 contains Table 1–274 which shows needs, outputs, and percent of needs met under the Normal Framework; Tables 1–275 and 1–276 show capital costs and operation, maintenance, and replacement costs.

8.2.2 The Area

The area is characterized by rather flat to rolling terrain with elevations ranging from about 600 feet to 1,000 feet above sea level. In the northwestern portion of the basin an exception to this general condition occurs where hilly, sandy, morainal uplands predominate and elevations reach nearly 1,400 feet. The oldest bedrock formations stretch across the northern one-third of the region. Limestone outcrops occur in Alpena, Cheboygan, Chippewa, and Presque Isle Counties. A wide band of undifferentiated bedrock composed of blue-gray limestone and calcareous shale lies across Cheboygan and Presque Isle Counties. Shale formations outcrop in Alpena, Presque Isle, Cheboygan Counties. The Michigan formation, composed of shale, sandstone, beds of gypsum, and some dolomitic limestone, outcrops in Iosco and Ogemaw Counties. The area experiences a humid continental climate with frequent and sometimes rapid weather changes caused by storms sweeping across the Great Lakes Region from the west and the southwest. The northern part of the area is cooler than the southern part. Cool breezes from Lake Huron serve to make the shoreline attractive for summer vacationists. Seasonal temperature variations can be extreme across the area. Mean annual precipitation ranges from 26 to 30 inches, with an average around 28 inches. Droughts occur occasionally but are not usually of long duration. Snowfall depths reach from 50 to 120 inches, increasing from southeast to northwest across the area. Mean annual growing seasons vary from nearly 130 days along the shoreline and in the southern counties to less than 90 days in the interior uplands. A cool, comfortable summer climate and abundant winter snowfall make the area attractive for year-round recreation activities.

The soil is formed chiefly from glacial deposits, and its composition varies from predominantly sand in the northern and western portions to mainly clay land and swampy areas in parts of Ogemaw, Iosco, Alcona, Alpena, and Montmorency Counties, and to more stony lands in Alpena, Presque Isle, and Cheboygan Counties. Characteristically, there is a layer of acid organic matter on the surface, underlain by a gray leached layer from which iron and aluminum have been removed. Typically the subsoils are low in lime content and fertility.

This planning subarea ranks last in population among the 15 planning subareas in the Great Lakes Basin. The rate of growth from 1940 to 1970 was well below the Great Lakes Basin average. Iosco County grew from 16,500 to 24,900 between 1960 and 1970, but Presque Isle County declined slightly during the decade. Since 1940, employment has increased less rapidly than in other areas of the Great Lakes Basin. It is expected to increase at a slightly faster rate than population. Total personal income is expected to increase a little faster than the expected Basin and national average annual rate of 4 percent. The per capita income should continue at about 70 percent of the national average. Only 26 percent of the people in Planning Subarea 3.1 were classified as urban in 1970, but a higher degree of urbanization can be anticipated. Additional population and economic data are provided in Subsection 8.1.1 and Section 1.

About 3 million acres of PSA 3.1 are forest land. More than 400,000 acres are in national forests, 879,900 acres are in State-owned forest land, and the balance is in holdings of other public agencies, the forest industry, and farmer-private ownership. The latter accounts for about one and a half million acres or about 50 percent of the total forested area.

The area in the Lower Peninsula is well endowed with inland lakes and shorelines. Shoreline length along the inland lakes is about 1,065 miles. This, added to the 263.3 miles of Lake Huron shoreline in PSA 3.1, results in a total shoreline of 1,225 miles in the planning subarea. Approximately 87 percent of the total shoreline is privately owned, with 879 miles of inland lake shoreline, and 185 miles of Lake Huron shoreline in private ownership.

The Lake Huron shoreline of the RBG is 361.0 miles and 91.2 miles of St. Marys River shore also lies within the RBG.

While the river basin group is not considered a manufacturing region in the State, this activity is locally significant. The forest resources provide material for the production of paper, cardboard, plywood, and other wood products, and pleasure boats, shoes, and miscellaneous metal products are also produced. The coastal counties along Lake Huron furnish limestone, cement, wood products, fish, and machinery.

Distance from centers of population tends to restrict industrial development to that which is directly related to the nearby forest and mineral resources, and to manufacture of high value or low bulk products.

Trades and services play an important role in the economy. Few major trade centers exist in this largely rural area. Services such as hotel accommodations, tourist camps, laundry services, and amusements have expanded to meet the increasing tourist trade.

The resources of the planning subarea lend themselves directly to recreation. Summer and winter recreation demands are met by a great diversity of facilities. Summer and fall activities include boating, water skiing, swimming, fishing, picnicking, camping, hunting, and other recreational activities. In the winter, snow skiing and snowmobiling are probably the most popular activities. Other important winter activities include ice fishing, sledding, tobogganing, ice boating, and ice skating.

The abundant water resources of the northern Lower Peninsula of Michigan pose no limitation to the development of outdoor recreation in River Basin Group 3.1.

Figure 1–35 shows the areal extent of River Basin Group 3.1 and the planning subarea. See also Section 1.

8.2.3 Projected Resource Needs and Problems

The projected needs for resource use by time periods are shown in Section 12 on Table 1–274.

8.2.3.1 Water Withdrawals

The needs within the water withdrawals category have been developed along conventional lines, and even though the needs are expected to more than double from 1970 to 2020, the only problems that have been identified are that presently developed quantities of water are not adequate to meet all of the needs projected for the future. In many cases there is an opportunity for choice among water sources to meet a particular need. The main sources of additional development of water will be the inland lakes and streams and ground water, with only municipal water and self-supplied industrial water drawing on the Great Lakes as a source of their supply. The major requirements will come after the year 2000 for self-supplied industrial water and for mining water supplies. There is no projected need for cooling water for power generation in the river basin group.

8.2.3.2 Nonwithdrawal Water Uses

The existing water quality situation was discussed in Subsection 8.1.4. Water quality standards include secondary treatment as a minimum for all municipal waste and an equivalent treatment level for all industrial wastes. In addition, a minimum of 80 percent phosphorus removal is required.

Problems of fish habitat in this river basin group are related to the rapid development of recreational properties, which has caused considerable damage to both lakes and streams. Dredging and filling have reduced the available spawning areas in some of the inland lakes. Septic tank runoff from heavy cottage development has speeded up the process of eutrophication in some of the inland lakes. Intense streamside cottage development has destroyed some of the aesthetic and cultural attractions on many of the streams. The construction of low head dams on trout feeder streams has elevated the temperatures beyond the limits where trout will survive. Some of the larger inland lakes of the river

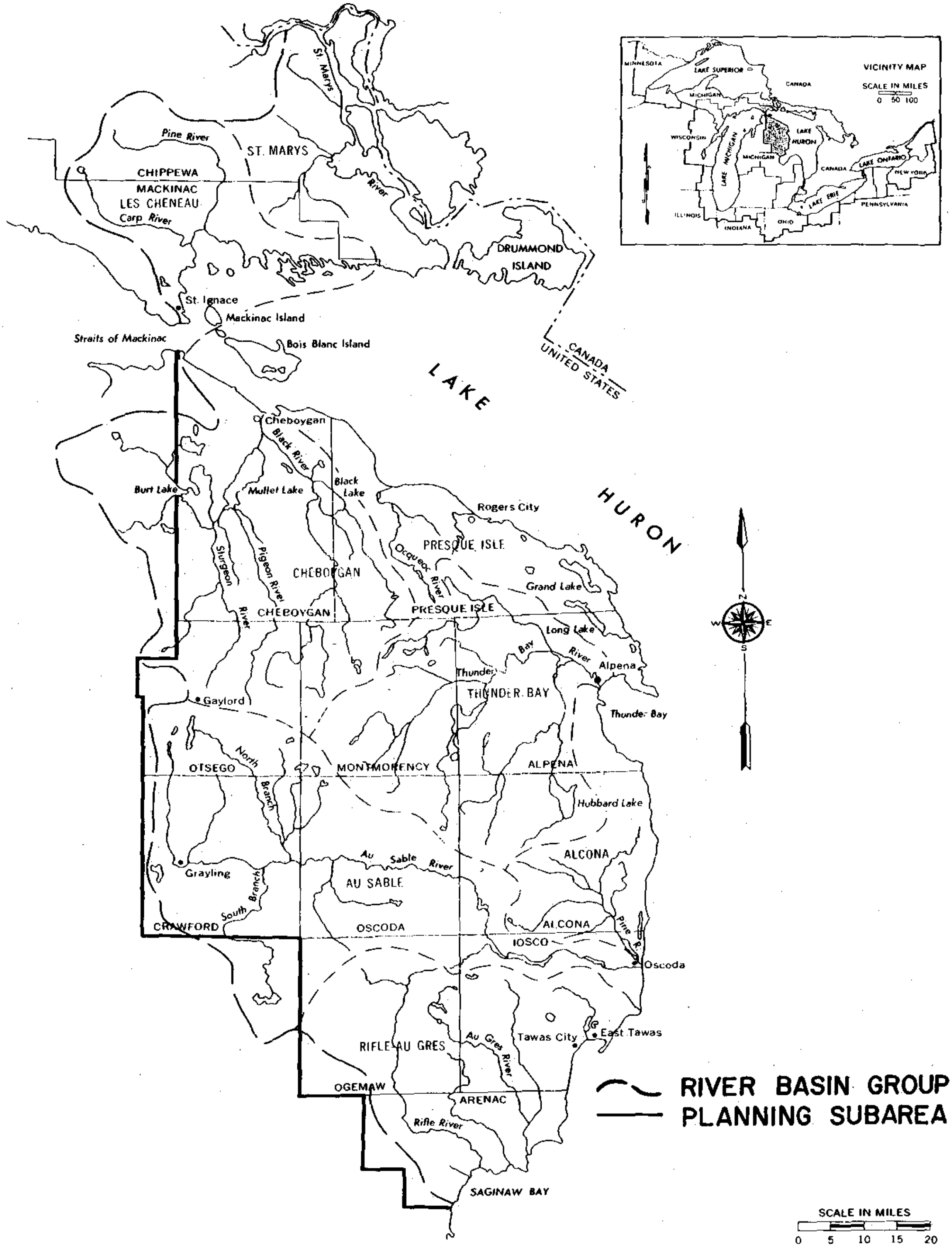

FIGURE 1–35 Lake Huron North, River Basin Group 3.1

TABLE 1-126 Use and Projected Needs for Recreational Boating, PSA 3.1

	1000 Boating Days	
Category	Great Lakes Waters	Inland Waters
1970 Use	384	1,047
1980 Needs	384	108
2000 Needs	516	276
2020 Needs	657	438

basin group are deep enough to support trout as well as warmwater fisheries. Many of the smaller lakes are managed exclusively for trout through periodic chemical treatment and annual maintenance plantings. Anadromous runs are limited in the rivers due to the location of hydroelectric dams and the lack of adequate sea lamprey control in Lake Huron. The few streams that do support runs of steelhead and salmon are very important to the species composition of the area. There is need for fish passage improvement around the hydroelectric dams, fish production through hatcheries, fish population control, additional fishing access, and habitat improvement and protection.

The relatively high boating participation factor of 12 boats per 100 population is primarily due to the many inland lakes located within a reasonable proximity of the area's rather sparse population. Although some of the lakes in this area receive intensive use, the area's water base is generally underutilized for recreational boating. This river basin group can absorb a transfer of about 4.5 million boat days from other areas, thus avoiding the need and related expense of increasing the water base of these nearby areas. However, it will be necessary to provide more uniformly dispersed access to the existing water base in order to preclude any local or isolated instances of undesirable intensive use. Recreational boating on the Great Lakes is generally limited to the small areas offshore at harbors, locations at which small craft are based, and locations contiguous to sheltered waters. Additional harbors and mooring facilities are necessary to enhance the enjoyment and safety of recreational boating on Lake Huron. Table 1-126 shows recreational boating use in PSA 3.1 and projects future needs.

Commercial navigation will be influenced by the overall treatment of this resource use throughout the Great Lakes Basin. Much of the area's population is supported by industries producing or utilizing large quantities of bulk commodities, and the economy of the area is highly dependent upon efficient, low-cost transportation systems. This is especially true for the limestone trade, which must depend on return shipments of coal to enable vessels to be operated economically. Improvements to accommodate supercarriers are not expected in the near future for the limestone and the coal trade but may become a reality later, depending upon the market conditions.

8.2.3.3 Related Land Uses and Problems

Agricultural land treatment needs are based on criteria which provide for the proper use and treatment of the land for sustained agricultural production within the inherent capability of the soil. Estimates of land treatment needs emphasize physical needs and were developed independently of the economic model used to determine the projected crop acreage and crop production requirements.

Much of the northern and eastern portions of River Basin Group 3.1 are subject to severe drainage restrictions, and production is reduced or limited by excess water in the soil profile. Drainage measures have both beneficial and adverse effects, and the implementation of them depends on the alternative possible uses of the lands having a wetness problem. In addition to the need for drainage on the agricultural land, some drainage will be necessary before urban expansion can occur on presently nonurban land.

Most of the public and industry-owned forest lands are under some degree of management; however, much of the private forest land is either unmanaged or inadequately managed. One of the greatest existing forest land problems is how to secure good management on this private land. Another management problem that must be considered is how to secure good management, protection, and establishment of trees and shrubs in areas surrounding urban built-up areas.

Shoreline erosion is not a serious problem in the river basin group. Of the 361 miles of Lake Huron shoreline, about 63 miles are subject to noncritical erosion, and about 8 miles, from Au Sable Point southward to just north of Tawas Point State Park, are subject to critical erosion. The remainder of the Lake Huron shoreline is made up either of stones and boulders or sand beaches occasionally interrupted by marshes. Storms over the Great Lakes generally move east, so the western Lake Huron beaches (the lee shore) are protected from damage.

Streambank erosion does present some problems but losses are relatively small. Data are provided in Table 1-121. The major problem in alleviating streambank erosion is that the eroded areas are scattered and expensive to treat, and there is need for further study of methods and effectiveness of treatment.

Flooding in the area may occur at any time, but the major floods are the result of rain and/or snow melt on frozen ground or nearly saturated ground, intense summer storms, or overbank flooding caused by ice jams. The greatest flood damage occurs in the rural areas. The flood problems of the urban areas are the result of constricted reaches of the rivers, inadequate channel capacity, encroachment on the natural flood plain, or a combination of these causes.

The principal problem relating to wildlife is one of declining value of wildlife habitat rather than loss of habitat. Deer and other forest game are decreasing in many of the areas. The decline of rare and endangered species is a problem that in some cases is very difficult to remedy, because the reasons for the decline of these animals and birds and how they are affected by habitat loss or overharvest are often not generally understood or agreed upon. Shrinking hunter access to wildlife land is a related problem, and occurs throughout the Great Lakes Basin except in the northernmost planning subareas where public land is adequate. This is a serious problem because wildlife habitat is expected to decrease while gross hunter demand is expected to increase.

The area contains a wealth of diverse and often unique aesthetic and cultural resources. The major problem is the need to preserve the outstanding values of these resources, which include beaches and wetlands, unique glacial formations, wildlife areas, and sites and objects pertaining to early Indian cultures and to exploration. Aesthetic and cultural aspects are interrelated with all other functions in a water and related land resource study. No specific alternative programs or projected requirements can be readily discerned. However, additional legislation may be needed to expedite a program of acquisition and management, and the private sector should be encouraged to participate in the program for preservation and protection of these unique and significant areas.

The Planning Subarea 3.1 possesses many high quality recreational areas and supports a diversity of popular recreational activities. The total annual requirements for water-oriented outdoor recreation activities in 1970 were nearly 2 million recreation days. This is estimated to increase to more than 6 million recreation days by 2020. Even though there are no standard metropolitan statistical areas in River Basin Group 3.1, there are some needs to be met in the smaller urban areas. Also, there is a transfer of urban needs from cities just to the south of this river basin group. The swimming beach acreage in RBG 3.1 appears adequate to meet present and future needs to the year 1980. The estimated amount of land which has been developed to meet the recreational demands for the first two time frames does not indicate additional needs.

8.2.4 Alternative Frameworks

Two alternative frameworks are presented for this as for other river basin groups. The Normal Framework does not reflect coordination of solutions to meet needs outside RBG 3.1 in the Lake basin or the Great Lakes Basin.

The Proposed Framework contains the recommendations of the Commission in an effort to reflect the views of the people of the basin and the policies and programs of the States. To some extent, it reflects coordination in the development of the Framework among a number of river basin groups, both in the Lake basin and in the Great Lakes as a whole.

8.2.4.1 Normal Framework (NOR)

NOR is based on meeting quantified needs and solving identified problems to the maximum practicable extent consistent with subobjectives and criteria discussed in Section 2 of the appendix. The program outputs and costs are summarized in Section 12 in Tables 1–274 to 1–276.

(1) Water Withdrawals

There is adequate water to meet the water withdrawal needs for the three time frames. The development of Lake Huron as a source is programed to supplement ground water to satisfy all of the needs for municipally supplied and self-supplied industrial water, with greater quantities programed for the period after year 2000. Ground water is the source for all rural domestic and livestock needs, and withdrawals for mining and irrigation needs are supplied from inland lakes and streams and ground water, with the larger amount being supplied from inland lakes and streams for irrigation use, including both agricultural and golf course irrigation. More than 50 percent of the supply for mining would come from ground water. There are no needs in the river basin group for water for thermal power cooling.

Land use changes and process modification including increased recirculation would have a considerable impact on the water withdrawal needs. Programs are included in the Normal Framework to initiate research to bring about process modification and increased recirculation to reduce the overall amount of water withdrawals.

(2) Nonwithdrawal Water Uses

NOR includes programs for both municipal and industrial wastewater discharge treatment to meet water quality standards prior to the 1972 Amendments to the Federal Water Pollution Control Act. It also provides that there will be no degradation of water quality where existing water quality is at a higher level than that provided by the existing standards. In addition to the basic requirement of secondary treatment and 80 percent phosphorus removal throughout the river basin group, there are a number of locations within the river basin group which will need advanced treatment by 1980 and several more that will need advanced treatment between 1980 and the year 2000. NOR includes programs to provide the needed municipal and industrial treatment facilities to handle the quantities of waste which are indicated by the needs.

Programs for agricultural waste treatment are not included, but the effects of fertilizers, pesticides, and nutrients from agricultural and land runoff require additional studies.

Needs are programed to be satisfied in all time periods for water-oriented outdoor recreation, and by year 2020 for recreational boating.

The fishery management programs included in the Normal Framework provide for land acquisition for fisherman access and habitat protection on the inland water areas. This program, coupled with increased future stocking from the new warmwater fishery hatcheries, is estimated to satisfy fisherman day needs. It should be emphasized that NOR at the present time does not have specific programs in which to provide substantial opportunities for new access facilities in the urbanized areas. Information on the potential and the corresponding costs of additional fishery opportunity development in these urbanized areas is not available.

Commercial fishing data are discussed in Section 5 and Subsection 8.4.3.

Commercial navigation needs, which are estimated to slightly double over the 50-year time span, have been programed to be met. Specific investments in NOR for commercial navigation are expenditures for construction and maintenance of Federal harbors at Cheboygan and Alpena. The commercial navigation programs are discussed in Section 5 and Subsection 8.4.1. Costs for private harbors at Calcite, Stoneport, Port Gypsum, and Bay Shore are not available.

(3) Related Land Uses and Problems

The programed agricultural land treatment is essentially a continuation of the ongoing programs at a level that has been followed in the past. It is not expected that a higher investment would result in substantially higher production levels of food and fiber that could be marketed more efficiently from this region than from some other region in the country. Nor is it expected that sediment reduction and other environmentally beneficial effects from higher levels of agricultural land treatment would justify a higher investment. Agricultural land treatment will be carried out by conventional methods throughout the 50-year period.

Drainage of cropland will improve the productivity of these lands and reduce the total land needed for food production. A properly managed program can benefit agriculture, water quality, and wildlife, reduce erosion, and reduce breeding places for mosquitoes or other insects. The drainage programs have been selected to include the on-farm drainage measures at the current rate of installation.

The forest land treatment program will control erosion, provide wildlife habitat, and enhance environmental values. NOR provides treatment at a faster rate than continuation of past trends or ongoing programs would provide. The shoreland erosion program in NOR would take care of the critical problems.

The streambank erosion program for NOR would provide treatment by 2020 of all of the streambank mileage classified as subject to severe erosion. This is about 37 percent of the stream mileage subject to some erosion. These measures would reduce the estimated damages by about 30 percent. Streambank erosion is widespread, and effective protective measures are very costly to install and maintain. Consequently, none of the moderate streambank erosion would be treated in NOR.

Both structural and nonstructural measures are included in NOR to alleviate flood damages. The structural programs are composed of storage, levees, floodwalls, and other protective works to prevent those potential damages which remain after the flood plain legislation is effective. Flood plain legislation will be least effective in the early years, reducing damages due to growth by about 10 percent between 1970 and 1980. It might be 40 percent effective in the next period and about 75 percent effective by the year 2020.

NOR includes programs to provide additional opportunities above the 1970 levels for hunting or simply observing wildlife. These programs include a continuation of the ongoing programs by the State agencies for acquisition and development, habitat management, law enforcement, and research. Additional programs that will be funded through the Michigan Department of Natural Resources are being included in the Normal Framework. The programs selected under NOR fully meet the user-day needs in all time periods, but do not fully meet acreage needs.

The Normal Framework for this river basin group envisions that outstanding, unusual, or significant aesthetic and cultural values will be acquired in an early time period. Additional legislation may be needed to expedite the program of acquisition and management, and the private sector should be encouraged to participate in the program for the preservation and protection of these unique and significant areas.

Outdoor recreation programs for NOR satisfy all of the intensive and extensive development. The acquisition and development of the State and national forest lands, mileage along the Lake Huron shoreline, and two new regional parks, plus the acquisition of land for scenic rivers, are expected to provide recreation in the latter time frame for the Normal Framework. In addition to intensive recreational use, extensive recreational use is also included as part of these programs.

(4) Framework Outputs and Costs

Section 12 contains Tables 1–274, 1–275, and 1–276 which provide information on needs, outputs, and percent of needs met, and capital and OM&R costs.

8.2.4.2 Proposed Framework (PRO)

PRO was formulated in response to reactions to the Normal Framework by the public as well as by State and regional officials. State, regional, and local policies with respect to population and economic growth do not deviate greatly from those of the OBERS projections used in NOR.

(1) Water Withdrawals

PRO supports development and programing to satisfy the water withdrawal needs in essentially the same manner as outlined in NOR. In the middle and long-range period there will be a shift to meet some needs with sources from water courses rather than from inland lakes. All needs are met. There are no needs in River Basin Group 3.1 for water for thermal power cooling. There are no problems believed to be associated with the supplying of adequate quantities of water for the various purposes.

(2) Nonwithdrawal Water Uses

PRO meets water quality standards of the 1972 Amendments to the Federal Water Pollution Control Act, including those problems associated with the overflow of storm sewers and sanitary waste from existing combined sewers, programed to be abated by 1977.

PRO includes a recommendation for the study of the most efficient means of controlling agricultural wastes. Adequate attention must be given to the treatment of nonpoint sources of agricultural wastes if water quality is to be maintained at a high level in this area.

PRO is the same as the NOR for water-oriented outdoor recreation, recreational boating, and sport fishing.

It should be emphasized that neither NOR nor PRO at the present time has specific programs in which to provide substantial opportunities for new access facilities in the urbanized areas.

To the extent technically feasible, economically justified, and environmentally acceptable, PRO recommends the maintenance of efficient, low-cost, deep draft navigation, and the provisions of incremental improvements to the navigation system at the harbors at Cheboygan and Alpena. PRO also includes a recommendation for extension of the navigation season to increase the efficiency at Calcite, Stoneport, Port Gypsum, and Bayshore. These are private harbors and cost for improvement is not available. Adequate measures are to be provided for the containment of polluted dredge spoil.

(3) Related Land Uses and Problems

PRO includes the recommendation that additional studies be made at the State level leading to the development and adoption of a comprehensive land use policy for the Great Lakes Region. Such studies are being initiated by the State of Michigan at the present time. These studies would enable land use decisions to be based on adequate information about suitable uses for the physical land base. This would result in improved land use policies and would permit water resources planning to complement land use objectives.

PRO recommends more extensive programs than NOR for agricultural land treatment, so that all agricultural land treatment needs exclusive of drainage will be met by the year 2020. This alternative land treatment program emphasizes environmental gains and enhancement and preservation of natural resources.

PRO recommends that only limited cropland drainage be programed, since there is little need to increase crop production in this region.

PRO recommends forest land management and treatment programs which would satisfy about 60 percent of the total needs by the year 2020. These are more extensive programs than those in NOR.

PRO suggests that a reassessment of shoreline erosion based on 1973 lake levels may indicate additional mileage of critical reaches. There are 50 miles of high-risk shoreline in 1973. PRO recommends that all critical shoreline reaches be programed for protection before 1990. Shoreland management plans will be implemented for all Great Lakes shores by 1980 so as to protect and preserve shoreland integrity and uniqueness.

PRO programs for protection by 2020 of all streambank miles subject to severe erosion.

PRO recommends that adequate sums of money be allocated to manage and control flood plain lands, considering that the cost may be allocated to flood plain damage alleviation, outdoor recreation, and other uses of the flood plain. Flood insurance could provide still another supplement to the many programs for reducing flood damage.

PRO includes the concept that the States should set time limits for local entities to manage and develop policies, objectives, programs, and implementation techniques for flood plain regulations. If the local entities do not meet the time limits, the States should then manage and regulate the flood plains according to State statutes.

PRO recommends the establishment of State-approved local control ordinances directed toward the control or treatment of runoff and reduction of sediment on urban and rural lands. State-established regulations would prevail, consistent with Federal Water Pollution Control Act Amendments of 1972, if local regulations are not implemented by July 1, 1977.

PRO includes resource utilization that will meet all water-oriented outdoor recreation needs. It is assumed that approximately 60 percent of the outdoor recreation needs will be met with public funds (Federal, State and local), and it is further assumed that the remainder will be met either by private funding or not at all. The priorities for the use of public funding will be:

(a) recreation developments, and acquisition and restoration of unique and natural areas of regional significance

(b) developments on lands now publicly owned

(c) other developments. To the extent public funds are available for investment in shorelands, they may be used where feasible to assist

(i) in acquiring land so as to preserve and protect its uniqueness

(ii) in clearing flood plains of damage-prone uses, and making them available for recreation use. PRO emphasizes a need for specific criteria to insure that such recreational developments are consistent with the maintenance of a high-quality environment.

(4) Framework Outputs and Costs

Section 12 contains Tables 1–277, 1–278, and 1–279 which provide information on needs, outputs, percent of needs met, and capital and OM&R costs for PRO, indicating by italics where they differ from NOR. Table 1–334 compares land treatment programs.

8.2.4.3 NOR and PRO Framework Costs

Table 1–349 in Section 12 lists the total costs (capital plus OM&R) for NOR and PRO for the periods 1971–1980 and 1971–2020.

8.3 Frameworks for River Basin Group 3.2

8.3.1 Summary

In 1970 the population of Planning Subarea 3.2 was 1.1 million, eighth among the 15 PSAs, and employment was 382,000 or just over 3 percent of the Basin total. Population and employment trends have paralleled those in the Great Lakes Basin since 1940.

Because of its location and available natural resources, three distinct areas of activity have developed in the river basin group: agricultural, forest-recreational, and urban-industrial. The agricultural areas are on the extremely productive soils of the Saginaw Valley; the recreation areas are in the forests, which provide scenic beauty and sparse population in the proximity of the large urban centers; and the urban-industrial center results from location on the Great Lakes, the availability of land in close proximity to the Detroit-Chicago corridor, which is being developed, and a multitude of other factors that are related to the growth of the area.

Water resources in this river basin group vary widely. Depending on locality, water may be plentiful or scarce, clean or polluted, and an asset or a problem. The eastern boundary of the river basin group is formed by Lake Huron and Saginaw Bay. In some areas flooding is a problem, but on the other hand, some industries, as well as residents, have trouble procuring enough water of a suitable quality for their needs.

The frameworks developed under the normal growth projections for this river basin group provide for water supplies for all uses to meet the needs of a balanced development, correcting conditions which have caused degraded water quality. They provide for increased recreational opportunities, expansion of commercial navigation and recreational boating, enhancement of fish and wildlife habitat for improved conservation, alleviation of flood damages, land treatment and drainage, and shoreline protection.

Section 12 contains Table 1–280 which shows needs, outputs, and percent of needs met under the Normal Framework; Tables 1–281 and 1–282 show capital costs and operation, maintenance, and replacement costs.

8.3.2 The Area

Figure 1–36 shows the areal extent of River Basin Group 3.2 and the corresponding planning subarea. Statistical information is in Section 1.

River Basin Group 3.2 is located for the most

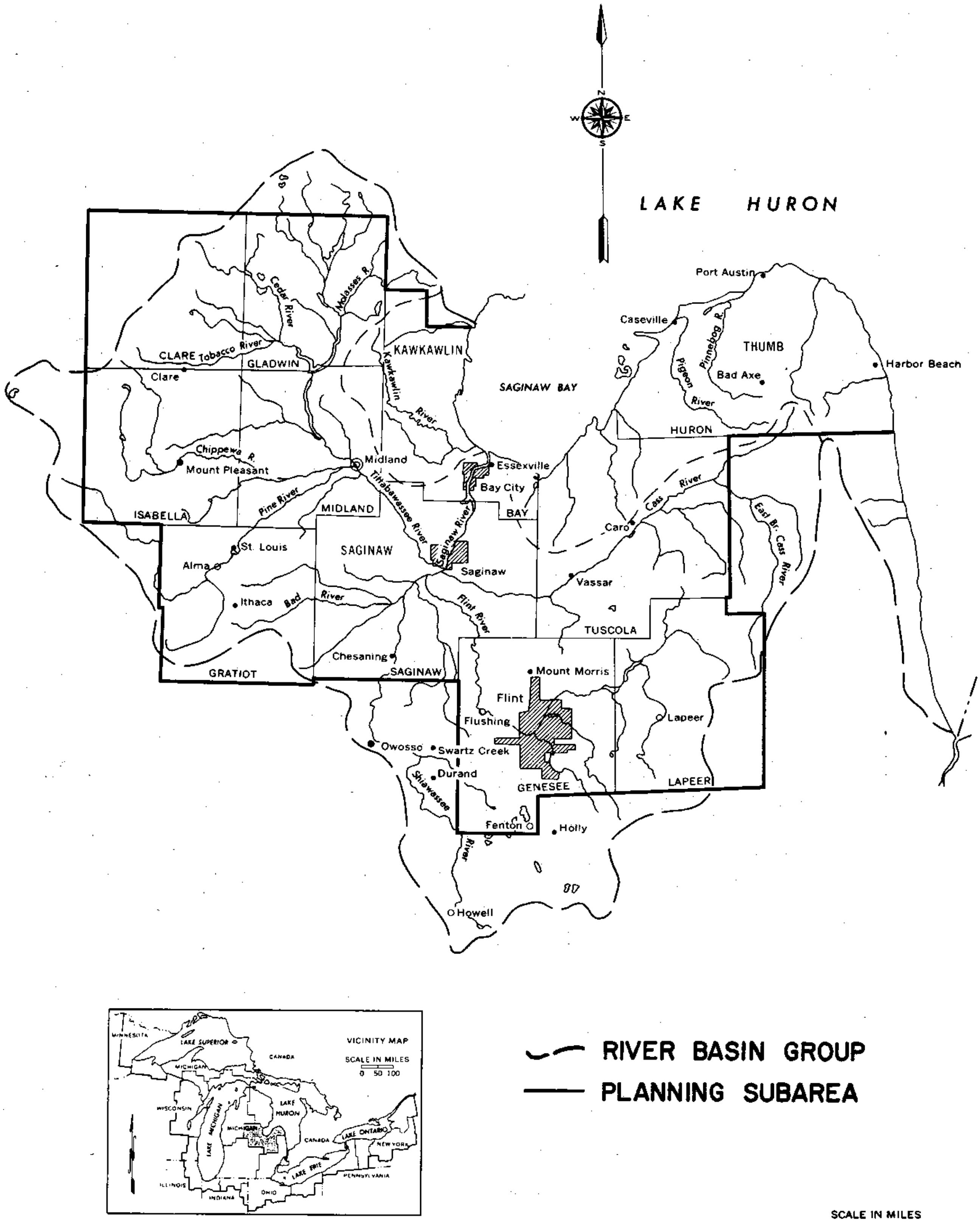

FIGURE 1–36 Lake Huron South, River Basin Group 3.2

part in what is known as the lakeless region of the State of Michigan. This is especially true in counties close to Saginaw Bay and lower Lake Huron. The lakeless nature of the river basin group and the flat, featureless, clay plains result from glacial lakes and the sediment deposited in them.

The river basin group has 204 miles of varied shoreline along Lake Huron, including rock outcrops, sand and shingled beaches, marshes, and clay bluffs. These individual types of shoreline provide wildlife habitat and opportunities for various kinds of recreation.

The area is subject to the variety of weather conditions associated with a humid continental climate. It lies in the pathway of storms that sweep across the Great Lakes Region from the west and southwest. The climate is characterized by frequent and sometimes rapid weather changes, by exteme seasonal temperature variations and by a fairly even annual distribution of precipitation, with the winter portion consisting mainly of snow. The mean annual temperature is nearly uniform over the area. The highest recorded temperature was 108 degrees Fahrenheit, and the lowest was −30 degrees Fahrenheit. The mean annual precipitation is slightly less than 30 inches. Average annual snowfall is about 40 inches, with the heaviest snowfall occurring in January. The growing season varies across the basin from 120 days in the north to about 148 days in the south.

Over the past years, both acreage devoted to farming and the number of farm employees have been steadily declining, but production has been steadily increasing. This greater efficiency is the result of more mechanization and improved technology. While the agricultural industry in the planning subarea is a significant sector of the economy, it has little to offer in terms of providing additional jobs, because of the trend toward larger farms, more mechanization, and increased efficiency. Agriculture accounted for about 2½ percent of the employment in 1970, a decline of 78 percent between 1940 and 1970. This decline was slightly more rapid than that in the nation or in the Basin.

The industry in PSA 3.2 was dominated in 1970 by manufacturing, which employed 156,000 workers and accounted for almost 41 percent of the total employment. (Employment in manufacturing was 25 percent in the nation and 35 percent in the entire Great Lakes Basin.) The leading employers were the chemical, primary metal, automobile, and food industries. Mining employment has been declining and losing significance in the basin economy.

The increasing importance of the service industries is also evident in this planning subarea. Even though employment in manufacturing will nearly double by 2020, this is less than the proportional growth in the total employment. Agricultural and mining employment will decline, while the service industries will employ a growing proportion of the total.

The trend toward increased urbanization is expected to continue, in part reflecting the continuing reduction of agricultural employment. The Flint area is the second most densely populated area in Michigan. The median age of the residents is 27½ years. Median age in the Saginaw Bay area is even lower—26 years.

Although no figures are available to indicate specifically the net migration into or within PSA 3.2, figures suggest that all counties experienced significant in-migration in recent years. The population and density figures should probably be raised somewhat for water resource planning purposes, to account for a significant and growing number of seasonal residents not counted in the census data. It has been estimated that seasonal residents may increase the PSA's summer population by as much as 8,000 to 10,000 persons. Taking into account short-term tourists, the peak seasonal total of domestic and recreational water users in the PSA may reach 1.2 million persons.

Planning Subarea 3.2 supports an active, diverse, year-round sport fishery that is based primarily on warmwater species, although the northern part of the planning subarea contains significant amounts of trout water and trout fishing opportunities. Michigan's inland Thumb area also provides excellent nesting and breeding grounds for a sizeable population of waterfowl, including the Canada goose. The natural habitat is also supplemented by a significant number of farm ponds which have been constructed recently near an excellent supply of food from the local farms. Further inland, the Saginaw Bay area also provides prime breeding and nesting habitat for various species of waterfowl. Both the Thumb and bay areas are heavily used during migrations by many species of waterfowl.

The excellent natural outdoor recreation resources in the planning subarea, its proximity to the major population centers of Flint, Saginaw, and Bay City, and its location relatively close to Detroit all indicate an increasing demand for outdoor recreation. The continuous upswing in population, income, and leisure time also plays an important part in the growing use of these land and water resources for outdoor recreation.

8.3.3 Projected Resource Needs and Problems

The projected needs for resource use by time period are shown in Section 12 on Table 1–280. Where needs can be quantified, they are not discussed in the text unless special conditions warrant such a discussion.

8.3.3.1 Water Withdrawals

One of the problems in River Basin Group 3.2 in connection with water withdrawals is that presently developed quantities of water are not adequate to meet all of the needs projected for the future. However, adequate sources of water are available, and no problem of quantity or quality has deterred any development for which other factors were favorable.

8.3.3.2 Nonwithdrawal Water Uses

Substandard water quality is the most significant aspect of nonwithdrawal water uses in RBG 3.2. In recent years severe water quality problems have been experienced in the Saginaw River over virtually its entire length, in the Flint River in the vicinity of the City of Flint, and in the lower portion of the Cass River. Other areas of water quality deterioration include the Shiawassee River from its mouth to Corunna, the Tittabawassee River between Midland and its confluence with the Saginaw River, and a number of minor streams, including the Pinconning and the Kawkawlin Rivers. These streams have smaller drainage areas and are predominantly agricultural in nature with very little industrial activity. Poor water quality results from storm water overflows, tributary waste loads, and untreated or partly treated sewage discharge from outlying areas in the RBG.

Major industrial activities in the river basin group include chemical establishments, refineries, slaughterhouses, food processing operations, and numerous automotive manufacturing facilities. The industrial concentrations are found along the Saginaw River between Bay City and Saginaw, in the Greater Flint area, in Midland, and in the Alma-St. Louis area. Since 1970 both industries and municipalities have made significant progress toward upgrading the quality of the Saginaw River through compliance with discharge improvement requirements.

There are no projections for increased hydroelectric power installations use.

Water pollution from industrial, municipal, and agricultural development in RBG 3.2 has diminished the fishing quality in many of the major rivers and impoundments, particularly around Flint, Saginaw, Bay City, and Midland. Additional problems are serious erosion and siltation from both urban construction and agriculture. In addition, fish management for valuable sport species and the removal of rough fish species is a problem. Pollution of the rivers and impoundments has discouraged many fishermen in this river basin group and caused them to seek their recreation in Saginaw Bay or further north in the other areas of the Great Lakes Basin. However, recent improvements in water quality and the newly planned impoundment on Pine River offer hope for reestablishing valuable fishery species within the river basin group. There is need for fish production through fish hatcheries, fish population control, habitat improvement and protection, and improved access.

Boating is a major recreational activity in RBG 3.2. About 1,500 miles of main stream and tributary rivers are suitable for canoeing. The lower 20 miles of the Saginaw River have been improved for commercial navigation, but they are also heavily used by small recreational craft.

About two-thirds of the Great Lakes shoreline in the RBG lies along Saginaw Bay. Four recreational boat harbors have been constructed with Federal and State participation along the eastern shore of the bay. The other one-third of the shoreline consists of the more severe and less sheltered coasts of Lake Huron. Only one Federally authorized and funded harbor has been built on this hazardous shore. This harbor, Harbor Beach, was built for lake carrier traffic but is also used by many small craft. The use of Great Lakes waters for recreational boating is limited by the lack of adequate mooring places and more suitable harbors. Most boating activity occurs on Saginaw Bay and in a small area of about 16,000 acres offshore of the five harbors and centers for marina development located on Lake Huron. Table 1–127 shows recreational boating use in PSA 3.2 and projects future needs. A positive resource management program is essential to protect and assure the existing water resource base and to meet the projected needs. The features of such a program would include the regulation and management of boating activities to achieve greater utilization of the water resources, resource management and protection, and facility

TABLE 1–127 Use and Projected Needs for Recreational Boating, PSA 3.2

	1000 Boating Days	
Category	Great Lakes Waters	Inland Waters
1970 Use	1,164	1,677
1980 Needs	480	72
2000 Needs	663	351
2020 Needs	888	717

development to increase opportunities to use the resource base.

The principal commercial harbor in this river basin group is the Saginaw River Harbor. Principal receipts are limestone, coal, and general cargo. General cargo is also exported. If the facilities at the two existing commercial harbors, Saginaw River Harbor and Harbor Beach, are maintained, the projected tonnage increase could be handled by these two harbors. Extension of the navigation season should have high priority.

8.3.3.3 Related Land Uses and Problems

Agricultural land treatment needs are based on criteria which provide for the proper use and treatment of the land for sustained agricultural production within the inherent capabilities of the soil. Treatment needs of cropland and other lands are developed by considering primarily the conservation of the soil resource in terms of soil loss tolerance. Conservation of the plant cover and the soil resource is considered in determining treatment needs of pasture land and woodland.

Slightly over 50 percent of the total land base in RBG 3.2 is subject to some drainage or flooding problems. About 12 percent of the cropland is subject to severe drainage problems, and an additional 12 percent of the cropland is subject to some water problems.

Present agricultural production is reduced or limited by excess water in the soil profile. In the determination of treatment needs, the beneficial and adverse effects of drainage measures must be weighed. The type of food or fiber to be produced must be taken into account, and it is important to consider possible alternative uses of land having wetness problems.

In addition to the need for drainage on agricultural lands, soil conditions will require some drainage on lands where urban expansion will occur. No quantification of this acreage is included in the Framework Study.

Maintenance of forest cover is needed for watershed protection, continued timber production, recreation, fish and wildlife habitat, aesthetics, and a combination of these values. A relatively small percentage of the land is devoted to forest land in RBG 3.2, and securing good management for the privately owned forests is a problem.

Of the 204 miles of shoreline in River Basin Group 3.2, only about 0.2 miles of shoreline near Port Sanilac is subject to critical erosion, and about 91 miles are subject to noncritical erosion.

Major problems connected with streambank erosion are that the miles subject to erosion are scattered and expensive to treat. There is a need for further study to determine the most economical way to protect against this problem.

The four major streams in River Basin Group 3.2 have watersheds of different size, shape, intensity of precipitation, pattern of interior drainage, and channel slope and corresponding flow patterns. The records show that damaging floods in Saginaw basin nearly always occur in the spring of the year and most commonly in the last half of March or the early part of April. These floods may be general throughout the river basin or local and limited to one or two tributaries, without serious rise in the other tributaries. The general floods in the Saginaw River seem to recur with an average frequency of about once in six or seven years. On any given tributary, the frequency is more nearly once in every two or three years. In the Thumb complex, the region contains several small rivers and streams which drain the section of land outlined by the shores of the Thumb and of the Lower Peninsula. This area is typical of lands draining into the southern portion of Lake Huron. Even though the rivers and drainage areas are small, this region is not without its flood problems. Flood damages were experienced in 1935, 1942, and 1948. The flood overflows in 1935 and 1948 were intensified by ice jams, and the flood of June 1948 was created by a severe rainstorm. However, other flooding has been extremely local and has caused only minor damages to cropland in most cases.

In this river basin group the greatest flood damages are projected to occur in the rural areas until the latter part of the 50-year study period. The flood problems in the urban areas are the result of constricted reaches of river, inadequate channel capacity, encroachment on the natural flood plain, or a combination of these causes.

Wildlife habitat in Planning Subarea 3.2 is diverse. It includes northern forests, active and fallow farmland, and fine waterfowl marsh. Urban areas comprise a significant portion of the planning subarea and have seriously degraded the wildlife habitat.

Changes in forest succession are occurring here, but to a lesser degree than in other parts of the Basin. Loss and degradation of wetland habitat around Saginaw Bay are among the most critical wildlife-oriented resource problems. Approximately 40,500 acres of fine marsh exist along the shores of the bay, and the area is a nationally known waterfowl concentration area. Construction of small-boat channels, docks, and other marine facilities in the marsh area brings about disturbances which adversely affect the wildlife resource. Shrinking hunter access to wildlife lands is another major problem and is of particular interest to this area where there are limited acreages of public land that are adequate for hunting or observing wildlife.

This problem is particularly serious because gross hunter demand is expected to increase while wildlife habitat is expected to decrease.

While specific needs and opportunities are not identified, there are a number of resource types listed in Appendix 22, *Aesthetic and Cultural Resources*, that need to be considered. Some of these concern the establishment of corridors and buffer zones around and between population centers and along shorelines and streams. Others relate to the acquisition and preservation of specific natural and cultural features. The major problem is the need to preserve the outstanding value of these resources. These cultural and aesthetic resources are well distributed throughout the planning subarea. No specific alternative programs or projected requirement can be readily discerned. However, additional legislation may be needed to expedite a program of acquisition and management, and the private sector should be encouraged to participate in the program for the preservation and protection of these unique and significant areas. A number of these areas need to be identified at an early date, and proper steps must be taken for their preservation.

The requirement for water-oriented outdoor recreation was nearly 3 million recreation days in 1970 and is estimated to increase to more than 20 million recreation days by the year 2020.

The land available for recreation in this planning subarea is rather limited. The forested northern section of the PSA lends itself well to camping and hunting and other recreational activities that depend upon the natural environment. The greatest current need is for the development of facilities usually associated with the urban areas. There is a shortage of trail development. The need for camping acreage is estimated to increase. Because there is a relatively little public land available for more intensive development, the total land acreage that must be acquired and developed is relatively large. More than 19,000 acres were required in 1970, but by the year 2020 the total land needed to satisfy the recreational demand will approach 84,000 acres. Several of the State parks and some of the State game and wildlife areas could support additional limited development. However, a significant amount of other resources with recreational potential that could be utilized exist in the planning subarea.

8.3.4 Alternative Frameworks

Two alternative frameworks are presented for this as for other river basin groups. The first alternative, the Normal Framework, does not reflect coordination of solutions to meet needs outside RBG 3.2 in the Lake basin or the Great Lakes Basin.

The second alternative, the Proposed Framework, contains the recommendations of the Commission in an effort to reflect the views of the people of the basin, and the policies and programs of the States. To some extent, it reflects coordination in the development of the framework among a number of river basin groups, both in the Lake basin and in the Great Lakes Basin as a whole.

8.3.4.1 Normal Framework (NOR)

NOR is based on meeting quantified needs and solving identified problems to the maximum practicable extent consistent with subobjectives and criteria discussed in Section 2 of the appendix. The program outputs and costs are summarized in Section 12 in Tables 1–280, 1–281, 1–282.

(1) Water Withdrawals

There is adequate water to meet the needs for municipal water for all three time frames if additional sources are developed from Lake Huron. NOR envisions that most of the water will come from Lake Huron, with a supplemental supply from ground water. Shortly after 1970, a withdrawal from Lake Huron for the Detroit metropolitan area began operation. Some of this water is sold for use in RBG 3.2. Only this portion of the water is considered in this section. That used in RBG 4.1 is considered in Section 9. The self-supplied industrial water will largely come from the Great Lakes and from inland lakes and streams, with a small quantity coming from ground water. Rural water will be supplied entirely from ground water sources. Water for mining and irrigation will come from both inland lakes and streams and ground water, with most coming from surface sources. Water for future additional thermal power cooling is projected to come entirely from Lake Huron.

Some land use changes and process modifications, including increased recirculation, could reduce water withdrawal needs. Programs to bring about process modification are included in NOR.

(2) Nonwithdrawal Water Uses

NOR includes programs for both municipal and industrial waste-water discharge treatment to meet all of the water quality standards prior to the Federal Water Pollution Control Act Amendments of 1972. It also provides that there will be no degradation of water quality where existing water quality is at a higher level than that provided by the existing standards. Between the years 1970 and 2020, a number of areas in RBG 3.2 are expected to require advanced waste treatment. Most will require this treatment before 1980.

Programs for agricultural waste treatment are not included, but the effects of fertilizers, pesticides, and nutrients from runoff require additional studies.

The fisheries management program included in NOR provides for land acquisition for access to and habitat protection on the inland lakes and streams. This program, even when coupled with additional stocking from hatchery-produced fish, will not wholly satisfy the fisherman-day needs.

The needs for recreational boating include additional inland water, access facilities, launching sites and related facilities, and berthing facilities along the shores of Lake Huron. These are included in the Normal Framework, but will not satisfy recreational boating needs.

Commercial fishing is discussed in Section 5 and Subsection 8.4.3.

Commercial navigation is considered on a system-wide basis in Section 5, and Subsection 8.4.1.

(3) Related Land Uses and Problems

The programed agricultural land treatment is essentially a continuation of the ongoing programs at a level that has been followed in the past.

Cropland drainage would be accomplished by the year 2020 on about one-third of the land having a wetness problem. This will improve the productivity of these lands and thereby reduce the total land needed for food and fiber.

Forest land treatment is accelerated above the existing level of treatment.

The shoreline erosion program would treat the 0.2 mile stretch of critical erosion along the Lake Huron shoreline. No protection would be afforded reaches subject to noncritical erosion.

Streambank erosion programs in NOR would provide treatment by 2020 for all of the streambank mileage classified as subject to severe erosion. No protection is provided for streambank erosion that is classified as moderate. Streambank erosion is widespread, and effective protection measures are very costly to install and maintain.

Both structural and nonstructural measures are included in NOR to alleviate flood damages. The structural measures are composed of facilities for storage, levees, floodwalls, and other protective works to prevent those potential damages which remain after the flood plain legislation becomes effective. Legislation will be least effective in the early years, and may reduce damages by about 10 percent. Some 40 percent of the damages are estimated to be prevented by flood plain legislation between 1980 and 2000, and about 75 percent by 2020.

A continuation of ongoing wildlife management programs budgeted by the State agencies for habitat management, enforcement, and research are included in NOR. Additional programs are included which would be funded through the State. Programs selected do not meet all of the requirements for 2020 in either habitat area or user days.

The Normal Framework for RBG 3.2 expects that outstanding, unusual, and significant aesthetic and cultural resources will be acquired early and set aside for the benefit of future generations. Additional legislation may be needed to expedite the program of acquisition and management, and the private sector should be encouraged to participate in programs to preserve and protect these unique and significant areas.

The programs selected for outdoor recreation for intensive and extensive development do not fully meet the needs. The acquisition and development of flood plains and mileage along the Lake Huron shoreline, and the acquisition and development of regional parks are the programs envisioned to supply recreation needs. However, there are severe limitations to the development of these areas. Existing private developments that clutter the lakeshore with cottages, summer residences, and year-round homes have preempted many of the high quality areas with potential for recreational development. The greatest current need is for development of facilities usually associated with the urban areas.

(4) Framework Outputs and Costs

Section 12 contains Tables 1–280, 1–281, and 1–282, which provide information on needs, outputs, percent of needs met, and capital and OM&R costs.

8.3.4.2 Proposed Framework (PRO)

PRO was formulated in response to reactions to the Normal Framework (NOR) by the public and State and regional officials. State, regional, and local policies concerning population and economic growth do not differ greatly from those of the OBERS projections used in NOR.

(1) Water Withdrawals

PRO supports programs that satisfy water withdrawal needs in essentially the same manner as outlined in NOR. All needs are met.

PRO endorses the concept of encouraging reduction in the rate of growth of per capita use of power, providing that the health, welfare, economy, and well-being of the inhabitants are not adversely affected. Developmental setbacks for power plants are recommended for all shoreline areas. Environmental considerations should be thoroughly explored and agreed upon in advance of plant location and design.

PRO supports the needed research in the relationship of resource use to the severity of resource problems in the Great Lakes Region, and realizes the need for basic understanding of critical human and natural resource interrelationships, so that water and related land planning and research may be fully integrated.

(2) Nonwithdrawal Water Uses

PRO meets standards of the Federal Water Pollution Control Act Amendments of 1972, and includes solutions to problems associated with the overflow of storm and sanitary wastes from existing combined sewerage systems to public waters. This problem is programed in PRO to be abated by 1977.

The Proposed Framework recommends study to determine the most efficient means of controlling agricultural wastes. Adequate attention must be given to the treatment of nonpoint sources of agricultural wastes if water quality is to be maintained at a high level.

To the extent technically feasible, economically justifiable, and environmentally acceptable, PRO recommends the maintenance of efficient, low-cost, deep draft navigation, provision of incremental improvements to the navigation system in the Saginaw River, and the extension of the navigation season. Adequate measures are to be provided for the containment of polluted dredged spoil.

The fisheries management programs included in PRO are the same as in NOR.

(3) Related Land Uses and Problems

PRO includes the recommendation that additional studies be made at the State level leading to the development and adoption of a comprehensive land use policy for the Great Lakes Region. Such studies are being initiated by the State of Michigan at the present time. Such studies would enable land use decisions to be based on adequate information about the physical land base and its suitability for various uses. Improved land use policies would result and would permit water resources planning to complement land use objectives.

PRO programs for agricultural land treatment are accelerated above those of NOR.

The Proposed Framework endorses the concept that field drainage of agricultural cropland is an integral part of the agricultural land treatment program, and PRO recommends drainage at a rate above that of NOR.

PRO recommends forest land management and treatment programs be conducted at a higher rate than in NOR.

Shoreland erosion was viewed by many as being a much more serious problem than is suggested in NOR. PRO recommends that a reassessment be made of the shoreline reaches, based on 1973 shoreline erosion in the Great Lakes. This may indicate additional mileage of critical reaches. There are about 50 high-risk miles under 1973 lake levels. PRO recommends that all critical reaches be programed for protection before 1990. Shoreland management plans will be implemented for all Great Lakes shores by 1980 to protect and preserve shoreland integrity and uniqueness.

PRO recommends the same streambank erosion treatment as NOR.

PRO recommends that adequate sums of money be allocated to manage and control flood plain lands. The cost may be allocated to flood plain damage alleviation, outdoor recreation, and other uses of the flood plain. Flood insurance could provide still another supplement to the many programs for reducing flood damage.

PRO includes the concept that the States should set time limits for local entities to manage and develop policies, objectives, programs, and implementation techniques for flood plain regulations. If the local entities do not meet the time limits, the States should then manage and regulate the flood plains according to State statutes.

PRO recommends the establishment of State-approved local control ordinances directed toward the control or treatment of runoff and reduction of sedimentation on urban and rural lands. State-established regulations would prevail if local regulations are not implemented by July 1, 1977, consistent with Federal Water Pollution Control Act Amendments of 1972.

PRO programs for outdoor recreation do not differ from NOR programs. They will not meet all water-oriented outdoor recreation needs. It is assumed that approximately 60 percent of the outdoor recreation needs will be met with public funds (Federal, State and local) and that the remainder will be met either by private funding or not at all. The priorities for the use of public funding will be:

(a) urban recreation developments, and acquisition and restoration of unique and natural areas of regional significance

(b) developments on lands now publicly owned

(c) other developments.

To the extent public funds are available for investment in shorelands they may be used where feasible to assist in acquiring shoreland to preserve and protect its uniqueness in urbanizing areas. Public funds may also be used for clearing flood plains of damage-prone uses and making them available for recreation use. PRO emphasizes a need for specific criteria to insure that such recreational developments are consistent with the maintenance of a high-quality environment.

(4) Framework Outputs and Costs

Section 12 contains Tables 1–283, 1–284 and 1–285, which provide information on needs, outputs, percent of needs met, and capital and OM&R costs for PRO, indicating by italics where they differ from NOR. Table 1–335 compares the land treatment programs.

8.3.4.3 NOR and PRO Framework Costs

Table 1–350 in Section 12 lists the total costs (capital plus OM&R) for NOR and PRO in the periods 1971–1980 and 1971–2020.

8.4 Lake Huron Intrarelationships

Various lake uses such as commercial navigation, recreational boating, and sport and commercial fishing, and such parameters as water quality, levels and flows, and shore erosion cross political boundaries. Although these activities and parameters have already been discussed for each river basin group, it will also be useful to discuss them in relation to the entire Lake Huron basin.

8.4.1 Commercial Navigation

The amount of traffic handled at commercial ports on Lake Huron is not a significant part of the total commercial traffic on the Great Lakes, but the traffic carried on Lake Huron itself is significant. It is not proposed that any of the harbors be enlarged to 31-foot depths in order to handle the large ore ships now being used on the Lakes. Programs in both NOR and PRO for River Basin Group 3.1 show development consisting of both structural changes at the Soo and extension of the navigation season. The season extension will have beneficial effects on the ports on Lake Huron, even though specific work at these ports is not a part of the program.

8.4.2 Recreational Boating

While there are 23 boat harbors on the Lake Huron shore, the use of Lake Huron for recreational boating is limited by the lack of suitable mooring places and space. There are a few mooring spaces available in the northern part of the basin. If additional facilities were developed, together with a suitable communication system for informing boaters of weather conditions, the Lake could be utilized for recreational boating much more extensively than it now is.

8.4.3 Commercial and Sport Fishery

The management objective of the State of Michigan is to enhance the sport fishery in Lake Huron and to utilize the commercial fishery in conjunction with the sport fishery as a management tool. In general, the sport fishery is far more valuable in terms of revenues produced, and affects far more people than would a rejuvenated commercial fishery. However, by proper management and coordination of the two, both can be made more effective in meeting needs for pleasure and food.

8.4.4 Water Quality

Lake Huron is second only to Lake Superior in the high quality of its water. Because of the relatively low concentration of people along the shore of the Lake, and because conditions in other Lakes have alerted individuals and governmental agencies to pollution problems, the quality of Lake Huron probably will be maintained at higher level. Certainly the use of the Lake for a public water supply for the Detroit metropolitan area and other places will encourage maintenance of high quality.

Section 9

LAKE ERIE BASIN

9.1 Study Area

No other Lake basin includes parts of as many States as does the Lake Erie basin, which includes parts of five of the eight Basin States. This results in greater political complexity. Hydrologically, the basin includes not only the Lake proper and its tributaries, but also the St. Clair River, Lake St. Clair, and the Detroit River. At the outlet the basin is defined to extend to below the mouth of Tonawanda Creek, a tributary of Niagara River. Statistical and descriptive information is in Section 1, and the area is shown in Figure 1–37.

The Lake Erie basin has a typically humid continental climate, with the moderating influences of Lake Erie felt along the lakeshores and the easternmost portion of the basin. There are no significant physiographic influences. The basin as a whole has a mean annual temperature of about 50°F, with extremes of −30°F and 100°F recorded.

Mean annual precipitation is about 34 inches. It ranges from 32 to 48 inches, and increases from north to south and west to east. Prevailing winds average about 10 mph in the basin and are from the south and west. Velocities as high as 91 mph have been recorded. Thunderstorms and fog are common occurrences on Lake Erie. Most of the basin experiences more than 150 frost-free days. Snowfall averages 40 to 100 inches annually from west to east over the basin. Humidity and precipitation are high in the basin. During most years ice formation on Lake Erie is relatively greater than on any of the other four Great Lakes. The western basin, shallow bays, and protected areas are normally ice-covered from mid-January to mid-April.

9.1.1 Human Characteristics

The Lake Erie Plan Area had the second largest population of the five plan areas in 1970, with 39 percent of the total Great Lakes Region population. Only the Lake Michigan Plan Area was more populous, with 46 percent of the Region's population. The 1970 overall population density in the Lake Erie Plan Area of 287 persons per square mile was the second greatest in the Region.

The Lake Erie basin is the most urbanized basin, with 88 percent of its population residing in the 10 major urban areas of Detroit and Ann Arbor, Michigan; Fort Wayne, Indiana; Lima, Toledo, Akron, Cleveland, and Lorain-Elyria, Ohio; Erie, Pennsylvania; and Buffalo, New York.

Population and some economic data are contained in Section 1.

The economic, social, and physical development of the Lake Erie basin has relied upon the availability and quality of its natural resources and the opportunities they afford. The availability of furs, forests, and farmland, combined with the ease of navigation and a good water supply, encouraged settlers to move west. Some of the earliest settlements were at Detroit, Cleveland, and Buffalo. Much of the land was cleared for agriculture in the 1800s, while canals and railroads opened the way for industrial development and shipping from lake shore communities. Commercial fishing for the highly valued whitefish and lake trout boomed in the early decades of the 20th century, but subsequently declined due to the deadly effects of the invading sea lamprey and poor water quality in many portions of the Lake. Heavy industry, chemical production, and manufacturing were important in the early economy of the cities.

The Lake Erie region is now characterized by a diversified economy which relies upon light and heavy industry, manufacturing, agriculture, and tourism and recreation. Industrial activity is concentrated in the highly populated metropolitan areas, and most is near the lake shore, since it requires a plentiful water supply and waterborne commerce. The chief products of manufacturing are automobiles, fabricated metal, primary metals, rubber, food, petroleum, chemicals, and paper. Total value added by manufacture in the region is estimated at more than $17 billion annually.

Despite decreasing acreage in actual agricultural production, agricultural sales in the Lake Erie region remain high. Generally speaking, agricultural production in the western portion of the basin is

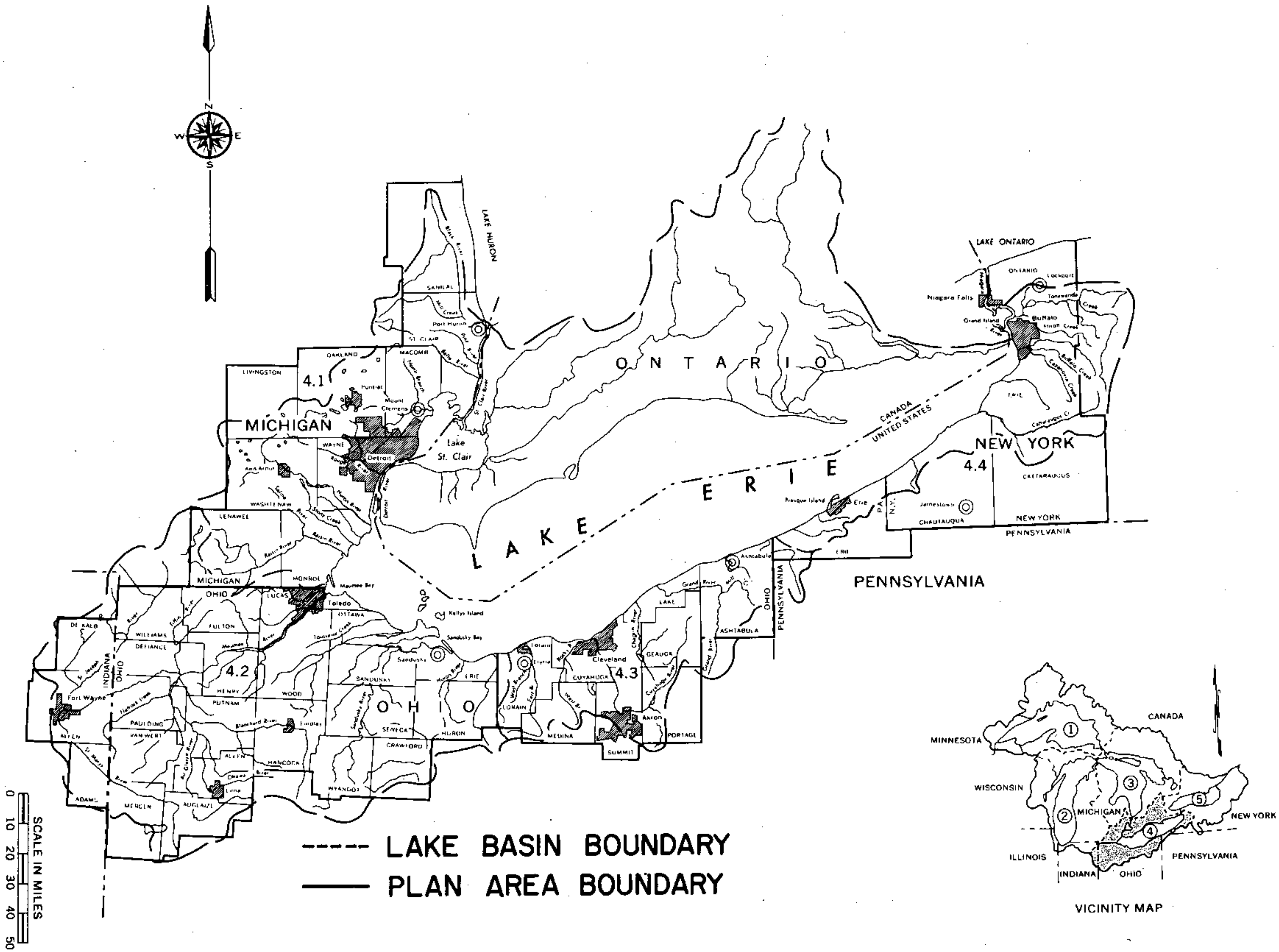

FIGURE 1-37 Plan Area 4, Lake Erie

characterized by dairy products, vegetables, fruits, field crops, and livestock and livestock products. The central and eastern sections of the basin produce nursery and greenhouse products, vegetables, and specialty crops such as grapes, pears, and sweet cherries.

Tourism and recreation add hundreds of millions of dollars to the basin's economy each year. The largest enterprises are in and near Sandusky, Ohio, and Erie, Pennsylvania.

The Lake Erie island area resort towns along the Lake, combined with State and regional parks, add to the attraction of the region. One of the most serious detriments to recreational growth is the degraded environmental condition of the basin water and land resource systems.

The availability of the Lakes and the St. Lawrence Seaway for waterborne commerce makes the Lake Erie basin a major distribution center for both raw materials and finished products. The basin has eleven major U.S. ports at Detroit, Toledo, Sandusky, Huron, Lorain, Cleveland, Fairport, Ashtabula, Conneaut, Erie, and Buffalo. Coal and iron ore are the largest volume commodities, but foreign package trade is also high in tonnage.

9.1.2 Water Resources

As natural storage reservoirs, Lakes St. Clair and Erie are among the region's most important assets. Average annual inflow to the Lake Erie system (which includes Lake St. Clair) from Lake Huron is 187,000 cubic feet per second (cfs). The average outflow at the Niagara River is 202,000 cfs. The net increase in flow of 15,000 cfs is generated by the natural and man-made conditions within the Lake Erie basin. Unfortunately, Lake Erie has become infamous in the past few years for its degraded quality. The concentration of heavy metals in fish in Lake St. Clair and accelerated eutrophication of the western and central basins of Lake Erie have focused national attention upon these resources. Lake Erie has phosphorus concentration about six times that of other Great Lakes. However, Lake Erie has the natural ability to cleanse itself of polluted materials in a shorter period of time than the other Great Lakes because of its rapid flushing rate.

Area streams and lakes have poor natural drainage, especially in the west. High dissolved solid concentrations and low-quality water occur in most stream reaches due to municipal, industrial, and agricultural wastes. Low dissolved oxygen concentrations and high algae growths are also characteristic of much of the surface water resource in the Lake Erie basin. Streams in the east drain from the Niagara and Portage Escarpments and are typically short and flow directly to Lake Erie.

The Maumee River has the largest drainage area of any stream in the basin and contributes the most sediment to the Lakes.

With the exception of River Basin Group 4.1 in the western portion, there are few inland lakes and ponds in the Lake Erie basin. Artificial impoundments, particularly in Ohio, are found frequently throughout the basin.

In general, the Lake Erie basin has the least overall ground-water potential of the five Great Lakes basins. However glacial drift provides excellent aquifers in selected areas of Michigan, New York, and Ohio. The carbonate aquifers are significant in the western Ohio and northern New York areas. Areas of limited ground-water potential occur in the lake plains along the southern shore of Lake Erie east of Sandusky and in the upland areas of Pennsylvania and New York. In these areas, overuse of ground water would reduce surface water availability, and vice versa. The total estimated ground-water potential of the Lake Erie basin is 1,946 mgd.

Chemical quality of the ground water has been a limiting factor in ground-water development in the Lake Erie basin. However, most poor-quality water can be treated to improve its quality if it is not too expensive to do so. Water from the surficial sand and gravel aquifers generally is good to fair in quality. Iron usually is present and the water can be hard and contain appreciable dissolved solids. Bedrock aquifers consistently yield hard to very hard water with dissolved solids often exceeding the recommended limit of 1,000 mg/l. Locally, and increasingly with depth, saline water is present. Iron and sulfate contents may be relatively high in local areas and increase treatment costs.

9.1.3 Land and Other Natural Resources

Most of the Lake Erie basin lies within the eastern lake section of the Central Lowland physiographic province. Glaciation of the entire basin has created the rolling morainal hills of moderate relief in the Michigan area, the extensive lake plains bordering the lake system, and much of the Maumee basin, and maturely dissected till-covered uplands of the Appalachian Plateau. The basin divide has altitudes generally over 1,000 feet, with the greatest altitudes reaching 2,300 feet in the Cattaraugus watershed of New York.

The prominent physiographic features include the Maumee lake plain, which was called the Great Black Swamp before it was drained, the inland Portage Escarpment along the southeastern shore of Lake Erie, and the deeply incised headwater valleys of Pennsylvania and New York. Several prominent linear sand beaches, which are remnants of beaches of the glacial lakes, parallel the Lake Erie shore. Many linear hills are moraines deposited at the glacial ice margins.

Bedrock exposures are increasingly prominent toward the eastern part of the basin. Along the Portage Escarpment and in the incised valleys, gently dipping shales and sandstones have been exposed by erosion or were not covered by drift. Many of the incised valleys are partially filled with thick deposits of glacial drift, especially in the New York area. Buried valleys occur in other parts of the basin. Rocks near the surface principally consist of carbonates in Indiana, western Ohio, and the northern part of New York, whereas shales and sandstone are dominant in the other areas.

The drift overlying the bedrock is dominantly fine grained throughout most of the basin except in Michigan and in local areas in New York and Ohio. The outwash and morainal deposits in these areas consist of coarse-grained material which contains significant ground-water resources. The lake plains are underlain by lacustrine deposits of clay, silt, and fine sand of low permeability. Similarly, clayey till mantles most of the bedrock upland of the Appalachian Plateau region. The soils which cover the basin were derived from parent material that varied from hard crystalline rock to lake plain sands and clays. Most of the soils are in the gray-brown podzolic group, with phosphorus and lime content low in the east to moderate in the west. Surface horizons are high in organic matter. Poor drainage is serious in northern Ohio and Erie County, Pennsylvania, where the soils have been developed from sandstone or shale.

About one-fifth of the region is covered by forest. Climatic and pedologic factors favor hardwood forest types throughout the basin, with softwoods appearing in mixed stands in New York. The most common trees are oak, ash, maple, elm, and hickory. Most of the forested land consists of small woodlots. Four major forest concentrations in the basin include the morainal areas in Michigan, the green belts around Detroit suburbs and Cleveland, and the dissected plateau east of Buffalo, New York. Several State parks also have large timber stands.

Mineral resources are primarily nonmetallic, consisting largely of oil and gas, sand and gravel, salt, gypsum, clay, and peat. Large salt deposits are located in the western portion of the basin, while clay production dominates the lakeshore region.

The Lake Erie region is highly urbanized. It is projected that urban built-up areas will gain primarily at the expense of cropland.

Table 1–128 and Figure 1–38 illustrate the base condition (1966–67) land use in the Lake Erie basin by urban and nonurban breakdown, and by a breakdown of the resource base.

The water and related land resource problems resulting from land use changes are many and complex. Table 1–129 projects changes in land use to 2020. Table 1–130 shows the same information broken down by PSA. Had it not been for massive planning in the past, resulting in the establishment of park districts and metropolitan authorities which today largely comprise those buffer zones immediately adjacent to the large cities, an even greater urban concentration would exist today.

Unfortunately, uniformly reliable data on current urban land use and management activities are not sufficient to form a basis for projection. It can be expected that some program of urban planning assistance, such as that provided by the Department of Housing and Urban Development under Section 701 of the 1954 Housing Act, as amended, will continue. As urban expansion reaches into new areas, more governmental units will be faced with a need for land use plans or revisions of existing plans. Thus, land use planning will continue to be an important function of local governments. There is also growing interest and activity in comprehensive land use planning at the State level.

For recreational use, the highest quality water resources are found within the Michigan portion of the basin. Rolling morainic terrain with wooded cover and numerous inland lakes in southeastern Michigan provide the setting for outdoor activities. The rivers of this portion of the basin offer additional opportunity for recreational areas. Especially significant for park development are the Huron and Clinton Rivers. Frontage on Lake Erie, Lake St. Clair, the Detroit River, and the St. Clair River provides a potentially valuable asset to the resource base. However there are inherent problems that restrict full use of these resources. For example, industrial and residential development, which is often deteriorated, precludes public recreation in important areas. Pollution of these waters by residential and industrial wastes has also seriously restricted the use of much of these resources.

In the Lake Erie basin, the Maumee River basin is the area most deficient in recreational resource capability. Recreational development there is largely confined to the river valleys.

From Toledo eastward to Buffalo, the greatest recreational resource features are the Lake Erie shoreline and the major stream valleys. The western and southern shores of Lake Erie contain more than 1,300 acres of beach. Of this total, more than 600 acres are publicly owned, and most of this is open to the public. However, about 40 acres in the vicinity of Cleveland, Detroit, and Buffalo are pol-

TABLE 1–128 Land Use, Lake Erie Plan Area, 1966–67 (thousands of acres)

PSA and State	Total Land Area	Urban Built-Up	Resource Base: Cropland	Pasture Range	Forest Land	Other	Total
PSA 4.1							
Michigan	3,980.4	759.5	2,215.6	117.7	665.7	221.9	3,220.9
PSA 4.2							
Indiana	880.6	102.2	638.9	40.6	71.9	27.0	778.4
Ohio	5,438.9	465.6	4,096.2	173.2	381.5	322.3	4,973.2
PSA Total	6,319.5	567.8	4,735.1	213.8	453.4	349.4	5,751.7
PSA 4.3							
Ohio	2,308.6	609.0	741.3	131.3	538.8	288.2	1,699.6
PSA 4.4							
Pa.	519.1	49.1	142.2	41.2	223.7	62.9	470.0
New York	2,550.8	435.9	716.5	211.4	1,140.8	46.1	2,114.8
PSA Total	3,069.9	485.0	858.7	252.6	1,364.5	109.1	2,584.9
TOTAL	15,678.4	2,421.3	8,550.7	715.4	3,022.4	968.6	13,257.1

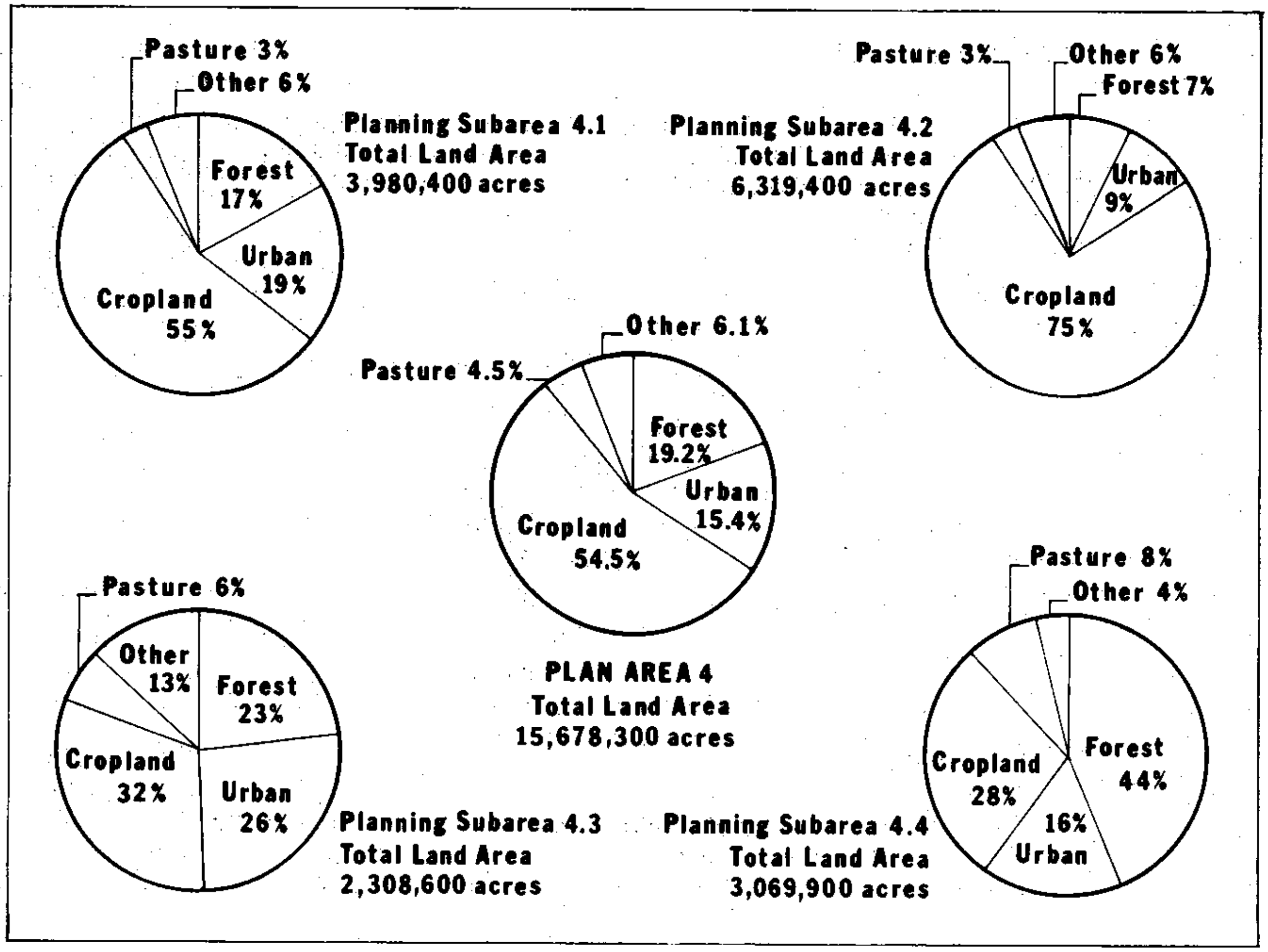

FIGURE 1–38 Land Use in the Lake Erie Basin

TABLE 1-129 Actual and Projected Land Use, Lake Erie Plan Area (thousands of acres)

Land Use	Actual 1966-67	Implied Change 1966-67 to 1980	Projected 1980	Implied Change 1980-2000	Projected 2000	Implied Change 2000-2020	Projected 2020
Lake Erie							
Total land area[1]	15,678.3	---	15,678.3	---	15,678.3	---	15,678.3
Total urban and built-up	2,421.2	550.2	2,971.4	871.7	3,843.1	687.0	4,530.1
Total nonurbanized land	13,257.1		12,706.9		11,835.2		11,148.2
Resource Base:							
Cropland	8,550.7	(333.1)[2]	8,217.6	(514.9)	7,702.7	(401.7)	7,301.0
Pasture	715.4	(28.9)	686.5	(48.2)	638.3	(39.3)	599.0
Forest Land	3,022.4	(138.1)	2,884.3	(225.7)	2,658.6	(179.9)	2,478.7
Other Land	968.6	(50.1)	918.5	(82.9)	835.6	(66.1)	769.5
Total[3]	13,257.1	(550.2)	12,706.9	(871.7)	11,835.2	(687.0)	11,148.2

Source: Developed by Economic Research Service, U.S. Department of Agriculture, East Lansing, Michigan.

[1]Total land area = total area - water area, and is assumed constant for projection periods.
[2]Bracket figures represent urban depletions for 1967-1980, 1980-2000, and 2000-2020.
[3]Detail may not add to total due to rounding.

luted to such an extent that they are now closed to swimming. Much of the remaining shoreline having beaches has been developed with residences, cottages, and industry. As in the Lake Michigan portion of the Basin, overdevelopment of the shoreline and severe degradation of the water quality hinder public development and utilization of this important resource. Industrialized portions of the Cuyahoga River in Cleveland, Ohio, are so polluted they have periodically caught fire.

The Bass Islands, north of Port Clinton, Ohio, include 6,000 acres with high recreational value. Lying within 250 miles of 21 million people, they have been used as a resort area for many years. Further east, the armlike peninsula of Presque Isle, near Erie, Pennsylvania, contains a 3,100 acre State park which receives both summer and winter use.

The major stream valleys include the Maumee, Sandusky, Vermilion, Black, Cuyahoga, Chagrin, and Grand in Ohio, and the Cattaraugus in New York. The Sandusky River has already been designated as a scenic river by Ohio; similar designation for the Chagrin has been proposed. The Cuyahoga River between Cleveland and Akron has been planned as a major recreational complex. A segment of the Maumee River was considered, but not selected, as an additional to the National Wild, Scenic, and Recreational Rivers System.

In portions of northeast Ohio; Erie County, Pennsylvania; and Cattaraugus and Chautauqua Counties, New York, there are significant areas of rolling terrain with significant aesthetic qualities. Parts of these areas contain substantial wooded tracts. Additional features of recreational significance include the Zoar Valley portion of Cattaraugus Creek, for which preservation has been proposed, and Niagara Falls. This world famous tourist attraction is located in Planning Subarea 4.4, but is hydrologically in the Lake Ontario basin.

The current State comprehensive outdoor recreation plan for Ohio includes scenic highways in several counties within the Lake Erie basin. The proposed North Country Trail would cut across River Basin Group 4.2.

Many of the States within the basin have also established their own trail systems. A portion of Ohio's Buckeye Trail is found within the Lake Erie watershed. It serves the Cleveland-Akron area and will tie in with the proposed North Country Trail. Several bicycle trails have also been developed in Ohio. The Maumee Valley Bikeway includes three round-trip tours totaling over 20 miles.

Interpretive nature trails are found in the Huron-Clinton Metropolitan Parks in River Basin Group 4.1.

The fish distribution and composition in Lake Erie differs from that in the other Great Lakes, primarily because of environmental factors. The Lake Erie fish ecosystem has undergone radical changes due to environmental changes coupled with high rates of harvest. Blue pike became nearly extinct in 1958 and are listed as an endangered species. White bass and channel catfish have been abundant since the 1900s, and harvesting emphasis has shifted to these species in the last 20 years.

The capability of Lake Erie to support fish is being maintained and may be increasing. The western basin of Lake Erie accounts for the major portion of Lake Erie commercial and sport fish production, and as many as 19 species have occurred in fish landings during the history of the fisheries.

In the 1970s, there has been a valuable, but unstable walleye population in western Lake Erie and a separate, less valuable but more stable population in the eastern basin. Since the start of this century, walleye, yellow perch, white bass, and channel catfish have occurred in Lake Erie commercial landings, and within the past quarter

TABLE 1-130 Actual and Projected Land Use, Lake Erie Plan Area by PSA (thousands of acres)

Land Use	Actual 1966-67	Implied Change 1966-67 to 1980	Projected 1980	Implied Change 1980-2000	Projected 2000	Implied Change 2000-2020	Projected 2020
PSA 4.1							
Total land area[1]	3,980.4	---	3,980.4	---	3,980.4	---	3,980.4
Total urban and built-up	759.4	294.5	1,053.9	417.1	1,471.0	276.3	1,747.3
Total nonurbanized land	3,221.0		2,926.5		2,509.4		2,233.1
Resource Base:							
Cropland	2,215.6	(202.6)[2]	2,013.0	(287.0)	1,726.0	(190.1)	1,535.9
Pasture	117.7	(10.7)	107.0	(15.2)	91.8	(10.1)	81.7
Forest Land	665.7	(60.9)	604.8	(86.2)	518.6	(57.1)	461.5
Other Land	222.0	(20.3)	201.7	(28.7)	173.0	(19.0)	154.0
Total[3]	3,221.0	(294.5)	2,926.5	(417.1)	2,509.4	(276.3)	2,233.1
PSA 4.2							
Total land area[1]	6,319.4	---	6,319.4	---	6,319.4	---	6,319.4
Total urban and built-up	567.8	62.7	630.5	101.6	732.1	106.8	838.9
Total nonurbanized land	5,751.6		5,688.9		5,587.3		5,480.5
Resource Base:							
Cropland	4,735.1	(51.7)	4,683.4	(83.6)	4,599.8	(87.9)	4,511.9
Pasture	213.8	(2.3)	211.5	(3.8)	207.7	(4.0)	203.7
Forest Land	453.4	(4.9)	448.5	(8.0)	440.5	(8.4)	432.1
Other Land	349.3	(3.8)	345.5	(6.2)	339.3	(6.5)	332.8
Total[3]	5,751.6	(62.7)	5,688.9	(101.6)	5,587.3	(106.8)	5,480.5
PSA 4.3							
Total land area[1]	2,308.6	---	2,308.6	---	2,308.6	---	2,308.6
Total urban and built-up	609.0	140.4	749.4	260.2	1,009.6	218.2	1,227.8
Total nonurbanized land	1,699.6		1,559.2		1,299.0		1,080.8
Resource Base:							
Cropland	741.3	(61.3)	680.0	(113.5)	566.5	(95.2)	471.3
Pasture	131.3	(10.8)	120.5	(20.1)	100.4	(16.8)	83.6
Forest Land	538.8	(44.5)	494.3	(82.5)	411.8	(69.2)	342.6
Other Land	288.2	(23.8)	264.4	(44.1)	220.3	(37.0)	183.3
Total[3]	1,699.6	(140.4)	1,559.2	(260.2)	1,299.0	(218.2)	1,080.8
PSA 4.4							
Total land area[1]	3,069.9	---	3,069.9	---	3,069.9	---	3,069.9
Total urban and built-up	485.0	52.6	537.6	92.8	630.4	85.7	716.1
Total nonurbanized land	2,584.9		2,532.3		2,439.5		2,353.8
Resource Base:							
Cropland	858.7	(17.5)	841.2	(30.8)	810.4	(28.5)	781.9
Pasture	252.6	(5.1)	247.5	(9.1)	238.4	(8.4)	230.0
Forest Land	1,364.5	(27.8)	1,336.7	(49.0)	1,287.7	(45.2)	1,242.5
Other Land	109.1	(2.2)	106.9	(3.9)	103.0	(3.6)	99.4
Total[3]	2,584.9	(52.6)	2,532.3	(92.8)	2,439.5	(85.7)	2,353.8

Source: Developed by Economic Research Service, U.S. Department of Agriculture, East Lansing, Mihcigan.

[1]Total land area = total area - water area, and is assumed constant for projection periods.
[2]Bracket figures represent urban depletions for 1967-1980, 1980-2000, and 2000-2020.
[3]Detail may not add to total due to rounding.

century harvesting emphasis has shifted to these species. Because of harvest and habitat stress factors, these populations are depressed and fluctuating, and consequently carp, freshwater drum, and smelt dominate the Lake Erie fish ecosystem. On a yearly basis Lake Erie has accounted for a third of the total Great Lakes fish production.

Sport fishing has played an important role in the development of resorts or vacation areas at the islands off various points along the south shore of Lake Erie. Fishing pressure and success on Lake Erie has been dictated by many factors. Each decade has experienced various social and/or economic conditions that dictated the status of the sport fishery. Due to commercial exploitation and environmental degradation, species composition has changed in recent years. Species which are currently available and sought by sport anglers are, somewhat in order of abundance, yellow perch, white bass, channel catfish, smallmouth bass, and walleye. United States sport fishing on Lake Erie during the past decade has been directed primarily at these. The yellow perch is by far the most popular and harvested species in the Lake, accounting for 96 percent, by number, of the catch. White bass and channel catfish angling is a spring and early summer fishery confined primarily to the western and central basins. Walleye and smallmouth bass angling is concentrated at the Bass Islands, at the reef areas of the western basin, and along the rocky shorelines of the central and eastern basins. These two species are the mainstay of the New York sport fishery. Annual walleye and smallmouth bass angler success is strongly dependent on the current population densities of these species.

In Michigan, the existing wildlife environment has suffered from human disturbance in marshlands. This has resulted in a decline of water-dependent wildlife in the Saginaw Bay area, St. Clair River, Lake St. Clair, inland southern Michigan and along the Lake Erie shoreline. Little documentation is available, but it is evident that herons, bitterns, rails, cranes, and other aquatic birds have also suffered from this habitat destruction.

In northwest Ohio wildlife habitat has generally undergone more detrimental change than any other area in the basin. Large-scale destruction of marshes has occurred here in the past. More recently changes in agricultural practices have seriously reduced the value of other habitat types. Rabbits, pheasants, squirrels, doves, and bobwhite quail have been declining in this area, indicating that upland habitat is being reduced in productivity and quantity. Raptorial birds are declining. Deer herd size is increasing, primarily due to restrictive hunting regulations and deer migration from adjoining States. Fur bearers are declining in numbers. Of particular significance is the muskrat. Ohio has the second highest muskrat harvest in the United States. Loss of any significant amount of remaining habitat and consequent reduction in muskrat will result in local economic losses. In northeast Ohio the impact of agriculture is less intense, and habitat for deer and other woodland game has increased. Northeast Ohio has medium deer and grouse densities. Change in ownership of nonurban land from agriculture to other private interests has greatly improved upland game habitat, although it has somewhat hurt the productivity of the habitat for some woodland species such as pheasant and bobwhite quail. Other wildlife species, with the exception of raptors, which are declining nearly everywhere, are doing well in this part of the State.

The status of wildlife and its habitat is poor in the Indiana portion of the basin.

Wildlife habitat in Erie County, Pennsylvania, is similar to that of northeast Ohio, as described above. Forest species such as snowshoe hare, wildcat, and porcupine, are occasionally seen in the southeast portion of this area. The open water on Lake Erie and Presque Isle Bay has declined in waterfowl value due to pollution that diminishes food organisms. Ducks are still found in high numbers but are decreasing. Fur bearers in inland marshes and streams are doing well, with high populations of muskrat and beaver. Other occasional species are osprey, bald eagle, and coyote.

A broad variety of wildlife habitat exists across the New York portion of the basin. Wildlife habitat suitable for farm game is located along the lake plain hill country that extends northeast from the Pennsylvania line to the Lake Ontario shore. This land supports medium densities of most farm game species except mourning dove, which is present in low densities. The Niagara River is an important waterfowl resting and feeding area during migration.

9.1.4 Resource Problems

Perhaps the most notorious Lake Erie basin water quality problem is that of eutrophication in the Lake itself. This has been thoroughly documented in the International Joint Commission's 1969 report on the "Pollution of Lake Erie, Lake Ontario, and the International Section of the St. Lawrence River;" in the 1968 Federal Water Pollution Control Administration's "Lake Erie Report: A Plan for Water Pollution Control;" and more recently, in "Project Hypo: An Intensive Study of the Lake Erie Central Basin Hypolimnion and Related Surface Water Phenomena," by the Canada Centre for Inland Waters and the U.S. Environmental Protection Agency, Region V. All of these studies have indicated that high levels of nutrients being discharged to Lake Erie have created a condition, particularly in the central basin, in which large algal concentrations develop, die, sink to the bottom, and decay. This may create a phosphate cycle which will be self-generating in several years, unless prompt abatement is implemented. High algal concentrations and oxygen depletion are the two main problems in the open waters of the Lake. The following stream segments have been reported by the States to have priority for correction of water quality deficiencies:

(1) River Basin Group 4.1

(a) Clinton River—Michigan, Pontiac to mouth, and the Red Run Basin

(b) Huron River—Michigan, Dexter through Ford Lake

(c) Saline River—Michigan, Saline to ten miles downstream

(d) South Branch River Basin—Michigan, Adrian to confluence with main branch.

(2) River Basin Group 4.2

(a) Maumee River—Indiana, main stem

(b) Cedar Creek—Indiana

(c) St. Marys River—Indiana

(d) St. Joseph River—Indiana

(e) Maumee River—Ohio, main stem downstream of Defiance, and northern tributaries

(f) Maumee River—Ohio, main stem from Indiana State line to Defiance, and southern tributaries to Maumee

(g) Lake Erie—Ohio, mouth of Maumee River to Erie County-Lorain County line

(h) Sandusky River—Ohio, main stem

(i) Portage River—Ohio, tributaries

(j) Lake Erie—Ohio, Michigan State line to Ten Mile Creek, and including Ten Mile Creek

(k) Sandusky River—Ohio, all tributaries

(l) Huron River—Ohio, entire basin

(m) Portage River—Ohio, main stem

(n) Vermilion River—Ohio, entire basin.

(3) River Basin Group 4.3

(a) Cuyahoga River—Ohio, Lake Rockwell dam to mouth, and tributaries

(b) Lake Erie—Ohio, western Cuyahoga County line to Grand River, including minor tributaries

(c) Lake Erie—Ohio, eastern Lorain County line to western Cuyahoga County line, including minor tributaries.

(d) Chagrin River—Ohio, entire basin

(e) Lake Erie—Ohio, mouth of Grand River to Ohio-Pennsylvania line

(f) Cuyahoga River—Ohio, upstream of Lake Rockwell

(g) Rocky River—Ohio, entire basin

(h) Grand River—Ohio, entire basin

(i) Ashtabula River—Ohio, entire basin.

(4) River Basin Group 4.4

(a) Niagara River—New York, main stem

(b) Tonawanda Creek—New York

(c) Scajaquada Creek—New York

(d) Chautauqua Creek—New York

(e) Lake Erie—New York

(f) South Branch Cattaraugus Creek—New York

(g) Murder Creek—New York

(h) Cattaraugus Creek—New York

(i) Big Sister Creek—New York.

Streambank erosion is severe in many of the tributaries in the Lake Erie basin. Particularly critical are the large sediment deposits in the Maumee Bay and at the mouth of the Cuyahoga River. These depositors are expensive to remove, and they limit many other water resource uses including commercial navigation, fishing, and recreation.

Several localities have enacted sediment control ordinances to control erosion primarily related to construction activities; similar action by other local governments may be anticipated. The problems of flood plain development are becoming more widely recognized, and better controls may be adopted in the future. Some municipalities have taken action to revise or supplement zoning ordinances to include flood plain zoning. The entire issue is so complex that only broad generalizations are possible.

Major problems associated with Lake Erie shoreline use are flooding, particularly at the eastern and western ends of the Lake, and the pressure for greater public ownership of the shoreline.

Extensive urban, agricultural, and transportation development has decreased the availability of fish and wildlife species and habitat in most parts of the Lake Erie basin. Warmwater and rough fish species dominate most of the area's inland lakes and streams. Some stocking programs supply coldwater trout species to basin streams in Michigan, but largely on a put-and-take basis. The decline of the high-value species and the increase in low-value species is the major problem of the Lake Erie fishery. The lack of adequate funding and support for collection of fishery data is also a problem. The lack of institutional arrangements is also a major hindrance to the coordination of fishery research and the improvement of fishery stocks throughout the Lake Erie basin. An additional problem with respect to commercial fisheries is the lack of coordinated research and management policies in the agencies bordering Lake Erie.

Wildlife has been depleted to the extent that deer are the only significant big game species, and small game species include fox, rabbit, and pheasant to a limited degree.

9.1.4.1 Problems Matrix

For each resource use category, the water and related land resources problems were judged to be either severe, moderate, minor, or no problem, for each river basin and complex in the Lake Erie basin, as indicated in Table 1–131. The problems evaluation was for the period of the present time to 1980.

9.1.5 Existing Resource Use and Development

9.1.5.1 Water Withdrawals

In the Lake Erie basin there are, overall, ade-

TABLE 1-131 Lake Erie Basin, Resource Problems Matrix

Resource Use Category	LAKE ERIE BASIN 4.0	Northwest River Basin Group 4.1	Black River Basin				St. Clair Complex				Clinton River Basin				Rouge Complex				Huron River Basin				Swan Creek Complex			
	Overall	Overall	Overall	Urban	Rural	Interface	Overall	Urban	Rural	Interface	Overall	Urban	Rural	Interface	Overall	Urban	Rural	Interface	Overall	Urban	Rural	Interface	Overall	Urban	Rural	Interface
WATER WITHDRAWALS																										
MUNICIPALLY SUPPLIED	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SELF-SUPPLIED INDUSTRIAL	1	1	-	-	-	-	-	-	-	-	-	-	-	-	1	1	-	-	-	-	-	-	-	-	-	-
RURAL DOMESTIC & LIVESTOCK	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
IRRIGATION	1	1	-	-	-	-	-	-	-	-	1	1	-	-	-	-	-	-	1	1	1	-	-	-	-	-
MINING	1	1	1	-	1	-	1	-	1	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
THERMAL POWER COOLING	1	1	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
NON-WITHDRAWAL WATER USES																										
MUNICIPAL WASTEWATER DISCHARGES	3	3	1	2	1	1	1	2	1	1	3	3	2	3	3	3	-	3	3	3	2	3	2	2	1	1
INDUSTRIAL WASTEWATER DISCHARGES	3	3	-	-	-	-	-	-	-	-	1	1	-	-	3	3	-	-	2	2	2	-	-	-	-	-
HYDROELECTRIC POWER	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
WATER ORIENTED OUTDOOR REC.	2	2	-	-	-	-	-	-	-	-	2	2	2	-	3	3	-	-	1	-	1	2	-	-	-	2
SPORT FISHING	2	2	-	-	-	-	1	-	1	-	1	-	1	-	1	-	1	3	1	-	1	3	-	-	-	3
RECREATIONAL BOATING	1	1	-	-	-	-	1	-	-	1	1	-	-	1	1	-	-	1	-	-	-	-	-	-	-	-
COMMERCIAL FISHING	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
COMMERCIAL NAVIGATION	1	1	1	-	-	1	1	-	-	1	-	-	-	-	1	-	-	1	-	-	-	-	-	-	-	-
RELATED LAND USES & PROBLEMS																										
LAND USE	-	3	2	3	2	2	2	3	2	2	3	2	2	2	3	3	2	2	2	3	2	2	2	3	2	2
AGRICULTURAL LAND TREATMENT	2	1	1	-	1	-	1	-	1	-	1	-	1	-	-	-	-	-	1	-	1	-	-	-	-	-
CROPLAND DRAINAGE	2	1	2	1	2	-	2	2	2	2	1	2	1	-	1	1	-	2	1	1	1	-	2	1	2	1
FOREST LAND TREATMENT	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SHORELAND EROSION	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
STREAMBANK EROSION	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
FLOOD PLAINS	2	3	1	3	1	1	1	2	1	3	3	3	2	3	3	3	-	-	3	3	3	2	3	2	3	3
WILDLIFE MANAGEMENT	3	3	2	2	1	2	3	3	3	2	3	3	3	2	3	3	-	3	3	3	2	2	3	2	3	3
AESTHETIC & CULTURAL	2	2	1	-	1	-	3	3	-	3	1	-	1	-	3	-	-	3	1	-	1	-	-	-	-	-
OUTDOOR RECREATION	2	2	-	-	-	-	-	-	-	-	2	2	2	-	3	3	-	-	1	-	1	-	-	-	-	-

Resource Use Category	LAKE ERIE BASIN 4.0 — SW RBG 4.2 Huron-Vermillion C.					Central River Basin Group 4.3	Black-Rocky C.				Cuyahoga River Basin				Chagrin Complex				Grand River Basin			
	Overall	Urban	Rural	Interface	Overall	Overall	Overall	Urban	Rural	Interface	Overall	Urban	Rural	Interface	Overall	Urban	Rural	Interface	Overall	Urban	Rural	Interface
WATER WITHDRAWALS																						
MUNICIPALLY SUPPLIED	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SELF-SUPPLIED INDUSTRIAL	-	-	-	-	1	1	1	1	-	-	1	1	-	-	1	1	-	-	1	1	-	-
RURAL DOMESTIC & LIVESTOCK	-	-	-	-	1	1	-	-	-	-	-	-	1	-	-	-	1	-	-	-	-	-
IRRIGATION	1	-	1	-	1	1	1	1	-	-	1	1	-	1	1	-	-	-	-	-	-	-
MINING	1	-	1	-	1	1	1	-	1	1	1	2	1	1	1	-	1	1	1	-	1	-
THERMAL POWER COOLING	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
NON-WITHDRAWAL WATER USES																						
MUNICIPAL WASTEWATER DISCHARGES	3	3	2	2	3	3	3	3	2	2	3	3	2	3	3	3	3	-	3	3	1	3
INDUSTRIAL WASTEWATER DISCHARGES	-	-	-	-	3	3	1	-	2	-	3	3	-	3	-	-	1	-	1	2	-	-
HYDROELECTRIC POWER	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
WATER ORIENTED OUTDOOR REC.	2	-	-	2	2	2	2	-	-	2	3	3	3	-	2	-	-	2	2	-	2	2
SPORT FISHING	2	-	2	-	2	2	2	-	2	-	2	2	2	-	-	-	-	2	2	-	2	2
RECREATIONAL BOATING	2	-	-	2	1	2	2	-	-	2	-	-	-	-	2	-	-	2	-	-	-	-
COMMERCIAL FISHING	-	-	-	-	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
COMMERCIAL NAVIGATION	-	-	-	-	1	2	2	-	-	2	2	-	-	2	-	-	-	-	-	-	-	-
RELATED LAND USES & PROBLEMS																						
LAND USE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
AGRICULTURAL LAND TREATMENT	-	-	-	-	2	2	2	-	2	-	-	-	-	-	-	-	-	-	2	-	2	-
CROPLAND DRAINAGE	2	3	2	-	2	2	2	2	1	-	2	2	1	-	2	2	1	-	1	1	2	-
FOREST LAND TREATMENT	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SHORELAND EROSION	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
STREAMBANK EROSION	-	-	-	-	1	-	-	-	-	-	1	-	1	-	-	-	-	-	-	-	-	-
FLOOD PLAINS	2	2	3	1	2	2	3	3	2	-	3	3	3	-	2	3	1	2	3	3	3	-
WILDLIFE MANAGEMENT	2	3	1	2	3	3	3	3	1	2	3	3	2	2	3	3	2	2	2	2	1	2
AESTHETIC & CULTURAL	2	-	-	2	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
OUTDOOR RECREATION	2	-	-	2	2	2	2	-	-	2	3	3	3	-	2	-	-	2	2	-	-	2

Legend: 3 Severe--Demands immediate attention
2 Moderate--Of major concern;potentially serious
1 Minor--Not considered a serious problem
- Problem insignificant or not known

TABLE 1-131 (continued)

LAKE ERIE BASIN 4.0																
NW RBG 4.1				Southwest River Basin Group 4.2												
Raisin River Basin					Maumee River Basin				Toussaint-Portage C.				Sandusky River Basin			
Overall	Urban	Rural	Interface	Overall	Overall	Urban	Rural	Interface	Overall	Urban	Rural	Interface	Overall	Urban	Rural	Interface
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	1	1	1	-	-	-	-	-	-	-	-	-	-
-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	1	1	-	1	-	-	-	-	-	1	-	1	-
-	-	-	-	1	1	-	1	2	1	-	1	-	1	-	1	-
-	-	-	1	1	-	-	-	-	1	-	-	2	-	-	-	-
3	3	2	3	3	3	3	3	3	3	3	2	2	3	3	2	3
1	-	2	-	3	3	1	3	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	2	2	1	2	1	1	2	-	-	2	2	-	2	2
1	-	1	3	2	2	-	2	2	2	-	2	-	2	-	2	2
1	-	-	1	2	2	-	-	2	2	-	-	2	2	-	-	2
-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-
1	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-
2	3	2	2	-	-	-	-	-	-	-	-	-	-	-	-	-
1	-	1	-	2	2	-	2	-	-	-	-	-	2	-	2	-
1	1	2	-	3	3	3	3	-	2	2	2	1	2	2	2	-
-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2	-	2	2	1	1	-	1	-	-	-	-	-	1	-	1	-
3	2	3	3	3	3	3	3	3	3	1	3	1	3	3	3	1
2	2	3	2	3	3	3	3	2	3	3	2	2	3	3	1	2
3	-	1	3	1	1	-	1	-	2	-	-	2	1	-	1	-
-	-	-	-	2	1	-	1	1	2	-	-	2	2	-	-	2

LAKE ERIE BASIN 4.0																
C RBG 4.3				East River Basin Group 4.4												
Ashtabula - Conneaut C.					Erie-Chau-tauqua C.				Cattaraugus Creek				Tonawanda-Buffalo C.			
Overall	Urban	Rural	Interface	Overall	Overall	Urban	Rural	Interface	Overall	Urban	Rural	Interface	Overall	Urban	Rural	Interface
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	1	-	-	1	-	-	-	1	-	-	-	1	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1	-	1	1	1	1	-	1	1	1	-	1	1	1	-	1	1
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1	2	1	-	3	2	3	1	2	2	3	1	2	2	3	2	3
1	2	-	-	1	-	-	-	-	-	-	-	-	2	2	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2	-	-	2	1	1	2	1	2	2	2	1	1	2	3	1	2
2	-	-	2	1	1	2	1	1	1	2	1	2	2	3	1	2
-	-	-	-	1	-	-	1	2	-	-	1	2	-	-	1	2
-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	1	1	1	-	-	1	1	-	-	2	2	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2	-	2	-	1	1	-	1	-	1	-	1	-	1	-	1	-
1	1	1	-	1	2	2	1	-	1	1	1	-	1	2	1	-
-	-	-	-	1	-	-	-	-	1	-	1	-	1	-	1	-
-	-	-	-	-	2	-	-	2	-	-	-	-	-	-	-	-
-	-	-	-	2	-	-	-	-	-	-	-	-	2	-	2	-
2	1	2	-	2	1	1	1	1	2	3	2	1	3	3	2	1
2	2	1	1	1	1	3	1	3	1	1	1	2	3	3	1	3
-	-	-	-	2	1	2	1	2	1	1	1	1	2	3	2	1
2	-	-	2	1	1	2	1	2	2	2	1	1	2	3	1	2

quate water supplies for withdrawal functions. However, quality problems inhibit some uses and there are local areas with short supplies. The approximate average withdrawal requirement in 1970 was 14,700 mgd, of which 60 percent was for thermal power cooling.

In 1970, 10,031,100 persons were served by central water systems. Of these, 8,151,600 were served by Great Lakes sources; 1,165,500 were served by inland lakes and streams; and 713,900 were served by ground-water sources. The municipal water supply sources and development are summarized in Tables 1–132 and 1–133.

Heavy water uses occur in areas of major population concentrations, namely Planning Subareas 4.1 and 4.3. Purification treatment is generally required of all surface water supplies, while ground-water supplies are disinfected and often receive some type of corrective treatment such as softening or iron removal.

In 1967 the Lake Erie region accounted for about 50 percent of the total value added by manufacture for the entire Great Lakes Basin. It also used approximately 40 percent of the total manufacturing water withdrawals. This included nearly one-third of the water withdrawn by municipal systems. Additional self-supplied withdrawals are shown in Table 1–134. It is estimated that more than 95 percent of the water self-supplied by manufacturers is taken from surface water supplies, with the Great Lakes or their connecting waterways the primary sources. The remainder, about 180 mgd, is obtained from company-owned wells.

Inland lakes and streams and ground water are the primary sources of rural domestic and livestock water supplies. Rural water supply information for 1970 appears in Table 1–135.

Nearly three times as much water was used to irrigate golf courses as was used to irrigate the region's high-value crops, although the golf course acreage was slightly less (Table 1–136). High-value crops, grown primarily in River Basin Group 4.1, include potatoes, vegetables, fruits, and sod. Inland lakes and streams and ground water were the principal sources of supply for irrigation uses.

Inland lakes and ground water are major water sources for the mineral industry in the Lake Erie basin (Table 1–137). Some parts of the industry operate on a year-round schedule. However, the principal water users in the mineral industry operate seasonally, usually from April to November (Table 1–138).

In 1970 electric power generation within the Lake Erie basin came essentially from 56 thermal electric plants over 10 MW in size. There are no hydroelectric power plants over 10 MW capacity in the basin. All but 15 of the 56 installed power plants

TABLE 1–132 Municipal Water Supply Development, Lake Erie Plan Area (mgd)

		1970 Average Demand			
PSA	State	Domestic and Commercial	Municipally Supplied Industrial	Total	Source Capacity
4.1	Michigan	474	265	739	1,295
4.2	Indiana	20	9	29	69
	Ohio	113	44	157	373
4.3	Ohio	374	143	517	800
4.4	Pennsylvania	55	10	65	78
	New York	177	95	272	413
TOTAL	---	1,213	566	1,779	3,028

TABLE 1–133 Water Sources for Municipal Water Supply, Lake Erie Plan Area, 1970 (mgd)

			Water Source		
PSA	State	Source Capacity	Great Lakes	Inland Lakes and Streams	Groundwater
4.1	Michigan	1,295	1,200	30	65
4.2	Indiana	69	---	48	21
	Ohio	373	197	128	48
4.3	Ohio	800	689	80	31
4.4	Pennsylvania	78	70	3	5
	New York	413	352	23	38
TOTAL	---	3,028	2,508	312	208

TABLE 1–134 Industrial Water Supply Development, Lake Erie Plan Area, 1970 (mgd)

			Self-Supplied	
PSA	State	Gross Water Requirements[1]	Withdrawals	Consumptive Use
4.1	Michigan	2,633	1,297	135
4.2	Indiana	1,194[2]	19	2
	Ohio		299	34
4.3	Ohio	2,786	1,306	85
4.4	Pennsylvania	2,342[2]	35	3
	New York		911	79
TOTAL		8,955	3,867	338

[1]Partially supplied by recirculation

[2]Figure is total for PSA

TABLE 1–135 Rural Water Supply, Lake Erie Plan Area, 1970 (mgd)

PSA	State	Developed Source Capacity	Consumptive Use
4.1	Michigan	49	12
4.2	Indiana	6	2
	Ohio	36	13
4.3	Ohio	25	6
4.4	Pennsylvania	3	1
	New York	14	5
TOTAL		133	39

TABLE 1-136 Irrigation Water Supply, Lake Erie Plan Area, Base Year, estimated

	Agriculture			Golf Courses		
		Withdrawal (mgd)			Withdrawal (mgd)	
PSA	Acres	100-Day Season	Annual	Acres	100-Day Season	Annual
4.1	23,437	37.4	10.3	2,200	12.6	3.5
4.2	4,969	8.6	2.4	12,620	60.4	16.5
4.3	4,935	7.8	2.1	18,600	89.2	24.4
4.4	5,220	9.0	2.4	2,400	11.5	3.2
TOTAL	38,561	62.8	17.2	35,820	173.7	47.6

TABLE 1-137 Source of New Water Used by Mineral Industries, 1968, estimated (mgd)

New Intake	April-November	Average for 365 Days
Streams	16.3	12.5
Lakes	49.2	34.2
Ground Water	34.1	30.2
Mines	13.4	9.8
Other	2.1	1.9
TOTAL	115.1	88.6

TABLE 1-138 Minerals Water Supply, Lake Erie Plan Area, 1968, estimated (mgd)

		New Water Intake		
PSA	Total Water Requirements[1]	Seasonal	Annual Average	Consumptive Use[2]
4.1	104.1	59.6	41.5	1.0
4.2	29.4	22.1	20.3	0.9
4.3	32.3	24.3	20.7	9.7
4.4	11.0	9.1	6.1	0.2
TOTAL	176.8	115.1	88.6	11.8

[1]New water intake plus recirculated water (seasonal)

[2]Annual average

and all but one of the five plants scheduled as of 1970 are privately owned. They vary in type and capacity (Table 1-139). Net power generation in the basin exceeded 61 billion KWh of electricity in 1970.

Condenser cooling systems operating in 1970 were of the flow-through type. Most of the large power sites are located on the Great Lakes or connecting channels.

9.1.5.2 Nonwithdrawal Water Uses

For study purposes this category includes municipal and industrial wastewater discharges as well as nonwithdrawal uses of water. Although significant consumptive uses of water are not associated with these functions, demands are imposed upon the water resource.

The water quality situation was discussed in Subsection 9.1.4. Waste discharges in the Indiana, Michigan, New York, and Pennsylvania portions of the basin are given in Table 1-140. Sport fishery use is shown in Table 1-141.

Lake St. Clair is heavily used for recreational boating as are parts of Lake Erie and the connecting channels and inland lakes and streams. Degraded water quality inhibits some use. The pertinent information on boating is in Table 1-142.

There are 16 Federal harbors and one private commercial harbor on Lake Erie. Total traffic handled, both shipments and receipts, is nearly 160 million tons annually.

9.1.5.3 Related Land Uses and Problems

Over 50 percent of the land area of the basin is cropland. Pasture and other land add an additional 10 percent to the agricultural resource base. Nearly 20 percent is forest land.

Table 1-143 lists the agricultural land treatment opportunities by planning subareas in the Lake Erie basin.

About 3,857,000 acres, or 37.6 percent of all agricultural land in the basin, is now receiving adequate conservation land treatment and management.

Conservation measures applied to agricultural lands in the Lake Erie basin have been accomplished by local soil and water conservation districts with technical assistance from the Soil Conservation Service.

The Lake Erie basin has nearly 50 percent of the drainage problem acres reported for the entire Great Lakes Basin. An analysis of the soil conditions in the Lake Erie basin indicates that over 1.3 million acres of crop and pasture land have a severe

TABLE 1–139 Electric Power Development, Lake Erie Plan Area

PSA	Type and Capacity (MW) Gas Turbine	Internal Combustion	Nuclear Steam	Fossil Steam	Total	Steam Electric Water Withdrawals (mgd)
4.1	401	76	70	6,013	6,560	3,850
4.2	116	18	--	1,148	1,282	892
4.3	53	21	--	3,345	3,419	2,548
4.4	---	5	--	1,575	1,580	1,470
TOTAL	570	120	70	12,081	12,841	8,760

TABLE 1–140 Municipal and Industrial Wastewater Flows, Lake Erie Plan Area, 1970

PSA	State	mgd Municipal	Industrial
4.1	Michigan	897	746
4.2	Indiana	37	4
	Ohio	N/A	N/A
4.3	Ohio	N/A	N/A
4.4	New York	202	920
	Pennsylvania	46	147
TOTAL	---	N/A	N/A

N/A - Not available

problem with no drainage improvement installed, and that 2.5 million acres have a drainage problem although some improvements have been installed (Table 1–144). These installations have not been maintained and do not provide the needed drainage. Planning Subarea 4.2 has the most serious drainage problem area in the region with over 2.4 million acres inadequately drained at present.

Drainage limitations also portend limitations on urban growth. Portions of six SMSAs in the Lake Erie basin, which are not presently in an urban built-up category, have wet soils that will create problems for future development. They will need internal and supplementary drainage in order to be developed for urban purposes.

Toledo, Ohio; Fort Wayne, Indiana; and Lima, Ohio, each have wet soil conditions on more than 80 percent of the nonurban land. Metropolitan areas which have a wetness problem in 50 to 80 percent of the soil include Cleveland-Lorain-Elyria, Ohio; Erie, Pennsylvania; and Buffalo, New York. Projected demands for urban development indicate shortages in available land base by 2020 in the Detroit metropolitan area. Large areas of development, particularly in the Detroit-Ann Arbor, Toledo, Ft. Wayne, and Cleveland-Lorain-Elyria areas, will take place on soils with poor drainage. This indicates an urgent need for zoning and proper land use planning.

Table 1–40 shows ownership and use of Lake Erie shoreland. Table 1–145 contains information on shoreline areas in the basin which are subject to erosion and flooding. Streambank erosion is severe in many of the tributaries in the Lake Erie basin, as

TABLE 1–141 Sport Fishery Uses, Lake Erie Plan Area, 1970

PSA	State	Ponded Waters (acres)	Fishing Licenses Resident	Non-Resident	Angler Days (1000)
4.1	Michigan	49,500	200,000	8,400	4,000
4.2	Indiana	700	35,000	1,100	100
	Ohio	40,700	155,000	7,700	9,800
4.3	Ohio	17,900	181,000	2,000	9,330
4.4	Pennsylvania	700	17,000	1,100	1,060
	New York	700	95,000	6,800	3,560
TOTAL	---	110,200	683,000	27,100	27,850

TABLE 1–142 Recreational Boating Development, Lake Erie Plan Area, 1969

PSA	State	Lake Erie Harbors	Access Sites[3]	Total No. of Boats	Total Boat Days in Use
4.1	Michigan	14[1]	90	118,000	3,447,000
4.2	Indiana	0	19	10,900	325,500
	Ohio	12		32,800	976,500
4.3	Ohio	15	10	24,800	699,000
4.4	Pennsylvania	5	0	1,500	44,000
	New York	9[2]	10	20,800	613,000
TOTAL	---	55	129	208,800	6,105,000

[1]Includes Lake Erie, St. Clair River, Lake St. Clair, and Detroit River harbors

[2]Includes Niagara River above Niagara Falls

[3]May include both inland lakes and streams

TABLE 1–143 Agricultural Land Treatment Needs, Lake Erie Plan Area, 1970 (thousands of acres)

PSA	Cropland	Pasture Land	Other Land	Total
4.1	1,173.5	86.2	45.4	1,305.1
4.2	3,653.6	120.5	46.4	3,820.5
4.3	494.4	84.2	121.5	700.1
4.4	383.1	144.9	23.9	551.9
TOTAL	5,704.6	435.8	237.2	6,377.6

TABLE 1–144 Drainage Limitations in the Lake Erie Plan Area (thousands of acres)

PSA	Total Land Area	Agricultural Land	Drainage Problems Severe	Drainage Problems Some
4.1	3,980.4	2,328	316	428
4.2	6,319.5	4,949	756	1,665
4.3	2,308.6	873	113	205
4.4	3,069.9	1,111	137	204
TOTAL	15,678.4	9,261	1,322	2,502

indicated in Table 1–146. Particularly critical are the large sediment deposits in Maumee Bay and at the mouth of the Cuyahoga River. These deposits are expensive to remove and they limit many other water resource uses, including commercial navigation, fishing, and recreation.

Table 1–147 summarizes the urban and rural acreage subject to flooding and average annual urban and rural damages as of 1970, by States and river basin groups.

There are 11 locations in the basin where levees, floodwalls, or channel improvements have been installed for flood control purposes, and 26 places where institutional measures are in effect. In three areas, one of which covers several small stream basins, land treatment measures have been used.

Table 1–148 shows the wildlife habitat in the Lake Erie basin. Wildlife habitat is about 80 percent of the total land, and about 40 percent of this is considered huntable. The same area is probably also used for bird-watching, photography, and related activities. In view of the population of the area, this is an inadequate amount of habitat to maintain wildlife populations and to provide a good hunting experience. The population increase and changes in farming practices are expected to further deplete the habitat area over the next 50 years. The Lake Erie basin provides nesting, migration, and wintering areas for waterfowl as shown in Figure 1–39. Poor water quality has reduced the capacity of the area to support waterfowl in recent years by reducing the food supply.

In an inventory of outstanding unusual, and significant aesthetic and cultural values in the Lake Erie basin, over 500 items in 24 categories were recorded.

Environmental systems of the Lake Erie basin in most critical need of planning attention are buffer zones, linkage corridors, shore zones, and resource clusters.

The principal problems related to outdoor recreation in the Lake Erie basin are the result of the

TABLE 1–145 Lake Erie Shoreline Conditions, 1970 (miles)

PSA	State	Total Shoreline	Subject to Erosion: Critical	Subject to Erosion: Noncritical	Subject to Erosion: Protected	Subject to Flooding	No Problem
4.1	Michigan	32.5	0	0	0	32.5	0
	Total	32.5	0	0	0	32.5	0
4.2	Ohio	85.5	0	28.0	38.4	10.8	8.3
	Total	85.5	0	28.0	38.4	10.8	8.3
4.3	Ohio	104.8	14.3	9.9	67.2	0	13.4
	Pennsylvania	4.0	0	4.0	0	0	0
	Total	108.8	14.3	13.9	67.2	0	13.4
4.4	Pennsylvania	44.3	6.0	32.0	6.3	0	0
	New York	70.9	0	10.6	12.8	0.7	46.8
	Total	115.2	6.0	42.6	19.1	0.7	46.8
TOTAL	---	342.0	20.3	84.5	124.7	44.0	68.5

TABLE 1–146 Streambank Erosion in the Lake Erie Basin, 1970

PSA	State	Bank Miles of Damage: Severe	Bank Miles of Damage: Moderate	Annual Damages ($): Land Loss	Annual Damages ($): Sedimentation	Annual Damages ($): Other	Annual Damages ($): Total
4.1	Michigan	324	563	35,800	9,700	16,200	61,700
4.2	Indiana	0	0	0	0	0	0
	Ohio	106	782	33,400	78,400	5,400	117,200
4.3	Ohio	79	247	19,300	319,700	2,300	338,600
	Pennsylvania	1	29	100	300	0	400
4.4	Pennsylvania	2	151	400	1,000	0	1,400
	New York	70	140	23,600	11,700	21,300	56,600
TOTAL	---	582	1,912	112,600	420,800	45,200	575,900

TABLE 1–147 Estimated Flood Damages, Lake Erie Basin, 1970

RBG	State	Estimated Average Annual Damages ($): Urban	Estimated Average Annual Damages ($): Rural	Estimated Acres in Flood Plain: Urban	Estimated Acres in Flood Plain: Rural
4.1	Michigan	23,953,050	2,104,030	57,870	206,400
4.2	Michigan	---	20,100	---	5,893
	Ohio	2,687,820	4,452,500	14,788	331,255
	Indiana	1,821,000	135,050	11,702	34,014
4.3	Ohio	1,218,400	594,500	14,286	57,909
	Pennsylvania	3,000	29,000	70	6,050
4.4	Pennsylvania	6,500	7,700	333	1,990
	New York	921,600	397,700	21,514	91,605
TOTAL		30,611,370	7,740,580	120,563	735,116

TABLE 1–148 Wildlife Habitat in the Lake Erie Plan Area, 1960

PSA	State	Total Land Area (acres)	Farm Habitat Acres	Farm Habitat % of Total Land	Forest Habitat Acres	Forest Habitat % of Total Land	Total Habitat (acres)
4.1	Michigan	3,980,400	2,502,000	63	454,000	11	2,956,000
4.2	Ohio	6,319,400	5,205,000	82	573,000	9	5,778,000
4.3	Ohio	2,308,600	1,150,000	50	517,000	22	1,667,000
4.4	Pennsylvania	519,100	282,000	54	124,000	24	406,000
	New York	2,550,800	1,192,000	47	857,000	34	2,049,000
TOTAL	---	15,678,300	10,331,000	66	2,525,000	16	12,856,000

NOTE: The area of the land resource base, made up of the farmland and forest land, and reported elsewhere, is based on 1966-1967 measurements and estimates. Habitat is based on 1960 information and estimates. In some instances changes in land use result in habitat being recorded as greater than the corresponding land base in the PSA or State.

TABLE 1–149 Land and Water Surface Usable for Recreation in the Lake Erie Plan Area, 1970 (thousands of acres)

PSA	Land	Lake Erie	Inland Lakes	Total
4.1	68.1	151.0	40.0	259.1
4.2	24.0	59.0	26.0	109.0
4.3	33.7	69.0	15.0	117.7
4.4	146.5	96.0	1.0	243.5
TOTAL	272.3	375.0	82.0	729.3

high population densities. It is likely to be impossible to provide adequate land, particularly near the urban areas, to meet the minimum standards generally accepted for recreational purposes. Some of the natural areas, particularly forests in the Maumee basin, are so fragile that to use them heavily would destroy their value. The numbers of people living in the basin and the industries which have developed have contributed to the pollution of Lake Erie to such an extent that many of the beaches which should be available for recreation are closed. There is adequate water on the Lake for recreational boating, but because of limited access, infrequent harbors-of-refuge, and inadequate communications, not all of the water surface can be utilized. Some of these matters can be taken care of by prudent investment. The western part of the Lake Erie shore is largely marsh. Thus it is not useful for many types of recreation, but it provides wildlife habitat. This use, however, is limited because so much of the marsh has been filled in for industrial purposes.

The general suitability of water and land for water-oriented outdoor recreation was described in Subsection 9.1.3. Table 1–149 gives the amount of water and land surface usable for recreation in the Lake Erie basin. Table 1–150 gives information on the Lake Erie beaches.

9.2 Frameworks for River Basin Group 4.1

9.2.1 Summary

The most severe problems in River Basin Group 4.1 are presently poor water quality resulting from municipal and industrial waste discharges, high levels of flood damages and areas subject to flood-

TABLE 1–150 Amount, Ownership, and Recreational Potential of Great Lakes Beaches, Lake Erie Plan Area (acres)

PSA	Publicly Owned Beaches: Usable: Open to Public	Publicly Owned Beaches: Usable: Restricted	Publicly Owned Beaches: Not Usable	Privately Owned Beaches: Open to Public: With Charge	Privately Owned Beaches: Open to Public: Without Charge	Privately Owned Beaches: Not Open to Public: Potential for Development	Privately Owned Beaches: Not Open to Public: Little/No Potential	Total
4.1	142.7	0	13.6	6.8	7.7	111.9	146.0	428.7
4.2	22.8	0	0	54.7	3.6	77.9	64.7	223.7
4.3	162.6	8.2	15.0	.7	4.8	8.9	46.9	247.1
4.4	216.1	21.6	12.2	21.2	40.7	42.6	63.7	418.0
TOTAL	544.2	29.8	40.8	83.3	56.8	241.3	321.3	1,317.5
%	41.3	2.3	3.1	6.3	4.3	18.3	24.4	

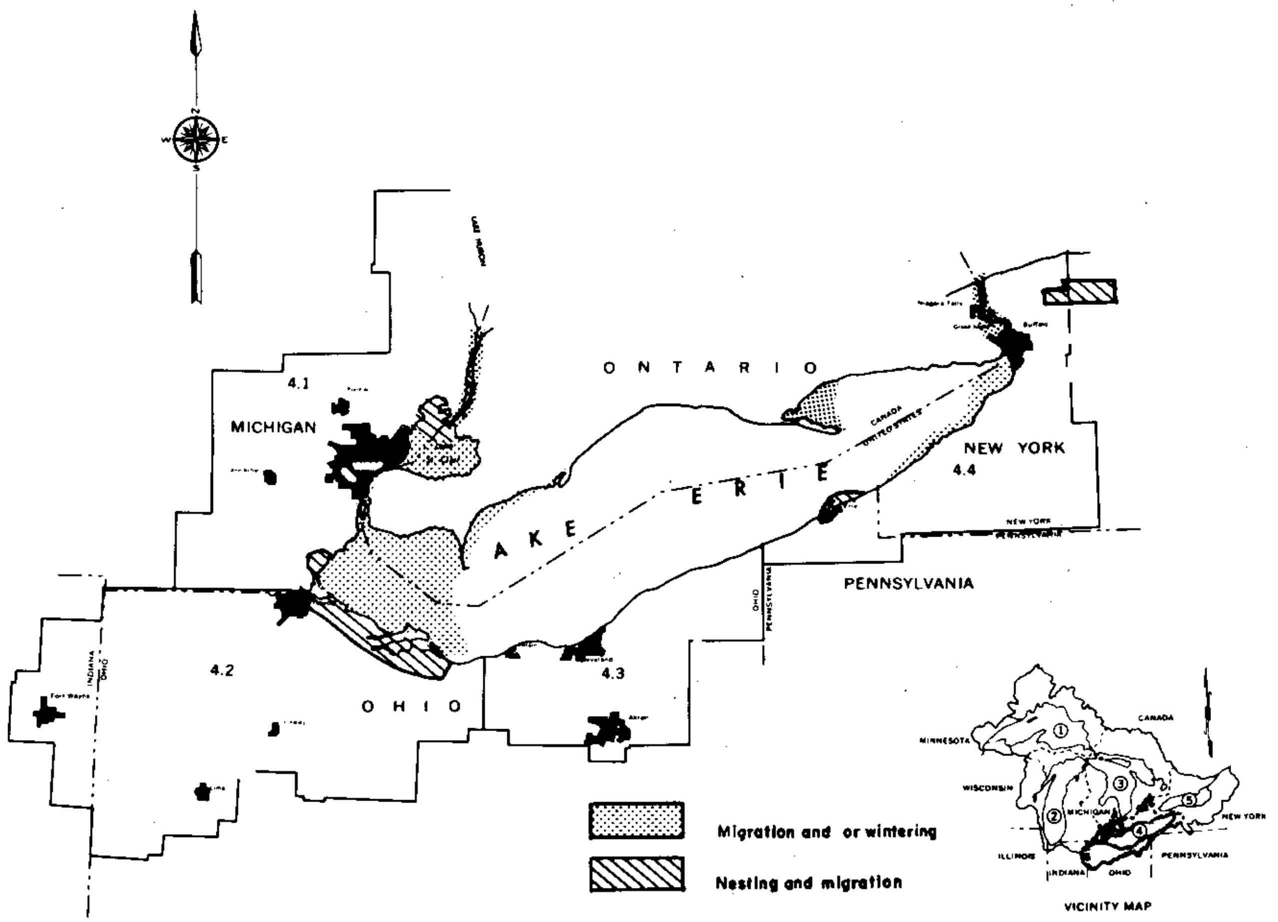

FIGURE 1–39 Primary Waterfowl Use Area, Plan Area 4

ing, and a shrinking wildlife habitat base. Overshadowing these problems is the fact that this is one of the most rapidly urbanizing areas in the entire Great Lakes Basin. This places considerable demand on the water and related land resources for all purposes. Many of the purposes conflict with each other: for example, recreational development versus wildlife protection along the Lake Erie shoreline. The subobjective and criteria for water withdrawals stipulate tat least-cost sources be selected. Normal growth in the area would include mineral production at any location where such resources have been identified. The extent of rural water withdrawals and irrigation water withdrawals in the future will depend on the policy with respect to land use in this area. It is assumed in the Normal Framework that the availability of water and related land resources will not be a constraint on achieving the normal growth level and normal economic expansion in this area. In the formulation of the Normal Framework it has been assumed that the existing dependence on the Great Lakes for water supply would continue in the future. Ground water would also be used where it is available in adequate quantity and quality, and there would be some minor withdrawals from inland lakes and streams. However, these are expected to increase for irrigation in the latter time periods.

With respect to nonwithdrawal water uses, the Normal Framework is designed to meet the existing water quality standards and precludes degradation of higher levels of water quality that exist at the present time. The framework has not been able to satisfy all of the recreation-day needs in this area. Of the total agricultural and forest land with opportunity for treatment, only a small portion has been programed for treatment in the formulation of the Normal Framework. It is not believed to be in the overall interest of national economic development to program higher levels of land treatment. This same judgment has also been made with respect to rectifying streambank erosion problems and to eliminating urban and rural flood damages. A high level of flood plain management will be necessary, including continued regulation of development in the flood plain, if damages are to be prevented in the future. Although there is opportunity for a substantial program of wildlife habitat acquisition and development, the framework does not anticipate satisfying all of the wildlife acreage needs. This is due primarily to lack of funds and other land uses that yield more monetary return. The framework has selected for acquisition and preservation only the aesthetic and cultural resources whose acquisition and preservation is expected to have a net gain of beneficial effects over adverse effects.

Section 12 contains Table 1-286 which lists the needs, outputs, and percent of needs met for the Normal Framework for River Basin Group 4.1; Tables 1-287 and 1-288 list the capital costs and operation, maintenance, and replacement costs.

9.2.2 The Area

All of the population in this area lies within the State of Michigan, although the headwaters of one stream lie a very short distance across the Ohio border. Population, per capita income, and employment are discussed in Section 1. The study area is located at the west end of Lake Erie and includes the area draining to the St. Clair River, Lake St. Clair, and the Detroit River. It drains 5,200 square miles, almost all in Michigan, about 4.4 percent of the land area of the Great Lakes Region and 24 percent of the Lake Erie basin. Figure 1-40 shows the areal extent of River Basin Group 4.1.

9.2.3 Projected Resource Needs and Problems

Future demands upon the resources, or requirements, were projected in Section 3. The projected needs for resource use by time level are shown in Section 12 in Table 1-286. Where needs can be quantified, they are not discussed in the text unless special conditions warrant such discussion.

9.2.3.1 Water Withdrawals

The total water withdrawal needs to 2020 are estimated at about 5,200 mgd above the base year withdrawals of 6,000 mgd. About 50 percent of the additional water withdrawal need is for thermal power cooling, with municipal water supply and self-supplied industrial withdrawals comprising about 20 percent each, and the balance split among rural domestic and livestock, irrigation, and mining needs.

Water withdrawal problems are relatively minor in this river basin group. Perhaps the greatest difficulty is associated with the financing of large regional water supply systems.

9.2.3.2 Nonwithdrawal Water Uses

In 1970 a total of 897 mgd of domestic, commercial, and industrial wastewater was treated in municipal facilities. This amount is projected to increase only slightly by 1980, and by nearly 75 percent by 2020. Industrial wastewater which was treated in industry-owned treatment facilities amounted to 746 mgd. This is expected to decrease in the future due to more in-plant recirculation and greater reliance on municipal treatment plants.

Between 1970 and 1980, twelve locations in the river basin group are expected to require advanced waste treatment facilities in order to meet water quality standards. An additional three locations are expected to add advanced treatment between 1980 and 2000, and an additional 2 locations between 2000 and 2020.

Existing water quality problems are severe in this river basin group, particularly in the Clinton River, Rouge River, Huron River, and Raisin River basins. Other areas of severe water degradation include the Detroit River where it enters Lake Erie, and the mouth of the Raisin River where it enters Lake Erie. Poor water quality results from nutrient discharges, agricultural wastes, some raw sewage overflow discharge from combined sewers, and primary and secondary treatment plant effluent in streams whose flow is inadequate to assimilate such wastes. Corrective programs are under way to upgrade water quality throughout RBG 4.1.

This highly urbanized river basin group is in the process of planning regional interceptors and waste treatment plants. Disagreements among local governments, regional planning agencies, and the State of Michigan with respect to whether certain municipalities should be forced to participate in regional systems has delayed construction. The 1972 Water Quality Agreement between the United States and Canada calls for a higher level of water quality to be achieved in Lake Erie at an earlier date than had previously been expected. The full ramifications of the agreement are not yet clear.

Implementation of construction programs to meet water quality standards has been hampered by the failure of the Federal government to meet its commitments to share in the cost of the construction of these plants. The State of Michigan has had to underwrite the Federal share. It is also difficult to provide facilities to reduce or eliminate combined sewage overflow and polluted storm water.

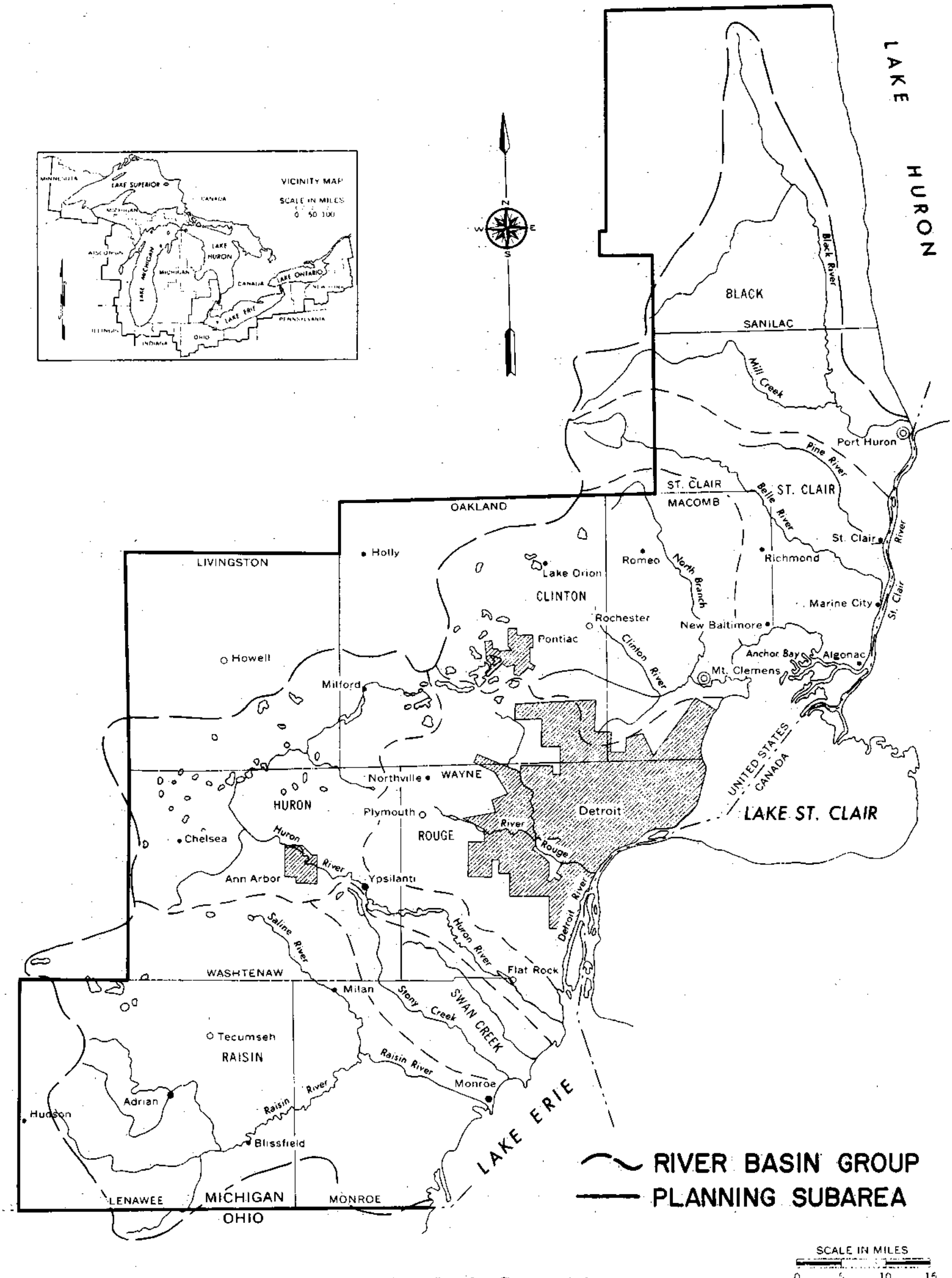

FIGURE 1–40 Lake Erie Northwest, River Basin Group 4.1

Throughout the entire river basin group there is a need to implement programs for the reduction of agricultural wastes, nutrients, sediments, insecticides, and herbicides.

The projected sport fishery needs are based on a transfer to other portions of the Great Lakes Basin of considerable demand originating in the planning subarea both now and in the future.

One of the most significant problems in this area affecting sport fishing has resulted from filling of shore marshes to create building sites. This practice has significantly reduced the available spawning areas, particularly for northern pike. Poor water quality due to industrial and municipal pollution has degraded many of the rivers and impoundments to the point where rough fish such as carp are all that remain. Portions of the Raisin River, Rouge River, and Willow Creek have water quality designations now which will not allow enhancement of the fishery in the near future.

An associated institutional problem is that about 60 of the existing reservoirs in River Basin Group 4.1 offer the best potential for intensive fish management, but they are not generally available because they are owned and operated by local units of government. There is a need to develop cooperative management plans with these units of government.

The 1970 use of and projected needs for recreational boating are divided between Great Lakes waters and inland waters as shown in Table 1–151. In addition to planning for the satisfaction of the boating day needs, it is also necessary to plan berthing facilities and launching sites.

One of the main problems in this area is that existing inland waters are overused at the present time for recreational boating. An additional problem is that land at many of the remaining 36 reservoir sites that have boating opportunities is being bought up and used for other purposes. The lack of stream improvements, lack of maintenance, and periodic low flows limit the amount of canoeing and small boat opportunity on inland streams.

The future waterborne commerce expected to be handled at ports in River Basin Group 4.1 will increase sharply as shown in Section 12 in Table 1–286. The present ratio of receipts to shipments is greater than 25 to 1 and will likely continue.

9.2.3.3 Related Land Uses and Problems

Of the 2,555,000 acres of agricultural land consisting of cropland, pasture land, and other land, about 1,305,000 acres are such that conservation practices could be effectively applied to reduce soil losses and to conserve plant cover.

TABLE 1–151 Use and Projected Needs for Recreational Boating, PSA 4.1

	1000 Boating Days	
Category	Great Lakes Waters	Inland Waters
1970 Use	969	2,478
1980 Needs	780	150
2000 Needs	1,191	741
2020 Needs	1,695	1,455

The greatest problem associated with the conservation of agricultural lands is the increasing pressure to convert to other uses. In many cases these other land uses reduce the amount of cover on the land and increase the rate of erosion and the amount of sediment.

Production under present use is reduced or limited by excess water in the soil profile of about 74,400 acres. Drainage has both beneficial and adverse effects, and the selection of a drainage program depends not only on food and fiber to be produced, but also on the alternative uses of the lands having a wetness problem.

Much of the land expected to convert from nonurban to urban uses in the Detroit-Ann Arbor and Toledo areas is wet, and drainage will be necessary before such urban expansion can occur. Drainage systems are needed on 434,400 acres for removal of excess surface and internal water.

Maintenance of forest cover is needed for watershed protection, continuing production of timber products, recreation, fish and wildlife habitat, aesthetics, and combinations of these values.

About 16 percent of the total acreage in Planning Subarea 4.1, or 665,000 acres, is forested, and 244,000 of these acres receive adequate land treatment. There is an opportunity to program for forest land treatment on the remaining 421,000 acres in order to realize the values cited above. Some of the major problems in this area are how to secure good management for private forest lands and how to protect and establish trees and shrubs in areas surrounding urban and built-up areas.

There are no reaches of shoreline in RBG 4.1 subject to critical or noncritical erosion. There are some flooding problems which will be discussed below under Lake Erie intrarelationships. The major problem related to shore use is that a very small amount of the shoreline is available for public use. Transportation facilities, power plants, and other uses continue to decrease shoreline availability. There is considerable need and interest in shifting to wildlife uses of the shoreline and protecting it for the continuation of those uses, as well as providing for more public use.

Streambank erosion results in increased sedimentation in streams, and the resultant degraded water quality prevents other uses of the water. A major problem in alleviating streambank erosion is that the streambanks in many cases are private property, and owners either do not have the resources or do not have the willingness to correct the problems.

In this river basin group, the greatest flood damages occur in the urban areas (see Table 1-286 in Section 12). Ice jams are a major cause of stream overflows in the Port Huron area. In the Clinton River basin, the capacity of the Red Run Drain has been exceeded, and this has caused flooding problems in the basin. Structural improvements have been authorized, but have not yet been implemented. Problems in the Rouge River basin result from inadequate sewer and drainage ditch capacity and from low basements. The flooding of agricultural land in the Raisin River basin is complicated by poor land drainage.

About 50 percent of the demand for wildlife availability is for consumptive use, or hunting, and 50 percent is for nonconsumptive use, such as birdwatching, photography, etc. Quantities are shown in the table. One of the greatest problems in this area is the need to set aside and protect areas having considerable wildlife value as feeding grounds or appropriate habitat. In particular, marshes in the lower Detroit River need to be protected and preserved. Private development activity on Celeron Island and chemical pollutants coming from Detroit are serious threats to waterfowl habitat. The projected population levels over the next 50 years will seriously threaten wildlife opportunities in RBG 4.1. From the standpoint of preserving wildlife opportunities, optimum population levels have already been exceeded in the river basin group.

If all of the hunter-day needs are to be satisfied in this river basin group, acreage as shown in Table 1-286 in Section 12 will be needed. In this highly urbanized area, 25 percent of the total planning subarea acreage was suitable for hunting in 1970. By 2020 there is need for 53 percent of the total land area to be suitable for hunting. However the 1970 supply of huntable land is projected to decrease by 300,000 acres if present land use trends continue.

With respect to aesthetic and cultural values in this river basin group, the major problems are industrial and residential use of shoreline, which competes with the preservation of aesthetic values, the inadequacy of funds for land acquisition, and the need to preserve outstanding values.

Needs for recreation days, water surface, and land are given in Table 1-286 in Section 12. Meeting the needs is a problem because there are considerable pressures for other land uses with greater economic returns than recreational use. These needs are for a two-fold increase in the intensively developed recreation land and about a five-fold increase in land for other summer activities by 2020. The present proportion of available recreation land to population in this highly urbanized area is much lower than accepted standards.

In addition to pressures for other land uses, some of the more serious problems associated with satisfying recreational needs in this area are degraded water quality, lack of adequate funding, development in the flood plains which precludes recreational use, and competing uses for shorelines.

9.2.4 Alternative Frameworks

Two alternative frameworks are presented for this as for other river basin groups. The Normal Framework (NOR) does not reflect coordination of solutions to meet needs outside the RBG in the Lake basin or the Great Lakes Basin.

The second alternative, the Proposed Framework (PRO), contains the recommendations of the Commission in an effort to reflect the views of the people of the Basin and the policies and programs of the States. To some extent, it reflects coordination in the development of the framework among a number of river basin groups, both in the Lake basin and in the Great Lakes Basin as a whole.

9.2.4.1 Normal Framework (NOR)

The Normal Framework is based on meeting quantified needs and solving identified problems to the maximum practicable extent consistent with subobjectives and criteria discussed in Section 2 of the appendix. The program outputs and costs are summarized in Section 12 in Tables 1-286, 1-287, and 1-288.

(1) Water Withdrawals

There is adequate water to meet water withdrawal needs up to and beyond 2020 if additional capacity is developed to withdraw Great Lakes water. A program to develop such capacity has been selected to satisfy all of the needs for municipally supplied water, self-supplied industrial water, and water for thermal power cooling in River Basin Group 4.1. Water needs for rural domestic and livestock use and for mineral production are all expected to be satisfied by the development of ground-water sources which are adequate to do this. Irrigation needs, including golf courses irrigation, will be primarily satisfied by water from the

Great Lakes in the short-range period. In the middle- and long-range periods, there will be a shift to meet these needs with sources from inland water courses and from ground water.

Land use changes and process modification and recirculation would have considerable impact on the water withdrawal needs. The framework includes the initiation of a program to influence land use in this respect. Programs also are included to initiate research to bring about process modification and recirculation.

The Corps of Engineers is currently investigating the possibility of land disposal of wastewater or some combination of land and surface water disposal which would conceivably make a substantial quantity of relatively high-quality water available.

All of the power cooling needs are expected to be supplied with water from the Great Lakes. The power will be generated by thermal electric generating plants.

(2) Nonwithdrawal Water Uses

The Normal Framework includes the criterion that the 7 day-10 year low flow will be maintained to the maximum extent possible in the streams in the area. Treatment plants are expected to provide a high level of treatment.

Two programs in NOR would provide municipal waste treatment facilities and industrial waste treatment facilities.

NOR includes programs to meet water quality standards prior to the Federal Water Pollution Control Act Amendments of 1972. Specifically, they provide needed municipal waste treatment facilities to handle the quantities of waste discharges that are indicated as needs. In addition to the basic requirements of secondary treatment and 80 percent phosphorus removal throughout River Basin Group 4.1, there are a number of locations that will need advanced waste treatment by 1980, and additional locations in successive time periods. The cost of the advanced waste treatment is included in the investment costs. No data are available on the cost of industrial waste treatment in this area. Municipal facilities handle a substantial volume of the industrial wastewater.

NOR includes a recommendation for implementation of the regional waste treatment concept as endorsed by the Southeast Michigan Council of Governments and the Michigan Water Resources Commission.

The new warmwater fish hatchery for southern Michigan is expected to provide substantial fishing improvement in 25,000 acres of inland waters in RBG 4.1. A major portion of the stocking will occur as renovation projects on existing lakes and impoundments. It is projected that with each new acre of water brought under intensive management for warmwater species, 25 angler days are provided. On that basis, an additional 625,000 angler days will be provided in RBG 4.1 as a result of the warmwater hatchery and related renovation projects planned. About a third of the total capital costs of the new hatchery and appropriate operational costs have been allocated to this river basin group.

Other fishery management programs included in NOR provide for land acquisition for fisherman access and habitat protection on about 1,060 acres of inland water areas in Livingston County. This program, coupled with future additional stocking from the new warmwater hatchery, is estimated to satisfy all of the angler day needs in the river basin group. It should be emphasized that the Normal Framework at the present time does not have specific programs to provide for new access facilities on Lake St. Clair and in the urbanized areas of the basin, namely in Detroit adjacent to the Detroit River, and along portions of Lake Erie. Information on the potential and the corresponding costs of additional fishery opportunity development in these urbanized areas is not available.

The Normal Framework includes recreational boating programs in all of the time periods, but less than 10 percent of the needs are met. Boating on inland areas is already at a saturated level, and additional stream access is the only solution proposed.

Commercial fishing will be discussed under Subsection 9.6, dealing with Lake Erie intrarelationships.

There are no specific investments included in the Normal Framework for port development for commercial navigation.

(3) Related Land Use and Problems

The programed agricultural land treatment is essentially a continuation of ongoing programs at a level that has been followed in the past. Higher levels are not warranted under national economic development criteria.

Drainage of cropland will improve the productive capacity of these lands and thereby reduce the total land needed for food production. A properly managed program can benefit the farmers, aid water quality and wildlife, and reduce erosion. Health benefits will accrue as drainage reduces breeding places for mosquitoes and other insects. Drainage programs have been selected to include the on-farm drainage measures included in the land treatment needs at a current program rate of installation. The drainage measures include tiling and field ditching. Drainage improvement is also needed on urban development areas. The amount of such drainage or where it will be needed has not been determined except by standard metropolitan statistical areas.

The forest land treatment program will control erosion, provide wildlife habitat, and enhance environmental values. This program provides forest land treatment at a higher level than that pursued in the past or present. The higher level is believed to be justified by the desired results. By 2020 about 37 percent of the total forest land with an opportunity for treatment as of 1970 will have received that treatment if the Normal Framework is implemented.

No shoreland erosion program is included in the Normal Framework because there were no needs.

The streambank erosion program will provide treatment by 2020 of all the streambank mileage subject to severe erosion.

The resource most directly involved in reducing flood damages is people. Damages would be less if settlement patterns and land use patterns were substantially different from what they have been.

To substantially reduce flood damages in urban areas in River Basin Group 4.1, regulated use of flood plains is an essential feature of the framework. Institutional reduction measures are appropriate throughout almost all of the RBG in the areas adjacent to main stem streams and principal tributaries.

NOR includes channel modification to reduce damages in the Black River, Clinton River, and Rouge River basins, as well as in numerous upstream watersheds. Flood proofing is included to reduce damages in the Black, Pine, Belle, Rouge, Huron, and Raisin River basins. Modification of existing building use is included to reduce damages in the Rouge, Belle, Huron, and Raisin River basins on the main stem and principal tributaries.

The Normal Framework for wildlife management includes a continuation of ongoing budgeted programs by State agencies for habitat management, enforcement, and research. Additional programs are included for the following:

(a) upland game habitat acquisition
(b) wetlands acquisition
(c) wetlands development
(d) waterfowl museum and ecology training facilities
(e) waterfowl hunter training
(f) increasing the number of new conservation officers.

NOR provides that the following outstanding, unusual, and significant aesthetic and cultural values be acquired in the early action period and set aside for the benefit of future generations:

(a) all 18 of the waterfowl habitat sites in the area
(b) all 29 of the historical structures and places in the area
(c) wetlands included in the wildlife programs discussed above.

NOR programs for meeting a portion of the recreational needs between the present time and 1980 include additional development on existing recreation areas, acquisition and development of 40 miles of stream valleys, additional beach development in St. Clair and Sanilac Counties, and acquisition and development of two new regional parks of 2,000 acres each.

Between 1980 and 2000, the Normal Framework would satisfy a portion of the recreational needs with continued development on existing recreation lands, acquisition and development of an additional 50 miles of stream valleys, and two additional regional parks of 2,000 acres each.

Between 2000 and 2020 no additional public investment is anticipated to provide new recreational lands and opportunities. Additional private development will be encouraged in this time period.

In each of the time periods, existing public lands currently undeveloped should be developed more intensively while maintaining a setting as natural as possible. NOR also provides that on class II lands (general outdoor recreational areas subject to substantial development for a wide variety of specific recreational uses, and including unique natural areas), all existing publicly owned lands that consist largely of State and regional parks and forests should be developed to their optimum capacity to provide additional recreational opportunity.

NOR also provides for additional access sites in suitable places on Lake Erie, Lake St. Clair, and their tributary streams; the reclamation of polluted beach areas along the Lake Erie shore in and near Detroit and Toledo; and the acquisition and development of land, where future studies may indicate to be appropriate, for small impoundments and recreational facilities for golfing, skiing, camping, swimming, picnicking, and other recreational activities in which the private sector can function effectively.

The Normal Framework falls far short of satisfying the recreation day needs in this planning subarea. These needs will have to be satisfied elsewhere in the Great Lakes Basin.

(4) Framework Outputs and Costs

Section 12 contains Tables 1–286, 1–287, and 1–288 which provide information on needs, outputs, percent of needs met and capital and OM&R costs.

9.2.4.2 Proposed Framework (PRO)

PRO was formulated in consultation with State officials in order to reflect State policies and programs, as well as the desires of area residents.

State, regional, and local policies with respect to population and economic growth do not deviate greatly from the OBERS projections used in NOR.

A specific objective of PRO for RBG 4.1 is to improve the quality of life for the residents of the area. Improvements in the quality of life will be contingent upon such factors as the restoration of water quality, the expansion of recreational opportunities, the minimization of unemployment, and the enforcement of existing legislation at all governmental levels, supported by funding as necessary from Federal, State, and local governments for the conservation, use, and development of water and related land resources. Limitations on growth of both the population and the economy may well be necessary.

(1) Water Withdrawals

There are no significant differences between PRO and NOR with respect to water withdrawals. PRO does include a recommendation that Federal commitments for financing of municipal water projects be met in order that development can be kept on schedule. PRO encourages the consideration of environmental impact in the selection of a site for each individual thermal power plant, and encourages the use of a cooling system appropriate to the site. The tendency will be toward supplemental cooling.

(2) Nonwithdrawal Water Uses

The Proposed Framework recommends that there be a substantial expansion of water quality management programs. Requirements of the Federal Water Pollution Control Act Amendments of 1972 will be met. Such management programs should address themselves to the consistent enforcement of existing water quality legislation, but should also address problems such as the widespread use of salt for snow removal, the substantial amounts of pollution resulting from overuse of fertilizers and from other inadequate land conservation measures, and the need for retention of storm water in the southeastern Michigan area. The use of supplemental cooling will involve increases in consumptive use of water. The reduction of heated water discharges is considered by many persons to be of sufficient importance to warrant such an increase.

While a portion of the recreational boating needs will have to be met in areas outside PSA 4.1, PRO recommends improvements in the recreational boating potential at Sterling State Park, located on the Lake Erie shore.

Commercial navigation is of substantial importance to the regional economy. PRO endorses the concept that port expansion is necessary to keep the Great Lakes in a competitive position with respect to other regions of the United States. Improvement of Detroit harbor and extension of the navigation season are included. The program is further discussed in Subsection 9.6, Lake Erie Intrarelationships. PRO recommends that consideration be given to the on-land disposal of dredge spoil as opposed to disposal in diked areas or in swamps and wetlands.

(3) Related Land Uses

The Proposed Framework for RBG 4.1 includes a recommendation for the development of comprehensive land use plans. Such planning is being initiated by the State of Michigan at the present time. This effort is endorsed.

Both agricultural and forest land treatment programs are substantially greater in PRO than in NOR. The expansion of agricultural land treatment programs is essential in light of the large amount of sediment found in rivers in the southern portion of PSA 4.1. Much of this sediment load could be reduced through the implementation of adequate erosion control programs. With respect to shore areas PRO takes into consideration Michigan's 1973 study of critical erosion damage and flooding damages. No specific programs are provided, however. This evaluation increases the classification of severity of flooding over the estimates included in NOR. PRO recommends that all new uses of the shoreland areas (industrial, commercial, and residential) be required to be set back from the water. It also recommends consideration of the Detroit Master Plan as a comprehensive plan for the riverfront area of metropolitan Detroit.

Flood plain management is recommended instead of structural measures for the reduction of flood damages. Flood plain management should stress the recreational benefits to be gained from setting aside the flood plain lands. Management programs such as zoning, then, would have benefits not only in the reduction of direct flood damages, but also in the provision of much-needed recreational opportunity.

A specific recommendation of PRO for RBG 4.1 is the protection of the Pointe Mouillee marshes. The construction of protective works to prevent these marshes from being eroded and washed away is essential to preserve one of the few wildlife reserves in the area. The preservation of this wildlife habitat is a high priority item.

With respect to outdoor recreation, the establishment of a joint Michigan-Ohio commission to deal with improvements in recreational opportunities is an important item in PRO. The expansion of public investment for recreation in the time frame between the year 2000 and the year 2020 is recommended.

(4) Framework Outputs and Costs

Section 12 contains Tables 1–289, 1–290, and 1–291 which provide information on needs, outputs, and percent of needs met, and capital and OM&R costs for PRO indicating by italics where they differ from NOR. Table 1–336 compares land treatment programs.

9.2.4.3 NOR and PRO Framework Costs

Table 351 in Section 12 lists the total costs (capital plus OM&R) for NOR and PRO for the periods 1971–1980 and 1971–2020.

9.3 Frameworks for River Basin Group 4.2

9.3.1 Summary

The population in PSA 4.2 is expected to grow from 1,725,300 in 1970 to 3,116,100 in 1980, an 80 percent increase. Also projected is a 50 percent decrease in employment in agriculture, forestry and fisheries; a modest increase in mining employment; and a substantial increase in manufacturing and other employment, including services.

There are three major economic centers in this planning subarea: Toledo, Ohio; Fort Wayne, Indiana; and Lima, Ohio. In Toledo availability of water resources is not judged to be a constraint on economic growth. However, there are considerable difficulties in satisfying the recreational needs of the area. Improvement in water quality, more regulation of land use, and a substantial program of land acquisition for recreational development could render the Toledo area a more attractive place to live and thereby enhance its opportunities for growth.

In the Fort Wayne area availability of water resources is more likely to be a constraint on economic growth. About year 2000 Fort Wayne may have some difficulty in satisfying its municipal and industrial water supply needs. Lima, Ohio, is anticipated to have the water needed for economic growth; it has recently expanded its water supply facilities.

At the present time, in the major areas of population concentration in the planning subarea, poor water quality and the lack of recreation facilities are deemed to be major constraints on the overall social well-being of the people who live in the areas. In the next 30 to 50 years the lack of available water may also be a problem in some localities.

One of the major resource problems in this area is the future role of present agricultural land. Already there are conflicts developing between agricultural land use and the preservation of wildlife, aesthetic and cultural values, and recreational opportunities. PSA 4.2 is the most valuable and productive agricultural area in the Great Lakes Basin. If the recreation and wildlife needs are to be satisfied, there will have to be some shifting of land use from agricultural uses to recreational and wildlife uses.

Somewhat related is the major problem of erosion and sedimentation in this river basin group. The Maumee River is one of the major contributors of sediment to Lake Erie. Increased sedimentation has changed the ecology of Maumee Bay and has been a major factor in changing the ecology of the western basin of Lake Erie by covering fish spawning grounds. Since the sources of the sediment are spread throughout the entire river basin, this will be a difficult problem to overcome.

Much of the Maumee River in Ohio and the Maumee River and its tributaries between Fort Wayne and the Ohio-Indiana State line was considered for addition to the national wild, scenic, and recreational river system, but was not included, and part has been designated for these uses by the State of Ohio under its authority.

The Normal Framework includes those programs that would maximize national economic efficiency. This selection of programs whose benefits exceed costs by the greatest amount has been based on the best judgments that can presently be made, since benefits and costs have not been evaluated, except for a very generalized estimate of costs. Programs have been selected to put underemployed and unemployed resources in this river basin group into employment wherever possible. It was assumed, however, that the economy of the planning subarea would not differ from that forecast by the OBERS projections and reflected in the needs.

The Normal Framework is summarized in Section 12 in Table 1–292 which lists the needs for the framework, the output or levels of needs satisfied from the program selections, and the percentage of needs met. Tables 1–293 and 1–294 list capital costs and operation, maintenance, and replacement costs.

9.3.2 The Area

River Basin Group 4.2 covers portions of the States of Ohio, Indiana, and Michigan. However, the corresponding planning subarea includes parts of only Ohio and Indiana. Therefore, economic and demographic data for Michigan are not included in this section. Descriptive and statistical information is provided in Section 1 and Subsection 9.1. The study area is located at the southwest end of Lake Erie, as shown in Figure 1–41. Besides the Maumee River basin, RBG 4.2 includes the Toussaint-Portage complex, the Sandusky River basin, and the Huron-Vermilion complex. The area has a strong agricultural base and extensive navigation and port development at Toledo and Sandusky.

9.3.3 Projected Resource Needs and Problems

The projected needs for resource use by time

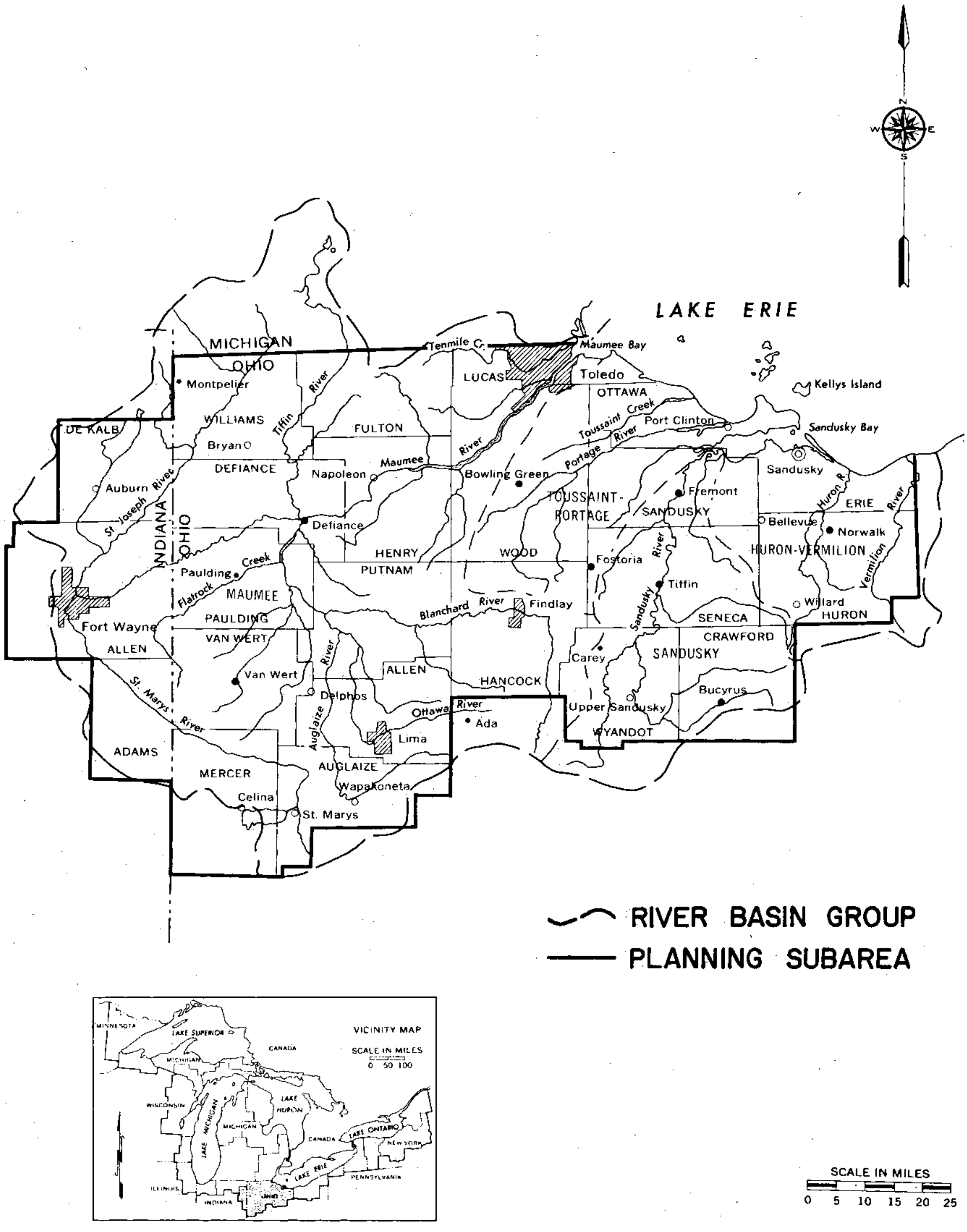

FIGURE 1–41 Lake Erie Southwest, River Basin Group 4.2

period are shown in Table 1–292 in Section 12. Where needs can be quantified, they are not discussed in the text unless special conditions warrant such discussion.

9.3.3.1 Water Withdrawals

The total withdrawals for RBG 4.2 as of 1970 are estimated at 1,500 mgd. By 2020, under the assumptions for the Normal Framework, this is expected to increase to over 9,500 mgd. Thermal power cooling accounts for about 90 percent of the additional water withdrawals needed between the present time and 2020.

Generally speaking, the availability of water to meet the water withdrawal needs is not a problem, with Lake Erie available as a source. However, because of the large need at Fort Wayne, Indiana, and its inland location, supplies here are expected to continue to come from reservoir storage. The self-supply of water by industry may be a problem because the ground-water resources are not of high quality throughout this entire area, and there is some pressure for industry to locate considerably inland in some of the moderate sized towns in the river basin group. The uneven distribution of good quality ground water and low flow of many streams in this river basin group are two of the major problems affecting water withdrawals. Funding of municipal water supply plants is also a difficult problem. Some taste and odor problems have occurred at municipal water supply intakes in Lake Erie and the river basin group.

9.3.3.2 Nonwithdrawal Water Uses

Of the 194 mgd of waste treated in municipal plants in RBG 4.2 during 1970, nearly 20 percent was in Indiana, the balance in Ohio. By 2020 the total will more than double, and the Indiana percentage will decrease somewhat.

Stream flows are too low to assimilate these wastes after primary treatment, and therefore advanced waste treatment is needed prior to 1980 throughout the Ohio portion of the river basin group and in areas of Indiana.

Industrially treated wastewater flows are projected to decrease until the year 2000 and then increase slightly, as shown in Table 1–292 in Section 12. Recycling of water within each plant, and increased reliance on municipal waste treatment systems affect these flows.

Some of the major problems associated with waste discharges are the difficulty of financing treatment plants, the need to reduce or eliminate combined sewage overflows, and the need to reduce sediment and nutrient loads.

TABLE 1–152 Use and Projected Needs for Recreational Boating, PSA 4.2

	1000 Boating Days	
Category	Great Lakes Waters	Inland Waters
1970 Use	498	804
1980 Needs	105	102
2000 Needs	231	243
2020 Needs	402	426

Some of the problems associated with providing sport fishing opportunities shown in Table 1–292 in Section 12 are the following:

(1) Impoundments in natural drainage ways are eutrophic in nature primarily because of intensive agricultural land management activities, and secondarily because of human wastes.

(2) Abandoned limestone quarries offer some potential, but it is difficult to maintain desirable fish population levels in them without maintenance stocking programs.

(3) Multiple recreational demands on certain inland impoundments reduce their utilization for fishing purposes.

(4) Water level fluctuations, especially during spawning seasons, have reduced species productivity in certain lakes.

(5) Excessive sedimentation at many impoundments has reduced their productive capacity.

(6) Water quality problems have degraded some streams, such as the Ottawa River between Lima and its mouth, sufficiently to preclude significant fish populations.

(7) Channel modifications, although producing some flood control and drainage benefits, have frequently not been maintained in such a way as to permit natural stream conditions that provide a desirable stream fishery habitat.

The main recreational boating problem in this river basin group is that inland waters are being used at about three times the desirable capacity while Great Lakes waters are being used at about one-third of desirable capacity. Needs are shown in Table 1–152. The use of the Great Lakes waters is limited by the number of suitable mooring places and the space between harbors. Facilities should be provided for disposing of vessel wastes.

Recreational boating is just one of the uses competing for the shoreline in this river basin group. This land use is not compatible with wildlife preservation, power plant use, and industrial and residential private use.

Commercial fishing needs and problems are discussed in Subsection 9.6, Lake Erie Intrarelationships.

Projected waterborne commerce is shown in Table 1–292 in Section 12. There is further discussion in Subsection 9.6. The problems related to port facilities will probably be those associated with changing the types of commodities handled. Other commercial navigation problems that apply to ports in this area are the shortage of municipal funds to put into port facilities and the fact that overland carriers do not afford lake ports equitable inland access in the form of nondiscriminatory rates and equal services. The Port of Toledo is a free port, or one into which foreign goods may be brought without imposition of customs duties if they are intended for reexportation or local consumption.

9.3.3.3 Related Land Uses and Problems

There are an estimated 3,820,500 acres in PSA 4.2 which would benefit from agricultural land treatment conservation measures. This is about 60 percent of the total land area. There are an estimated 2,421,000 acres of agricultural land in this planning subarea with a wetness problem. Production on this land within its present use is reduced or limited by excess water in the soil profile. There is an acute shortage of well-drained soil for urban development around Toledo, Fort Wayne, and Lima.

There are an estimated 348,000 acres of land in the planning subarea on which forest land treatment conservation measures would be suitable. One of the major problems is the declining acreage of forest land as it gives way to agricultural uses, highways, power lines, reservoirs, and urban recreational and industrial development. It is difficult to satisfy demands for these goods and services without a decline in forest land. The land use conflict is particularly acute in buffer zones around urban areas and in the corridors linking urban areas.

About one-third of the Lake Erie shoreline is subject to noncritical erosion, and much is subject to inundation during severe easterly storms. There is a considerable need in this area for marsh and wetland management, and because of the expanding metropolitan areas of Cleveland and Toledo, there is a need for more publicly owned shoreline.

A major problem in alleviating streambank erosion is that high erosion rates occur largely on private land, and the owners may not have the finances or the desire to implement streambank erosion projects. More regulation is needed in urban and suburban construction projects.

In RBG 4.2 the greatest flood damages occur in urban areas, as shown in Table 1–292 in Section 12. The major problems are encroachment on the natural flood plain areas and the lack of local zoning and regulation.

In the Maumee River basin, major rural damages and rural flood control problems are limited to the flood plains. The flood problems of the urban areas are the result of constricted reaches of the rivers, inadequate channel capacity, encroachment on the natural flood plain, or combinations of these causes.

The principal damage from floods in the Portage River basin results from the loss of crops during the growing season. Encroachment on the flood plain and constricted channels are major problems in the Sandusky River basin.

Floods on the Vermilion River are often accompanied by ice jams so that resulting flood stages are higher than they would be from river discharge alone.

There does not appear to be an adequate supply of land and wildlife habitat to satisfy (in the Normal Framework) the needs given in Table 1–292 in Section 12. There is a shrinking resource base. Wildlife habitat land is being reallocated to other uses. Some farming activity leaves little wildlife habitat on the land. Due primarily to the lack of funds for wildlife enhancement, channel modification in this area has reduced wildlife habitat.

An additional acute problem in this area is the need for preservation or protection of the remaining wetlands adjacent to the Lake Erie shoreline.

The existing aesthetic and cultural values have been summarized in Subsection 9.1. The major problem is the need to preserve outstanding values. There are a number of linkage corridors of merit in this area, and there is a need for buffer zones around Toledo and Fort Wayne. There are inadequate funds for land acquisition.

In order to provide about six times as many recreation days in 2020 as were provided in 1970, it is estimated that an additional 8,200 acres in this river basin group would be needed for intensive land-based water-oriented recreational use, as well as an additional 39,100 acres for less intensive land-based recreational use.

The conflicting land use pressures from agricultural, aesthetic and cultural, wildlife, and recreation uses have been cited above. Additional problems associated with satisfying the recreational needs are that much of the water throughout the river basin group is too low in quality to provide pleasant recreational opportunities, that many of the streams in this area have low flows in the recreation season, and that land acquisition for recreation purposes in urban areas is excessively expensive because of the competing land uses. Poor water quality is a definite prohibition on recreational opportunities in Lake Erie near Toledo, the Ottawa River below Lima, the Blanchard River below Findlay, and the Maumee River below Fort Wayne.

9.3.4 Alternative Frameworks

Two alternative frameworks are presented for RBG 4.2 as for other river basin groups. The Normal Framework does not reflect coordination of solutions to meet needs outside the RBG in the Lake basin or the Great Lakes Basin.

The second alternative, the Proposed Framework, contains the recommendations of the Commission in an effort to reflect the views of the people of the basin and the policies and programs of the States. To some extent, it reflects coordination in the development of the framework among a number of river basin groups, both in the Lake basin and in the Great Lakes Basin as a whole.

9.3.4.1 Normal Framework (NOR)

NOR is based on meeting quantified needs and solving identified problems to the maximum practicable extent consistent with subobjectives and criteria discussed in Section 2 of the appendix. The program outputs and costs are summarized in Section 12 in Tables 1-292, 1-293, 1-294.

(1) Water Withdrawals

NOR satisfies all of the water withdrawal needs in RBG 4.2 for the respective time periods. The Great Lakes are likely to be the source for most of the municipal, self-supplied industrial, and thermal power cooling water withdrawals. Ground water is likely to be the source for all of the rural domestic and livestock needs, most of the mining needs, and a part of the irrigation needs. Irrigation water withdrawals include water for both agricultural and golf course irrigation.

In the middle- and long-range time periods reservoir storage will play an increasingly important part in meeting the municipal water withdrawal needs. About 84 mgd will be needed by 2020 from new offstream reservoirs in the Ohio portion of RBG 4.2. About 56 mgd will be needed by 2020 from instream or offstream reservoirs for meeting Fort Wayne's needs. Some of these reservoirs may also be in Ohio.

(2) Nonwithdrawal Water Uses

NOR includes programs of both municipal and industrial waste treatment to meet water quality standards existing before the Federal Water Pollution Control Act Amendments of 1972. It also provides that there will be no degradation of water quality where existing water quality is at a level higher than that provided for in the standards.

About 67 percent of the total municipal wastewater flow in the Ohio portion of RBG 4.2 comes from the Toledo area. The Normal Framework includes advanced waste treatment throughout the entire Ohio portion of the area. It also includes advanced waste treatment in the period between the present time and 1980 at four locations in Indiana. Removal of 80 percent of the phosphorus is included, except for municipal waste treatment plants in Ohio whose total capacity is less than 1 mgd. Smaller communities in Indiana discharging the ditches with low flows will be expected to provide treatment facilities in the near future.

Throughout the 1970–2020 time frame, NOR includes the provision of additional boat access sites at suitable places in Lake Erie and on its tributary streams; acquisition and development of land for recreational use on all suitable upstream watershed impoundments; acquisition and preservation of areas of significant cultural, historical, or biological interest; and reliance on the private sector to develop quality recreational facilities for golfing, camping, swimming, picnicking, and other activities that complement public recreational development. If these programs are implemented, they would require an increase of 50 percent by 1970 and 150 percent by 2020 in the land being used for recreation in the river basin group.

Two programs are expected to provide the needed fishing opportunity in River Basin Group 4.2 and adjacent Lake Erie waters. One of these is the program of reservoir construction as outlined in the Northwest Ohio Water Development Plan. Fourteen multiple purpose reservoirs which would contribute to satisfying the angler-day needs in this area are included in that plan. Two of these reservoirs would provide for development of trout fishing, four would include development for angler access, four would include development of angler facilities, and six would include recreational reservoir development.

The second program contributing to the satisfaction of angler-day needs in this area is municipal and industrial waste treatment, which will permit development of the fishery in streams with improved water quality.

NOR includes programs to satisfy much of the recreational boating-day needs. Great Lakes needs could be more than met but inland lakes needs would not be fully met. The framework provides for 5,000 new water surface acres of impounded waters to be developed between the period 1980–2000, and an additional 5,000 between 2000 and 2020. In addition, NOR provides for 15 public access areas at inland lakes to be developed between 1980 and 2000, and 25 more between 2000 and 2020. NOR also includes Great Lakes marina and harbor construction to provide an additional 12,000 berths by 2020, with 3,000 of these berths developed by 1980. The framework also includes construction of inland marinas and public access to the Great Lakes.

Commercial fishing and commercial navigation programs are discussed under Subsection 9.6, Lake Erie Intrarelationships.

(3) Related Land Use

The programed agricultural land treatment is essentially a continuation of ongoing programs at a level that has been followed in the past. Included are on-farm and project drainage measures such as tiling and field ditching.

The forest land treatment program in NOR is at approximately the same level as ongoing programs, except for an accelerated program in the interest of controlling erosion, improving fish and wildlife habitat, improving timber production, and improving hydrologic conditions.

NOR includes a level of streambank erosion control that would, by 2020, provide for corrective treatment on all streambank reaches subject to severe erosion. None of the moderate streambank erosion would be treated in the Normal Framework. Streambank erosion is widespread, and effective protection measures are very costly to install and maintain.

NOR includes in the early action period programs to reduce urban and rural flood damages on all the main stem and principal tributaries of the Maumee, St. Joseph, St. Marys, Auglaize, Blanchard, Tiffin, Portage, Sandusky, Huron, and Vermilion Rivers. Types of programs are institutional or land regulation and zoning programs, floodproofing, modification of existing building use, relocation and damageable property, emergency measures, and flood warning and evacuation systems. An urban redevelopment program is included for the Maumee, St. Marys, Vermilion, Blanchard, and Sandusky River basins. Channel modification programs are included for the Blanchard and Sandusky River basins.

In the upstream watershed areas, throughout the entire river basin group, channel modification appears to be a desirable program for some streams. There are a few scattered opportunities for reservoir development to reduce rural flood damages in parts of the St. Joseph River basin.

In the period between 1980 and 2000, the same programs apply. However, in this time period some channel modification, levees, floodwalls, and other local protective works are included for Fort Wayne on the Maumee River, at St. Marys on the St. Marys River, and at Bucyrus and Tiffin on the Sandusky River. Levees, floodwalls, and other protective works are included for Milan on the Huron River.

Channel modifications and reservoirs appear to become a feasible alternative in the late time period in many of the upstream watersheds. In the period between 2000 and 2020, most of the structural measures would have been implemented, and a rather extensive and effective program of flood plain management is needed to reduce damages on the main stem and principal tributaries and to protect those areas from flooding.

The Indiana Division of Fish and Wildlife plans to acquire as many as 2,500 to 3,000 acres by 1980 as additions to existing game lands in the Great Lakes Basin in Indiana. Some of this would be in River Basin Group 4.2, and is included in the Normal Framework. Also included are the following management programs:

(a) Local zoning ordinances should be adopted or amended to limit the proliferation of residential and industrial development and to maintain open space.

(b) Land should be acquired by counties to conserve critical components of wildlife habitat and to guarantee public access to natural areas.

(c) Easements should be obtained or other incentives offered to private landowners to insure the preservation of natural, unique ecological, and scenic areas.

(d) Lease agreements between State agencies and landowners for controlled access to private land should be retained and expanded.

(e) Legislation should be enacted and policy developed on stream and lakeshore filling to prevent further destruction of privately owned marshes as well as degradation of water courses by municipal dumps (for example, the Ohio Stream Littering Law and the Indiana Department of Natural Resources, Natural Resource Commission Wetlands Policy Statement).

(f) Public land should be acquired, including some of the remaining wetlands in the Lake Erie marsh region of Ohio.

(g) More attention should be given to the consumptive and nonconsumptive uses of fur bearers. Ohio is currently one of the two top commercial muskrat harvesting States in the nation.

Landowner complaints indicate that more recreational use could be made of beaver to help satisfy some of the projected demand. Expanded educational programs on the aesthetic and wildlife values created by the beaver are needed to reduce landowner resistance to this species where it causes little economic damage. A better policy is needed if this species is to continue to be a positive force in the improvement of wildlife habitat.

The Ohio Division of Wildlife has tentative plans to purchase approximately 23,000 additional acres of wildlife lands in the Great Lakes Basin in Ohio. Some of these lands would be in River Basin Group 4.2. This acquisition is included in NOR. In addition to these lands, the State hopes to purchase as much of the remaining Lake Erie shoreline wetlands as possible.

NOR provides for the acquisition and preservation in River Basin Group 4.2 of the following types of aesthetic and cultural features:

(a) one upland game bird habitat location
(b) one waterfowl habitat location
(c) historical structures at 29 locations.

NOR includes additional recreational development to satisfy about 60 percent of the water-oriented outdoor recreation needs as they accrue during the period 1970 to 2020. Programs to accomplish this include instream and offstream reservoir storage, land use changes, public acquisition of land, and some programs for the collection and dissemination of information.

The Normal Framework provides for the construction, before 1980, of six State parks as outlined in the Northwest Ohio Water Development Plan; additional development of Crane's Creek State Park to its optimal level of economic and management efficiency; addition of recreational facilities at Grand Lake; acquisition and construction of recreational facilities at the proposed Auglaize River parkway; a Maumee River parkway; a Sandusky River parkway; a new regional park in northeastern Indiana; reservoir development at Bucyrus, Ohio; and additional development of recreational land in the Lake Erie Islands, including necessary harbors of refuge.

In the 1980–2000 period the framework includes acquisition and development of segments of the Blanchard, St. Joseph, Huron, Defiance, Portage, Maumee, Auglaize, and Sandusky River valleys; of additional land on Lake Erie Islands; and of the Powell Creek recreation areas.

NOR provides for acquisition and development during the 2000–2020 time frame of segments of the Maumee, Sandusky, Portage, St. Joseph, Blanchard, Tiffin, Huron, Vermilion, and St. Marys River valleys; and of two new 200-acre State parks oriented to provide considerable water surface area, if possible.

If these programs are implemented, they would require the acquisition and development of 11,900 acres by 1980 and 35,000 acres by 2020. This compares with a 1970 estimate of 24,000 acres of land suitable and being used for recreation in the river basin group.

(4) Framework Outputs and Costs

Section 12 contains Tables 1-292, 1-293, and 1-294 which provide information on needs, outputs, percent of needs met, and capital and OM&R costs.

9.3.4.2 Proposed Framework (PRO)

PRO was formulated in consultation with State officials in order to reflect State policies and programs, as well as the desires of area residents. State, regional, and local policies with respect to population and economic growth do not deviate greatly from the OBERS projections used in NOR.

The Proposed Framework anticipates a level of population somewhat lower than that expected in NOR. This lower level should be realized if the objective to maximizing environmental quality with minimum unemployment is to be achieved. The prevailing attitude in the area is that environmental problems must be resolved before additional effort is exerted to attract additional population or economic growth.

The problems addressed indicate that restoration of a very high level of water quality, timely conservation of recreational opportunities, acquisition of aesthetic and cultural values, and enforcement of existing local, State, regional, and Federal laws, supported by funding as necessary from Federal, State, and local levels, are needed as top priority, if the desired objectives of the public in the area are to be achieved for PRO and for future conservation, use, and development of water and related land resources.

The Proposed Framework includes a strong educational program to encourage conservation of water resources and the wise use of power. It is expected that the Ohio Environmental Protection Agency and the Ohio Department of Natural Resources would take the lead role in accomplishing such education in this area.

Provision of water supply and waste treatment should be self-supporting. This concept is included in the Proposed Framework. Rate structures and legislation should be modified as necessary to achieve this.

The Proposed Framework includes implementation of the Northwest Ohio Water Development Plan, following reconciliation of differences between Ohio and Indiana.

PRO encourages research on heavy metals. It includes the concept that industry must be responsible and held liable for safe disposal of toxic wastes. Soil conservation practices, with the exception of widespread channelization, should be stepped up for agricultural lands, and agricultural wastes should be treated where they occur, using regulation as well as soil conservation land treatment practices.

The public desires the establishment of a park along the Maumee River in River Basin Group 4.2. Such a proposal is included in PRO and has been endorsed by the State of Ohio as a part of its wild, scenic, and recreational river system. The area involved in recreational opportunities is greater in PRO than in NOR. In PRO there will be more emphasis on acquiring easements rather than fee-simple acquisition of recreational land in this area.

The Proposed Framework includes a recommendation that there be stronger legislation with respect to the use of the flood plains in the State of Ohio. Such legislation should be enforced by the State rather than at the local level.

Population density zoning should eventually occur. Changes in tax assessments or appraisal methodology were suggested in order to enhance the conservation and preservation of land in its present use rather than uses which will result in more taxes. This will assist in filling the need in this area for environmental enhancement.

Additional studies should be undertaken to assess the advantages and disadvantages of the continued building of islands in Maumee Bay and around the shoreline of Lake Erie. Until such studies have been completed, such construction should be deferred. PRO includes more money for the acquisition of wildlife areas and wetlands than was included in the Normal Framework.

In considering the Proposed Framework, a number of persons supported the concept that docking and lock usage fees for commercial navigation should be set sufficiently high that those firms utilizing new facilities will pay for them. Others preferred that such fee not be imposed.

PRO recommends that power plants in River Basin Group 4.2 be sited and constructed so as not to destroy any marshlands.

Future development in River Basin Group 4.2 should encourage light rather than heavy industry, increase tourism, education, and service-oriented businesses, and thus achieve water quality protection. Policies and regulations pertaining to use of resources which are in short supply should encourage reduction in per capita use of such resources through increased emphasis on conservation and increased efficiencies, and should consider increasing rate structures with increased use, taking into account the overall effects of such rate structures. Stringent air and water quality standards, solid waste disposal regulations, and flood plain management through regulation, incentives, penalties, and revenue sharing are also included in the Proposed Framework for facilitating these policies. Shore erosion should be controlled and abated by 1980 around the shoreline of Lake Erie. Existing policies with respect to Federal, State, and local funding should be amended so that this objective can be accomplished.

(1) Water Withdrawals

There are no specific program differences between PRO and NOR and all needs are met.

(2) Nonwithdrawal Water Uses

Waste treatment programs in PRO meet the requirements of the Federal Water Pollution Control Act Amendments of 1972. Other programs are essentially the same as in NOR, except that commercial navigation reaches a higher stage of development in PRO. Improvement of Toledo and Sandusky Harbors and extension of the navigation season are included. See Section 5 and Subsection 9.6.1.

(3) Related Land Use

Agricultural land treatment, cropland drainage, and forest land treatment are all accelerated in PRO above the levels of NOR in order to conserve the resource base. The comparison is shown in Table 1–337.

Recreation development emphasizes urban-related areas and relies more heavily on the private sector to maintain high-quality facilities in the choice recreation areas.

(4) Framework Outputs and Costs

Section 12 contains Tables 1–295, 1–296, and 1–297, which provide information on needs, outputs, percent of needs met, and capital and OM&R costs for PRO, indicating by italics where they differ from NOR. Table 1–337 compares land treatment programs.

9.3.4.3 NOR and PRO Framework Costs

Table 1–352 in Section 12 lists the total costs (capital plus OM&R) for NOR and PRO for the periods 1971–1980 and 1971–2020.

9.4 Frameworks for River Basin Group 4.3

9.4.1 Summary

Population in RBG 4.3 is projected to increase nearly 80 percent from 1970 to 2020. While per capita income will continue above the national average, the difference will be less. About one-third of the employment is in manufacturing. The small amount of employment in agriculture, forestry, fisheries, and mining is expected to decline.

As in other areas in this basin, the water-oriented outdoor recreation needs and wildlife management or hunting needs are difficult to satisfy due to the many competing land uses. RBG 4.3 is one of the most densely populated in the entire Great Lakes Basin. The pressures for residential and commercial developments are expected to be so great in the future that there will be pressure to forego meeting irrigation and mining needs.

Other problems are water quality and erosion and sedimentation.

The Normal Framework has been formulated by the selection of those programs which would tend to minimize the public costs involved in satisfying the needs. To some extent the overall effect of optimizing the maximum beneficial effects over the adverse effects has also been considered. NOR has been based on the assumption of maintaining the 7 day-10 year low flow in the streams throughout the river basin group. In some cases this assumption has dictated which source of water for withdrawals is to be incorporated or selected. Thermal power plants were assumed to be located on or near the shores of Lake Erie and to use the Lake as a source for cooling water.

NOR includes somewhat more land acquisition and development for public use in this area than in some of the other planning subareas. This is because this area is highly urbanized at the present time. Unless acquisition is undertaken soon, the overall environmental quality of the river basin group may be lowered enough to deter people from coming to live and work in this area. This would not be in the interest of national economic development since there is considerable investment in having a viable economy in this area. An adequate level of environmental quality is essential, even in the national economic development objective, in order to maintain this as an attractive area. As a result a somewhat higher level of stream valley development and aesthetic and cultural value preservation has been included in NOR.

Section 12 contains Table 1–298 which lists the needs, outputs, and percent of needs met for Lake Erie River Basin Group 4.3 for NOR; Tables 1–299 and 1–300 list the capital costs and operation, maintenance, and replacement costs of the framework.

9.4.2 The Area

River Basin Group 4.3 is a highly populated, highly industrialized, highly polluted portion of the Lake Erie drainage basin. It includes five river basins or complexes: the Black-Rocky complex, Cuyahoga River basin, Chagrin River basin, Grand River basin, and Ashtabula-Conneaut complex. The last extends into Pennsylvania, and includes 4 miles of Lake Erie shoreline. Additional information is given in Section 1. Figure 1–42 shows the areal extent of River Basin Group 4.3. Planning Subarea 4.3 is restricted to eight counties located in northeastern Ohio, and economic and demographic data relate to those counties.

9.4.3 Projected Resource Needs and Problems

The projected needs for resource use by time level are shown in Table 1–298. Where needs can be quantified, they are not discussed in the text unless special conditions warrant such discussion.

9.4.3.1 Water Withdrawals

The total water withdrawals for RBG 4.3 in 1970 were estimated as 4,520 mgd. By 1980 under normal growth conditions, there is estimated to be a need for additional water withdrawals of 350 mgd. This need is projected to increase to 10,600 mgd by 2020. In 2020 about 80 percent of the water withdrawals will be for thermal power cooling, 15 percent for self-supplied industrial water, nearly 5 percent for municipal water, and about 1 percent split among rural domestic and livestock, irrigation, and mining.

There are problems associated with the satisfaction of irrigation and mining withdrawal needs. These are not water withdrawal problems as much as they are land use problems.

The major problems related to municipal water withdrawals appear to be the need for more efficient management of existing systems, elimination of small and inefficient systems, extension of some individual systems to greater area-wide distribution, and the provision of adequate financing and a more equitable rate structure. In addition, it is very difficult to overcome legal obstacles and public opposition to the construction of municipal water supply projects.

There is a need for additional funds for State personnel to inspect water supply systems and plants more frequently.

In the Cuyahoga River basin several communities have exceeded the capacity of ground water to meet their needs. In the Chagrin River basin several communities have also approached the limits of their well-field capacity and are expected to rely increasingly on surface water in the future. In the Grand River basin there is a need for some small water supply systems to be replaced with larger regional systems. There are no water resource deficiencies in the Ashtabula-Conneaut complex.

In summary, the main problems associated with municipal water supply in this area are those of management and the method of paying for the cost of water supply development.

Although the self-supplied industrial water withdrawals are expected to be less than 1½ times those of 1970, the consumptive use of this water is projected to increase more than ninefold by the year 2000. This is due to an expected increase in the in-plant recirculation of industrial process water, which will decrease withdrawal rates but increase consumptive use rates. Problems associated with power production include thermal pollution, the potential harmful effects of heated water discharging into Lake Erie, air pollution due to particulate and gaseous stack emissions, and the attractiveness of electric power facilities. Some concern has also been expressed over the possible danger of radio-

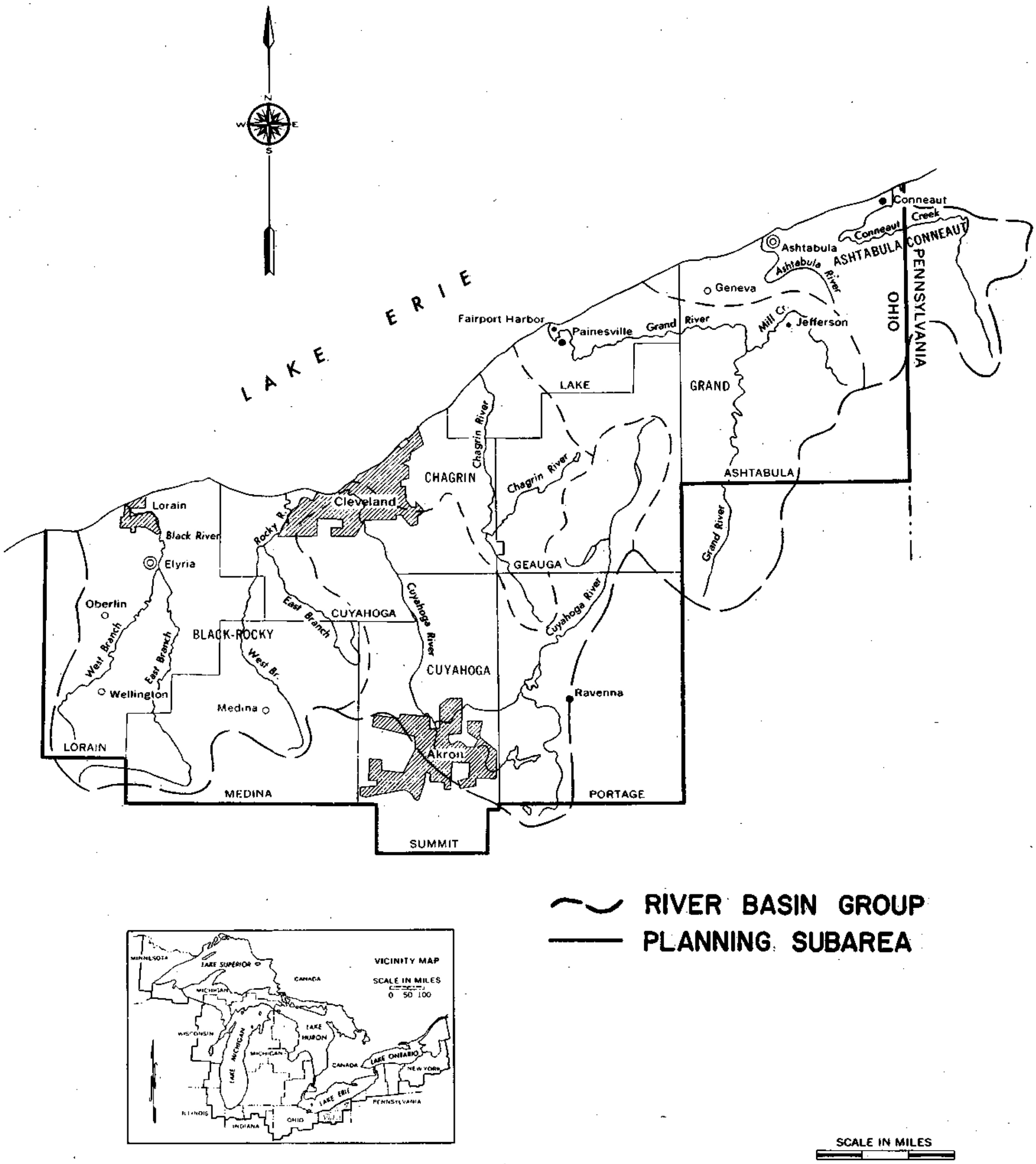

FIGURE 1–42 Lake Erie Southeast, River Basin Group 4.3

active wastes in relatively densely populated areas. There is a lack of sufficient information on the environmental impacts of siting and operating nuclear power plants, and there is a need for better dialogue with the public concerning the development of such plants.

9.4.3.2 Nonwithdrawal Water Uses

Among the major water quality problems in the area are high bacterial counts, which prevent body contact recreation in most principal streams; low dissolved oxygen levels, which hinder fish production; and the construction and operation of treatment facilities, made difficult by complex problems associated with financing, manpower, and legislation. There is a need for regional authorities and master planning in the consolidation and integration of collection systems and treatment facilities. Enforcement of water quality standards and the checking of industrial waste treatment discharges is very expensive from a government point of view. There is a need to reduce agricultural wastes, including nutrients, sediments, insecticides, and herbicides. There is a need for an expanded area-wide surveillance system and a need to reduce dissolved solids.

In the Black-Rocky River complex the discharge of untreated or inadequately treated sewage seriously affects the recovery capabilities of the streams. Although several proposed projects would appear to have marginal effects on the water quality directly downstream, advanced waste treatment is required to achieve a satisfactory level of stream water quality.

At the present time, the headwaters of the Cuyahoga River above Akron, Ohio, generally exhibit good water quality and serve as a source of public water supply. However, water quality degradation is expected due to the potential urban development in the general Cleveland-Akron area. There is, therefore, an immediate need to assure that this urban development does not result in such degradation. The river below Akron is seriously polluted, with the lower reach of navigation channels exhibiting gross amounts of oils, solids, and oxygen-consuming materials stemming from both municipal and industrial discharges. Advanced waste treatment must be installed in this basin to reach suitable water quality standards.

In the Chagrin and Grand basins and Ashtabula-Conneaut complex, advanced waste treatment is also considered necessary. Although quality in the upper reaches is better than that in the more densely developed downstream areas, municipal and industrial discharges to the rivers degrade the quality of water reaching Lake Erie.

TABLE 1–153 Use and Projected Needs for Recreational Boating, PSA 4.3

	1000 Boating Days	
Category	Great Lakes Waters	Inland Waters
1970 Use	327	372
1980 Needs	90	45
2000 Needs	189	138
2020 Needs	258	210

In recent years a considerable investment in industrial wastewater treatment has been made in this area. This fact, coupled with increasing recirculation and an increasing dependence of industrial plants on waste treatment by municipal systems, will tend to minimize the capital and OM&R costs associated with future industrial waste treatment facilities in this area.

The sport fishing opportunity that must be planned for year 2020 is an increase of nearly 60 percent in the existing angler opportunity days. One of the major limitations affecting fish production and distribution in RBG 4.3 is that all ponded waters in this area are to some degree eutrophic. Accelerating rates of eutrophication are occurring as the result of intensive agricultural use. Sedimentation has been responsible for altering habitat in older impoundments. Too much vegetation was removed in the process of clearing reservoir sites, so other impoundments suffer from lack of habitat development. Water level fluctuation, thermal stratification, and low dissolved oxygen conditions are other problems in impoundments in northeastern Ohio. Low water quality is also a major deterrent to stream fishing opportunities. In headwater areas, limiting factors on fishing productivity are related to agricultural and flood control practices, particularly siltation. Impoundments on tributaries in the headwaters of the Cuyahoga River are thought to have eliminated the upstream and lateral nursery areas that supply the sport fishery along the main stem of the river. Although the role that pesticides play in limiting fish production is not entirely clear, there is concern that this is also a problem.

The total number of craft using the boatable water within RBG 4.3 is expected to nearly double between 1970 and 2020, and the number of boat days to increase by about two-thirds (Table 1–153). One of the major problems in this area is that there are few harbors of refuge on the Great Lakes. Although commercial harbors are used by recreational craft, no improvements have been made specifically for such craft. This area has only a few streams suitable for canoeing. The lack of stream improvements, lack of maintenance, and periodic low flows limit the amount of canoeing and small boat opportunity on these streams. The lower reaches of several streams have been improved for commercial navigation but are little used by recreational craft due to unattractive industrial surroundings and the presence of large ships. Many of the small streams are navigable for only a few hundred feet from the mouth. The main rivers and tributaries which have been identified as good canoeing waters are the Cuyahoga and Black Rivers, and Conneaut Creek. There is need for a continuing program for improving small boat harbors on Lake Erie. This is essential to the expansion of recreational boating on these waters. Future opportunities for recreational boating in this area must be largely oriented toward the Great Lakes because inland waters now are utilized to capacity. It is important that reservoir sites be identified and land acquisition begun if inland boating is to be increased.

Commercial fishing needs and problems are discussed in Subsection 9.6, Lake Erie Intrarelationships.

Harbors in this area include Lorain, Cleveland, Fairport, Ashtabula, and Conneaut, Ohio. Annual dredging is needed if use is to continue.

Needs are shown in Section 12 in Table 1–298. Ports in this area are projected to handle considerably more receipts of iron ore in the future than they have in recent years. Competitive iron ore from the East and possible movement of coal by pipeline could present serious problems for commercial navigation in this area in the future.

9.4.3.3 Related Land Uses and Problems

It is estimated that practices could be applied to reduce soil losses and conserve plant cover on about 700,100 acres of agricultural land—about 30 percent of the total land in PSA 4.3. These conservation practices would have beneficial effects on the natural resource base beyond those directly related to production of food and fiber. These effects, particularly needed in this area, include reduction of sediment in the surface water and improvement of plant cover.

The greatest problem associated with the conservation measures on agricultural land is the increasing pressure to convert these lands to other uses.

Drainage measures can have both beneficial and adverse effects depending on the possible alternative uses of the land. Urban development in this area may alter or cut off natural surface or subsurface drainage patterns.

Analysis of soil drainage limitations, which is discussed in detail in Appendix 16, *Drainage,* indicates that almost all of River Basin Group 4.3 has severe drainage limitations, with the exception of the area around Akron, the upstream Cuyahoga area, and a portion of the Grand River valley. This means that it would be very difficult to provide adequate drainage in most of this river basin group, but does not necessarily mean that this land cannot be used for cropland.

Maintenance of forest cover is needed for watershed protection and for continuing multiple resource uses. There are about 539,000 acres of forests in the planning subarea. This represents 23 percent of the total land area. On 109,000 acres of this land, treatment is adequate. There is an opportunity for forest land treatment on the remaining 430,000 acres.

The major problem associated with forest land treatment is that of maintaining the forest land in the face of pressures for change. Reduction of sediment in streams and increased opportunity for recreation and aesthetic and cultural uses would be the major benefit from a program of forest land treatment in this subarea. In addition, forest land treatment would help maintain high quality water in those upstream reservoirs that are proposed for water supply.

In RBG 4.3 there are an estimated 14.3 miles subject to critical erosion along the shoreline of Lake Erie, all in Ohio. There are an additional 9.9 miles subject to noncritical erosion in Ohio, and 4.0 miles in Pennsylvania, based on 1970 evaluations. Severe damage from shoreline erosion occurred during the record high lake levels of 1951 and 1952, and again in 1973. In several highly developed areas, erosion has become critical, and many homes will be lost unless protected immediately.

The Northeast Ohio Water Development Plan has suggested a long range subobjective of making all of the shoreline of this planning subarea available for public use. This runs counter to the actual trend. Since 1952 there has been about a 50 percent increase in the number of miles of shoreline developed for residential use, a 75 percent increase in commercial and industrial use, an 11 percent increase in public parks, and a decrease in agricultural and undeveloped frontage.

There are 356 streambank miles in this river basin group subject to moderate or severe streambank erosion. In the streams for which the drainage area is less than 400 square miles, there are about 276 bank miles subject to moderate damage and 45 bank miles subject to severe damage. The total average annual damages for these reaches is \$32,200. For streams with drainage of more than 400 square miles, there are 35 bank miles subject to severe damage. The damages for this reaches are estimated to total \$268,600 annually. The total annual damages are estimated at $300,800. Cleveland Harbor, Ohio, undergoes the highest amount of maintenance dredging of any of the navigation facilities on the Great Lakes, averaging about 1,220,000 cubic yards per year. About 60 percent of the material dredged is from channels along the Cuyahoga River upstream from its mouth. The remainder is from the outer harbor. Maintenance dredging is also necessary in the harbors at Lorain, Fairport, Ashtabula, and Conneaut, Ohio.

In RBG 4.3 the greatest flood damages occur in urban areas, as shown in Table 1–298 in Section 12. Encroachment on the flood plain and the lack of flood plain regulations and zoning are major problems resulting in the high damage levels.

The 1970 level of wildlife user-day supply in this river basin group and the needs are shown in Table 1–298 in Section 12. Nearly a 50 percent increase in supply is needed by 1980 and more than double the supply by 2020. Major problems are those of land use and maintaining adequate acreages of wildlife habitat. The small size of most public hunting areas in this area severely limits their ability to provide quality hunting opportunities and major game species. Use of public land for both consumptive and nonconsumptive purposes will become more intense. Population-related problems increase more rapidly than the population growth rate. Therefore, crowding and the resultant lowering of the quality of the outdoor experience will probably be the foremost of the foreseeable problems on public wildlife lands. The restriction of hunting access on private land is another problem in this area. Water pollution is also a major problem. Air pollution tends to deter people in their pursuit of nonconsumptive wildlife experiences. Air pollution also limits what can be planted to enhance wildlife habitat. Established white pine plantations are dying within a zone of 30 miles of the industrial centers in this area. It is important that channel modification projects include wildlife enhancement features.

The outstanding, unusual, and significant aesthetic and cultural values in this area have been covered in Subsection 9.1.3. The primary problem here is one of competing land uses and lack of money available for acquisition. In this particular area buffer zones and linkage corridors are extremely important if aesthetic and cultural values and social well-being are to be maintained.

To meet estimated recreation-day requirements, the present availability must be markedly increased by 1980 and then nearly doubled by 2020. This emphasizes the need for land use planning and the very immediate need for identification, preservation, and conservation of recreational opportunities throughout the entire river basin group. The land required in order to meet this need has been estimated in Table 1–298 in Section 12.

Two other problems are specifically relevant for the area. There is a considerable need for additional water for boaters and water skiers. The demand for such facilities will not be adequately met in the near future. On the other hand, large amounts of needs for swimming can be met on relatively smaller areas of water surface. Lake Erie has vast expanses of water surface that are potentially available to meet the need for power boating. However, at the present time, activities are restricted to a significant degree by limited launching and docking facilities, by rough water, and by limited public ownership of lake frontage.

Planning Subarea 4.3 contains several large cities, so the problem of providing urban recreational opportunities is of paramount importance. Exclusive of Cuyahoga Metropolitan Park District land and municipal golf courses, there are only 3.5 acres of recreation land per 1000 persons in the City of Cleveland. Similarly, Akron provides only about 2.7 acres per 1000 population. Present standards indicate a need of 6 to 10 acres of land per 1000 persons for neighborhood, community and district parks. The use of several public beaches in the Cleveland area has been greatly limited by pollution.

9.4.4 Alternative Frameworks

Two alternative frameworks are presented for this as for other river basin groups. The Normal Framework does not reflect coordination of solutions to meet needs outside RBG 4.3 in the Lake basin or the Great Lakes Basin.

The Proposed Framework contains the recommendations of the Commission in an effort to reflect the views of the people of the basin, and the policies and programs of the States. To some extent, it reflects coordination in the development of the framework among a number of river basin groups, both in the Lake basin and in the Great Lakes Basin as a whole.

9.4.4.1 Normal Framework (NOR)

NOR is based on meeting quantified needs and solving identified problems to the maximum practicable extent consistent with subobjectives and criteria discussed in Section 2 of the appendix. The program outputs and costs are summarized in Section 12 on Tables 1–298, 1–299, and 1–300.

(1) Water Withdrawals

NOR satisfies all of the municipally-supplied, self-supplied industrial, and rural domestic and livestock water withdrawal needs in each of the time periods. The Great Lakes are the primary source for almost all the municipal needs and all of the self-supplied industrial needs. Ground-water withdrawals in this area were estimated to be 31 mgd for municipal water in 1970. The resource capability for ground water has been estimated to be 300 mgd. Therefore, it is obvious that the Normal Framework could include more ground-water development than is reflected in the program selections. Lake Erie has been selected as the source because of the economic advantages expected to accrue as a result of establishing regional water systems. NOR satisfies all of the rural domestic and livestock water withdrawals from ground-water development.

NOR includes programs that satisfy all of the irrigation and mining needs, even though land use pressures for other uses may be so great that irrigation and mining could phase out over the planning period. Adequate water is available if land use policies are adopted which encourage irrigation and mining.

All of the thermal power cooling water withdrawals are expected to come from Lake Erie.

(2) Nonwithdrawal Water Uses

NOR includes waste treatment measures to meet the water quality standards before the Federal Water Pollution Control Act Amendments of 1972, and provides that water quality not be allowed to be degraded in areas where water quality is higher than the existing standards. The recommended waste treatment includes conventional secondary treatment plus 80 percent removal of phosphates as a minimum. Advanced waste treatment is included in NOR for all of the locations in this river basin group.

Ongoing fishery management programs directed towards ponded waters presently hold the greatest promise for developing and expanding the sport fishing potential of northeastern Ohio. Ongoing programs should include frequent stocking of ponds with walleye and smallmouth bass. On a few select stream systems, there should be follow-up inventories of these populations to ascertain the changing ecology of the streams. Chemical eradication of rough fish and subsequent establishment of primary and secondary predatory species should also be included as an ongoing program for the management of sport fisheries. Also, where feasible, the development, preservation, and management of nursery habitats for game species should be undertaken. This is expected to become an important facet of inland water management. Pike and walleye should continue to be stocked in inland waters. It is expected that future expansion of the Pacific salmon program will be limited.

Obtaining public access to fishing waters through easement or agreement, and through the construction of impoundments, is a high priority for present and anticipated programs. Additional access to the Lake Erie shore and offshore fishing are also included in the Normal Framework.

The future prospect for river and stream warmwater fisheries is not optimistic. Improvement in water quality will help, together with some reservoir construction, and increased access to streams. Programs beyond 1980 will be directed toward efforts to develop new inland water areas strictly for sport fishing and allied interests, and toward additional access to Lake Erie waterfront angling, particularly in the reach between Lorain and Painesville, Ohio.

NOR programs aim to shift the fishing opportunities in River Basin Group 4.3 away from substantial dependence upon impoundments toward an increasing level of fishing in the improved streams and rivers of the RBG.

This combination of fishery management measures is expected to be adequate to satisfy all of the angler-day fishing needs in this area in the respective time periods.

The Normal Framework includes programs to increase the recreational boating opportunity on the Great Lakes as well as on inland lakes and streams. Needs would be nearly met in the early time periods and exceeded in 2020. NOR provides for the construction of three harbors for recreational boating, two of which have already been approved. One is at the Chagrin River about 17 miles east of Cleveland and the other at Geneva-on-the-Lake about 17 miles east of Fairport. The third harbor would be between Lorain and the Rocky River.

Another program included in NOR is additional breakwater protection at existing harbors. All of the commercial harbors in the area have areas that could be developed as marinas. However, the existing breakwater systems are designed for commercial navigation and do not provide adequate protection for small boats.

NOR also includes programs to develop additional access to Great Lakes waters in order to supplement the present intensive use of inland waters. Twelve such sites are included between 1970 and 1980, and an additional nine between 1980 and 2000.

Commercial fishing and commercial navigation programs are discussed in Subsection 9.6, Lake Erie Intrarelationships.

(3) Related Land Use

The Normal Framework includes programs to provide agricultural land treatment by 2020 on about 31 percent of the total land on which treatment would be effective. Drainage would be provided by 2020 on about 15 percent of the total lands with a wetness problem. The agricultural land treatment and drainage programs are essentially a continuation of ongoing programs.

The forest land treatment program provides for an accelerated level of forest land treatment. Programs for shoreline erosion will protect areas where continued critical erosion is likely to endanger life or public safety within the next five years, and where continued erosion is likely to endanger property or wildlife habitat or landmarks of historical and natural significance within five years.

NOR provides for streambank erosion treatment on those bank miles that are subject to severe erosion damages. Reaches selected for treatment are those where the benefits of damage reductions are likely to exceed the cost of accomplishing those reductions. No program is included in the Normal Framework for abatement of moderate streambank damage.

The most important programs included in the framework for reducing urban and rural flood damages and protecting acres subject to flooding are flood plain management or regulation. In the early time period the Normal Framework includes channel modifications, floodwalls, and local protection works to be developed in the Cuyahoga River areas of Brooklyn Heights, Valley View, and Independence. In the upstream watersheds of the Black and Rocky River basins, the framework includes channel modification and reservoir protection. All of the other reduction measures are applicable to essentially all of the main stem and principal tributary areas.

In the period between 1980 and 2000, NOR includes programs for channel modification in the Eastlake area of the Chagrin River. The other reduction measures are also continued during this period. In the late action period, the primary program is flood plain management.

The wildlife programs in NOR at the present time satisfy only a small part of the needs. The State of Ohio Division of Wildlife plans to acquire at least 10,000 acres of the remaining wetlands in the lake shore and marsh region of Ohio. Some of this is expected to be in River Basin Group 4.3.

NOR includes programs for the acquisition and preservation of the following types of outstanding, unusual, and significant aesthetic and cultural values in River Basin Group 4.3:

(a) two upland game bird habitat locations
(b) eight waterfowl habitat locations
(c) historical structures and places at 45 locations
(d) sites and objects pertaining to early Indian culture at two locations.

Because of the necessity for an aesthetic and cultural environment to be maintained in this urbanized area in the interest of social well-being, the Normal Framework also includes programs for the acquisition and preservation of the following additional outstanding, unusual, and significant aesthetic and cultural values:

(a) four animal wildlife habitat areas
(b) two habitat areas for birds of prey
(c) four wetland areas
(d) four beach areas
(e) ten waterfall and rapids areas
(f) twelve proposed State parks
(g) twenty-five proposed municipal parks.

No cost estimate is available.

In NOR the programs meet only about half the recreation-day needs by 2020.

The following programs are included during the 1970–1980 time frame:

(a) the complete acquisition of land in the Cuyahoga River valley and the acquisition of easements on the valley wall lands as set forth in the Cuyahoga River Valley of Ohio Recreation Feasibility Study

(b) acquisition and development of the Lake Shore Park Beach in Lake County, listed in the State plan

(c) development of an additional recreation facility at the Berlin Reservoir to be acquired as needed

(d) acquisition of land and recreational development for an impoundment and recreation facility on the upper part of the Chagrin River

(e) the acquisition and development of lands along the Rocky River valley in Medina County and along the lower Grand River and Chagrin River valleys.

The framework includes the following additional developments between 1980 and 2000:

(a) the acquisition and development of lands along the Black River

(b) acquisition and development of river valleys should be continued

(c) recreational development at the Mogadore Reservoir near Akron

(d) development of wildlife areas for certain recreational activities.

The following program elements are included in NOR for the 2000–2020 time frame:

(a) intensification of development in those metropolitan park areas having the potential to support increased development

(b) acquisition and development of lands on the Upper Cuyahoga River and the Conneaut River valley

(c) development of the Lake Erie beach east of Conneaut.

(4) Framework Outputs and Costs

Section 12 contains Tables 1–298, 1–299, and 1–300 which provide information on needs, outputs, percent of needs met, and capital and OM&R costs.

9.4.4.2 Proposed Framework (PRO)

PRO was formulated in consultation with State officials in order to reflect State policies and programs, as well as the desires of area residents.

State, regional and local policy assumptions with respect to population and economic growth do not deviate greatly from the OBERS projection used in NOR.

The objective of PRO is to achieve a very high level of environmental quality while minimizing unemployment.

The water supply and waste treatment in the future in River Basin Group 4.3 should be self-supporting, and changes in rate structures and legislation should be made as soon as possible to accomplish this objective.

PRO includes a strong educational program to promote conservation of water resources and energy, the wise use of power, and the reduction of waste. The lead for this program is expected to be taken by the Ohio Environmental Protection Agency and Ohio Department of Natural Resources.

The Normal Framework does not, in the opinion of the State of Ohio and the public in the area, have sufficient programs to meet shore erosion needs in River Basin Group 4.3. Therefore, it is recommended in the Proposed Framework that all of the shoreline area subject to shore erosion be corrected. The specific financial and institutional arrangements for accomplishing this are not yet defined, but the Proposed Framework does recognize that the Normal Framework programs are not extensive enough in the eyes of the public and the State of Ohio.

Although islands in Lake Erie might be useful for recreational, jetport, and other purposes, PRO does not include such recommendations as probable in the future. It is definitely necessary that more information on the advantages and disadvantages of such undertakings should be available before any recommendations could be acted on even in a preliminary fashion. PRO does recognize, however, that there is a need for improved transportation throughout the Basin, both for commerce and for personal transportation.

The Proposed Framework for the Cleveland area includes a recommendation that additional ways be agreed upon to protect open space from development, including mining and irrigation. This objective is highly desired in the Cleveland area. Methods might include financial incentives and tax relief for private land owners, including farmers.

PRO should have a substantially greater program for urban recreation than is reflected in NOR. The requirements go well beyond the water-oriented recreation activities considered in this study.

PRO includes a recommended study on existing and proposed levels of radioactivity in Lake Erie.

The Proposed Framework includes a recreational program with aesthetic and cultural and other environmental benefits based on the creation of a Cuyahoga Valley National Park. This is similar to but more extensive than the proposal included in the NOR.

Additional legislative measures should be passed giving the International Joint Commission authority to prevent land fill encroachment along the shores of the Great Lakes.

Money should be spent and resource projects undertaken to develop successful programs that will draw on volunteers to clean up pollution—water pollution as well as air pollution and solid waste pollution.

PRO recognizes, not only for this area but throughout the Basin, the importance of an investigation into nuclear plant hazards and safety, because of the remote possibility of irreversible radioactive pollution of the Great Lakes.

PRO includes a recommendation for a permanent ban on drilling for oil and gas in Lake Erie.

(1) Water Withdrawals

Programs are the same for PRO as for NOR except for irrigation and mining. All crop irrigation is to be phased out by 1980 and only golf course irrigation provided. Mining needs are met to 1980 and held constant from that point on. No difference is shown in programs for thermal power cooling, but the emphasis is on selection of a cooling system to suit the requirements of each site rather than generalized regulation of method.

(2) Nonwithdrawal Water Uses

While there are no differences between NOR and PRO in the amount of wastewater treated, PRO complies with the Federal Water Pollution Control Act Amendments of 1972. Commercial navigation, discussed in Subsection 9.6, is emphasized more in PRO than in NOR, with provisions for a system to provide greater harbor and channel depths and extension of the navigation season.

(3) Related Land Use

Agricultural land treatment, cropland drainage, and forest land treatment are carried on at faster rates and to a greater extent in PRO than in NOR. A comparison is shown in Table 1–338. Other programs are the same, but the emphasis in providing water-oriented outdoor recreation is on development in the vicinity of urban areas and encouragement of private enterprise to maintain good facilities at high-quality recreation locations.

While water withdrawals for mining needs are met only until 1980, and held constant from then on because of local preferences for other uses of the land, it is noted that this may run counter to the following pertinent "issues" adopted by the Great Lakes Basin Commission on May 15, 1973, and August 17, 1973:

> The Proposed Framework should recommend that no intensive urban or other essentially irreversible surface development be undertaken without a mineral survey to determine the quantity and quality of the mineral resources that might be affected.
>
> That as part of the planning programs, particularly in urbanizing areas, due consideration be given to the preservation for possible future utilization of known mineral deposits.

(4) Framework Outputs and Costs
Section 12 contains Tables 1–301, 1–302, and 1–303, which provide information on needs, output, percent of needs met, and capital and OM&R costs for PRO, indicating by italics where they differ from NOR. Table 1–338 compares land treatment programs.

9.4.4.3 NOR and PRO Framework Costs

Table 1–353 in Section 12 lists the total costs (capital plus OM&R) for NOR and PRO for the periods 1971–1980 and 1971–2020.

9.5 Frameworks for River Basin Group 4.4

9.5.1 Summary

Problems that at the present appear to be most severe in River Basin Group 4.4 are the degraded water quality in the lower reaches of many of the tributary streams and the Niagara River and the flooding of many thousands of acres of urban and rural flood plains. Erosion along the Lake Erie shore is also a problem. Increasingly, there will be competition for the use of the available land for a great many purposes—a problem which is indicated now by the declining wildlife habitat. The frameworks adopted for the river basin group recognize these problems as well as the needs for additional resource use. Treatment of municipal and industrial waste to meet water quality standards is a major program. Major water withdrawals will be from Lake Erie and the Niagara River, except locally where inland lakes and streams and ground water are more advantageous sources. The alleviation of damages from flooding can be accomplished largely through legislation and other institutional measures, with some structural measures proposed for specific areas. The importance of managing the land in such a fashion that wildlife habitat can be developed and enhanced at the same time that other uses are accommodated is recognized. Land treatment programs are incorporated.

Section 12 contains Tables 1–304, 1–305, and 1–306, which list needs, output, and percent of needs met, as well as capital and OM&R costs for the NOR Framework in River Basin Group 4.4.

9.5.2 The Area

This area lies at the northeastern end of the Lake Erie basin and includes part of the area that drains into the Niagara River from its headwaters to approximately the lower end of Grand Island. Almost the entire portion of the Lake Erie basin in Pennsylvania is included in RBG 4.4. The corresponding planning subarea includes all of Niagara County, New York, which extends to Lake Ontario, and includes part of that shoreline and all of the Niagara River and some minor streams. Population in the RBG is largely concentrated in the Erie, Pennsylvania, and Buffalo, New York, metropolitan areas. The PSA includes the City of Niagara Falls. Figure 1–43 shows the areal extent of River Basin Group 4.4 and Planning Subarea 4.4. Section 1 and Subsection 9.1 provide some statistical information.

Manufacturing is important in both the Erie and Buffalo areas, and trades and services are also significant in the economy. Fruit, vegetables, and dairy farming are major agricultural activities. The planning subarea ranks eighth in value of farms among the 15 planning subareas in the Great Lakes Region. Farms are typically small. The most important vegetables are tomatoes and snap beans. The number of acres of orchards, groves, and vineyards in PSA 4.4 is second highest in the Great Lakes Region, with grapes, pears, and sweet cherries being the most significant fruit crops.

New York and Pennsylvania are strong home-rule States that place most of the responsibility for water and related land resources with the municipalities. In addition to municipal and county planning boards, regional resource planning and management groups have been established in the area. The Erie County Metropolitan Planning Department covers Erie County, Pennsylvania, and the Northwestern Pennsylvania Resources Planning and Development Commission covers a multi-county area that includes Erie County. This is one of the 10 official areas of the State designated by the governor as a basic unit for State planning and programs.

In New York there are regional water resources planning boards (under authority of Title 11, Article 15, New York State Environmental Law), including the Allegheny River Basin Board (covering the Lake Erie shore area of Chautauqua County), and three regional planning and development boards: the Western Board (also known as the

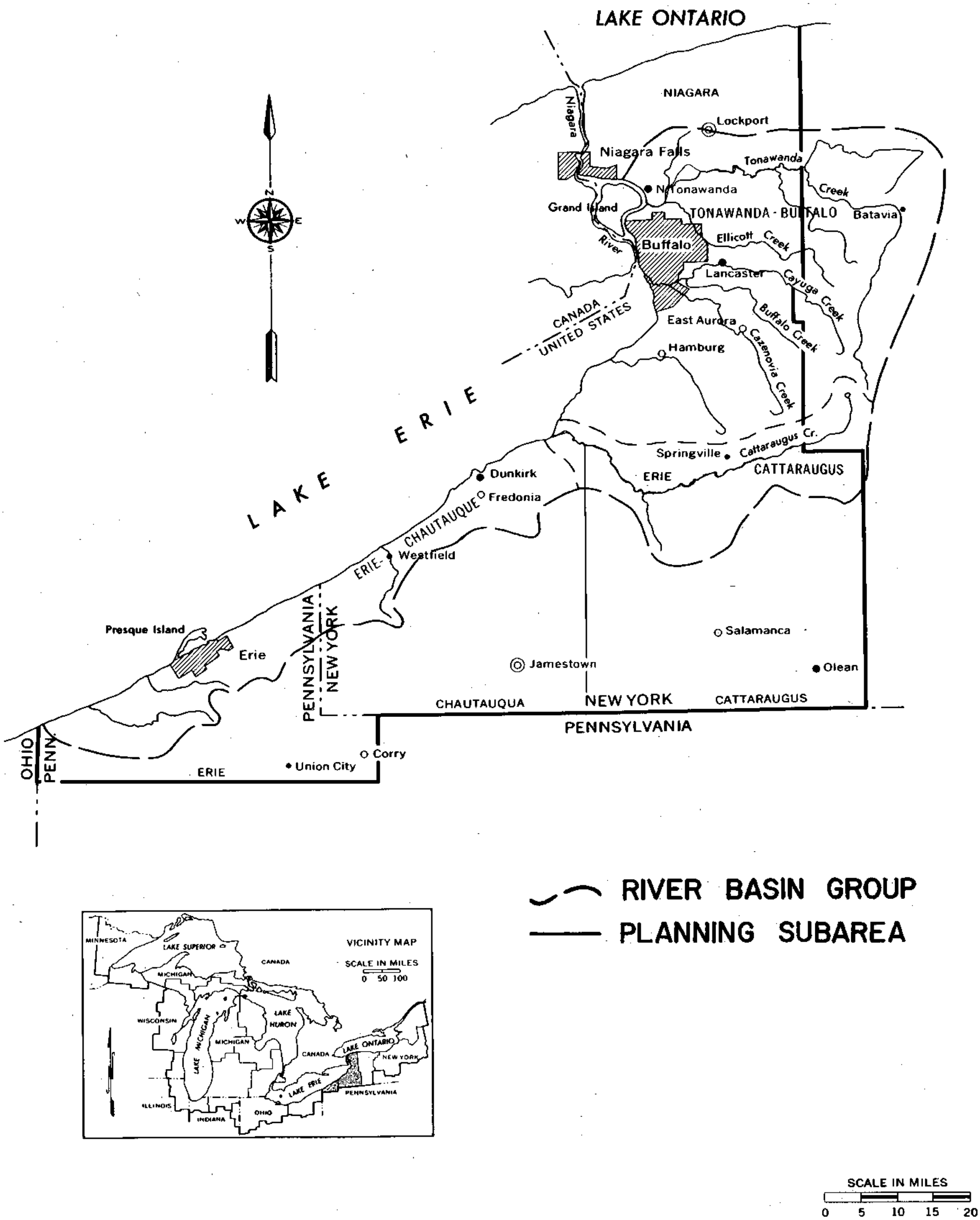

FIGURE 1–43 Lake Erie Northeast, River Basin Group 4.4

Erie and Niagara Counties Board), the Genesee-Finger Lakes Board, and the Southern Tier West Board. A regional water resources planning board was established in the Lake Erie drainage basin in portions of Erie, Niagara, Genesee, Wyoming and Cattaraugus Counties but was terminated in 1974 after completing a comprehensive water and related resource management plan which was adopted by the State with some modifications.

9.5.3 Projected Resource Needs and Problems

The projected needs for resource use in RBG 4.4 by time level are shown in Table 1–263 in Section 12. Where needs can be quantified, they are not discussed in the text unless special conditions warrant such discussion.

9.5.3.1 Water Withdrawals

The total withdrawal needs to 2020 are estimated for RBG 4.4 at about 7,700 mgd above the base year withdrawal of 2,790 mgd. About 84 percent of the additional requirement is for thermal power cooling, 11 percent is for self-supplied industrial water, and the remainder is for municipally supplied water, irrigation, mining, and rural domestic and livestock, with demand decreasing in the order presented.

Water withdrawal problems are not great. There is an adequate supply in Lake Erie and the Niagara River, and the major withdrawals will be from these sources. Inland lakes and streams and ground water will supply local requirements as appropriate.

9.5.3.2 Nonwithdrawal Water Uses

The increase in municipal wastewater discharges to be treated in RBG 4.4 reflects in part the increasing reliance of industry on municipal treatment plants. Industrial wastewater discharges to be treated by industry will also increase, but at a much slower rate. This slower rate reflects the increase in the amount of recirculation in plants and the reliance on municipal plants mentioned above.

The disposal of untreated wastes directly into the Niagara River at several points must be eliminated. Combined sanitary and storm sewer systems are a problem in this river basin group, and the untreated storm water overflows contribute to poor water quality in the Niagara River and Lake Erie. There are 15 locations in Pennsylvania and New York that need advanced wastewater treatment at an early date. Drilling for oil and natural gas in Lake Erie is presently restricted in New York in response to concern over exploration practices which could degrade water quality.

TABLE 1–154 Use and Projected Needs for Recreational Boating, PSA 4.4

	1000 Boating Days	
Category	Great Lakes Waters	Inland Waters
1970 Use	390	267
1980 Needs	153	96
2000 Needs	162	105
2020 Needs	225	162

The angler days needed in 1980 will be about 40 percent greater than those available in 1970, and by 2020 about 55 percent greater. Degraded water quality and limited access contribute to the problem of providing an adequate sport fishery.

The needs for boating water to provide adequate additional boat days, as shown in Table 1–154, are divided between inland water and the Great Lakes, with needs for the latter significantly greater in each time period. Problems associated with using the existing water surface are access to inland lakes and streams, degraded water quality on some of the streams, which makes boating and canoeing unattractive, and the need for marinas and harbors of refuge on Lake Erie.

Needs for commercial navigation are given in Table 1–304. There are no problems peculiar to the area. The dredging of habors is necessary as a continued maintenance program. Enlargement will be necessary if larger ships are to be accommodated. This is further discussed in Subsection 9.6.

9.5.3.3 Related Land Uses and Problems

Conservation land treatment measures could be profitably applied to about 552,000 acres in RBG 4.4. These measures could be expected to reduce erosion and flooding and the consequent sedimentation, and to increase the production of food and fiber. About 341,000 acres have drainage problems which impede the most effective present use and could practicably be mitigated by drainage measures.

It is estimated that 75 percent of the forest land is adaptable to forest treatment which will permit better multiple use of the forest and assist in solving other problems such as flooding, erosion, and sedimentation.

There are 6 miles of Lake Erie shoreline subject to critical erosion in Pennsylvania and 32 miles in that State subject to noncritical erosion. There are also 10.6 miles in New York subject to noncritical erosion. This total is about 42 percent of the lakeshore in the river basin group.

About 90 percent of the total cost of streambank erosion comes from streams draining more than 400 square miles, even though the total mileage in smaller drainage areas is several times greater.

The area subject to flooding and the losses are given in Table 1–304. As areas now rural become urbanized, the losses from flooding will increase sharply unless measures are taken to prevent the flooding or alleviate the losses.

The problems relating to wildlife values are similar to those in other parts of the basin, including gradual encroachment on the habitat, deterioration of the habitat, and desire on the part of more people to hunt or observe wildlife. The quantities involved are given in Table 1–304 in Section 12. The number of user days available must increase by about 50 percent in the next 50 years if needs are to be met.

There are aesthetic and cultural values in the area, many of which have been identified. Around each of the metropolitan areas, buffer zones are desirable to make urban life more pleasant, and to give relief from the continuous buildup of homes and businesses.

Over half again the number of recreation days used in 1970 must be provided by 1980, and by 2020 the 1970 supply must be doubled if needs are to be met. The amount of water and land surface intensively and extensively developed is shown in Table 1–304 in Section 12. However, the table cannot adequately show the problem of providing recreation facilities for the people who live in the inner city.

9.5.4 Alternative Frameworks

Two alternative frameworks are presented for this as for other river basin groups. The Normal Framework does not reflect coordination of solutions to meet needs outside RBG 4.4 in the Lake basin or the Great Lakes Basin.

The alternative, the Proposed Framework, contains the recommendations of the Commission in an effort to reflect the views of the people of the basin and the policies and programs of the States. To some extent, it reflects coordination in the development of the framework among a number of river basin groups, both in the Lake basin and in the Great Lakes Basin as a whole.

9.5.4.1 Normal Framework (NOR)

NOR is based on meeting quantified needs and solving identified problems to the maximum practicable extent consistent with subobjectives and criteria discussed in Section 2 of the appendix. The program outputs and costs for RBG 4.4 are summarized in Section 12 in Tables 1–304, 1–305, and 1–306.

(1) Water Withdrawals

NOR satisfies all of the water withdrawals at all time periods. The municipally supplied water and self-supplied industrial water are principally obtained from the Great Lakes, but some supplies are obtained from ground water and inland lakes and streams. Rural domestic and livestock water and that required for irrigation and mining are obtained from the inland surface water and ground water sources. Water for thermal power cooling is obtained from the Great Lakes. There is a possibility of adverse effect on water quality, recreation, sport fishing, and aesthetics at some future time if surface water withdrawals from inland streams become too great. These effects can be anticipated and increasing reliance placed on the Great Lakes, if necessary. The framework provides for storage in the periods to 2000 and 2020 to assist in providing water for irrigation uses.

(2) Nonwithdrawal Water Uses

NOR includes waste treatment measures providing secondary treatment, plus 80 percent phosphate removal, in all waste treatment plants as a minimum. Standards existing prior to the Federal Water Pollution Control Act Amendments of 1972 will be met. Advanced waste treatment is anticipated to be required at 15 areas in Pennsylvania and New York. In some of these places, low-flow augmentation from potential storage impoundments will provide some additional enhancement of water quality, but such augmentation is not considered a substitute for advanced waste treatment. It is anticipated that regional waste collection and treatment systems will be used in a number of places to improve efficiencies in the handling the wastewater.

The NOR programs for meeting projected fishery needs combine the creation of additional habitat with the management and provision of access to existing habitat. Improvement in stream flow conditions, as well as the creation of additional water area, should improve the fishery base in River Basin Group 4.4. A significant nonstructural program incorporated into NOR is the acquisition of fishing rights along some 68 miles of streams in the river basin group. Provision of adequate wastewater treatment should reverse the declining fishery production in the river basin group and provide additional opportunities for anadromous fish to utilize the upstream reaches of the area's water resources. Additional public access to inland lakes and streams, new impoundments, and Lake

Erie will provide additional opportunity to meet angler-day needs. Proposed harbor improvements in the recreational navigation portion of the Normal Framework will enhance the downstream habitat of high-value anadromous fish, and thus increase spawning in upstream areas.

Programs selected to enhance recreational navigation opportunities include improvement of harbors and marinas on the Lake Erie shore in Pennsylvania and New York, and provision of access to existing waters and to impounded waters that would be created for recreational and flood control purposes. In addition to the structural elements of the recreational navigation program, a significant level of needs can be met by zoning and management measures which must necessarily accompany the institution of structural programs in RBG 4.4.

Commercial fishing and commercial navigation are covered in Section 5 and Subsection 9.6.

(3) Related Land Uses and Problems

NOR includes programs to provide agricultural land treatment for about 38 percent of the total land on which treatment could be effectively accomplished. The framework includes providing drainage by 2020 to about 8 percent of the total land with a wetness problem. These agricultural and land drainage programs are essentially a continuation of ongoing programs.

The forest land treatment program included in NOR provides for treatment of about 38 percent of the lands that can be treated effectively.

NOR provides for shoreline erosion abatement measures to be built before 1980 on the 6 miles of shoreline subject to critical erosion.

Streambank erosion problems will be alleviated through structural measures on the severe erosion areas.

NOR programs for prevention of potential flood damages consist of nonstructural measures as well as structural programs for storage impoundments, levees, floodwalls, and other protective works. Flood plain legislation is an integral part of the framework. NOR assumes that for the immediate time period, damages to existing development in the flood plain can best be reduced by structural measures and that nonstructural measures cannot be fully implemented except where existing legislation will permit and enforcement is adequate. NOR programs in RBG 4.4 are estimated to alleviate 50 percent of the projected average annual damages in urban areas and 15 percent of the projected damages in rural areas by 1980. Included in these estimates is the assumption that 10 percent of the projected average annual damages due to growth will be alleviated through the implementation of flood plain legislation. By the year 2000, structural and nonstructural measures are estimated to alleviate nearly 97 percent of the total average annual damages in urban areas, and approximately 80 percent of the projected average annual damages in rural areas.

The enhancement of wildlife resources in RBG 4.4 can be accomplished through land acquisition for upland and big game species, technical assistance to rural land owners for the development of a sound wildlife management program, acquisition of public hunting lands to offset the trend toward diminished private land access, legislative zoning to increase emphasis on green belts and open space, wetlands acquisition, and State fish and game agency educational programs to promote better land owner-hunter relationships. In addition to these specific program elements, the overall effect of increasing water quality will be beneficial to the wildlife species in the region.

There is great potential for multi-purpose use of proposed recreational facilities in this particular planning subarea. Proposed single- and multiple purpose storage impoundments are estimated to provide a significant amount of the recreation-day needs in the future.

Land use changes, including acquisition and reservation of flood plain areas and recreational sites along Lake Erie and several streams in RBG 4.4, can provide a much needed recreational source for area residents. Several new State parks are projected in NOR in the years 2000 and 2020, as well as an emphasis upon the increased utilization and efficient use of existing forest lands. The designation of three river valley preserves, extending over 40 miles of the area's streams, can provide a focus for aesthetic enjoyment as well as a haven for wildlife species. Of particular note in NOR is the Pennsylvania proposal for creating a scenic easement program of approximately 30 miles of streambank within the river basin group. These easements would be instituted through legislative measures and are projected to provide open space areas for aesthetic and recreational opportunities and complement the existing park systems.

(4) Framework Outputs and Costs

Section 12 contains Tables 1–304, 1–305, and 1–306, which provide information on needs, outputs, percent of needs met and capital and OM&R costs.

9.5.4.2 Proposed Framework (PRO)

PRO was formulated in consultation with State officials in order to reflect State policies and programs, as well as the desires of area residents.

State, regional, and local policy assumptions with respect to population and economic growth do not deviate greatly from the OBERS projection used in NOR.

The overall objective of improving the well-being of New York and Pennsylvania residents in River Basin Group 4.4 can be partially attained through implementation of framework programs which conserve, preserve, and develop water and related land resources in the basin. In Pennsylvania (Erie County and Lake Erie), PRO is based upon a conservation policy which simultaneously encourages economic development and environmental enhancement through wise use of resources. Regarding environmental policy, Pennsylvania's constitution guarantees the people's rights to clean air, pure water, and the preservation of environmental values. Further, Pennsylvania is designated to act as a trustee for the people to conserve and maintain these resources for the benefit of all the people. However, action programs are evaluated not only in terms of their effectiveness in conserving natural resources, but also in terms of the changes they cause in the economies of the affected areas. Under home rule, local governments in Pennsylvania initiate actions within a framework of State regulatory and permit systems.

During recent years Pennsylvania has acquired increasing legislative authority for the regulation of activities that affect the environment. This includes successive amendments to the Clean Stream Law to cover all forms of pollution, restoration of open-pit mining sites, and the regulation of activities, including agriculture, conducive to erosion. Legislation is pending for the management of flood plains, and authority has already been given to initiate a scenic river system in the State. In addition, a State Environmental Master Plan is being prepared as a tool for improving and protecting the environment.

PRO recognizes the capability of the Erie County land and water resources to sustain substantial increases in economic growth. Further, future growth is relatively independent of Federal-State water resources investment. With the environmental safeguards mentioned previously, Pennsylvania's policy will continue to encourage developmental growth through State programs and local initiative. Pennsylvania's portion of RBG 4.4 is included in the Appalachian Regional Development Program. A Statewide comprehensive investment plan is being developed as a tool for improving the State's economy.

In the New York portion of RBG 4.4, as in Pennsylvania, water and related land resources are capable of sustaining substantial increases in overall population growth and economic development. Growth in the region is directed through investment and programs under the multiple objectives of regional development, environmental quality, and economic efficiency. The establishment of program alternatives to meet people's needs and resource opportunities reflects these multiple objectives. The State's regional planning boards, its State development plan, and its environmental plan reflect these objectives.

TABLE 1–155 Estimated Population Change, PSA 4.4

	Change (in millions)			
	1970	1980	2000	2020
NOR[1]	1.8	2.1	2.5	3.1
New York[1]	1.6	1.7	2.1	2.6
Pennsylvania[1]	.2	.4	.4	.5
PRO[2]	1.8	1.9	2.1	2.2
New York[3]	1.6	1.6	1.8	---
Pennsylvania[4]	.2	.3	.3	---

[1]OBERS 1968 Series C data.

[2]Total of New York and Pennsylvania figures.

[3]Official New York State Projections, New York State Office of Planning Services.

[4]Erie County Population Analysis, report and baseline projections in comprehensive waste water quality management study for the Lake Erie Basin (Pennsylvania portion).

The Proposed Framework for RBG 4.4 was formulated in response to public reaction and comment at public meetings in Erie, Pennsylvania, and Buffalo, New York. Further consultation with the States of New York and Pennsylvania provided the basis for the information which follows.

Based upon public attitudes and more detailed State planning activities in River Basin Group 4.4, normal (OBERS, 1968) projections of population and employment appear to be higher, at least through the year 2000, than those now anticipated for RBG 4.4. Based on existing information, Table 1–155 depicts the population base presently being used in State planning efforts for PSA 4.4.

The effects of a slowing population growth rate and changing migration patterns will not significantly alter the region's labor force until after the year 2000. It is conceivable, however, that economic conditions, measured in terms of average per capita income and output per worker in PRO, could lead to a better balanced and stabilized economy than would be the case under growth rates assumed in NOR.

With a few exceptions, PRO generally supports the types of structural and nonstructural programs established to meet resource needs and opportunities quantified in NOR. More detailed planning will identify more specifically the quantities of resource needs associated with PRO.

The emphasis upon environmental quality could stimulate new technologies and policies aimed at more beneficial use of water and land resources. In resource development these policies will likely be based on the philosophy of pricing the true cost of resource use and passing the cost on to the direct beneficiaries of developed programs. Further, PRO supports additional research and technological innovation aimed particularly at waste management, shoreland erosion control, and power development problems.

PRO recommends the development of a comprehensive, coordinated, joint plan using New York State's Erie-Niagara Basin Comprehensive Water Resources Plan for that portion of RBG 4.4.

Great Lakes Basin Commission policy statements that influence PRO investments and resource management programs are described in Annex D. (See Introduction for availability of Annex D.) Basinwide policy affects River Basin Group 4.4 in the following ways and resource categories:

(1) Recreational programs should be provided as close as practicable to urban areas given available resource supplies.

(2) A comprehensive shoreland management program is of the highest priority.

(3) The promotion of a low-cost commercial navigation system is desirable and attainable with environmental safeguards.

(4) A lake level control program for Lake Erie needs to be established.

(5) A comprehensive wastewater management plan will be required to meet the requirements of the Federal Water Pollution Control Act Amendments of 1972.

(6) Aesthetic and cultural zones within the region should be identified and preserved to the maximum extent possible.

Planning studies more detailed than the Framework Study have been accomplished in portions of Pennsylvania and New York. The results of these more specific planning studies should serve as guides for future resource programs.

(1) Water Withdrawals

More detailed planning studies by the Erie-Niagara Basin Regional Water Resources Planning Board have supplemented the Framework Study by estimating municipal water supply costs for the 1980 time period at approximately $51 million (total cost includes transmission system and improvements to existing systems which were excluded in Framework Study).

Total power production is not anticipated to change significantly from the Normal Framework over the projection period despite emphasis on environmental considerations. As requirements for improving environmental quality become stiffer, more energy may be needed to accommodate these needs. Under a comprehensive shoreland use policy, plants may be required to utilize total supplemental cooling systems in contrast to some use of Lake Erie for heat dissipation in NOR.

(2) Nonwithdrawal Water Uses

Water quality programs in PRO are based on compliance with the Federal Water Pollution Control Act Amendments of 1972, which require whenever possible, achievement of water clean enough for recreational uses, and clean enough for the protection and propagation of fish, shellfish, and wildlife, by July 1, 1983; and require that there be no discharges of pollutants into area waters by 1985.

The Act extends the Federal pollution control requirements to all U.S. waters. NOR assumes that only interstate waters are covered by Federal legislation. PRO prescribes that municipal and industrial wastewater discharges will be given best available treatment and that nonpoint pollution sources will be controlled by 1983.

Public, private industry, and government support exists for encouraging commercial shipping by deepening harbors and channels beyond the average of 27 feet at Erie, Pennsylvania, and Buffalo, New York. There is ample support for channel and harbor depths of 31 feet in Buffalo and Erie harbors, and PRO recommends that this deepening be undertaken. By 2020 an active program will be required to maintain waterborne commerce opportunities between Lakes Erie and Ontario. The two options available are Joint Canadian-American improvements of the Welland Canal and/or an all-American Lake Erie-Lake Ontario Waterway east of the Niagara River through portions of River Basin Groups 4.4 and 5.1. PRO recommends the completion of current studies, the development of more accurate economic, social, and environmental costs, and later review and decision, pending consideration of the several alternative developments. PRO does, however, include for the middle range planning period (1980 to 2000) additional lockage and channel capacity in the St. Lawrence Seaway. This may force an earlier decision on the alternatives for maintaining commerce between Lakes Erie and Ontario.

(3) Related Land Uses

PRO supports the continuation of ongoing agricultural land treatment programs with no additional project action for drainage of croplands. Certain land treatment practices will be accelerated to increase treatment measures on 370,100 acres. PRO recommends an accelerated forest land treatment program that would treat 60 percent of the forest land needs by 2020, or approximately 516,000 acres. Comparison with NOR is shown in Section 12 in Table 1–339.

Based on public meetings and the conclusions of more detailed studies, PRO acknowledges the immediate need for action to control and prevent urban and rural flood damages, particularly in the

Erie-Niagara basin. NOR appears to have underestimated the potential for flood damages in the area through 1980. In response, a vigorous flood plain management program which includes implementation of State-approved nonstructural and structural measures is recommended.

Based on the experience of protecting Presque Isle, as well as the costs of future proposals, it is felt that NOR estimates are low. The following is a list of alternative plans for the protection of Presque Isle proposed by the U.S. Army Corps of Engineers, Bufallo District:

Plan	Cost Estimate
Full breakwater	$32 million
Partial breakwater	$18 million
Groins	$9 million
Sand recirculation	$ 5 million

The magnitude of the above estimates, and the failures of previous protection projects, indicate that successful stabilization of Presque Isle will be much more costly in the Proposed Framework.

(4) Framework Outputs and Costs

Section 12 contains Tables 1–307, 1–308, and 1–309, which provide information on needs, outputs, percent of needs met and capital and OM&R costs for PRO, indicating by italics where they differ from NOR. Table 1–339 compares land treatment programs.

9.5.4.3 NOR and PRO Framework Costs

Table 1–354 in Section 12 lists the total costs (capital plus OM&R) for NOR and PRO for the periods 1971–1980 and 1971–2020.

9.6 Lake Erie Intrarelationships

There are a number of uses of Lake Erie which must be considered with respect to the Lake itself rather than with respect to any river basin group. The use of the Lake for some activities may not recognize the international boundary, nor the boundaries of the four States which border the Lake. Those activities which utilize the Lake as a whole are discussed in this subsection. The relationships with the other Great Lakes were discussed in Section 5.

The physical geography of the Lake Erie basin, out of which has developed and on which has been superimposed the very high degree of economic development, has created some situations within Lake Erie that are more aggravated than in the other Lakes. Lake Erie is the smallest of the Great Lakes in volume, with less assimilative capacity. It has the second largest concentration of population along its shores of any of the Lakes, resulting in large inputs of pollutants. The Maumee River brings in large amounts of sediment eroded from agricultural land and other land in the Maumee basin. Lake Erie is the most polluted of the Lakes, to the extent that it has almost become a symbol for lake pollution and high eutrophication.

9.6.1 Commercial Navigation

The major Lake Erie ports are at Detroit, Toledo, Sandusky, Lorain, Cleveland, Erie, and Buffalo, and there are a number of smaller ports. Ports near the western end of the Lake ship about 86 percent of the coal handled in the Great Lakes, and Detroit receives about 30 percent of the total. Ports in Lake Erie receive over half of the iron ore and limestone shipped on the Lakes and ship about 16 percent of the limestone. Detroit receives about 26 percent of the general cargo handled, and Lake Erie ports ship about the same percentage of the overseas cargo. Commercial navigation is an important function on this Lake. Toledo has one of the two inland free ports in the United States.

Some vessels now being utilized between Lake Superior and Lake Michigan are built to the length and beam compatible with the new Poe Lock at the Soo, but are only partially loaded because of depth limitations in the channels and harbors. It is only natural, therefore, that alteration of the channels and harbors in the Great Lakes is being considered. This will have an important favorable impact on commercial navigation on Lake Erie, and on ports which serve that navigation. Extention of the navigation season will have a similar favorable impact, and if the season is extended to include the St. Lawrence Seaway System, the amount of overseas traffic will no doubt increase markedly. Ongoing studies relating to the modification of the system and extension of the season were discussed in Section 5.

The Normal Framework does not include specific programs for the extension of the Great Lakes navigational season.

Most of the problems associated with the structural and operational changes in the Great Lakes-St. Lawrence navigation system and the Lake Erie part of that system are being addressed in ongoing studies. NOR provides for timely completion of ongoing studies, development of new technology, and strong local port promotion policies. These could significantly affect the total traffic handled at Lake Erie ports.

PRO includes consideration of channel improvements, including a lock and dam in the St. Clair

River (34 feet depth); dredging Detroit River and other channels; deepening to 31 feet the harbors of Detroit, Toledo, Sandusky, Lorain, Cleveland, Conneaut, Erie, and Buffalo; extension of the navigation season for six weeks in segments of the system from western Lake Superior through the Soo Locks, St. Marys River and to southern Lake Michigan, through the St. Clair and Detroit Rivers and Lakes St. Clair and Erie, and through the Welland Canal into Lake Ontario; and for four weeks through the St. Lawrence River system.

9.6.2 Recreational Boating

If the recreational boating needs are to be met in the Lake Erie basin, much of the increased use will have to be on Lake Erie itself. This will require a program of construction of small boat harbors, both as harbors of refuge and as locations for marinas and berthing facilities. Also needed will be access points on the Lake and a smallcraft weather warning system. Both frameworks include in each of the four river basin groups in the Lake Erie basin an appropriate program for upgrading the facilities mentioned in order to keep pace with the public desire for boating opportunities.

9.6.3 Water Quality

The fame, or notoriety, of Lake Erie has become worldwide because of the seriously degraded quality of its water. While the situation is serious, it is not as hopeless as has often been presented. The eutrophication, the acceleration of which is largely charged to the input of phosphorus to the Lake, has reached dangerous proportions in parts of the Lake, and questions have been raised as to whether the trend toward deterioration can be reversed. Lake Erie has the smallest assimilative capacity of any of the Lakes, but it also has the most rapid turnover of water. However, this exchange of water through inflow and outflow does not occur uniformly throughout the Lake, and the places where flow and exchange do not take place have become critically polluted. The frameworks recommend measures for treating the municipal and industrial wastes which enter waters that flow to the Lake. PRO is more stringent than NOR. These measures are given the highest priority in the Framework Study.

9.6.4 Levels and Flows

The frameworks do not recommend greater regulation of levels and flows of Lake Erie than currently exists in the Niagara River and in diversions to the New York State Barge Canal and the Welland Canal. Regulation of lake levels for various purposes results in conflicts. A scheme to maximize commercial navigation opportunity will not necessarily complement one to generate power. Nor would either of them necessarily be consistent with a scheme to minimize erosion along the shoreline or to enhance wildlife, recreation, and aesthetic and cultural values.

With the completion of the study of levels and flows by the International Joint Commission, some additional consideration may be given to specific work to be accomplished in Lake Erie. Likewise, while the International Field Year for the Great Lakes (IFYGL) has concentrated on data collection for Lake Ontario, some of the product of that investigation will be applicable to Lake Erie. The Normal Framework includes recommendation for the continuation of IFYGL activities and the extension of related studies to Lake Erie.

Much of the shoreline of Lake Erie is subject to damage from erosion. Any control of lake levels to alleviate this damage will have an effect on other functions, and the interrelationships must be carefully weighed.

9.6.5 Commercial and Sport Fisheries

The commercial fishery of Lake Erie has undergone major changes in the past century and a half. The changes have been caused by changing demand for fish species, changing techniques for harvesting the various species, and changes in the numbers of various species. Lake Erie still supports a considerable number of fish and a large harvest could be taken, but the species available are not those which are in demand, so a large commercial fishery is not profitable.

Sport fishing has also been an important feature of Lake Erie for many years, particularly in the western basin. The most desired species are usually not the most prevalent, and a larger sport fishery could be supported if fishermen were willing to take some of the more abundant, less desirable species.

With four States of the United States and the Province of Ontario in Canada each managing the fishing in its waters in a somewhat different fashion, there has been very little consistency in the regulation of either commercial fishing or sport fishing, except through the limited coordination activities of the Great Lakes Fishery Commission. In general, the sport fishery has experienced fewer limitations and less management than the commercial fishery. The present policy of the States points to managing in the interest of the sport fishery in the Lake. Physical facilities, stocking, access, and other devices will be used to develop the sport fishery, and the commercial fishery will be managed to complement the sport fishery.

The Normal Framework supports the measures being taken to this end, including such physical developments as may be warranted, stocking, control of the fishery to maintain a proper balance between predators and prey fish, and the necessary studies, research, sampling, and similar programs that will lead to a better identification and knowledge of the fishery characteristics of the Lake and the way in which the fishery can be managed.

Section 10

LAKE ONTARIO BASIN

10.1 The Study Area

All of the U.S. portion of the Lake Ontario basin lies in New York except for the extreme headwaters of the Genesee River, which are in Pennsylvania. In addition to the Lake Ontario basin itself, the study area includes the U.S. portion of the St. Lawrence River basin. This is also in New York State. Hydrologically, all of the Niagara River basin is in the Lake Ontario basin. However, because of Buffalo's economic impact and orientation toward Lake Erie, the Lake Ontario basin boundary adopted for this study is opposite Grand Island, which is in the Niagara River just above the power intake. This boundary line, which is essentially at Niagara Falls, places Buffalo in the Lake Erie basin and all power diversion and return in the Lake Ontario basin. For the purposes of economic and demographic studies, however, all of Niagara County is included in Planning Subarea 4.4. See Figure 1–44 for a map of the area. Descriptive and statistical information was included in Section 1.

River Basin Groups 5.1 and 5.2 include most of the tributaries to Lake Ontario and three-fourths of its shoreline. Most streams in RBG 5.3 flow into the St. Lawrence River, which heads in the RBG.

Four major physiographic provinces are represented in the Lake Ontario basin. The Appalachian Plateau includes the hilly uplands covering the southern half of the Genesee and Oswego drainage areas and the unique Finger Lakes region. All of the lowlands bordering Lake Ontario and extending along the St. Lawrence River through the Thousand Islands are part of the Eastern Lake section of the Central Lowland province. The broad lowland extending to the lower reaches of the Great Lakes Basin is part of the St. Lawrence Valley province. The Adirondack province includes the mountainous headwaters of the Black, Oswegatchie, and Grass-Raquette-St. Regis River systems.

The Adirondack Mountains include the highest points in the Great Lakes Basin, and the lowest point in the Basin is at its outlet where the St. Lawrence River flows into Canada. Thus the Lake Ontario basin has the greatest extremes in altitude of any Lake basin: from over 4,500 feet to 150 feet above sea level. Much of the basin has rugged topography, particularly the deeply incised valleys of the Appalachian Plateau and the severely eroded Adirondack Mountains.

The Lake Ontario basin's physiography provides one of the most scenic areas within the Great Lakes Basin. Recreation seekers from the basin and throughout the nation are attracted to Niagara Falls and the gorge below, the beautiful, historic Finger Lakes region, the forested, lake-dotted Adirondack Mountains, and the Thousand Islands area of the St. Lawrence River.

Glaciation in the Lake Ontario region resulted in less extensive deposition of material than in the upper Great Lakes Basin, but a more rugged landscape was developed in the Lake Ontario region. Ice movement from the north was inhibited by the highlands of the Adirondack and Appalachian Plateau provinces. Many glacial features appear in the basin, including drumlin fields, waterfalls, kame, kettle, and esker topography, meltwater channels, caves, solution channels, and disappearing streams, and many fossiliferous bedrock exposures.

Glacial deposition resulted in a relatively thin veneer of shaley till over most of the Appalachian Plateau region. Deposition in the narrow, deeply incised bedrock valleys was much greater, with depths up to 1,000 feet, largely of fine-grained material. A thin veneer of lake clays, silts, and fine sands mantles the Central Lowland province area. Following the glacial action, marine seas invaded the St. Lawrence Valley and deposited marine clays and silts as far west as Ogdensburg, New York.

Bedrock exposures of poor permeability are quite common in the basin. Except for a carbonate sequence cropping out along the northern edge of the Appalachian Plateau province, shales and siltstone dominate this province. Another, older carbonate sequence, along with underlying sandstone, is present in the Black River and St. Lawrence lowlands. These sedimentary rocks crop out around the basement rock comprising the Adirondack Mountains.

The Adirondacks principally consist of an igneous-metamorphic complex of some of the oldest rocks on the continent. The sedimentary rocks gently dip away from the Adirondacks and southward in the Appalachian Plateau.

The factors that determine the climatic character

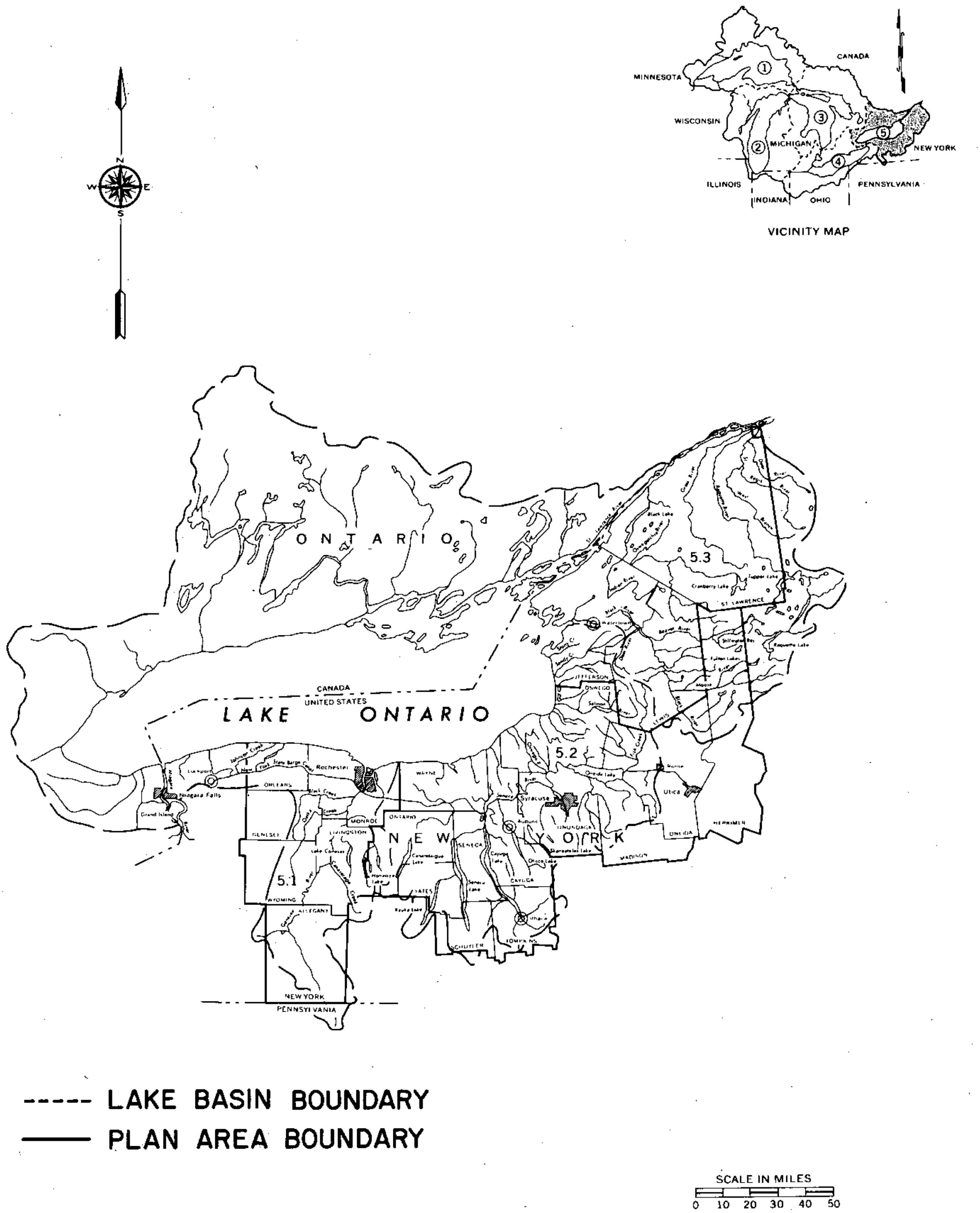

FIGURE 1–44 Plan Area 5, Lake Ontario

of the Lake Ontario basin are the presence of large bodies of water, Lakes Erie and Ontario, the existence of relatively high mountains in and adjacent to the eastern reaches of the basin, and prevailing winds from west to east in the summer and from southwest to northeast in the winter. As these winds pass over Lake Ontario, they absorb considerable moisture, which is deposited as orographic precipitation upon encountering the high land masses of the Tug Hill plateau and the Adirondack Mountains.

The mean annual precipitation ranges from 32 inches along the lakeshore to 52 inches in the eastern portion of the basin. The annual average snowfall is 64 inches along the shoreline and 128 inches in the northeastern portion of the basin. Mean daily temperatures range from 17°F to 25°F in January, and from 78°F to 84°F in July. Extremes may be −55°F and about 100°F. The number of frost-free days varies from 160 to 200 along the lakeshore and from 120 to 160 in the interior. Although the wind velocity averages about 10 miles per hour, velocities as high as 73 mph have been recorded.

10.1.1 Human Characteristics

The Lake Ontario Plan Area had 9 percent of the total Great Lakes Region's population in 1970, and ranked third in population among the five plan areas, with the Lake Michigan and Lake Erie regions having more population. The 1970 overall population density of 143 persons per square mile is one of the lowest in the Region. SMSAs within the Lake Ontario region include Rochester, Syracuse, and Utica-Rome, New York. Over 70 percent of the population lives in the nine counties making up these SMSAs.

The Lake Ontario region is largely rural. Small towns and rural communities dot the entire region, except the eastern highlands. Fruit, vegetable, and dairy production are of major importance, along with localized areas of diversified manufacturing and industry. Poor climate, soils, and topography discourage agriculture (with the exception of dairying) in PSA 5.3, but mineral, forest, and recreational resources strengthen this area's economy. Industrial activity is highly diversified over PSA 5.2. Syracuse is the principal industrial center, producing such varied products as machinery, food, paper, and chemicals like caustic soda. Dominant agricultural activity in this area includes dairying and fruit and vegetable production. Grape production is high in this region. Near the lakeshore fruit orchards and dairy farms dominate the landscape of PSA 5.1, while livestock production is prevalent in the more rugged inland plateaus. Industrialization in the Rochester area is characterized by paper, chemical, and specialized photographic equipment. All the major cities in the Lake Ontario basin serve as trade and service centers for the residents.

The Lake Ontario basin has four Federal harbors: Rochester, Great Sodus Bay, Oswego, and Ogdensburg. Coal, chemicals, and food and petroleum products are major commodities shipped from these ports. In 1968 Lake Ontario carried 47.1 million tons of traffic; the St. Lawrence River between the international boundary and Lake Ontario carried 33.1 million tons that same year.

An abundance of generally high-quality land and water resources form the basis for the important tourism and recreational enterprises in the Lake Ontario basin. It has been estimated that approximately $273 million are spent annually by recreationists in the basin. Lakeshore and interior resorts are favorite summer and winter recreation areas.

10.1.1.1 Institutions

New York is a strong home rule State which places most of the responsibility for water and related land resources with municipalities. In addition to municipal and county planning boards, regional resource planning and management groups have been established. Functional planning for comprehensive water resource development in New York is accomplished through the coordination of State, local, and Federal agencies by several regional water resources planning boards. The water resources boards are established under authority of Title 11, Article 15, of New York State Environmental Law as a result of applications by several counties for the responsibility to prepare comprehensive plans for the areas they represent. Regional water resources boards are presently in existence in the Genesee, Black, and St. Lawrence River basins, and formerly existed in the Oswego River basin.

The New York State Office of Planning Services also provides guidance, encouragement, and financial aid to six regional planning and development boards responsible for portions of the Lake Ontario basin. These boards, whose members are local officials and other citizens named by their county governments, coordinate the planning of units within their boundaries and also work to coordinate local and regional plans with State programs. The boards' boundaries follow the State's geographic regions for planning and development and include the following regions: Genesee-Finger Lakes, Southern Tier Central, Southern Tier East, Central, Upper Mohawk Valley, and Black River-St. Lawrence.

10.1.2 Water Resources

10.1.2.1 Lake Ontario and the St. Lawrence River

Average annual inflow to Lake Ontario through the Niagara River and the Welland Canal is 202,000 cubic feet per second. Average annual outflow into the St. Lawrence River is 239,000 cubic feet per second.

The net increase in flow of 37,000 cfs is generated by the natural inflow from the drainage basin and affected by manmade conditions within the Lake Ontario basin. The inflow is regulated by flow control in the Niagara River and through lock operations in the Welland Canal. Outflow and lake levels are regulated by structures in the St. Lawrence River.

Lake Ontario is generally considered to be the second most polluted of the Great Lakes. It is approaching a serious stage of eutrophication, which in part has prompted the recently begun International Field Year for the Great Lakes, a joint U.S.-Canadian research program. It is hoped that this research and a step-up in water pollution control efforts within the last decade or so will prevent Lake Ontario from reaching the state of degradation Lake Erie has reached. However, this will be exceedingly difficult because Lake Erie outflow is a major contributor to the water quality problems in Lake Ontario.

The Lake Ontario outflow at its northeast end forms the St. Lawrence River, which flows from Lake Ontario across the St. Lawrence plain into the Gulf of St. Lawrence. The broad, multiple-channel river head and the small islands between the channels is called the Thousand Islands area. East of this area the river channel narrows abruptly where it flows across a hard, resistant rock protrusion of the Canadian Shield. The river outlet is a long, horn-shaped passage which opens into the Gulf of St. Lawrence.

10.1.2.2 Inland Lakes and Streams

Climatic, topographic, and geological factors influence the flow and runoff of basin streams. The basin contains more than 28,000 miles of rivers and streams. Going from west to east in the basin and from north to south in the eastern portion, average runoff increases from about 15 inches to 40 inches annually. Many regional streams have their origins in the highland regions of the Adirondacks, the Tug Hill Plateau, and the Appalachians. The flows are flashy, with steep gradients and numerous waterfalls. As the streams reach the flatter lake plain areas, they become sluggish and meander before draining into Lake Ontario. Major rivers in the basin include the Genesee, Oswego, Seneca, Black, and Raquette Rivers.

The Oswego, Seneca, Oneida, and Clyde Rivers have been canalized for barge and recreational traffic and are a part of the New York State Barge Canal system. Rivers, lakes, and embayments have a surface area of 449,300 acres, with inland lakes accounting for about 75 percent of the total. Most inland lakes are found in the headwater areas.

Planning Subarea 5.3 contains over 281 inland lakes, most of which are located in St. Lawrence County. The central section (PSA 5.2) has fewer lakes (approximately 85), but they cover 191,000 acres. The Finger Lakes in PSA 5.2 occupy a series of nearly parallel troughs in the southwestern portion of the Oswego River basin. The lakes range in size from 30 square miles to Lake Oneida's 80 square miles. The numerous natural lakes in the Lake Ontario basin provide a high degree of natural flood control.

The Genesee River and some of its tributaries are major sediment transporters. The Barge Canal makes use of the Oswego River and its two major tributaries, the Seneca and Oneida Rivers. The dependable supply of the Oswego River is equal to the low flow of the tributary rivers. However, subject to legal constraints, these flows can be supplemented as needed by water from Lake Erie and the Genesee River on the west, from the Finger Lakes, from the Rome summit area by minimum diversions from the Mohawk and Black Rivers, and from diversion from a small reservoir on the Susquehanna headwaters. Discharge is generally dependable in RBG 5.3.

10.1.2.3 Ground Water

Moderate to poor ground-water resources are available in the Lake Ontario basin. Most of the basin is underlain by fine-grained sedimentary or igneous rocks. The better-yielding aquifers occur locally in the carbonate rocks of central New York, the sandstone and carbonate rocks along the St. Lawrence valley, and the sand and gravel in the glacial drift in valley bottoms. The Adirondack area of RBG 5.3 has the greatest estimated ground-water yield of the basin, and one of the greatest in the entire Great Lakes Basin. The Lake Ontario basin is estimated to be capable of producing 4,910 mgd.

Areas of critical water supply occur along the entire Lake Ontario lowlands from Niagara Falls to the Black River. The bedrock aquifers have low yields, and saline water is present in much of the lowland area south of the Lake. Sustained droughts create severe water shortages in the Ontario low-

TABLE 1–156 Land Use, Lake Huron Plan Area, 1966–67 (thousands of acres)

PSA and State	Total Land Area	Urban Built-Up	Resource Base Cropland	Pasture Range	Forest Land	Other	Total
PSA 5.1							
New York	2,458.7	271.1	1,055.1	162.9	871.5	98.1	2,187.6
PSA 5.2							
New York	5,427.4	250.7	1,759.1	443.7	2,545.7	428.2	5,176.7
PSA 5.3							
New York	3,385.6	145.9	633.9	254.4	2,215.4	136.0	3,239.7
TOTAL	11,271.7	667.7	3,448.1	861.0	5,632.6	662.3	10,604.0

TABLE 1–157 Actual and Projected Land Use, Lake Ontario Plan Area Basin (thousands of acres)

Land Use	Actual 1966–67	Implied Change 1966–67 to 1980	Projected 1980	Implied Change 1980–2000	Projected 2000	Implied Change 2000–2020	Projected 2020
Lake Ontario							
Total land area[1]	11,271.7	---	11,271.7	---	11,271.7	---	11,271.7
Total urban and built-up	667.7	103.2	770.9	138.8	909.7	157.4	1,067.1
Total nonurbanized land	10,604.0		10,500.8		10,362.0		10,204.6
Resource Base:							
Cropland	3,448.1	(39.3)[3]	3,408.8	52.0	3,356.8	59.7	3,297.1
Pasture	861.0	(8.5)	852.5	11.4	841.1	12.8	878.3
Forest Land	5,632.6	(48.0)	5,584.6	65.8	5,518.8	74.2	5,444.6
Other Land	662.3	(7.4)	654.9	9.6	645.3	10.7	634.6
Total[2]	10,604.0	(103.2)	10,500.8	138.8	10,362.0	157.4	10,204.6

Source: Developed by Economic Research Service, U.S. Department of Agriculture, East Lansing, Michigan.

[1]Total land area = total area - water area, and is assumed constant for projection periods.
[2]Detail may not add to total due to rounding.
[3]Bracketed figures represent urban depletions for 1967-1980, 1980-2000, and 2000-2020.

lands and in the Black River valley. Locally, the sand and gravel aquifers are very productive.

10.1.3 Land and Other Natural Resources

With the exception of the narrow lake plains area in the basin, soils are typically poor, having high acidity, and composed of a mixture of sand, gravel, and stones. Swamps are common in the headlands. Bedrock outcrops and glacial till deposits over the basin make poor soil constituents. Land cover in the region is highly variable. Northern hardwoods predominate with many varieties of conifers intermixed. Red spruce and balsam fir characterize the Adirondack region, with white pine, hemlock, and northern white cedar present in the Tug Hill Plateau.

The vast amount of land in agriculture and forest gives the Lake Ontario basin a decidedly rural-scenic setting. Over 80 percent of the land is included in these categories. That portion of the land which is forested varies from about 20 percent in the Genesee and Oswego basins to nearly 100 percent in the Adirondacks. Most of the forest land in the Adirondack region is in the State-owned Adirondack Forest Preserve. Outside this region most of the forest land is privately owned, although there are scattered State and county-owned forests. Dairying is the predominant agricultural activity in the basin, with fruit and vegetable production important in the western half of the basin and in the Finger Lakes region. Distribution of the uses of the land in the basin is shown in Table 1–156 and Figure 1–45. Table 1–157 provides information on land use in the basin in 1966–67 and projects future changes to the land resource base. Table 1–158 provides the same information broken down by PSA.

The distribution of rocks and glacial debris defines the type and location of mineral resources within the Lake Ontario region. Precambrian and Cenozoic formations produce significant quantities of iron ore, lead, base metals (especially zinc), talc,

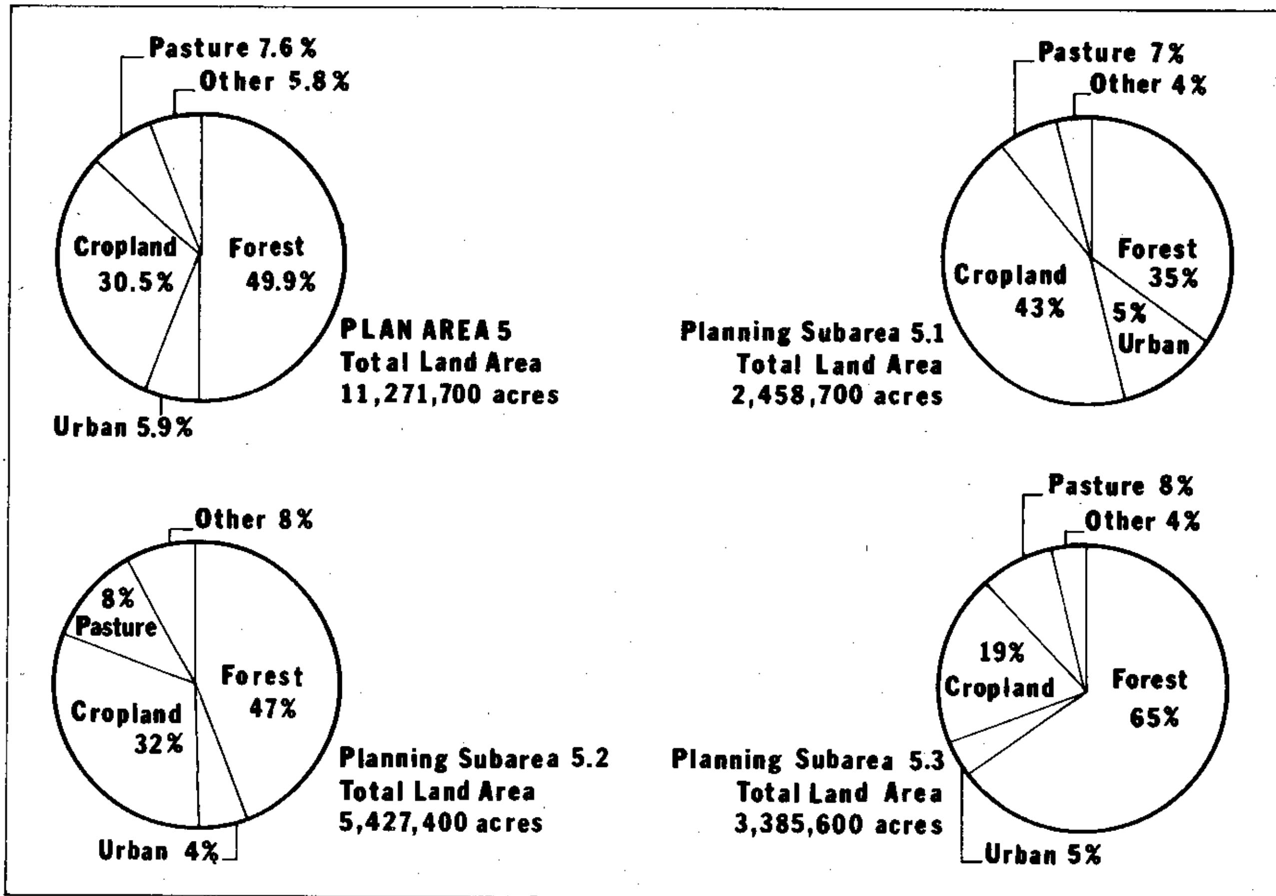

FIGURE 1–45 Land Use in the Lake Ontario Basin

marble, limestone, and dolomite. Sand and gravel, peat, marl, and salt are extracted from unconsolidated glacial and lake plain deposits.

The basin's water and land resources are especially favorable for the growth and maintenance of wildlife and fish resources. The basin is especially noted for its large deer population. Small game species like rabbit, raccoon, pheasant, and squirrel are among the many animals that are common in the basin. Coldwater and warmwater fishing in the basin is very productive. Muskellunge, northern pike, bass, walleyed pike, salmon, and brook, lake and rainbow trout are favorite fish game species.

The United States shoreline of Lake Ontario (including islands) between the Niagara River and the Iroquois Dam on the St. Lawrence River is about 726 miles in length. The southern shore is extremely regular with few natural embayments. The shoreline consists principally of eroded clay and silt bluffs, but from Braddock Bay eastward there are occasional ponds or bays. These bays have sandbar barriers across their mouths, which render them ineffective as recreational boat harbors. Sand beaches are narrow and infrequent west of Oswego; however, there are good beaches at Fair Haven and Hamlin Beach State Parks and at Ontario Beach in Rochester. East of Oswego, excellent sand beaches are common up to Henderson Harbor. From Henderson Harbor northward to the head of the St. Lawrence River the shore is low and rocky.

One of the more striking shore formations lies east of Sodus Bay where the erosion of drumlins has created unusual topography. The Thousand Island region at the head of the St. Lawrence River cuts through an area of glaciated crystalline rocks forming an isthmus between the ancient Laurentian Highlands of Canada and the Adirondacks of New York. This "granite knob" country, though low in relief, has a jumbled topography that gives the countryside a picturesque appearance, exemplified by the St. Lawrence River flowing through the Thousand Islands.

10.1.4 Resource Problems

For each resource use category, the water and

TABLE 1–158 Actual and Projected Land Use, Lake Ontario Plan Area by PSA (thousands of acres)

Land Use	Actual 1966–67	Implied Change 1966–67 to 1980	Projected 1980	Implied Change 1980–2000	Projected 2000	Implied Change 2000–2020	Projected 2020
PSA 5.1							
Total land area[1]	2,458.7	---	2,458.7	---	2,458.7	---	2,458.7
Total urban and built-up	271.1	30.2	301.3	40.6	341.9	51.4	393.3
Total nonurbanized land	2,187.6		2,157.4		2,116.8		2,065.4
Resource Base:							
Cropland	1,055.1	(14.6)[2]	1,040.5	(19.6)	1,020.9	(24.8)	996.1
Pasture	162.9	(2.2)	160.7	(3.0)	157.7	(3.8)	153.9
Forest Land	871.5	(12.0)	859.5	(16.2)	843.3	(20.5)	822.8
Other Land	98.1	(1.4)	96.7	(1.8)	94.9	(2.3)	92.6
Total[3]	2,187.6	(30.2)	2,157.4	(40.6)	2,116.8	(51.4)	2,065.4
PSA 5.2							
Total land area[1]	5,427.4	---	5,427.4	---	5,427.4	---	5,427.4
Total urban and built-up	250.7	72.2	322.9	91.1	414.0	98.0	512.0
Total nonurbanized land	5,176.7		5,104.5		5,013.4		4,915.4
Resource Base:							
Cropland	1,759.1	(24.5)	1,734.6	(31.0)	1,703.6	(33.3)	1,670.3
Pasture	443.7	(6.2)	437.5	(7.8)	429.7	(8.4)	421.3
Forest Land	2,545.7	(35.5)	2,510.2	(44.8)	2,465.4	(48.2)	2,417.2
Other Land	428.2	(6.0)	422.2	(7.5)	414.7	(8.1)	406.6
Total[3]	5,176.6	(72.2)	5,104.5	(91.1)	5,013.4	(98.0)	4,915.4
PSA 5.3							
Total land area[1]	3,385.6	---	3,385.6	---	3,385.6	---	3,385.6
Total urban and built-up	145.9	.8	146.7	7.1	153.8	8.0	161.8
Total nonurbanized land	3,239.7		3,238.9		3,231.8		3,223.8
Resource Base:							
Cropland	633.9	(.2)	633.7	(1.4)	632.3	(1.6)	630.7
Pasture	254.4	(.1)	254.3	(.6)	253.7	(.6)	253.1
Forest Land	2,215.4	(.5)	2,214.9	(4.8)	2,210.1	(5.5)	2,204.6
Other Land	136.0	(*)	136.0	(.3)	135.7	(.3)	135.4
Total[3]	3,239.7	(.8)	3,238.9	(7.1)	3,231.8	(8.0)	3,223.8

Source: Developed by Economic Research Service, U.S. Department of Agriculture, East Lansing, Michigan.

[1]Total land area = total area − water area, and is assumed constant for projection periods.
[2]Bracket figures represent urban depletions for 1967–1980, 1980–2000, and 2000–2020. (*) indicates < 50 ac. depletion.
[3]Detail may not add to total due to rounding.

related land resources problems were rated as severe, moderate, minor, or no problem for each river basin complex in the Lake Ontario basin, and the results are presented in Table 1–159. The problems evaluation was for the base year. The problems most prevalent throughout the basin were in the field of outdoor recreation. Wildlife management also requires attention at an early date. In RBGs 5.1 and 5.2 municipal and industrial wastewater discharges create problems which are serious and demand immediate attention.

In Lake Ontario proper major problems include:

(1) the growth of *Cladophora*, a filamentous green alga largely from nutrient inputs coming into Lake Ontario through the Niagara River

(2) the die-off of alewife within the Lake, creating undesirable conditions along the beaches

(3) the buildup of sulfate and chloride ions and total dissolved solids in the Lake.

In the Rochester area high bacterial counts from metropolitan sewage have caused many public beaches to be closed.

The nutrient-laden waters of Lake Erie, wastes from the heavy industrial complex along Buffalo Creek, and direct waste discharges from municipalities and industries constitute a major pollution load to the Niagara River, creating excessive growth of *Cladophora* in the lower reaches of the river below the falls.

10.1.5 Existing Resource Use and Development

10.1.5.1 Water Withdrawals

In the 1970 base year, 1,994,440 persons in the Lake Ontario basin were served by central water

TABLE 1-159 Lake Ontario Basin, Resource Problems Matrix

	LAKE ONTARIO BASIN 5.0																																							
		River Basin Group 5.1									River Basin Group 5.2													River Basin Group 5.3																
			Niagara Orleans C.				Genesee River Basin					Wayne-Cayuga C.				Oswego River Basin				Salmon River C.					Black River Basin				Perch River Basin				Oswegatchie River Basin				Grass Complex[1]			
Resource Use Category	Overall	Overall	Overall	Urban	Rural	Interface	Overall	Urban	Rural	Interface	Overall	Overall	Urban	Rural	Interface	Overall	Urban	Rural	Interface	Overall	Urban	Rural	Interface	Overall	Overall	Urban	Rural	Interface	Overall	Urban	Rural	Interface	Overall	Urban	Rural	Interface	Overall	Urban	Rural	Interface
WATER WITHDRAWALS																																								
MUNICIPALLY SUPPLIED	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SELF-SUPPLIED INDUSTRIAL	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
RURAL DOMESTIC & LIVESTOCK	1	1	-	-	1	-	-	-	1	-	1	-	-	1	-	-	-	1	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
IRRIGATION	2	2	2	-	2	-	1	-	1	-	2	1	-	1	-	2	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MINING	2	2	2	-	1	2	2	-	1	-	2	2	-	1	2	2	-	1	-	-	-	1	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
THERMAL POWER COOLING	2	1	-	-	-	1	1	3	-	1	2	1	-	-	2	-	-	2	-	2	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
NON-WITHDRAWAL WATER USES																																								
MUNICIPAL WASTEWATER DISCHARGES	2	2	2	2	2	2	3	3	2	1	3	2	-	1	1	3	3	2	-	1	-	1	1	1	1	2	1	-	-	-	1	-	1	1	-	-	1	1	1	-
INDUSTRIAL WASTEWATER DISCHARGES	2	2	-	1	1	1	2	3	1	2	3	2	-	3	1	3	3	3	-	1	-	1	1	1	1	2	1	-	-	-	-	-	-	-	-	-	1	1	1	-
HYDROELECTRIC POWER	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
WATER ORIENTED OUTDOOR REC.	3	3	2	2	1	3	3	3	2	3	3	3	3	2	3	3	3	2	3	2	-	2	3	2	2	2	1	-	2	-	2	3	2	2	2	2	2	2	2	2
SPORT FISHING	1	1	-	-	-	1	-	-	-	-	1	-	-	-	1	-	-	-	-	-	-	-	1	1	-	-	-	1	-	-	-	1	-	-	-	1	-	-	-	1
RECREATIONAL BOATING	-	1	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
COMMERCIAL FISHING	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
COMMERCIAL NAVIGATION	2	2	-	-	-	-	2	2	-	-	2	-	-	-	-	2	2	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	2	2	-	-	2	2	-	-
RELATED LAND USES & PROBLEMS																																								
LAND USE	2	2	-	-	1	1	2	3	2	-	2	1	-	1	1	2	3	2	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
AGRICULTURAL LAND TREATMENT	1	1	1	-	1	-	2	-	2	-	-	-	-	-	-	1	-	1	-	-	-	-	-	-	1	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-
CROPLAND DRAINAGE	-	-	-	-	1	-	-	-	1	-	-	-	-	-	-	1	-	2	-	-	-	-	-	-	1	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-
FOREST LAND TREATMENT	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1	-	-	1	-	-	-	1	-	-	-	1	-	-	-	1	-
SHORELAND EROSION	1	1	-	-	-	1	-	-	-	1	-	-	-	-	1	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
STREAMBANK EROSION	2	2	-	1	-	-	3	3	-	-	2	-	1	-	-	-	3	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	1	-
FLOOD PLAINS	2	2	1	-	-	-	1	3	3	-	2	-	-	-	-	3	3	3	-	-	-	-	-	1	2	2	2	-	-	-	-	-	-	-	-	-	-	-	-	-
WILDLIFE MANAGEMENT	2	3	3	3	3	3	3	3	3	3	2	2	-	2	3	2	3	2	3	2	2	2	2	1	1	-	2	2	-	-	-	2	-	-	-	2	-	-	-	2
AESTHETIC & CULTURAL	1	1	-	-	-	1	1	2	1	-	1	-	1	1	1	1	2	1	-	-	-	-	1	1	-	-	-	-	-	-	-	1	-	-	1	1	-	-	1	1
OUTDOOR RECREATION	3	3	2	2	1	3	3	3	2	3	3	3	3	2	3	3	3	2	3	2	-	2	3	2	2	2	1	-	2	-	2	3	2	2	2	2	2	2	2	2

[1]The full name of this area is the Grass-Raquette-St. Regis Complex

Legend:
- 3 Severe--Demands immediate attention
- 2 Moderate--Of major concern; potentially serious
- 1 Minor--Not considered a serious problem
- \- Problem is insignificant or not known

TABLE 1–160 Water Sources for Municipal Water Supply, Lake Ontario Plan Area, 1970 (mgd)

PSA	State	Source Capacity	Water Source: Great Lakes	Inland Lakes and Streams	Groundwater
5.1	New York	174	136	20	18
5.2	New York	240	32	175	33
5.3	New York	82	19	50	13
TOTAL	---	496	187	245	64

TABLE 1–161 Municipal Water Supply Development, Lake Ontario Plan Area (mgd)

PSA	State	1970 Average Demand: Domestic and Commercial	Municipally Supplied Industrial	Total	Source Capacity
5.1	New York	81	50	131	174
5.2	New York	136	51	187	240
5.3	New York	16	29	45	82
TOTAL	---	233	130	363	496

TABLE 1–162 Industrial Water Supply Development, Lake Ontario Plan Area, 1970 (mgd)

PSA	State	Gross Water Requirements[1]	Self-Supplied: Withdrawals	Consumptive Use
5.1	New York	245	50	5
5.2	New York	588	262	19
5.3	New York	229	76	7
TOTAL		1,062	388	31

[1]Partially supplied by recirculation

TABLE 1–163 Rural Water Supply, Lake Ontario Plan Area, 1970 (mgd)

PSA	State	Developed Source Capacity	Consumptive Use
5.1	New York	10.8	5.2
5.2	New York	32.1	12.3
5.3	New York	9.3	4.9
TOTAL		52.2	22.4

systems; 809,800 were served by Great Lakes sources; 975,100 were served by inland lake and stream sources; and 209,500 were served by ground-water sources. Municipal water supply sources and development are summarized in Tables 1–160 and 1–161.

Industries in the Lake Ontario basin utilized about 36 percent of the water withdrawn by municipal systems in 1970. Heavy water uses occur in each of the three river basin groups. In RBG 5.1 the manufacture of photographic equipment requires a considerable amount of water. In RBG 5.2 there is considerable dependence by industry on municipally supplied water. Industries that use a considerable amount of water in this area include paper and paper board and primary metal producers.

In 1967 the Lake Ontario region accounted for 6 percent of the total value added by manufacture for the entire Great Lakes Basin. It used approximately 4 percent of the total manufacturing water withdrawal. About 98 percent of the water self-supplied by industries is taken from surface water supplies, with inland lakes and streams as the primary source. The remainder is obtained from company-owned wells. Table 1–162 contains data on industrial water supply development.

Ground water is the source of most of the water supplies for rural domestic and livestock, spray water, and nonfarm uses throughout the entire Lake Ontario basin (Table 1–163).

In 1970 an estimated 49 mgd of water was supplied over a 100-day season to irrigate 11,842 acres of high-value cropland and 5,770 acres of golf courses in the Lake Ontario basin. Ground water is the principal source, with some water from surface supplies (Table 1–164).

Minerals operations are largely on a seasonal

TABLE 1–164 Irrigation Water Supply, Lake Ontario Plan Area, Base Year, estimated

	Agriculture			Golf Courses		
		Withdrawal (mgd)			Withdrawal (mgd)	
PSA	Acres	100-Day Season	Annual	Acres	100-Day Season	Annual
5.1	4,492	8	2.2	1,000	5	1.4
5.2	7,350	13	3.6	4,200	20	5.5
5.3	0	--	---	570	3	0.8
TOTAL	11,842	21	5.8	5,770	28	7.7

TABLE 1–165 Minerals Water Supply, Lake Ontario Plan Area, 1968, estimated (mgd)

		New Water Intake		
PSA	Total Water Requirements[1]	Seasonal	Annual Average	Consumptive Use[2]
5.1	4.5	2.7	1.9	0.4
5.2	14.3	12.8	12.2	3.7
5.3	12.9	2.2	2.0	1.3
TOTAL	31.7	17.7	16.1	5.4

[1]New water intake plus recirculated water (seasonal: April-November in PSA 5.1 and PSA 5.2; May-October in PSA 5.3

[2]Annual average

TABLE 1–166 Source of New Water Used by Mineral Industries, Lake Ontario Plan Area, 1968, estimated (mgd)

New Intake	April-November	Average for 365 Days
Streams	4.2	3.5
Lakes	9.6	9.6
Ground Water	2.4	1.6
Mines	1.3	1.3
Other	0.2	0.1
TOTAL	17.7	16.1

TABLE 1–167 Electric Power Development, Lake Ontario Plan Area

	Type and Capacity (MW)						Steam Electric
	Hydroelectric						
PSA	Conventional	Pumped Storage	Gas Turbine	Fossil Steam	Nuclear Steam	Total	Water Withdrawal (mgd)
5.1	2,011	240	38	470	517	3,276	737
5.2	86	0	5	806	642	1,539	1,046
5.3	1,207	0	1	0	0	1,208	0
TOTAL	3,304	240	44	1,276	1,159	6,023	1,783

basis. Inland lakes are the major source of water for this industry in the Lake Ontario basin (Tables 1–165 and 1–166).

In 1970 electric power supply within the Lake Ontario basin came principally from generating plants of 10 MW and larger, consisting of 5 fossil steam plants, 1 pumped storage plant, 13 hydroelectric plants, 2 gas turbine plants, and 2 nuclear steam plants. Additional nuclear development scheduled as of 1970 included one plant in RBG 5.1 and four locations in RBG 5.2 (Table 1–167). Power generation for the basin exceeded 34 billion kilowatt-hours of electricity in 1970.

All condenser cooling systems operating in 1970 were of the flow-through type. Although most of the large thermal power sites are located on the Great Lakes, the connecting channels, or in the St. Lawrence River, there are also some plants along the shores of inland lakes.

10.1.5.2 Nonwithdrawal Water Uses

The following stream segments have been reported by the States as having priority for correction of water quality deficiencies:

(1) River Basin Group 5.1
- (a) Genesee River—upper portion from Pennsylvania line to Mt. Morris, New York
- (b) Lake Ontario—western section
- (c) Genesee River—from Mt. Morris to New York State Barge Canal
- (d) Canaseraga Creek
- (e) Keshequa Creek
- (f) Honeoye Creek
- (g) Genesee River—lower portion
- (h) Black Creek
- (i) Oatka Creek
- (j) Van Campen Creek

(2) River Basin Group 5.2

TABLE 1–168 Municipal and Industrial Wastewater Flows, Lake Ontario Plan Area, 1970

PSA	State	mgd Municipal	Industrial
5.1	New York	225	298
5.2	New York	128	188
5.3	New York	15	145
TOTAL	---	368	631

(a) Lake Ontario—central section
(b) Onondaga Lake
(c) Chittenango Creek
(d) Seneca Lake—upper portion
(e) Oneida River
(f) Oneida Creek
(g) Owasco Inlet
(h) Canandaigua Outlet
(i) Oswego River
(j) Fish Creek—Barge Canal portion
(k) Seneca River
(j) Red Creek
(k) Crusoe Creek
(l) Skaneateles Creek
(m) Seneca Canal

(3) River Basin Group 5.3
(a) Lake Ontario—eastern section
(b) St. Lawrence River
(c) Sandy Creek
(d) Hammond Brook
(e) Oswegatchie River
(f) Indian River
(g) Grasse River
(h) St. Regis River
(i) Elm Creek
(j) Raquette River

Waste discharges treated in the base year are shown in Table 1–168.

There are numerous hydroelectric plants in the tributary streams of the St. Lawrence River in RBG 5.3. Over 80 percent of the present hydroelectric capacity of the Great Lakes Basin is found in the Lake Ontario basin, primarily in RBG 5.1 (Niagara River) and RBG 5.3. It has been estimated that over 5,700 MW of potential pumped storage capacity could be developed at sites in the Lake Ontario basin. An additional 627 MW of conventional hydropower is also undeveloped in the basin.

The New York Power Authority's Niagara Hydroelectric Project consists of the Robert Moses Niagara power plant and the Lewiston pumped storage plant. These plants working together make it possible to utilize effectively the flows available from the Niagara River for power. The 1950 Treaty between the United States and Canada concerning Niagara Project power diversions provides that during the hours 8 a.m. to 10 p.m. April 1 to September 15, and 8 a.m. to 8 p.m. September 16 through October 31, at least 100,000 cfs must be allowed to flow over Niagara Falls. At all other times the flow over the falls may be reduced to no less than 50,000 cfs. In order to use the larger nighttime flows available under the Treaty for power diversions it was necessary to provide the storage reservoir facilities. At night when power requirements are small some of the available water is pumped into the Lewiston pumped storage reservoir. The following day when peak power demands are large, stored water is released through the Lewiston units which are then functioning as turbine generators. The water released augments daytime diversions from the Niagara River for use at the Robert Moses Niagara power plant.

Commercial fishing in Lake Ontario has never been comparable to that of the other Lakes. Sport fishing has been of significant importance in the eastern basin and in shoal and bay areas since before 1900. Table 1–169 provides information on the Lake Ontario sport fishery in 1970. Smallmouth

TABLE 1–169 Sport Fishery, Lake Ontario Plan Area, 1970

PSA	State	Ponded Waters (acres)	Fishing Licenses Resident	Fishing Licenses Non-Resident	Angler Days (1000)
5.1	New York	11,860	75,620	1,100	2,600
5.2	New York	211,950	152,660	3,500	6,200
5.3	New York	39,800[1]	43,650	3,200	3,000
TOTAL	---	263,610	271,930	7,800	11,800

[1]The discrepancy between this figure and the averages given in the text discussion also appears in Appendix 8, *Fish*, and has not been resolved.

TABLE 1-170 Recreational Boating Development, Lake Ontario Plan Area, 1969

PSA	State	Lake Ontario Harbors	Access Sites[2]	Total No. of Boats	Total Boat Days in Use
5.1	New York	12	5	24,500	648,000
5.2	New York	12	29	82,000	2,460,000
5.3	New York	9[1]	8	30,600	918,000
TOTAL	---	33	42	137,100	4,026,000

[1]Includes St. Lawrence River

[2]Inland lakes

bass continues to be the most important game fish and presently supports a multimillion dollar sport fish business complex. Yellow perch, bullheads, northern pike, and various other panfish make up the list of important angler species. The eastern basin supports almost the entire sport fishery and most of the commercial fishery in Lake Ontario.

Since 1950, smelt dipping has become a major family-oriented sport fishery during the spring spawning run. A winter ice fishery is popular for yellow perch, and to a much lesser degree, northern pike.

Results from the 1968–70 New York and Ontario experimental salmon stocking program were very poor, due primarily to high mortality from lamprey predation. Canadian tributaries received lamprey control treatment in 1971, the New York waters in 1972. It is anticipated that lamprey control will be repeated every four to six years.

In addition to lamprey control, adequate salmonid stocking must be insured. Plans for expansion of existing State hatchery facilities and possible construction of one or two State and/or Federal hatcheries are in the formative stage.

The major fishery problems related to Lake Ontario proper are listed below in order of priority:

(1) protection and enhancement of the habitat base

(2) development of a major salmonid sport fishery through

- (a) lamprey control
- (b) salmonid stocking
- (c) acqusition and development of access sites
- (d) promotion

(3) development of a fish stock monitoring system for the open lake and inshore areas

(4) protection and enhancement of the existing inshore warmwater fishery

(5) development of a commercial fishery where compatible with the sport fishery

(6) automated processing of all data

(7) coordination with Ontario and upper Lakes to insure total fish management of the Lake on a sound basis

(8) research to develop management methods to solve present and predicted needs

(9) cost-benefit data to help determine the most justifiable total fishery for the Lake

(10) education of the public as to the potential of the Lake and best methods available to utilize the total fishery.

In River Basin Group 5.1 there is a need for additional lake fisheries in the upper portion of the Genesee basin. Problems in the 5.1 area restricting fishing opportunities include water quality impairment, high intensity boating use, and the need for development of shorelines on the larger lakes. Drawdown and water level regulation are problems in some of the lakes.

Current fish management programs in PSA 5.1 include stocking, stream improvement, and special fishing regulations. The trout stocking program totals 100,000 yearling trout and 22,000 fingerling trout annually. The species stocked are lake trout, rainbow trout, brown trout and brook trout.

The waters in Planning Subarea 5.2 offer an excellent variety and abundance of fish habitat, and consequently, the number of important sport species is large. This presents a problem in determining the most important species on a priority basis. Lake and rainbow trout are extremely valuable sport species in the Finger Lakes. Pollution from industrial, agricultural, and domestic sources is the major problem affecting fishing throughout the 5.2 area. Fluctuating water level is a problem on many waters. Natural and manmade barriers are a problem to anadromous fish management.

Because of the wide range of habitat, Planning Subarea 5.3 supports a large number of fish species. Fishable waters in this area, excluding marshes and farm ponds, include approximately 31,000 acres of ponded cold water, 29,200 acres of ponded warm water, 2,630 miles of coldwater streams, and 721 miles of warmwater streams. Much of the designated coldwater habitat also supports the warmwater species. There is a need for ponded trout waters in most of the section outside of the Adirondack Mountains.

Both pollution and power dam regulation are major fishery problems in PSA 5.3, causing low flows harmful to fish. Existing dams are the major problem in anadromous fish management. This is particularly true of the Black River. In the upper reaches of the river systems, and to some degree in the downstream reaches, beavers have ruined once-excellent trout waters over the past 20 years.

About 137,000 boats operated in the Lake Ontario basin in 1968. The vast majority of recreational craft used today are 20 feet or less in length. Boating opportunities developed in River Basin Groups 5.1, 5.2, and 5.3 are shown in Table 1–170.

River Basin Group 5.1 experiences only a modest influx of nonresident boaters because of its limited quantity of water suitable for recreational boating. Lake Ontario beaches in RBG 5.1 are generally narrow and composed of sand and gravel. The shoreline is generally regular with little natural shelter. Ponds are cut off from the Lake. The narrow and shallow outlet channels are usable only by small boats familiar with the waters. The ponds themselves are much used by small boats. The principal streams that have been identified as good canoeing waters are the Genesee River and Johnson Creek. The lack of stream improvements, lack of maintenance, and periodic low flows limit the amount of canoeing and small boat opportunities on the inland streams in the area.

River Basin Group 5.2 experiences a large influx of nonresident boaters because of its large quantities of water suitable for recreational boating. There are few reservoir sites in the RBG 5.2 area. The large inland lakes, particularly the Finger Lakes, are extensively used for recreational boating. Lake Ontario shoreline characteristics in RBG 5.2 are varied. Most of the area east of Oswego is well-suited for recreational boating, with a number of sheltered open water areas. There are five Federal harbor projects along the lakeshore in the RBG 5.2 area: Oswego Harbor, Great Sodus Bay, Little Sodus Bay, Port Bay, and Port Ontario. The latter two have not been built as yet. Private interests have provided boating facilities at three other locations. These harbors provided mooring for 835 vessels in 1967. Part of the RBG 5.2 area, the northeastern corner, is still in almost wilderness condition and not readily accessible to boaters. However, these areas are available to canoeists and some of the canoe waters connect to extensive systems of canoe waters east of the Great Lakes Region. The principal canoeing streams are the Salmon River, the Moose River, Fish Creek, and Fall Creek.

TABLE 1–171 Agricultural Land Treatment Needs, Lake Ontario Plan Area, 1970 (thousands of acres)

PSA	Cropland	Pasture Land	Other Land	Total
5.1	533.5	96.3	24.4	654.2
5.2	998.5	304.6	109.2	1,412.3
5.3	368.2	141.9	19.8	529.9
TOTAL	1,900.2	542.8	153.4	2,596.4

River Basin Group 5.3 experiences a large influx of nonresident boaters because of its large quantities of water suitable for recreational boating, its scenic beauty, and freedom from an urban environment. Few potential reservoir sites exist in the area. Only a few large sites are available. Along the Lake Ontario shoreline there are several large bays available to offer shelter and boatable water when use of the open Lake would be hazardous. This area also includes the upper 114 miles of the St. Lawrence River from the head of the river at Lake Ontario. The river in the area is essentially an arm of the Lake, and the drop in water surface elevation from Lake Ontario is small. The current is slow and in many cases imperceptible. There is an abundance of sheltered waters for boating, including areas suitable for construction of marinas and launching ramps. The upper 40 miles of the river is the famous Thousand Islands section noted for its scenic beauty. This combination of sheltered water and beautiful scenery attracts boaters from well outside the area, including many from outside the State. There are Federal harbor projects at Sacketts Harbor, Cape Vincent, Morristown, and Ogdensburg. These provide some facilities for recreational craft. Some of the inland lakes in the more rugged portion of the area are not readily accessible. It is State policy to maintain such areas as wilderness. Principal rivers and tributaries that have been identified as good canoeing waters are the St. Lawrence, Black, Oswegatchie, Indian, Grass, and Raquette Rivers.

There are Federal harbors on Lake Ontario at Rochester, Great Sodus Bay, Oswego, and on the St. Lawrence River at Ogdensburg.

Major commodities at Rochester include exports of coal to Canada and imports of cement from Canada.

No commerce has been reported at Great Sodus Bay in recent years. Traffic at Oswego consists of receipts of cement from Canadian and from U.S. lake ports and shipments of fuel oil to Canada from the United States.

At Ogdensburg, traffic of 0.3 million tons in 1969 included imports of pulp and newsprint from

TABLE 1–172 Drainage Limitations in the Lake Ontario Plan Area (thousands of acres)

PSA	Total Land Area	Agricultural Land	Drainage Problems Severe	Drainage Problems Some
5.1	2,459	1,316	147	87
5.2	5,427	2,631	251	234
5.3	3,386	1,024	206	117
TOTAL	11,272	4,971	604	438

Canada and receipts of gasoline and fuel oil from other U.S. lake ports.

Table 1–171 lists the existing agricultural land by planning subareas in the Lake Ontario basin. About 1,414,700 acres or 33 percent of all agricultural land in the basin is now receiving adequate conservation land treatment and management.

Conservation measures on agricultural lands in the Lake Ontario basin have been accomplished by private land owners and local soil and water conservation districts with technical assistance from the Soil Conservation Service.

About 14 percent of the total agricultural land in the Lake Ontario basin, or 1,656,000 acres, has a wetness problem (Table 1–172). About two-thirds of this is wet cropland and pasture land needing on-farm action, and the balance is wet cropland and pasture land needing project action. Dry soil conditions occur in the Rochester, Syracuse, Utica, and Rome areas, and urban expansion there is not constrained by soil wetness. The large lake plain areas in RBGs 5.1 and 5.2 have historically had poor drainage.

More than 5.6 million acres, or 50 percent of the Lake Ontario region, is covered by forests. About 5 million acres are classed as commercial forest land. Hardwoods such as maples, beeches, and birches predominate. The Adirondack Mountain area has the major concentration of forest in the Lake Ontario basin. Ownership is 80 percent private, 10 percent forest industry, and the balance, State, Federal, and other public. About 3.8 million acres of the total could benefit from forest conservation treatment.

Table 1–40 in Section 5 summarizes shoreline use and ownership for the Lake Ontario basin. The shorelands within one-half mile of the lakeshore are predominantly agricultural or open lands. The lands immediately adjacent to the Lake are generally open or in low-density development. Urban development is concentrated in the areas of Rochester, Irondequoit, and Oswego. The Lake Ontario shoreline includes numerous bird nesting and migration areas.

Major islands and island groups in Lake Ontario include Grenadier-Fox-Litt Islands, Galloo Island, and the Stony Islands. These islands are for the most part privately owned and used primarily for hunting and fishing activities.

The Lake Ontario shoreline has considerable unprotected mileage subject to noncritical erosion and a somewhat lesser amount of unprotected shoreline subject to critical erosion, as shown in Table 1–173.

Beach erosion control reports have been completed for Fort Niagara State Park, Hamlin Beach State Park, Fair Haven State Park, and Selkirk Shores State Park, and projects have been authorized. The first two of these are awaiting funds in order to be built; the latter two have been deferred due to a lack of local interest.

Table 1–174 summarizes existing streambank erosion by river basin group. Streambank erosion results in some siltation of reservoirs in the Lake Ontario basin and increases the amount of harbor dredging for commercial navigation. Increased sediment resulting from urbanizing areas could become the major source of sediment in the streams in this area as well as a serious pollution threat as a carrier of contaminants.

Table 1–175 summarizes the urban and rural acreage subject to flooding and urban and rural average annual flood damages as of 1970 by river basin group.

There are two channel improvements and one levee project in RBG 5.1; three channel improvements and a watershed treatment area in RBG 5.2; and institutional measures in both. There are no existing flood damage protection measures in RBG 5.3. The flooding which occurred in June 1972 resulted in very high levels of both urban and rural damages in the Genesee River basin.

TABLE 1–173 Lake Ontario Shoreline Conditions, 1970 (in miles)

RBG	State	Total Shoreline	Subject to Erosion: Critical	Subject to Erosion: Noncritical	Subject to Erosion: Protected	Subject to Flooding	No Problem
5.1	New York	81.6	12.3	46.7	11.7	10.9	0
5.2	New York	132.5	4.5	84.1	9.4	0	34.5
5.3	New York	75.5	0	38.2	4.5	7.5	25.3
TOTAL	---	289.6	16.8	169.0	25.6	18.4	59.8

TABLE 1–174 Streambank Erosion in the Lake Ontario Basin, 1970

PSA	State	Bank Miles of Damage Severe	Bank Miles of Damage Moderate	Annual Damages ($) Land Loss	Annual Damages ($) Sedimentation	Annual Damages ($) Other	Annual Damages ($) Total
5.1	New York	45	266	29,200	203,800	1,600	234,600
5.2	New York	109	674	25,600	29,600	13,800	69,000
5.3	New York	77	340	8,000	4,300	9,600	21,900
TOTAL	---	231	1,280	62,800	237,700	25,000	325,500

TABLE 1–175 Estimated Flood Damages, Lake Ontario Basin, 1970

RBG	State	Estimated Average Annual Damages ($) Urban	Estimated Average Annual Damages ($) Rural	Estimated Acres in Flood Plain Urban	Estimated Acres in Flood Plain Rural
5.1	New York	213,500	496,600	7,535	72,153
5.2	New York	116,100	822,800	8,060	130,837
5.3	New York	9,500	205,100	768	46,195
TOTAL		339,100	1,524,500	16,363	249,185

TABLE 1–176 Wildlife Habitat in the Lake Ontario Plan Area, 1960

PSA	State	Total Land Area (acres)	Farm Habitat Acres	Farm Habitat % of Total Land	Forest Habitat Acres	Forest Habitat % of Total Land	Total Habitat (acres)
5.1	New York	2,458,700	1,525,700	62	579,100	24	2,104,800
5.2	New York	5,427,400	2,909,800	54	2,080,900	38	4,970,700
5.3	New York	3,385,700	1,160,300	34	2,011,300	59	3,171,600
TOTAL	---	11,271,700	5,595,800	50	4,671,300	41	10,247,100

NOTE: The area of the land resource base, made up of the farmland and forest land, and reported elsewhere, is based on 1966–1967 measurements and estimates. Habitat is based on 1960 information and estimates. In some instances changes in land use result in habitat being recorded as greater than the corresponding land base in the PSA or State.

10.2.5.3 Related Land Uses and Problems

A good diversity of habitat exists across the basin. This diversity makes it possible for a greater variety of wildlife to exist, as well as making the habitat more productive. Table 1–176 shows types of habitat available.

The Niagara River is an important waterfowl resting and feeding area during migration. Scattered small wetlands are found, mostly near the Lake Ontario shore, but none are of great waterfowl importance. The primary waterfowl use areas are shown on the map, Figure 1–46.

Planning Subarea 5.1 is about equally divided into southern forested uplands and northern agricultural lowlands. The lowland portion contains numerous wetlands in lakeshore bays and inland areas.

Forest game populations in the southern half of the planning subarea are of low to medium density. Farm game is doing well in the lowland portion of the planning subarea, with pheasant populations higher than is usual in the Basin. This may indicate that changes in farming practices which are detrimental to habitat have not yet occurred here as extensively as elsewhere. Most fur bearers are found at medium densities in the shore marshes and marshes associated with inland rivers and streams.

Planning Subarea 5.2 is a large sprawling area which encompasses a wide variety of habitats, including agricultural lands, small woodlots, idle farmlands, marshy stream bottoms, lake-associated marshes, wooded river bottoms, and intermediate and mature forests. A broad urban belt bisects the planning subarea from east to west, and expansion of the zone is eliminating wildlife habitat. However, idle farmland is more common in the vicinity of urban areas, and due to its high quality as wildlife habitat, the increases in this acreage partially compensate for habitat losses.

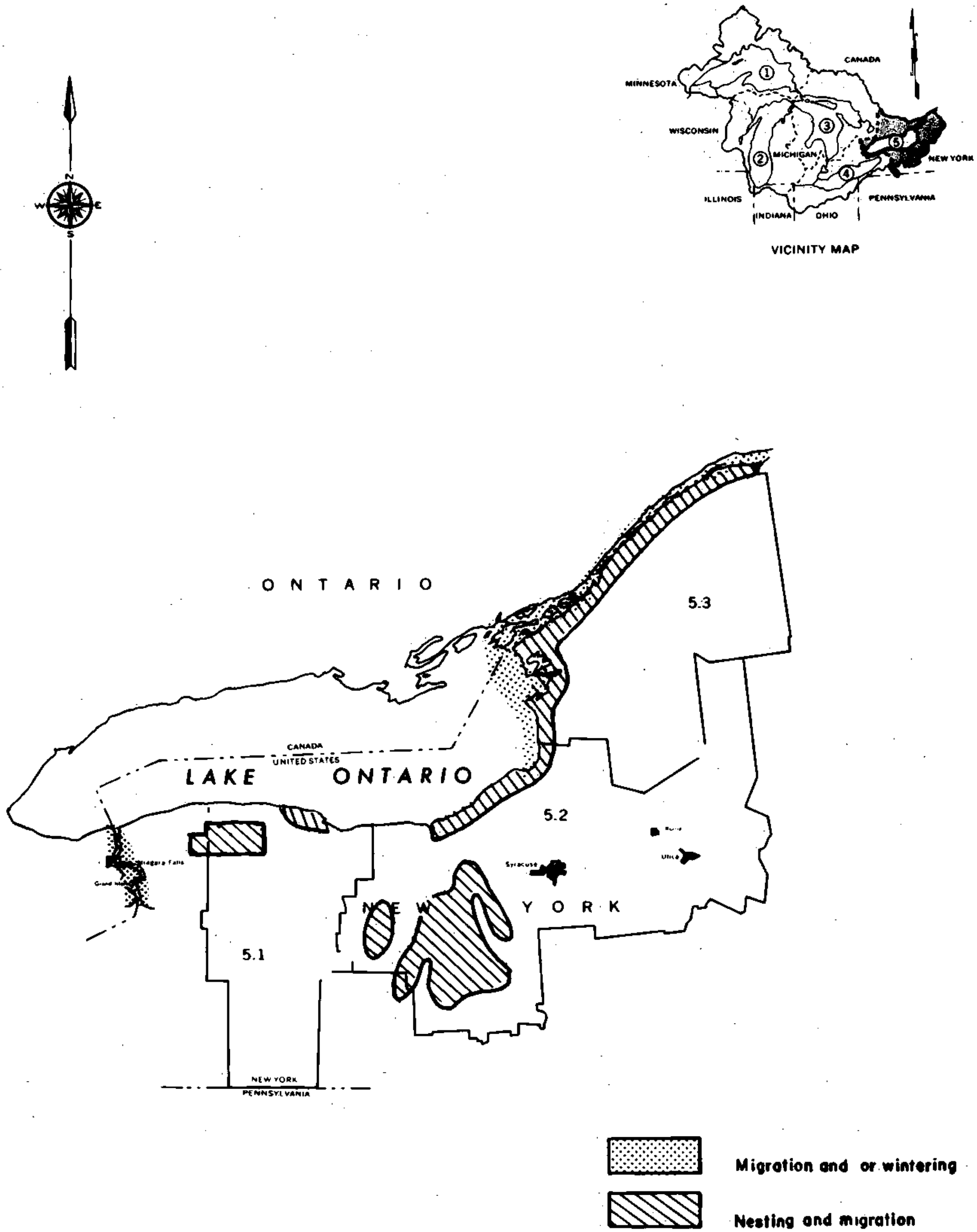

FIGURE 1–46 Primary Waterfowl Use Area, Plan Area 5

TABLE 1–177 Land and Water Surface Usable for Recreation in the Lake Ontario Plan Area, 1970 (thousands of acres)

PSA	Land	Lake Ontario	Inland Lakes	Total
5.1	94.5	38.0	10.0	142.5
5.2	159.5	51.0	170.0	380.5
5.3	211.0	77.0	32.0	320.0
TOTAL	465.0	166.0	212.0	843.0

A diversity of wildlife species exists here due to the variety of habitats. Forest game populations in the eastern and southern portions of the planning subarea are at low to medium densities. The farm game species, such as rabbit, ring-necked pheasant, and mourning dove, are doing well, and fur bearers are also thriving. The plentiful wetland habitat is important to most fur bearers as well as to waterfowl and the few bald and golden eagles.

Planning Subarea 5.3 is the most complex region of the New York portion of the Great Lakes Basin. It includes a large part of the Adirondack Forest Preserve as well as a portion of the St. Lawrence River island complex. Many different habitat types exist across the planning subarea. Forest game populations vary greatly among species. Fur bearers are generally of medium density throughout the area, with some species at high levels. The presence of unusual wildlife species at healthy population levels is indicative of the high value of the wilderness habitat. One interesting species, the coyote, has become well-established here, adding more diversity to the fauna.

Farm game habitat is not as plentiful as forest and forest transition habitat, with farm game species generally restricted to the farm lowlands along the Lake Ontario and St. Lawrence River shorelines.

Over 350 outstanding, unusual, and significant aesthetic and cultural features have been identified in the Lake Ontario region. Details are in Appendix 22, *Aesthetic and Cultural Resources.*

The land and water resources of the Lake Ontario basin offer a variety of features important for recreation. Table 1–177 shows the land and water surface area available for recreation use. Forested land is abundant, and a portion of it is under public ownership. Inland lakes and rural landscapes offer considerable scenic appeal to the tourist.

The 290-mile Lake Ontario shoreline, with its beaches, bluffs, sand dunes, inlets, and bays, is a dominant recreational feature of the basin. Island shoreline is an additional resource. Beach areas on Lake Ontario are less prominent than on any of the other Great Lakes. The total beach area amounts to only about 63 acres, 33 acres in public ownership and 30 acres in private ownership (Table 1–178). The water adjoining seven of the 33 acres in public ownership has been polluted to such an extent that the shoreline cannot be used.

The Thousand Islands area at the outlet of Lake Ontario and the beginning of the St. Lawrence River has been a prime tourist attraction for many years. New York State and Canada both have developed substantial recreational facilities in this area.

The headwater areas of the streams draining into Lake Ontario from the south have much rolling terrain with very significant aesthetic qualities. The Finger Lakes area and Genesee Gorge are included in this area. The eastern end of this basin extends into the western part of the Adirondack Park and includes much rugged relief covered with forests.

Problems of providing outdoor recreation in the Lake Ontario basin are generally the same as in the other areas, except that in most cases there is an inflow of people for recreation rather than an outflow towards other areas. The principal problem in the western part of the basin is an inadequacy of beach area. Most of the existing beach area is privately owned and both the privately and publicly owned areas are so heavily polluted that very little is available for use. The eastern part of the basin receives a great deal of use from persons outside the basin, and a continuing improvement of the

TABLE 1–178 Amount, Ownership, and Recreational Potential of Great Lakes Beaches, Lake Ontario Plan Area (acres)

	Publicly Owned Beaches			Privately Owned Beaches				
	Usable			Open to Public		Not Open to Public		
PSA	Open to Public	Restricted	Not Usable	With Charge	Without Charge	Potential for Development	Little/No Potential	Total
5.1	2.5	0	6.9	0	0	0	24.9	34.3
5.2	11.5	0	0	3.9	1.7	0	0	17.1
5.3	11.9	0	0	0	0	0	0	11.9
TOTAL	25.9	0	6.9	3.9	1.7	0	24.9	63.3
%	40.9	0	10.9	6.2	2.7	0	39.3	

highway system permits longer and more frequent trips from the very heavily urbanized areas of New York. Little beach area is available on the Lake Ontario shore in this portion of the basin also. The beach that is available and many of the beaches in State parks in the Thousand Islands area are in public ownership.

The existing developed supply of land and water surface areas available for recreation in the Lake Ontario basin is shown in Section 12 in Table 1–222. This table also shows projected needs and outputs from the Proposed Framework for the Lake basin developed from the frameworks for RBGs 5.1, 5.2, and 5.3.

10.2 Frameworks for River Basin Group 5.1

10.2.1 Summary

The most severe present problems in River Basin Group 5.1 are lack of resource supply to provide additional recreational opportunity, low flows in many streams, the difficulty of finding adequate supplies of high-quality water for rural domestic and livestock needs, competing land uses, and the widening gap between wildlife habitat supply and wildlife needs. The land base suitable for wildlife is decreasing as the needs for such land are increasing. This is due to urbanization and the accompanying pressures for residential, commercial, and industrial land uses.

Other major problems include flooding in the Genesee River basin, the proper maintenance of lake levels, and of flows throughout the Barge Canal and in the streams in the river basin group, the adequate protection of fishery values in the eastern part of Lake Ontario, and the adequate preservation of aesthetic and cultural recreational values throughout the entire Lake basin.

Municipal water supply and waste treatment systems in the Normal Framework include programs to encourage industries to join municipal or regional industrial supply and waste treatment systems, and for such systems to be combined into larger regional systems where economies would result.

In the Normal Framework the availability of water and related land resources is not likely to be a constraint on achieving the projected growth level, with the possible exception of meeting rural domestic and livestock needs. Ground water should be used to the maximum extent possible, where it is available in adequate quantity and quality, because of the considerable savings in treating ground water as compared to treating surface water in this area.

The Normal Framework includes programs to meet the water quality standards existing prior to the Federal Water Pollution Control Act Amendments of 1972, and precludes degradation of higher levels of water quality where they exist at the present time.

The framework has not been able to satisfy all of the water-oriented outdoor recreation, sport fishing, erosion control, flooding, and wildlife needs in this river basin group. This is partially due to the topography of the land and partially due to competing land uses. A high level of flood plain management will be necessary, including continued regulation of development in the flood plain if damages are to be prevented in the future.

Section 12 contains Table 1–310, which lists the needs, outputs, and percent of needs met for the Normal Framework in River Basin Group 5.1; Tables 311 and 312 contain capital costs and operation, maintenance, and replacement costs for the Normal Framework.

10.2.2 The Area

Planning Subarea 5.1 lies within the State of New York, and all of the population considered is in that State, even though River Basin Group 5.1 extends a short distance into Pennsylvania. Population, per capita income, and employment were discussed in Section 1. Planning Subarea 5.1 is located in the northeastern portion of the Great Lakes Basin along the southern shore of Lake Ontario, and consists of six northwestern New York counties. The Niagara-Orleans complex (which includes the Niagara River below Grand Island) and the Genesee River basin combine to drain over 3,515 square miles of New York and Pennsylvania land. Figure 1–47 shows the planning subarea counties and depicts major drainage areas.

10.2.3 Projected Resource Needs and Problems

The projected needs for resource use in RBG 5.1 by time level are shown in Section 12 on Table 1–310. Where needs can be quantified, they are not discussed in the text unless special conditions warrant such discussion.

10.2.3.1 Water Withdrawals

The total water withdrawal needs to 2020 are estimated for RBG 5.1 at nearly 4,000 mgd above the base year water withdrawals of 944 mgd. Over 90 percent of the additional water withdrawal need is for thermal power cooling.

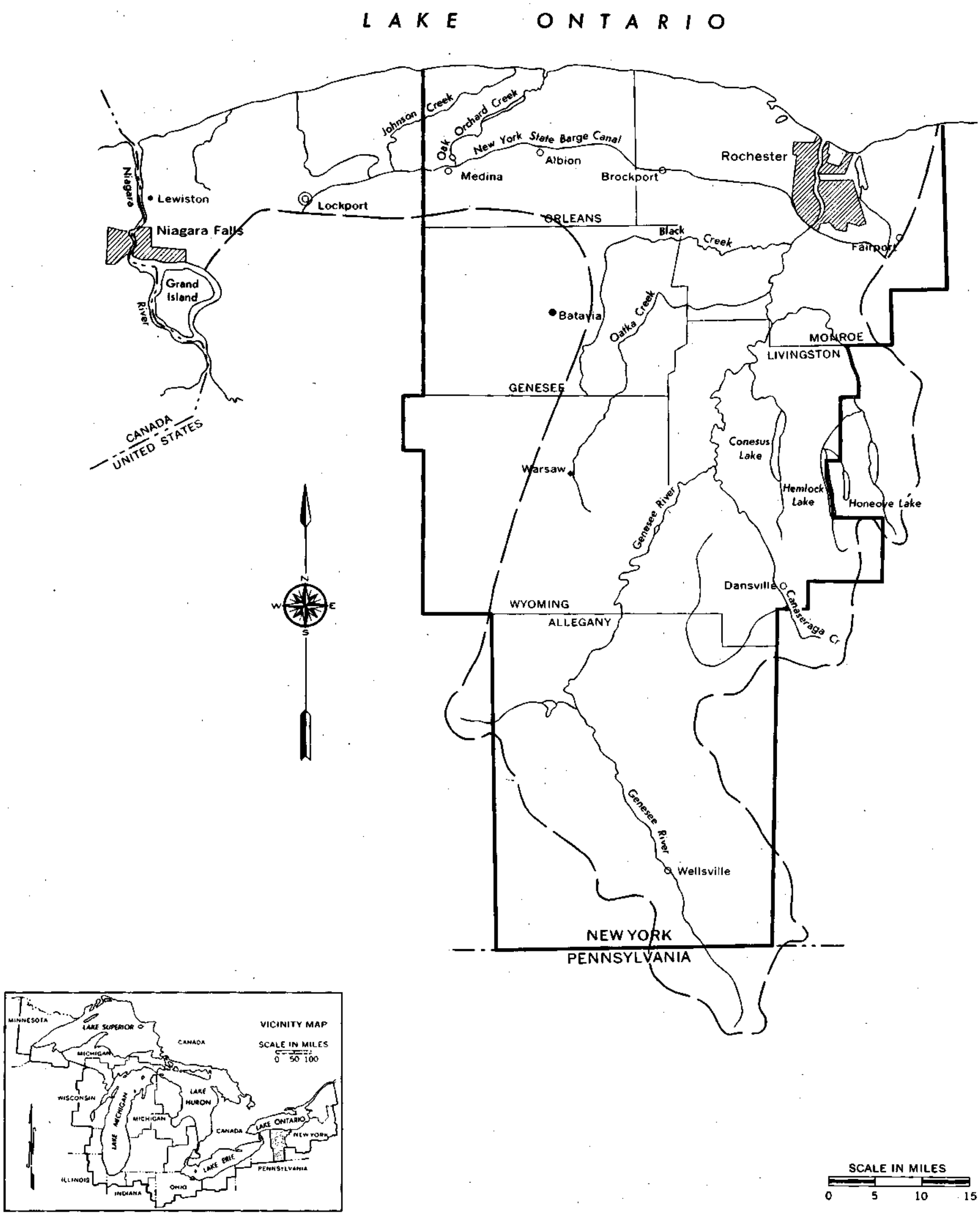

FIGURE 1–47 Lake Ontario West, River Basin Group 5.1

The water withdrawal problems are relatively minor in this river basin group, with perhaps the greatest being the difficulty of obtaining adequate water of satisfactory quality if water quality standards are not met. Of slightly lesser concern, but also important, is the difficulty of satisfying irrigation needs where they are expected to occur. The same water that is needed on the land for irrigation is also needed in the streams for fishing and other purposes.

10.2.3.2 Nonwithdrawal Water Uses

In 1970 a total of 225 mgd of domestic, commercial, and industrial wastewater was treated in municipal wastewater treatment facilities in RBG 5.1. This amount if projected to increase slightly by 1980, and more than double by 2020. Industrial wastewater which was treated in 1970 in industry-owned wastewater treatment facilities amounted to 298 mgd, of which over half was condenser cooling water. This waste flow is expected to occur at about the same rate through 1980 and then increase through 2020. The needs shown include an increasing amount of cooling water. Streams or stream reaches that will require advanced waste treatment to meet the water quality standards include Eighteen Mile Creek, Oak Orchard Creek, Sandy Creek, Salmon Creek, the portion of the Genesee River downstream from Avon, and its tributaries, including Honeoye, Keshequa, Wolf, Oatka, Black, Conesus, and Canaseraga Creeks. In its last 5 to 6 miles, the Genesee River is in its most serious state of degradation. The discharge from an industry primary treatment plant was the principal cause of this condition. This industry has secondary treatment facilities which began operation after the base year. These should greatly reduce the effluent loading. Poor-quality water may also be attributed to intermittent discharges from combined sewer overflows from the City of Rochester and the latent oxygen demand of the extensive sludge deposits.

Other serious water quality problems which may not readily be resolved by conventional treatment methods include:

(1) an accelerating rate of eutrophication in some of the smaller interior lakes as a result of cottages ringing the lakes. Some recent sewer construction in an effort to abate such pollution should be carefully surveyed as to its success.

(2) rapidly rising chloride levels in area waters. The possibility of immediately reducing the amount of salt applied to roads during the winter should be examined.

(3) extensive use of pesticides in the fruit belt of the lake plain area. Closer control is clearly needed.

(4) extremely large sediment loads carried by the Genesee River. Most of this load originates from upstream bank and sheet erosion. Large quantities are eventually deposited in the harbor area where they are annually dredged. A study should be made to determine what measures might be taken to reduce this sediment load.

An additional significant planning problem in this river basin group is that the Rochester embayment, which includes the Monroe County shoreline of Lake Ontario and Irondequoit Bay, has water pollution problems caused by the discharge of municipal and industrial wastes. High bacterial counts for the metropolitan sewage have caused the main public beaches in the embayment to be closed.

Pumped storage hydroelectric power plants are expected to be built after 1980 with needs for water as shown in Table 1–310.

The sport fishing needs shown in Table 1–310 reflect an assumed transfer of considerable angler-day needs from other portions of the Great Lakes Basin, specifically the Buffalo area.

The effect of poor water quality on fishing opportunity is the most serious fishing problem at the present time. In some of the better trout streams tributary to the Genesee River, there are problems of conflict between irrigation water withdrawals and the maintenance of flows for fishing and other uses. If the New York State program for lamprey control recently initiated in the Lake Ontario basin is successful, there will be a substantially higher amount of fishing opportunity in Lake Ontario adjacent to this river basin group than there is at the present time. A lakewide coordinated lampricide program is needed.

There is also a serious need to collect fishery use data for the river basin group and for Lake Ontario. There is a need to develop additional opportunities for lake fishing in the upper portion of the Genesee River basin. Other problems affecting fishery habitat include:

(1) eutrophication in many of the inland lakes and the bays along Lake Ontario

(2) destruction of stream trout by pesticides

(3) conflict between shoreline use on large lakes for recreation and for fishing. It is difficult to fish some of the lakes during daytime hours, especially on the weekends, due to boating and water skiing.

(4) destruction of fish spawning areas due to drawdown through water level regulation on some of the inland lakes

(5) destruction of trout stream habitat through gravel removal and channel dredging

(6) sedimentation threatening trout spawning areas in streams.

In addition to planning for the satisfaction of the boating day needs, it is also necessary to plan berthing facilities and launching sites. Present

TABLE 1–179 Use and Projected Needs for Recreational Boating, PSA 5.1

	1000 Boating Days	
Category	Great Lakes Waters	Inland Waters
1970 Use	282	366
1980 Needs	144	57
2000 Needs	195	117
2020 Needs	267	207

boating day use is about equally divided between Lake Ontario and inland waters. Needs for Lake Ontario by 1980 are over twice the needs for inland waters (Table 1–179). There will continue to be more needs for Lake Ontario through 2020, although needs for inland waters will increase at a greater rate. A major requirement for meeting needs is the provision of access, launching sites, and berthing facilities.

Problems associated with recreational boating are that use of Lake Ontario is limited by the scarcity of mooring sites, and the inland lakes are crowded beyond the desirable capacity for recreational boating.

PSA 5.1 has few inland waters. If recreational boating is to develop as projected, additional surface water must be provided. Access sites to new waters as well as additional access sites for existing waters are also needed. Another urgent need is a better communication system to inform recreational boaters on Lake Ontario of weather conditions and forecasts.

Very little cargo is handled on the U.S. shore of Lake Ontario. From the present time to 2020, the several ports along Lake Ontario in the U.S. are expected to handle less than a million tons of cargo annually. This small amount of commerce consists primarily of coal shipments and smaller amounts of other traffic.

The most significant priority for the Port of Rochester is strong port promotion to increase the general cargo traffic with Canada and overseas.

10.2.3.3 Related Land Uses and Problems

It is estimated that on about 654,200 acres, or 29 percent of the total agricultural land in RBG 5.1, conservation practices could be effectively applied to reduce soil losses and to conserve plant cover.

The greatest problem associated with the conservation of agricultural lands is the increasing pressure to convert these lands to other land uses that often reduce the amount of cover on the land and increase the amount of sediment. Sedimentation regulations and laws are needed, particularly in urban areas, if water quality is to be improved by reducing the amount of sediment.

It is estimated that 234,000 acres of agricultural land has a drainage problem and that on 147,000 acres the problem requires project action.

Programs along the Lake Ontario plain area are needed at the present time. The Oatka Creek watershed area is likely to need a project action program by 1980.

The difficulty of meeting land use needs for expanding urban areas as a result of the wetness problem is not as acute in PSA 5.1 as it is in other areas of the Great Lakes Basin. In the Rochester area about 33 percent of the nonurban land base has a wetness problem which would need to be corrected before this land could be used for urban uses. The remaining 67 percent is suitable for urban development.

There are about 867,000 acres of non-Federal forests in River Basin Group 5.1, of which 424,000 acres receive adequate conservation treatment. There is opportunity for treatment on the remaining 443,000 acres in order to realize the maximum multiple benefits. There are no national forests in River Basin Group 5.1 and only 5,400 acres of Federal forest land.

There are several critical bird nesting and migration areas along the Lake Ontario shoreline in Planning Subarea 5.1, adjacent to Johnson Creek, Oak Orchard Creek, and Braddock Bay.

Most of the shoreline subject to flooding is in Monroe County west of Rochester, while critical and noncritical shoreline erosion occurs mostly in Orleans and Niagara Counties.

Needs for streambank erosion control are shown in Table 1–310. Streambank erosion results in increased sedimentation in streams. This prevents other uses of the water as a result of the degraded water quality. The effect of sedimentation on fishing has been previously noted. Another problem related to stream bank erosion is that it is very difficult to correct because the streambanks often are private property, and owners may not have either the resources or the willingness to correct the problems.

In River Basin Group 5.1 the greatest flood damages occur in rural areas. Floods in the summer of 1972 in the Genesee River basin have reemphasized the flooding problem, especially the land loss resulting from floods in the upstream areas.

Some of the more important wildlife problems include posting by land owners, which restricts access and leads to underharvest; loss of wetlands due to industrial and municipal developments; single-purpose flood control, navigation, and agricultural drainage programs; cottage development; and water pollution severe enough to affect wildlife food supply and population levels along 100 miles of stream.

About one-half of the need shown in Table 1–310 is for hunting and one-half for nonconsumptive wildlife use, such as observation and photography.

Urban encroachment on wildlife habitat is the most important wildlife problem in the lowlands. Conversion of agricultural land to residential or industrial uses not only permanently destroys habitat, but also effectively restricts wildlife management and the use of surrounding lands. Between 1970 and 2020 it is estimated that 122,200 acres of wildlife habitat will be lost through urbanization in Planning Subarea 5.1.

A wildlife use problem that goes hand-in-hand with posting is the tendency for sportsman groups to reserve the right to hunt on private land by direct payment to the landowner. This is a partial solution to the restricted access problem, but it also aggravates the overall problem because hunting preserves are operated well below maximum sustained yield, and for only a select few, thus limiting overall hunting opportunity.

Loss of wetlands is an important wildlife problem because this habitat is in short supply in the planning subarea. These losses are frequently due to single-purpose programs for navigation and waste disposal. Poor water quality reduces wildlife population and impairs the aesthetic qualities of the water system, thus diminishing its ability to satisfy nonconsumptive wildlife demand. This is particularly true in the lower Genesee River basin. The Iroquois National Wildlife Refuge northeast of Buffalo provides about 177,000 user-days. The refuge attracts ducks, geese, whistling swans, and coots. In several places in the river basin group, the pressure for more recreation has resulted in wetlands being dredged or filled by various levels of government to provide additional park lands and facilities such as boat channels, marinas, boat ramps, roads, building sites, and golf courses. Industry and commerce also take their toll of wetlands.

The existing aesthetic and cultural values in this river basin group have been cited above. Major problems are competition between industrial or residential use of shoreline and preservation of aesthetic values, inadequate funding for land acquisition, and the need to preserve outstanding values.

The projected need is for land-based water-oriented outdoor recreation developed capacity to be more than doubled by 1980, and more than quadrupled by 2020. In order to satisfy this need by 1980, it has been estimated that an additional 800 acres of land must be provided.

The problem of beach closings has already been cited above. The increasing populations with higher incomes and more leisure time create an ever-increasing pressure on recreational facilities, especially day-use recreational activities such as playing fields, golf courses, and bicycle trails.

A critical obstacle in meeting recreational needs is the lack of Lake Ontario beach acreage available to the public. Only 34 acres of beach, of which 25 acres are privately owned, were available in Monroe and Orleans Counties, according to the International Joint Commission inventory of beach areas. Most beaches in public ownership were heavily polluted at the time of the survey in 1967. Unless there is a shift from private to public ownership in this area, it will be very difficult to meet the recreational needs of the Rochester area. Some of the prime land areas for industrial development in this area are along the shorelines and the stream valleys along the lower Genesee River. Transportation routes also conflict with aesthetic and recreational land uses.

10.2.4 Alternative Frameworks

Two alternative frameworks are presented for this as for other river basin groups. The Normal Framework does not reflect coordination of solutions to meet needs outside RBG 5.1 in the Lake basin or the Great Lakes Basin.

The Proposed Framework contains the recommendations of the Commission in an effort to reflect the views of the people of the basin and the policies and programs of the States. To some extent, it reflects coordination in the development of the framework among a number of river basin groups, both in the Lake basin and in the Great Lakes Basin as a whole.

10.2.4.1 Normal Framework (NOR)

NOR is based on meeting quantified needs and solving identified problems to the maximum practicable extent consistent with subobjectives and criteria discussed in Section 2 of the appendix. The program outputs and costs are summarized in Section 12 on Tables 1–310, 1–311, and 1–312.

(1) Water Withdrawals

There is adequate water to meet water withdrawal needs for RBG 5.1 up to and beyond 2020 if additional source capacity is developed. Most of the municipal water supply, self-supplied industrial water, and water for thermal power cooling is expected to come from Lake Ontario. The largest portion of the demand occurs in the Rochester area. The rural water supply needs will be satisfied by a combination of water from inland lakes and streams and from ground water. The irrigation and mining water supply needs are all expected to be satisfied from inland lakes and stream sources. Some reservoir development is possible.

The Normal Framework, in addition to including the development of sources to meet the needs as they accrue, includes a program for periodic surveys of water use for the respective purposes.

The additional power development to 1980 in the framework includes only nuclear thermal generating capacity, and the bulk of the new capacity and generation to 2020 is expected to be nuclear thermal generating power plants along the shores of Lake Ontario. Some increase in fossil fueled and in noncondensing plants is also included. The Normal Framework provides for nearly doubling hydroelectric power installation after 1980. It has been assumed that 960 MW of pumped storage will be developed in RBG 5.1 by 2000, and an additional 1200 MW by 2020.

(2) Nonwithdrawal Water Uses

The Normal Framework provides, as a criterion, that the 7 day–10 year low flow will be maintained to the maximum extent possible in the streams in RBG 5.1. New York State is well into the implementation of its pure waters program, having constructed and expanded many municipal waste treatment plants in the Great Lakes Basin within the last decade. Federal reimbursement for the State's prefinancing of much of the Federal cost of this construction is still pending.

The Normal Framework provides that secondary waste treatment will be programed throughout the entire area, with 85 percent BOD removal or better in all cases. In addition, some of the larger plants are also required to remove phosphates.

New York State has prepared a water quality plan to meet 1990 needs. The plan as it existed on December 31, 1971 was adopted for NOR. It includes sewage treatment plant projects, either construction of completely new plants or expansion of existing plants, at 23 locations.

Other waste treatment improvements, other than sewage treatment plants, are also provided for in the New York State Plan to 1990 at 13 locations. These improvements have also been selected and endorsed for the Normal Framework.

The waste treatment projects which have been approved or completed in New York State under the jurisdiction of the Department of Environmental Conservation have been assumed to be ongoing programs and in place as of the base year. In addition to the conventional secondary treatment and phosphate removal as already noted, the Normal Framework also includes provisions for advanced waste treatment for the following: the lower main stem of the Genesee River around the Little Finger Lakes, plants discharging to Conesus and Honeoye Lakes, Eighteen Mile Creek, Sandy Creek, Oak Orchard Creek, Salmon Creek and its tributaries, Brockport and West Creeks, the Rochester embayment, and Irondequoit Bay and Irondequoit Creek.

The NOR program to meet fishery needs and solve problems consists of several features. One is the construction of about 16 upland reservoirs, of which four are also for recreation use. The remainder of them are primarily for fishing. The second is a series of ongoing fish management programs, consisting of implementation of the stream protection law; various abatement programs to enhance water quality; stocking programs, including stocking of anadromous fish in the lower Genesee River and Irondequoit Bay; stream improvements; and the initiation and enforcement of special fishing regulations. These management programs are expected by 1980 to raise present capability of the river basin group's fishery resources to the level of supporting an additional 545,000 user-days annually.

Also included in the ongoing programs are measures for the acquisition of fishing access along 97 miles of stream, requiring 224,000 acres of land. This will provide more fishery than the reservoirs will provide.

The 2000 and 2020 aspects of the fishery programs include a continuation of the management programs. In the period between 1980 and 2000, additional fishery opportunities would be supplied by the construction of four major reservoirs and four upstream reservoirs. All of these are multiple-purpose projects with fishing benefits as well as recreational benefits. In the period between 2000 and 2020 the framework includes the construction of an additional major reservoir for warmwater fishing.

The fishery programs, as outlined, do not meet all of the anticipated angler-day needs. It is expected that a portion of the needs will have to be satisfied in other areas of the Great Lakes Basin or in other major river basins throughout the country.

NOR will not satisfy all of the boating-day needs in any of the time periods. Lake Ontario needs are more than met by 2020, whereas inland water needs are only about 10 percent met by that year. The programs consist of constructing marinas, harbors, and access sites on Lake Ontario, with equal amounts in the three time periods; constructing an impoundment; and additional marinas and access points on inland lakes and streams.

Commercial fishing and commercial navigation are discussed under Subsection 10.5, Lake Ontario Intrarelationships, and in Section 5.

(3) Related Land Use

The programed agricultural land treatment for RBG 5.1 is essentially a continuation of ongoing programs at a level that has been followed in the past. The drainage program provides for drainage of cropland between now and 1980 and for group project action on the same land to obtain required outlets for the field drainage. There are no additional drainage programs after 1980.

A forest land treatment program is included in the Normal Framework at a higher level than has been practiced in the past or present. The desired result is believed to justify the higher treatment level. The accelerated portion of the forest land treatment program provides that the existing authorities and manpower and budget levels be expanded and increased throughout the projection period. About half of the acreage to be treated in each time period will receive treatment similar to the ongoing programs, and the other half will receive accelerated treatment.

The Normal Framework includes programs to protect Lake Ontario shoreline subject to critical erosion.

The streambank erosion program would provide treatment by 2020 on all the streambank mileage in RBG 5.1 subject to severe erosion.

Institutional measures or flood plain management are included in NOR for the reduction of both urban and rural flood damages in each of the time periods. These measures are not expected to be effective in reducing rural damages in upstream watershed areas, however. The framework provides for reservoir storage in the Canaseraga and Oak Orchard Creek watersheds in the period between the present time and 1980. This will reduce the rural damages and rural acreage subject to flooding.

Another program element included in the early action period for flood damage reduction is the provision of structural protective works in Canaseraga and Oak Orchard Creek watersheds, on the Genesee River at Wellsville, on the rural flood plains in the Red Creek watershed, and in the Oatka Creek watershed. The projects in the Canaseraga, Oak Orchard Creek, and Oatka Creek watersheds will be effective in reducing rural damages and protecting rural acreage subject to flooding, and the projects in the Wellsville and Red Creek areas will be effective in reducing urban damages and protecting urban acreage.

The Normal Framework also includes proposals for land use changes, land treatment, and increased efficiency in utilizing the land in order to reduce damages. The framework also includes recommendations for lake regulation around Conesus Lake, around Honeoye Lake, and in the Canaseraga Creek watershed (Silver Lake) in order to reduce urban and rural flood damages in those locations.

In the period 1980–2000 additional channel modification is included for the rural flood plains in the Genesee River basin, and the other programs are continued.

In the period between 2000 and 2020 the programs, as described between the present time and 1980, are continued. No additional structural programs or reservoir storage are called for in this time period.

The NOR program for wildlife management includes a continuation of ongoing programs by State agencies for habitat improvement, enforcement, and research.

Additional programs included in the Normal Framework are:

(a) acquisition of wetlands

(b) lease or purchase of unique and critical wildlife areas

(c) management and development of State lands

(d) acquisition of public hunting lands

(e) hunting and access easements on private lands.

NOR provides that the following outstanding, unusual, and significant aesthetic and cultural values be acquired in the early action period and set aside for the benefit of future generations:

(a) waterfowl areas

(b) 18 historical structures and sites

(c) wetlands included in the wildlife programs discussed above.

(The names of the values refer to the inventory contained in Appendix 22, *Aesthetic and Cultural Resources*).

NOR includes construction before 1980 of several small reservoirs in upstream areas, and the acquisition and development of recreational opportunities along 10 miles of river valley.

Between 1980 and 2000, NOR would satisfy an additional portion of the recreational needs with the construction of four major and four minor reservoirs, and the additional acquisition and development of 10 miles of flood plain.

Between 2000 and 2020, NOR includes the construction of two additional major reservoirs and four smaller upstream reservoirs. The framework, also in this time period, includes acquisition and development of 10 additional miles of flood plains, the development for recreational use of State forest lands, and the development for recreational use of wildlife lands.

The program elements listed above for recreational development in the State parks represent development on only about 16 percent of the existing undeveloped State and county park areas. In 1970 the Allegheny State Park contained no recreational development.

In addition to the programs cited above, the following elements should be given priority for acqusition and development throughout the 1970–2020 time frame:

(a) development of additional recreational facilities on State forest land

(b) development of recreational facilities in public wildlife areas

(c) public access sites on streams and lakes where additional potential for use exists

(d) encouragement of the private sector to continue development of quality recreational facilities for golfing, skiing, camping, swimming, and for other activities where it can function effectively.

(4) Framework Outputs and Costs

Section 12 contains Tables 1–310, 1–311, and 1–312 which provide information on needs, outputs, percent of needs met, and capital and OM&R costs for NOR in RBG 5.1.

10.2.4.2 Proposed Framework (PRO)

PRO was formulated in consultation with State officials in order to reflect State policies and programs, as well as the desires of area residents.

State, regional, and local policy assumptions with respect to population and economic growth do not differ greatly from the OBERS projections used in NOR.

The Proposed Framework for RBG 5.1 reflects the comprehensive and ongoing plans of the State, the Genesee-Finger Lakes Regional Planning Board, and the Genesee Regional Water Resources Planning Board.

The State of New York Office of Planning Services (OPS) has prepared and is keeping up to date demographic projections for the entire State based on methodology quite different from OBERS. In general, these projections are lower than the NOR projections, due to decreasing migration rates into the New York State portion of the Great Lakes Basin, and the recent downward trend in fertility rates. However, in PSA 5.1 the OPS projections are higher than the NOR projections. Subsequent planning efforts in PSA 5.1 by the Great Lakes Basin Commission should utilize OPS projections. The differences in the projections are illustrated in Table 1–180.

(1) Water Withdrawals

There are no significant differences between the Proposed Framework and the Normal Framework for RBG 5.1 with respect to water withdrawals.

(2) Nonwithdrawal Water Uses

A major multiple-purpose reservoir in the upper reaches of the Genesee River has been considered as a part of the PRO early action program in RBG 5.1 for the reduction of flood damages and for recreation and other purposes. Additional studies indicate that this may not be the best solution, but the question has not yet been completely resolved. Waste treatment in PRO is consistent with the requirements of the Federal Water Pollution Control Act Amendments of 1972. Needs and outputs are the same as NOR, but treatment is more stringent in some areas and costs may be higher.

TABLE 1–180 Comparison of Population Projections, PSA 5.1

	1000s of People			
	1970	1980	2000	2020
GLBC (1968 OBERS)	946	978	1,222	1,538
New York State (OPS)	---	1,084	1,403	N/A

(3) Related Land Uses

The PRO Framework recommends the continuation of ongoing agricultural land treatment programs and the acceleration of other appropriate practices on 506,900 acres in RBG 5.1. No additional drainage action on existing croplands through 2020 is recommended. An accelerated forest land treatment program is recommended to improve forest management on 235,000 acres by 2020. Table 1–340 compares NOR and PRO in these categories.

(4) Framework Outputs and Costs

Section 12 contains Tables 1–313, 1–314, and 1–315, which provide information on needs, outputs, percent of needs met, and capital and OM&R costs for PRO, indicating by italics where they differ from NOR. Table 1–340 compares land treatment programs.

10.2.4.3 NOR and PRO Framework Costs

Table 1–355 in Section 12 lists the total costs (capital plus OM&R) for NOR and PRO in RBG 5.1 for the periods 1971–1980 and 1971–2020.

10.3 Frameworks for River Basin Group 5.2

10.3.1 Summary

The most severe present problems in River Basin Group 5.2 are the following:

(1) lack of adequate funding for the construction of municipal waste treatment facilities, coupled with the difficulty of establishing and adequately enforcing water quality standards and meeting the deadlines specified in enforcement conferences and international agreements

(2) meeting the water-oriented outdoor recreation needs

(3) the difficulty of providing adequate quantity and quality of water for rural domestic and livestock use

(4) streambank erosion in the Oswego River basin.

One of the difficult planning tasks for the river basin group involves the regulation of the inland lakes and streams. Many of the Finger Lakes feed to the New York State Barge Canal. The proper regulation of the flow from the Finger Lakes into the Barge Canal and subsequently to the east or west or to the north to Lake Ontario through the Oswego River presents a very difficult problem. The many uses and problems pertaining to the Finger Lakes, particularly recreation, shoreline erosion, boating, and flood control, are all affected by the regulation plans that are adopted. There are complex interrelationships among recreation, power generation, commercial navigation, fishing, and water quality which all have to be considered.

The Finger Lakes themselves are an outstanding natural resource, and the proper allocation of their use, and management for their continued use for future generations pose difficult engineering as well as institutional and political problems.

The Normal Framework does not consider the availability of water and related land resources to be a likely constraint to achieving the normal growth level. There is a considerable dependence in this river basin group on inland lakes and streams for municipal, self-supplied industrial, irrigation, and mining water. Ground water is the primary source for rural domestic and livestock water and for mining water. There is also a much larger amount of reservoir storage for municipal water supply in this river basin group than in most of the others in the Great Lakes Basin.

Lake Ontario will continue to be the source of most of the cooling water for thermal power generation.

The Normal Framework includes programs to meet the existing water quality standards prior to the Federal Water Pollution Control Act Amendments of 1972, and precludes degradation of levels of water quality higher than the standards where it exists at the present time. The framework supports a continuing implementation of the New York State pure waters program and asks that more funds be made available for construction as well as administration and enforcement of that program.

The Normal Framework in RBG 5.2 has not been able to satisfy all of the water-oriented outdoor recreation needs. Sport fishing needs are not met in 1980, but are essentially met in 2000 and 2020. One of the major problems in this area is the conflict between private land use and the desirability of acquiring and allocating for various public uses the land adjacent to the Finger Lakes and to the other inland lakes and streams.

A high level of flood plain management will be necessary, including continued regulation of development in the flood plain, if damages are to be prevented in the future. Transportation corridors and urban expansion will have to be carefully planned and the results of that planning stringently enforced if desirable land use patterns are to be achieved in this river basin group.

Section 12 contains Table 1–316 which lists the needs, outputs, and percentage of needs met for the Normal Framework for River Basin Group 5.2; Tables 1–317 and 1–318 contain capital costs and operation, maintenance, and replacement costs for the Normal Framework.

10.3.2 The Area

Planning Subarea 5.2 is within the State of New York. It is located in the northeastern portion of the Great Lakes Basin along the southern shore of Lake Ontario. The political and hydrologic makeup of the area is described in Section 1. The Oswego River basin constitutes about 75 percent of the drainage area of the river basin group.

Figure 1–48 locates the subarea counties and depicts major drainage areas.

10.3.3 Projected Resource Needs and Problems

The projected needs for resource use by time level are shown in Section 12 on Table 1–316. Where needs can be quantified, they are not discussed in the text unless special conditions warrant such discussion.

10.3.3.1 Water Withdrawals

The total water withdrawal needs to 2020 are estimated for RBG 5.2 at 3,370 mgd in addition to the base year supply of 1,570 mgd. Nearly 75 percent of the additional water withdrawal needs is for thermal power cooling.

The water withdrawal problems are relatively minor in this river basin group, perhaps the greatest being the possible degradation of surface water quality as a result of mining operations, particularly in and adjacent to urbanized areas. Groundwater quality in the vicinity of mining operations is also likely to be degraded. Ground-water quality in Onondaga County is poor, and a shift to Great Lakes sources is expected which will be rather expensive for that area. One of the main problems

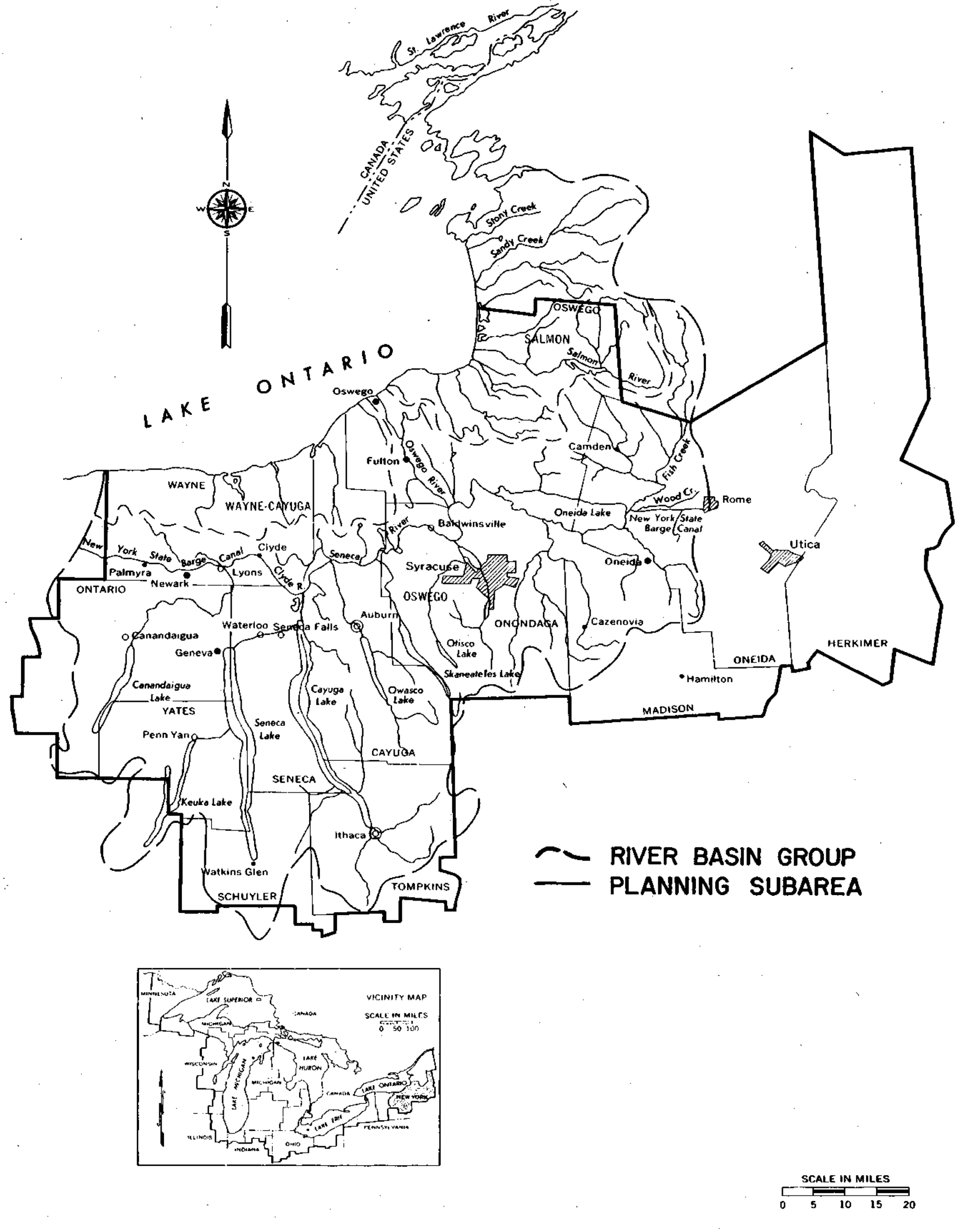

FIGURE 1–48 Lake Ontario Central, River Basin Group 5.2

is the proper allocation of surface waters to the various uses and the proper regulation of inland lakes and the barge canal system in order to achieve optimum benefits from these several uses.

10.3.3.2 Nonwithdrawal Water Uses

Domestic, commercial, and industrial wastewater treated by municipal wastewater treatment facilities in RBG 5.2 is expected to more than double by 2020. Only modest increases in the industrially treated wastewater are expected throughout the planning period, largely due to anticipated recirculation by industry. Reaches in the river basin group that are major zones with poor water quality include Naples Creek, Canandaigua Inlet, Keuka Inlet, Dresden area (Seneca Lake), Catherine Creek, Geneva area (Seneca Lake), Cayuga-Seneca Canal, Cayuga Inlet, Ithaca area (Cayuga Lake), Cayuga Outlet, Skaneateles Creek, Ninemile Creek, Harbor Brook, Onondaga Creek, Ley Creek, Onondaga Lake, Onondaga Outlet, New York State Barge Canal (Macedon to Three Rivers), Chittenango Creek, Limestone Creek, Buttermilk Creek, Canaseraga-Cowaselon-Canastota Creeks, Sconondoa Creek, Oneida Creek, Oneida Lake, Oneida River, and Oswego River (Three Rivers to Lake Ontario).

The overall water quality in this river basin group has been a very severe problem for some time. Perhaps the worst areas are in the rural parts of the Wayne-Cayuga Complex and throughout the Oswego River basin.

A good many of the Finger Lakes themselves have, for the most part, water of satisfactory quality, although in many cases, either at the inlet or the outlet, or at some point along the perimeter of the lake, the water is of a quality which restricts its use. The solution in most of these cases is to provide adequate treatment of municipal and industrial wastes and wastes from shoreline homes, and to control wastes from watercraft.

Problems in two of the lakes are particularly critical. Decades of use as a receptacle for all types of untreated wastes have rendered Lake Onondaga unsuitable for public water supply, recreation, or fishing, and turned it into one of the most serious pollution problems in New York State. Even under natural conditions, hydrologic factors would have made assimilating wastes particularly difficult, and the combination of raw or partially treated discharges, the first flush from the combined sewer system which carries quantities of untreated sewage to the lake, and the large deposits of organic and inorganic sediments have contributed to a very critical situation.

The other particularly critical lake is Oneida Lake. The tributaries flowing into the lake and the lake itself receive large quantities of phosphate from municipal and industrial wastes. In addition, the lake receives many direct discharges from cottages, from the barge canal traffic vessel wastes, and from a large number of pleasure craft.

There is opportunity for the development of hydroelectric power, and this may prove to be an economical way to provide some needed capacity and to conserve nonrenewable energy sources. Studies of economic and financial feasibility have not been made.

The sport fishing demand for RBG 5.2 is projected to be about 150 percent of the base year level by 1980 and 250 percent of the base year level by 2020.

Pollution, including industrial, agricultural, and domestic wastes, is the major problem affecting fish habitat throughout the area. The sources, and the most critical locations, are discussed with water quality. In 1970 Onondaga Lake was closed to all fishing due to very high levels of mercury in fish.

Other factors associated with habitat deterioration are high water temperature, flooding, erosion, dry stream beds, and siltation. Fluctuating water level is a problem on many waters. Irrigation and poor logging practices also contribute to degradation.

The New York State Barge Canal System affects fish habitat through navigational pollution and through water level fluctuations. Dredging and dumping of spoil, primarily in the barge canal system, has been a real problem.

Natural and manmade barriers are a problem to anadromous fish management. Suburban expansion and increased population have brought with them many activities that cause habitat degradation. Highway construction and private development along stream and lake shores also contribute to the overall problem. In addition to problems created by man, beaver have caused deterioration of high-quality streams in the past 20 years. This is particularly true of spring streams in upper Salmon River and Fish Creek tributaries located in the Tug Hill section. Cutting of cover and shallow flooding of vegetation creates drastic adverse changes in the water quality of once-excellent trout streams.

Fluctuation of water levels in Lake Ontario in connection with power production and navigation sometimes may create low water levels in estuaries and marshes near stream mouths. Such low water levels are detrimental to production of many species of fish.

The opportunities for salmon fishing in this area will be substantially increased if the lamprey control program begun by the State of New York in 1971 and 1972 is successful.

In 1970, Lake Ontario provided 20 percent and

TABLE 1–181 Use and Projected Needs for Recreational Boating, PSA 5.2

	1000 Boating Days	
Category	Great Lakes Waters	Inland Waters
1970 Use	492	1,968
1980 Needs	84	336
2000 Needs	153	732
2020 Needs	237	1,218

inland waters provided 80 percent of the boating-day supply in RBG 5.2 (Table 1–181). The needs are projected to increase to 2020, when the total needs will be about 60 percent above base year supply. The needs will be supplied by Lake Ontario and by inland waters in about the same proportions.

Planning for the satisfaction of the boating-day needs involves berthing facilities and launching sites. One of the major problems related to recreational boating is that the facilities at inland lakes are inadequate, even though the surface area is available. Access sites and marinas are needed. The lack of stream improvement and the inability to maintain low flows limit the use of small tributaries in the river basin group by canoes and small boats. However, some very attractive canoe waters exist in the northeastern part of the RBG. On the boating waters in Lake Ontario the use on holidays and weekends exceeds the design capacity, and intensive management is required. There are insufficient mooring sites for Great Lakes recreational craft. Only eight exist at the present time. Access points are needed also.

An updated program concerning small boat harbors on Lake Ontario is essential to the expansion of recreational boating on these waters. Present programs do not provide for adequate facilities in time to meet the projected needs. In addition to more harbors on the lake, a better system of getting weather and storm forecast information to recreational boaters is needed.

The RBG 5.2 area has a large quantity of inland waters, and no additional improved waters need to be provided for boating needs. The New York State Barge Canal provides some boating water and access among the lakes. While a number of potential multiple-purpose reservoir sites exist in this area, there are no studies at the Federal level concerning their development. The State of New York is making studies of water resource problems, including boating.

Very little cargo is handled on the U.S. shore of Lake Ontario. There are no major ports in this area. Great Sodus Bay and Oswego are the commercial harbors. No commerce has been reported at Great Sodus Bay in recent years. Traffic at Oswego consists of Canadian imports, intralake receipts of cement, and exports of fuel oil to Canada. The total income generated by the above traffic is estimated at $15,000,000 in 1980, and is projected to increase to $26,000,000 in 2020, for a tonnage of 0.6 million tons and 0.8 million tons respectively.

The most significant need in this area is strong port promotion to build up the general cargo traffic with Canada and overseas. Cargo handled at the ports in River Basin Group 5.2 is not expected to exceed one million tons annually between now and 2020.

10.3.3.3 Related Land Uses and Problems

Conservation practices could be effectively applied to about 26 percent of the total land in RBG 5.2 to reduce soil losses and to conserve plant cover.

The erosion and sedimentation rates in River Basin Group 5.2 are the highest of those in the eastern part of the Great Lakes Basin, principally because of the intensive agricultural practices. Other parts of the area are less intensively used, and although relief conditions are more severe, erosion rates are lower.

Increasing pressure to convert agricultural lands to other uses is also a major problem. In many cases, these other land uses reduce the amount of cover on the land and increase the amount of sediment. Control of erosion is needed, particularly in urban areas, if water quality is to be improved by reducing the amount of sediment.

An estimated 485,000 acres of agricultural land has a drainage problem which limits production under present use. About 251,000 of these acres could profit from a drainage program that would help to develop and maintain economical farm units. Both onfarm installations and project action programs will be required. Drainage to improve pasture, forest, or other land is not thought to be needed.

No estimate is available for the drainage improvement needed on areas for urban development. The lack of dry land for urban development is not a very serious problem. In the Syracuse Standard Metropolitan Statistical Area about 24 percent of the nonurban land base has a wetness problem which would need to be corrected before this land could be used for urban uses. In the Utica-Rome SMSA about 18 percent of the nonurban land base has a wetness problem.

Maintenance of forest cover is needed for watershed protection, continuing production of timber products, recreation, fish and wildlife habitat, aesthetics, and combinations of these values.

There are about 2.5 million acres of non-Federal forests in PSA 5.2, nearly half the total area. On one-third of the forest land, treatment is adequate. There is an opportunity to program for forest land treatment on the remaining two-thirds.

There are 88.6 miles of shoreline in the RBG subject to erosion. The lake bluff area just east of Sodus Bay has houses dangerously close to the top of the receding bluff. Of the total, 84.1 miles are subject to noncritical erosion, and 4.5 miles are subject to critical erosion. Only about 7 percent of the entire shoreline in the river basin group is protected. None of the shoreline is subject to flooding. There are several critical bird nesting and migration areas along the shoreline, particularly in the Mexico Bay area. One of the major concerns with respect to shoreline use is that, if many power plants are built there, the heated condenser cooling water will tend to reduce the ultimate value of the area as a bird nesting and migration area and will also curtail the quality of the fishing in the area adjacent to these plants.

Needs for streambank erosion control are shown in Table 1–316. Streambank erosion is difficult to correct because many of the streambanks are private property. Owners do not have the resources or the willingness to correct the problem.

Flooding can occur in the Oswego River basin at any time of the year, and there is usually some flooding every year. High flows result nearly every spring from a combination of rainfall and melting snow. Summer storms usually affect only a small area. Although the basin has a total of 5,121 square miles, its principal flood problems occur at points where the tributary drainage area is 200 square miles or less. As of the present time, areas with average annual damages greater than $20,000 occur along the Seneca River from its confluence with Skaneateles Creek to its confluence with the Oneida River, along almost the entire shoreline of Oneida Lake, and along the entire length of the Oneida River. Most of the entire Barge Canal reach in RBG 5.2, as well as most of the Finger Lakes shorelines and the streams connecting the Finger Lakes with the Barge Canal, are expected to be subject to major flooding damages in the period between the present time and 2020. The exceptions to this are Seneca Lake, Owasco Lake, the Oswego River, and the streams connecting Owasco Lake with the Seneca River. Needs for alleviating damages are shown in Table 1–316.

Some of the more serious wildlife problems include:

(1) fluctuating water levels on both inland lakes and on Lake Ontario

(2) the construction of marinas, shoreline cottages, resorts, and roads on areas which intrude on wetlands and other important wildlife habitat

(3) dredging and filling activities

(4) drainage of inland wetlands

(5) posting of private lands

(6) early season haying operations

(7) fall plowing which reduces winter cover, feeding, and nesting areas for cottontails and pheasant

(8) use of herbicides.

The 1970 wildlife user-day demand is expected to increase by 75 percent by 2020. Half of this is for hunting and half is for nonconsumptive use. In order to meet the needs, 609,000 acres must be set aside by 2020.

Along the shoreline of Lake Ontario there is a critical need for planning and detailed study of the existing and potential future environmental systems. A system of buffer and linkage patterns corridors stretches along the shoreline from Niagara Falls to Syracuse and Utica and then northward to Watertown. These corridors warrant planning attention and detailed study to insure the future availability and proper use of the resource features. Emphasis must also be given to the resource clusters and scattered single resource features, since these serve as the attractions for recreationists visiting the area. A lack of consideration for their future and for their proper use could result in their degradation and loss. One of the more difficult planning problems in the area is what land to set aside for future recreational and aesthetic and cultural use. The land adjacent to the Barge Canal, the Finger Lakes, and the streams connecting them form a highly valuable aesthetic and cultural network of linkage corridors. Some conflicts exist between the use for recreation and the maintenance of aesthetic and cultural values and uses for other purposes.

The land-based water-oriented recreation-day developed capacity in 1970 must be nearly quadrupled to meet 2020 requirements. In order to satisfy this need by 1980, it is estimated that an additional 800 acres of land in RBG 5.2 will be needed for intensive land-based water-oriented recreational use, as well as 19,300 acres for land-based, less intensive recreational use. There is also an unsatisfied demand in this area for playfields, nature and bicycle trails, sledding and ice skating areas, and swimming beaches. Perhaps the major problem in this area is the extensive private ownership of shorelines along the Finger Lakes, which makes public development of recreational facilities, particularly swimming facilities, difficult and expensive.

10.3.4 Alternative Frameworks

Two alternative frameworks are presented for this as for other river basin groups. The Normal Framework does not reflect coordination of solutions to meet needs outside RBG 5.2 in the Lake basin or the Great Lakes Basin.

The second alternative, the Proposed Framework, contains the recommendations of the Commission in an effort to reflect the views of the people of the basin and the policies and programs of the States. To some extent, it reflects coordination in the development of the framework among a number of river basin groups, both in the Lake basin and in the Great Lakes Basin as a whole.

10.3.4.1 Normal Framework (NOR)

NOR is based on meeting quantified needs and solving identified problems to the maximum practicable extent consistent with subobjectives and criteria discussed in Section 2 of the appendix. The program outputs and costs are summarized in Section 12 in Tables 1–316, 1–317 and 1–318.

(1) Water Withdrawals

There is adequate water to meet water withdrawal needs for RBG 5.2 up to and beyond 2020 if additional source capacities are developed. The additional municipal water supply capacity to be developed is split largely between inland lakes and streams, reservoir storage, and Lake Ontario. By 2020 an additional 100 mgd will be needed from Lake Ontario, 51 mgd from development of inland lakes and streams, 20 mgd from ground water, and 80 mgd from reservoir storage.

Shifts from ground water to Lake Ontario sources are expected to occur in many areas of Onondaga County. The Onondaga County Water District obtains water from Lake Ontario and wholesales it to the Onondaga County Water Authority and the City of Syracuse. The quantity is expected to increase, as systems now using ground-water sources shift to purchasing water from the Authority. A major expansion of the Onondaga County Water District facilities will be needed by about 1990. Treatment for water supply is not a major problem but may become so if the pollution levels of Lake Ontario continue to increase.

It is expected that essentially all of the self-supplied industrial water in RBG 5.2 will come from inland lakes and streams. These needs reflect the expectation that, as manufacturing production expands, the gross water requirement will be met in part by new withdrawals of water to satisfy the needs and in part by recirculation and redirection of use of water in the existing and new plants.

The need for additional developed capacity for rural domestic and livestock water withdrawals is rather small throughout the entire planning period to 2020. It is not expected that any difficulty will arise in meeting these needs. They are likely to be met from ground-water development.

It is expected that the water for minerals production will be supplied from ground water and from inland lakes and streams.

Most of the irrigation water needed by 2020 could come from inland lakes and streams, with lesser amounts from reservoir storage and from ground water. This water withdrawal need will be difficult to meet without additional resource development.

In NOR all of the water withdrawals for thermal power cooling in RBG 5.2 are expected to be from Lake Ontario. It is expected that this would be the least-cost source and that the least-cost site for the generation of additional power would be along the shores of Lake Ontario.

NOR also assumes that the river basin group will have additional hydroelectrical power generation of 2,100 megawatts by 2020. Opportunities exist in the Salmon River basin and at several locations in the Oswego River basin. These would be pumped storage plants. Their economic feasibility has not yet been established. Should they not be built, this would not materially affect the overall power supply of the region.

(2) Nonwithdrawal Water Uses

NOR includes a criterion that the 7 day–10 year low flow will be maintained to the maximum extent possible in the streams in RBG 5.2. Programs meet the requirements prior to the Federal Water Pollution Control Act Amendments of 1972. New York State is well along with implementing its pure waters program, having constructed and expanded many municipal wastewater treatment plants in the Great Lakes Basin within the last decade. NOR provides that secondary treatment will be included throughout the entire area with 85 percent BOD removal or better in all cases. New York State has prepared a water quality plan which includes sewage treatment plant projects (construction of new plants or expansion of existing plants) at 35 locations by 1990. Other waste treatment improvements are also provided for in the New York State plan at 19 locations by 1990.

The waste treatment projects which have been approved or completed under the jurisdiction of the Department of Environmental Conservation have been assumed to be ongoing programs and in place as of 1970, or the base year. In addition to conventional secondary treatment and phosphate removal, the Normal Framework includes provisions for advanced waste treatment primarily in Onondaga County and in some of the streams connecting the Finger Lakes with the Barge Canal. Advanced waste treatment is expected to be needed in the Canandaigua Outlet, the Keuka Outlet, Catherine Creek, Seneca River, City of Geneva, Owasco Outlet below Auburn, all around Onondaga Lake, and around most of Oneida Lake itself. Phosphate reduction is needed along the Oswego River.

The fishery program to meet needs and solve problems consists of several features. They include the following in the period to 1980:

(a) acquisition of fishing access rights along 422 miles of streams, of which 80 percent are in the eastern Oswego County area, with the Fish Creek watershed the principal stream

(b) stream modification to improve 348 miles of the stream habitat using some instream structures and bank stabilization devices. Sixty-five percent of the reaches would be in the eastern Oswego County area.

(c) the continuation of stocking programs and harvest management

(d) the preservation of natural shorelines where exceptional habitat exists, such as much of the Finger Lakes shoreline

(e) regulation of major inland lakes so drawdown has minimal effect on habitat.

Both the maintenance of water quality through waste treatment and the initiation of low flow implementation from inland lakes would create additional fishing opportunity.

It has been estimated that the projected increase in supply of fishery opportunities in RBG 5.2 as a result of these various programs might approximate 3.1 million angler days. The current supply is over 6.2 million angler days.

Special research projects included in the Normal Framework as ongoing programs include studies of lamprey control, rainbow and lake trout production, and the practicality of articifical spawning channels. These are being carried on in the Finger Lakes by Cornell University as a cooperative State-Federal program.

Fishery plans beyond 1980 are speculative and depend considerably upon the success of new programs in the area. If the lamprey control and anadromous fish programs are successful, there will be economic justification for bold planning to obtain the maximum possible fisheries in the area. The degree of water pollution abatement and habitat protection that can be accomplished in this decade will determine the success or failure of most projected plans for the river basin group. The Normal Framework includes a continuation of the programs which are outlined above for the early action period.

NOR programs fail to satisfy all of the boating day needs for RBG 5.2 in the early time periods. They meet inland water needs in 2020, but only 80 percent of Lake Ontario needs.

The NOR Framework includes in all time periods the development of Great Lakes harbors, marinas, and access sites, inland marinas, and lake and stream access sites.

Commercial fishing and commercial navigation are discussed in Subsection 10.5, Lake Ontario Intrarelationships, and in Section 5.

(3) Related Land Use

The programed agricultural land treatment in NOR is essentially a continuation of ongoing programs for RBG 5.2, at a level that has been followed in the past.

Drainage programs for cropland have been selected to include onfarm drainage measures included in the land treatment needs at a current rate of installation.

The program for forest land treatment is at a higher level than a continuation of the past trend or ongoing programs would indicate.

The NOR Framework provides that all of the 4.5 miles of the shoreline subject to critical erosion in RBG 5.2 will be treated in the period to 1980.

The streambank erosion program would provide treatment by 2020 of all of the streambank mileage subject to severe erosion.

In the period before 1980, NOR includes four types of management to reduce urban and rural flood damages and to protect acreage subject to flooding. These measures include flood plain zoning, channel modification, reservoirs, and lake regulation. Lake regulation is applicable to Seneca Lake, Cayuga Lake, Canandaigua Lake, Owasco Lake, Skaneateles Lake, Otisco Lake, Onondaga Lake, and Oneida Lake. Flood-proofing is a viable flood reduction measure and is included in the framework for the entire river basin group. Diversion is included as a flood damage reduction measure for the Oswego River. Reservoirs are included as a reduction measure for Onondaga Lake, for the outlet from Cayuga Lake, for the outlet from Owasco Lake, and for the outlet from Oneida Lake. Each of the above reservoir alternatives would reduce damages in the rural flood plains.

In the upstream watershed areas other reduction measures which are useful in reducing damages include a modification of existing building use, the relocation of damageable property, emergency measures, and a flood warning and evacuation system. Reservoirs are included in the framework to reduce rural flood damages in the upstream watershed area just west of Rome, the Oswego River drainage area below Three Rivers, and the Oneida River watershed area between Oneida Lake and Three Rivers. Channel modification appears to be a desirable alternative in the upstream watershed of Flint Creek, the area just west of Rome; the Oswego River below Three Rivers; the Oneida River between Oneida Lake and Three Rivers; and watersheds 454, Black Wine Creek, Egypt, Sodus Ditch, and the area northeast of Clyde north of the Clyde River.

Zoning reduction measures are included in the program for the reduction of both urban and rural flood damages in each of the time periods. These measures are not expected to be effective in reducing rural damages in upstream watershed areas, however.

Generally speaking, in the time periods 1980–2000 and 2000–2020, there is a shift from structural measures to institutional measures to prevent additional flood damages.

For wildlife management, NOR includes a continuation of ongoing programs by State agencies for habitat enforcement and research. Additional programs included in the Normal Framework would have to be funded through new sources.

In the periods between the present and 1980, the framework includes acqusition and management of wetland, acquisition of access and hunting easements on private land, and technical assistance in developing wildlife potential on private land to increase hunting opportunity on land under lease.

In the period between 1980 and 2000 the Normal Framework includes the following:

(a) continuing development of State-owned land

(b) expanding programs of cooperative agreement for access to private lands

(c) provision of technical assistance in developing wildlife potential on private lands

(d) completion of the scheduled acquisition program for wetlands.

In the period 2000 and 2020, the Normal Framework includes acquisition of upland blocks of land or remaining privately owned property within existing game management areas, expansion of the program for access to private land, and continuing technical assistance to develop wildlife potential on private lands.

The framework provides that outstanding, unusual, and significant aesthetic and cultural values be acquired in the early action period for the benefit of future generations, and that corridors be developed as appropriate to maintain the quality of life in the urban parts of the area.

NOR recommends Como Reservoir, two new parks, and acquisition and development of 20 miles of river valley for meeting a portion of the recreational needs between the present time and 1980. The two new parks will utilize about 2,000 acres each, and the 20 miles of river valley will utilize 6,400 acres. In addition, the framework suggests that better utilization be made of existing State forest lands and State game lands by providing additional recreation facilities thereon.

For those lands managed for high-density recreational use, new lands will have to be acquired in and near urban areas throughout the planning area. These recreation areas should be oriented solely toward day use activities, including outdoor games and sports, picnicking, swimming, nature and bicycle trails, and other compatible uses.

Between 1980 and 2000 the framework would provide:

(a) additional recreation facilities on State forests and game lands

(b) the development of three new parks of 2,000 acres of land

(c) the acquisition and development of 30 miles of river valley consisting of 9,600 acres of land

(d) Butternut reservoir (south of Syracuse on Butternut Creek) and five additional major reservoirs

(e) the acquisition and construction of five Barge Canal recreation sites

(f) the acquisition and construction of four inland lake recreational sites.

Between 2000 and 2020 the Normal Framework includes the development of three new parks of 2,000 acres each and the acquisition and development of 30 miles of river valley.

Even with the development cited, the Normal Framework is not able to satisfy all of the water-oriented recreation-day needs in RBG 5.2. The unsatisified needs would have to be satisfied elsewhere in the Great Lakes Basin or remain unsatisfied.

(4) Framework Outputs and Costs

Section 12 contains Tables 1–316, 1–317, and 1–318, which provide information on needs, outputs, percent of needs met, and capital and OM&R costs for NOR in RBG 5.2.

10.3.4.2 Proposed Framework (PRO)

PRO was formulated in consultation with State officials in order to reflect State policies and programs, as well as the desires of area residents.

The Proposed Framework substantially reflects the comprehensive and ongoing plans of the State and its regional planning board in the Oswego River basin, described in Subsection 10.1.

The State of New York Office of Planning Services (OPS) has prepared and is keeping up to date demographic projections for the entire State. These projections are lower than the OBERS projections used for NOR, primarily due to decreasing migration rates into the New York State portion of the Great Lakes Basin. The recent downward trend in fertility rates has also contributed to the difference between OPS and OBERS projections. Subsequent planning efforts in RBG 5.2 area by the Great Lakes Basin Commission

TABLE 1–182 Comparison of Population Projections, PSA 5.2

	1000s of People			
	1970	1980	2000	2020
GBLC (1968 OBERS)	1,361.4	1,571.7	2,015.9	2,556.5
New York State (OPS)	---	1,496	1,823	---

TABLE 1–183 Comparison of Municipal Water Supply Data, PSA 5.2 (mgd)

	1980		2020	
	GLBFS	NYS	GLBFS	NYS
Supply (1968)	187	139	187	139
Developed Capacity (1968)	239	---	239	---
Requirement	268	189	490	451
Need	29	50	251	312

(GLBC) should utilize OPS projections. The differences in the projections are illustrated in Table 1–182.

(1) Water Withdrawals

There is considerable difference between the estimates of municipal water supply needs for RBG 5.2 made by New York State Department of Environmental Conservation and those prepared for this Framework Study. Table 1–183 illustrates the comparative data.

It appears that the primary difference is in the methodology and is related mostly to two factors: the GLBC data include some portion of counties which are not included in the Great Lakes Basin, and the GLBC data assume a higher level of developed capacity for Onondaga County sources from the Great Lakes than has been reflected in the New York State work. New York State estimates the capital cost of providing future municipal water supply needs and improvements by 1980 at some $140 million for the Proposed Framework.

The Proposed Framework includes development of reservoirs for Ithaca's water supply on Six Mile Creek as well as for Madison and Oneida Counties on Fish Creek.

The irrigation data included in the GLBC studies are somewhat different from the New York State data because irrigation in the GLBC study includes golf course irrigation as well as agricultural cropland irrigation.

A number of major findings and recommendations in the Oswego River basin comprehensive plan for management of water and related resources are included in the Proposed Framework. The coordinated plan was prepared by the Eastern Oswego River, Cayuga Lake, Wa-Ont-Ya, and Chemung River Basin Regional Water Resources Planning Boards and was adopted by the State in 1974.

One of the primary constraints in the Oswego River basin area is that there is no centralized authority for regulating releases from the lakes and regulating flows throughout the Oswego system. The Department of Environmental Conservation and the Department of Transportation are acting cooperatively as resource management agencies until an acceptable system for basin management can be devised and implemented. Legislation to accomplish this has been drafted for submission to the State Legislature.

The PRO Framework supports the establishment of such a system in the interest of resolving water resources and management problems in the Oswego River basin.

PRO also supports the basin plan recommendation for immediate adoption of the following reordering of functional priorities for water level control and flow regulation:

(a) public water supply (where applicable)

(b) water damage prevention, water quality, and environmental management

(c) lake shoreline recreation, including pleasure boating

(d) commercial navigation

(e) agricultural water supply

(f) hydroelectric power generation.

PRO also includes:

(a) the improvement of the basic hydrologic data network, including the cooperative New York State-United States Geological Survey Stream Gaging Program to assure that dependable information is available at all key locations to judge the state of the system in relation to public needs

(b) the utilization of failsafe communication systems to transmit this information to a basin operation center

(c) the utilization of modern data processing equipment to process data from the recommended hydrologic network into a format to support timely operational decisions

(d) utilization of failsafe communication systems between the operational center and individual operation facilities (that is, lake outlets and gates).

The Proposed Framework for RBG 5.2 concludes that public interests can best be served by consolidating into single administrative units many existing local government operations for water and wastewater facility management. Further, the Proposed Framework supports the creation of county and/or regional agencies to administer water supply and wastewater collection and treatment facilities in urban areas where they do not currently exist.

PRO recommends that sufficient resources be made available to support expanded agricultural demands and urges recognition of agricultural water supply as a legitimate use of canal resource capability. Satisfaction of potential agricultural water supply demands without impairment of other beneficiary uses will require stricter operational control of lake levels and lake releases. The PRO Framework recommends that future diversions from barge canal facilities for agricultural water supply purposes be accepted as a legitimate use of these facilities and that an appropriate fee schedule reflecting the benefits received by agricultural water users be designed and instituted.

(2) Nonwithdrawal Water Uses

PRO provides for waste treatment consistent with the Federal Water Pollution Control Act Amendments of 1972. Numerically the outputs are the same as NOR. Costs may be higher, and work may be accelerated.

Other nonwithdrawal use categories for RBG 5.2 are the same in PRO as in NOR, except for commercial navigation, which is discussed in Subsection 10.5 and in Section 5.

(3) Related Land Uses

The following comments are based on the summary of findings and recommendations in the Oswego River Basin Plan.

PRO concurs in the recommendation for the acceleration of land conservation programs throughout the watershed system. For RBG 5.2 accelerated land treatment is recommended at more than twice the rate of present ongoing land treatment programs. New means for financial assistance for these programs by State and local government deserve exploration. PRO further recommends a prompt investigation of the feasibility of debris control structures on main streams tributary to the basin's principal lakes. Forest land treatment measures should also be accelerated so as to treat some 860,000 acres of forest land by year 2020.

The PRO Framework concurs in the recommendation that shoreline zoning be established and that detailed plans for the development and management of the shorelines of the lakes be prepared. These are for inland lakes. The PRO Framework also recommends that the appropriate basin agency be given authority to assure that lake and basin shoreline management objectives are achieved.

The PRO Framework also concurs with the Oswego River Basin Plan's conclusion that public access to public waters is a necessary element of plans to use these waters fully. Irreplaceable resource areas of unique scenic, ecological, or cultural interest should be preserved, and selected reservoir sites having identifiable public benefits should be protected from encroachment. Therefore, the PRO Framework concurs in the recommendation for public acquisition of these areas by appropriate local and State agencies and further recommends State financial assistance for this purpose.

Streambank erosion protection for RBG 5.2 is the same in PRO as in NOR.

The PRO Framework recommends that a first step in a program of flood plain management should be immediate action by local municipalities to pass appropriate legislation to permit private property owners to get insurance under the Federal flood insurance program.

The Proposed Framework recommends additional study leading to authorization of a system of flood damage reduction measures to reduce the threat of catastrophic floods and associated major damages and reduce the magnitude of damages of lesser floods. The system will probably include improving the flood carrying capacity of the Oneida River, improving several outlets and outlet structures, constructing a channel to divert flood waters from the Clyde or Seneca Rivers to Lake Ontario, and Federal participation in potential multiple-purpose upland reservoirs.

The Proposed Framework concurs with the Oswego River Basin Plan's recommendation for the acceleration and expansion of efforts by State government to develop the recreational potential of the present Barge Canal and its predecessor, the Erie Canal.

The PRO Framework recommends Level C studies in the Oswego River basin. The purpose of these studies would be to provide a basis for the authorization and subsequent implementation of recommendations in the basin plan. The studies may be carried out in cooperation with Federal agencies, such as the U.S. Army Corps of Engineers, which has a Congressional authorization for Oswego River basin studies, and the Soil Conservation Service.

Central authority is needed to manage the lake system, which is now operated by numerous governmental entities. Such management could reduce flood damages and coordinate competing uses on lakes and streams of the Oswego River basin for recreational, agricultural, water supply, commercial navigation, municipal water supply, and other purposes.

The Great Lakes Basin projection of recreation needs may be too high when compared to the projections made by New York State. This is attributable largely to differences in methodology. Different types of recreation experiences are included in the respective studies, as well as differences in evaluation of public and private recreational supplies. Of particular importance is the fact that the New York data include boating needs under water-oriented outdoor recreation, and the Framework Study treats these needs separately.

The Proposed Framework recommends land use zoning around the lakes to encourage a shift over time to more opportunities for public recreation.

Such a recommendation will have to be implemented if the GLBC Proposed Framework Basinwide recommendations, which call for 60 percent of the recreation needs to be satisfied with public facilities and 40 percent to be satisfied with private facilities, are to be satisfied. In New York the historic trend is for 20 percent of recreation needs to be supplied by public facilities. An increase to the PRO objective of 60 percent will take a long time, if it can be accomplished at all. Specifically, one of the land use problems around the Finger Lakes is that lots in the second tier back from the lakes have no lake access.

The items for the Proposed Framework are based largely on the summary of findings and recommendations of the regional water resources planning boards in the Oswego River basin. The Proposed Framework supports the increase of standards of all coldwater streams and the increased standards of the Erie-Niagara Barge Canal to Class B Level.

(4) Framework Outputs and Costs

Section 12 contains Tables 1-319, 1-320, and 1-321, which provide information on needs, outputs, percent of needs met, and capital and OM&R costs for PRO, indicating by italics where they differ from NOR. Table 1-341 compares land treatment programs.

10.3.4.3 NOR and PRO Framework Costs

Table 1-356 in Section 12 lists the total costs (capital plus OM&R) for NOR and PRO in RBG 5.2 for the periods 1971-1980 and 1971-2020.

10.4 Frameworks for River Basin Group 5.3

10.4.1 Summary

The most significant problems in River Basin Group 5.3 are the increasing pressures for recreational and seasonal home development and the difficulty of insuring that such development will proceed in a way that will preserve the aesthetic, cultural, and unique natural resource values of this area. There is also concern over proposals to locate thermal power plants along the eastern shore of Lake Ontario because of fears that some of the plants might damage the fish and wildlife resources on the shelf in eastern Lake Ontario and in the Lake and bays.

Generally speaking, these problems are not severe. Some are moderate and most of them are minor. RBG 5.3 is not a very densely populated area. There are some economic problems in terms of maintaining adequate incomes and employment opportunities in the area. From a natural resource point of view, the physical problems are relatively minor when compared to the rest of the Great Lakes Basin.

One of the constraints in planning in this river basin group is the "forever wild" provision of the New York State Constitution that applies to the Adirondack State Park.

The Normal Framework satisfies all of the water withdrawal needs, which are relatively minor in this area. There is considerably less dependence on Lake Ontario water in this river basin group than there is in RBGs 5.1 and 5.2.

Municipal and industrial waste treatment programs provide for a minimum of secondary treatment throughout the river basin group plus additional treatment where it is deemed to be needed.

There are surplus opportunities for providing recreation day use, angler days, boating days, and wildlife user days. It is expected that RBG 5.3 will satisfy a considerable part of the needs that are generated but not satisfied in other river basin groups in the Lake Ontario basin.

Although there are substantial opportunities to provide agricultural land treatment, forest land treatment, drainage, and to abate shoreline and streambank erosion, these programs are generally not as extensive in this area as they are in other areas because of the less valuable agricultural land and different land use. Much of this land is hilly and covered with forest with low sedimentation rates. Shoreline problems are also different because of regulation of levels of the St. Lawrence River, and the fact that storm effects from winds blowing across bodies of water are not prevalent.

The aesthetic and cultural values are very extensive in this river basin group, and along with some other areas in New York State and portions of Pennsylvania, this area may well constitute the only large expanse of land intervening between the projected eastern megalopolis and the projected Great Lakes megalopolis.

This condition emphasizes the need for timely policy decisions regarding future development and the need for well-thought-out plans to insure that these aesthetic and cultural values are available for the use of future generations.

Section 12 contains Table 1-322 which lists the needs, output, and percent of needs met for the Normal Framework in RBG 5.3. Tables 1-323 and 1-324 show capital costs and operation, maintenance, and replacement costs.

10.4.2 The Area

This area lies entirely in New York State and extends beyond the Great Lakes Basin proper to include the area in the United States tributary to the St. Lawrence River. St. Lawrence County is thus included, and the basins of the Oswegatchie, Grass, Raquette, and St. Regis Rivers, as well as smaller basins. Nearly 65 percent of RBG 5.3 is tributary to the St. Lawrence River. Both the highest and lowest elevations in the Great Lakes Basin are in this RBG. Statistical and descriptive information are provided in Section 1 and Subsection 10.1 Figure 149 shows a map of the area.

10.4.3 Projected Resource Needs and Problems

The projected needs for resource use by time level are shown in Section 12 in Table 1–322. Where needs can be quantified, they are not discussed in the text, unless special conditions warrant such discussion.

10.4.3.1 Water Withdrawals

The total water withdrawal needs to 2020 are estimated for RBG 5.3 at 55 mgd above the base year water withdrawal of 135 mgd. Most of the water withdrawal needs are for municipal water supplies, the second largest need being that for irrigation water supply. There is no thermal power cooling. The water withdrawal problems are relatively minor.

Although water use for mineral production is relatively small, it is important to have periodic surveys of the water use patterns of the mineral industry to keep abreast of the intake and discharge water use changes.

10.4.3.2 Nonwithdrawal Water Uses

In 1970 a total of 15 mgd of commercial, domestic, and industrial wastewater was treated in municipal wastewater facilities in RBG 5.3. This amount is projected to increase by one-third by 2020.

Industrial wastewater treated in 1970 in industry-owned wastewater treatment facilities amounted to 145 mgd. This waste load is expected to decrease to 69 mgd by 1980, largely due to recirculation, to 15 mgd by 2000, and back up to 19 mgd by 2020. The motivation for the recirculation is to a large extent the effluent treatment requirement resulting from the water quality standards. This recirculation will result in an increased consumptive use. Water quality problems have been identified in River Basin Group 5.3, but none so severe that they demand immediate attention. One problem is that hydroelectric power plant operations restrict flow downstream from the plants at some times when the flow is needed to maintain the dilution necessary to meet water quality standards. This is a problem in the upper Black River, the Oswegatchie River, and the Raquette River. In the St. Lawrence River there are some problems associated with toxic wastes, including mercury, from hard products industries. In inland lakes throughout the river basin group, there is some pollution due to septic tank drainage from cottages. In the Black River basin there is heavy organic loading, mainly from pulp and paper mills. Sometimes the water quality fails to meet standards for bacteria and dissolved oxygen as a result of these industrial wastes. In the Oswegatchie River there are zones of localized pollution caused by paper mill, dairy, heavy metal, and sewage wastes, where water quality fails to meet standards for dissolved oxygen, toxic and floating solids, discoloration, and soluble solids. In the Grass River there are localized zones of heavy organic loading from metal and dairy industries, and from municipalities. In the Raquette River there is organic loading from paper mills, and from municipalities in the lower reaches. Perhaps the greatest conflict resulting from the above pollution is the impact that it has on the quantity and quality of the fishing opportunity in the river basin group. Adequate waste treatment for industrial and municipal wastes is needed in the Black River from Black River to Lowville. Eventually, improved industrial and municipal waste treatment will also be needed in the Black River from Port Leyden to Keyuta Lake, if desired conditions are to be maintained for trout fishing.

In the Oswegatchie River, municipal waste treatment and, more critically, adequate industrial waste treatment will eventually be needed in the reach from the mouth to Rensselaer Falls. Eventually, improved waste treatments for municipal waste will also be needed from Elmdale to Edwards, but adequate treatment for industrial waste in this reach must be regarded as the most important requirement. The last polluted reach of the Oswegatchie extends from Newton Falls to Cranberry Lake. Eventually, improved industrial and municipal waste treatment in combination with the present low-flow augmentation will be needed to bring this sector into compliance with State standards.

Adequate waste treatment for industrial wastes will be needed in order to correct water quality problems in the Grass River below Massena. Eventually, advanced waste treatment for all of the dairy waste in the area along the Grass River between the dam at Madrid and just below the town of Canton will be needed. Advanced waste treatment is required for some local and municipal and industrial wastes in the Raquette River basin,

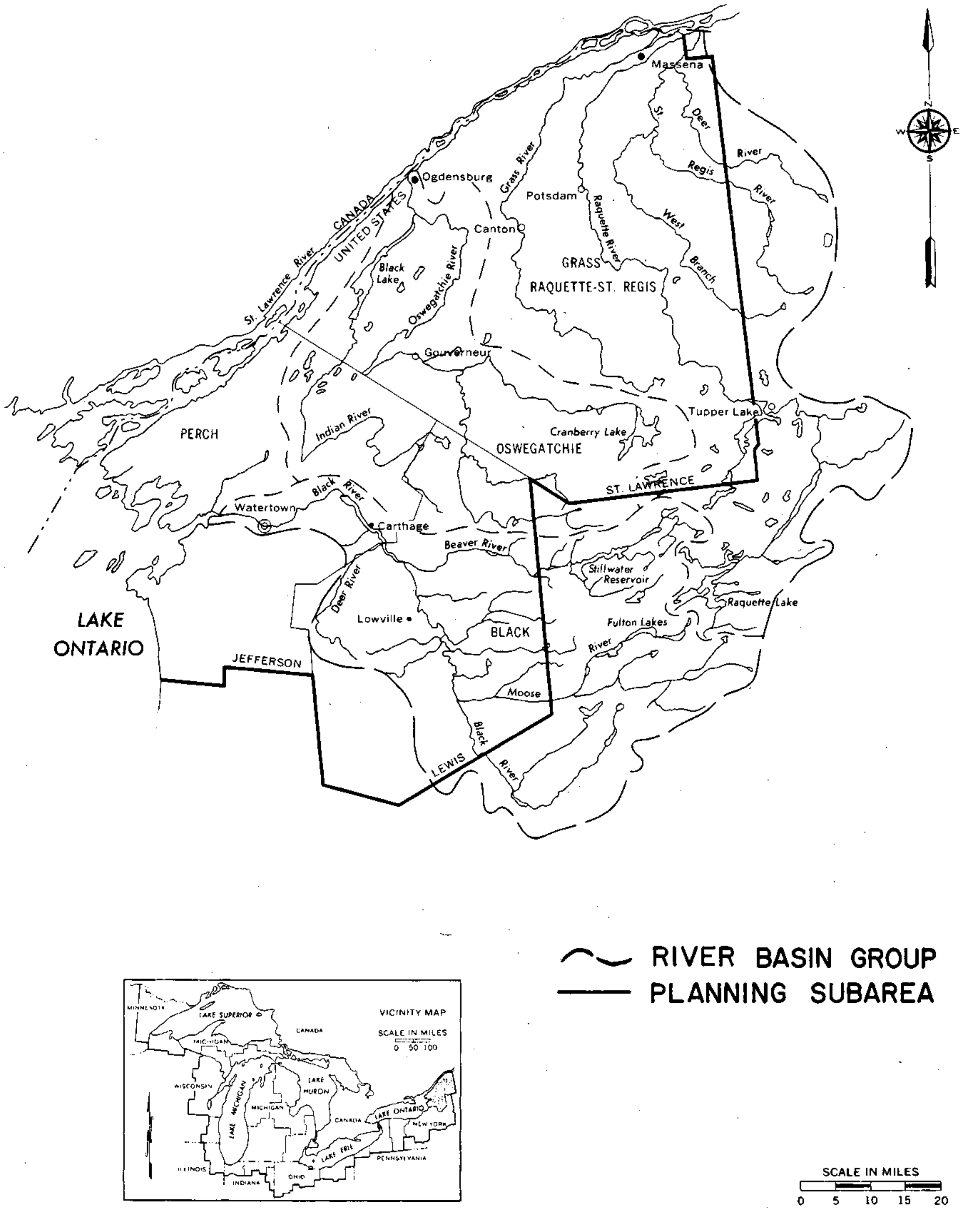

FIGURE 1–49 Lake Ontario East, River Basin Group 5.3

but particularly for the paper mill there. Also, there is a need for a modified schedule of streamflow regulation by upstream power plants. There are some problems with industrial wastes receiving poor treatment and discharging to the St. Lawrence River in the area of Massena as well as at Ogdensburg. This situation is expected to be alleviated by the mid–1970s.

The sport fishing needs for RBG 5.3 by 2020 are projected to be an additional 2 million angler days above the existing supply of 3,006,000 angler days. These figures are based on an assumed transfer of angler-day needs from other areas of the Lake Ontario basin. It is likely that this river basin group will satisfy some of the needs originating from the Syracuse and Rochester and Buffalo areas as well as from areas to the east and south outside the Great Lakes Basin.

There is a need for ponded trout waters in most of the sections outside the Adirondack Mountains. Except for this need, the area is capable of supporting present and projected angling demands through 1980. If habitat improvement and intensive management practices are provided, the area could support considerably more angling pressure than has been projected.

As shown in Table 1–184, the recreational boating needs in RBG 5.3 are relatively small in terms of the existing supply. The area provides quite good boating opportunities at the present time. In addition to planning for the satisfaction of the boating-day needs, it is also necessary to plan berthing facilities and launching sites. Many potential canoe and small boat streams in this area need improvement and maintenance. Low flows also contribute to problems of providing opportunities for canoe and small boat experiences. There is insufficient mooring along Lake Ontario.

An updated program concerning small boat facilities on Lake Ontario and the St. Lawrence River is essential to the expansion of recreational boating on these waters. The present programs do not provide for adequate facilities within a reasonable time frame to meet the projected needs. In addition to more facilities on the Lake, another urgent need is a better system to advise recreational boaters of weather conditions and forecasts. Additional improved access is needed both for inland waters and sheltered Lake Ontario water.

TABLE 1–184 Use and Projected Needs for Recreational Boating, PSA 5.3

	1000 Boating Days	
Category	Great Lakes Waters	Inland Waters
1970 Use	549	369
1980 Needs	12	3
2000 Needs	9	6
2020 Needs	0	9

Very little cargo is handled in the ports of River Basin Group 5.3. From the present time through 2020, Ogdensburg on the St. Lawrence River is expected to be the only significant harbor in this area. Traffic is less than a million tons and is projected to reach only 0.6 million tons by 2020. The most significant need for this area is strong port promotion to increase the bulk and general cargo traffic with Canada and overseas. The topic is further considered in Subsection 10.5, and Section 5.

10.4.3.3 Related Land Uses and Problems

The agricultural land that can effectively be treated to reduce soil losses and to conserve plant cover is about 11 percent of the total land in the RBG 5.3.

In this particular river basin group the economic return from livestock and livestock products, particularly dairying, is much greater than the return from crop production. Crop and tillage rotation, drainage, changes in land use, reestablishment of vegetative cover, and brush control are among the practices needed.

It is estimated that 323,000 acres of agricultural land have a drainage problem.

Project action for drainage is needed on about 206,000 acres. There is not expected to be any difficulty in meeting land use needs for urban areas in the river basin group.

Maintenance of forest cover is needed for watershed protection, continuing production of timber products, recreation, fish and wildlife habitat, aesthetics, and combinations of these values. This is particularly important in this area because of the vital role that the forest plays in attracting tourists to the region and in providing a source of income from the timber industry in this region. Timber cutting on public lands in the Adirondack area is prohibited by the New York State Constitution.

The greatest existing forest land problem is how to secure good management for private forest lands which constitute over one-third of the total area of PSA 5.3. The bulk of the privately owned forest is owned by farmers or other individuals, with only about one-fifth of it being owned by the forest industry. On only 490,000 acres of 2.2 million forested acres is treatment adequate. The single most important type of need in this area is for forest stand improvement, with reforestation and grazing control of moderate importance.

There is no Lake Ontario shoreline in RBG 5.3

subject to critical erosion, and only a small amount subject to flooding. Some protective works have been built. Much of the shoreline in Jefferson County is agricultural and undeveloped, with about an equal amount being residential. Only a very small amount of the shoreline is commercial and industrial, and only 3 percent is available for recreational use. The shoreline is 96 percent privately owned. The principal change in the land use of the shoreline in the last twenty years has been a large increase in residential development, with a similar decrease in agricultural and undeveloped frontage. The absence of critical erosion problems in this area is attributable to the natural resistance of the rocky shore and lake level regulation, which reduces peak lake levels.

There are 417 bank-miles in the planning subarea subject to moderate or severe streambank erosion damage amounting to an annual average of $21,900.

In this river basin group the greatest flood damages occur in rural areas. Flooding in the Black River basin affects primarily the flat lands between Lyons Falls and Carthage. This is the only place in RBG 5.3 where major flood damages (estimated $133,000 annual average) occur. This land is used almost entirely for agricultural purposes, with dairying the principal activity. Flooding here may occur at any time of the year. Often the combination of heavy spring rainfall and melting snow with the breaking up of river ice causes flood conditions in this reach of the basin. Although flooding in the reach between Carthage and Lake Ontario is less frequent, the damage is serious, as it affects industrial and residential areas.

Floods are not as serious a problem in the Oswegatchie basin. Sometimes, however, the damages are intensified due to ice jams. At Gouverneur approximately 25 residential units suffer damage.

Floods are also not a serious problem in the Grass, Raquette, and St. Regis River basins. Floods that have occurred appear to be due to ice jams rather than to high discharges.

Major damages are expected to occur in the lower reaches of the Oswegatchie, Grass, Raquette, and Black River basins by 2000 and 2020, respectively, unless flood plain management programs or other alternatives are effective in preventing these damages.

Problems affecting wildlife at the present time include:

(1) climate cycles of severe winters which periodically reduce some species

(2) illegal shooting and dog predation which limit the distribution of deer and some other species

(3) damages caused by some species, such as beaver, in areas of intensive land use

(4) the difficulty of providing access for hunters to the Adirondack zone, which is open for hunting

(5) forest preserve prohibition against the construction of many roads and maintenance of winter travel routes

(6) disagreement over management practices, such as antlerless deer seasons

(7) damage to wetland areas by filling and dredging, agricultural drainage and channeling, land fills, urbanization, pollution (including overenrichment), creation of impoundments, and fluctuating water levels

(8) the lack of information concerning population status of several species, including some forms considered to be endangered, such as the pine marten.

Advanced vegetative succession coupled with selective cutting of softwood trees has seriously reduced productive forest habitat in many areas. Logging is prevented by the State Constitution within the forest preserve, and this results in general deterioration of whitetailed deer in winter range. Other problems are the destruction of whitetailed deer in winter concentration areas by timber harvest and the construction of impoundments and the harassment of yarded deer by snowmobiles.

There is a need to introduce new wildlife species. Some zones have stable land use patterns but lack wildlife species adapted to such use. Statistics on needs are shown in Table 1–322.

The existing aesthetic and cultural values in RBG 5.3 have been mentioned in Subsection 10.1. The major problem is the need to preserve outstanding values. Much of the land in this area is in private ownership, and regulations are needed in order to insure that if such ownership continues, private development will not take place which will detract from the overall attractiveness of the area. There are numerous clusters of single and multiple aesthetic and cultural values. If these are to be preserved, there will probably need to be a considerable increase in the funds spent for land acquisition in this area for aesthetic and cultural values.

The land-based water-oriented recreation-day developed capacity of 2 million recreation days annually in 1970 will need to be increased by nearly 3 million recreation days annually by 2020.

The present amount of water surface acreage appears to be adequate to meet the requirements of water-dependent activities until the year 2020.

One of the major recreation problems in RBG 5.3 is the overuse of shoreland areas for recreation. The eastern Lake Ontario shoreline has very few reaches suitable for development. The inventory conducted for the International Joint Commission disclosed only 12 acres of beach on Lake Ontario in this subarea, all of it in public ownership.

This subarea receives heavy use from the Albany, Schenectady, and Utica areas, especially for weekend and vacation use. Furthermore, the extension of the freeway north from Albany opened the Adirondack area to people from the New York City area. It is anticipated that the intensity of use in this general area will increase steadily in the future.

10.4.4 Alternative Frameworks

Two alternative frameworks are presented for this as for other river basin groups. The Normal Framework does not reflect coordination of solutions to meet needs outside the RBG in the Lake basin or the Great Lakes Basin.

The second alternative, the Proposed Framework, contains the recommendations of the Commission in an effort to reflect the views of the people of the basin and the policies and programs of the States. To some extent, it reflects coordination in the development of the framework among a number of river basin groups, both in the Lake basin and in the Great Lakes Basin as a whole.

10.4.4.1 Normal Framework (NOR)

NOR is based on meeting quantified needs and solving identified problems to the maximum practicable extent consistent with subobjectives and criteria discussed in Section 2 of the appendix. The program outputs and costs are summarized in Section 12 in Tables 1–322, 1–323, 1–324.

(1) Water Withdrawals

The water withdrawal needs are relatively minor in RBG 5.3. There is adequate water to meet all of the water withdrawal needs up to 2020 if additional source capacity is developed. The additional source capacity for municipal water supply will come largely from inland lakes and streams and from Lake Ontario, with only a minor amount from ground water. No additional needs are indicated for self-supplied industrial water. The rural domestic and livestock waters are all expected to come from ground water. The irrigation water needs are satisfied about one-half from inland lakes and streams and one-half from the development of ground water. Reservoir storage is a possibility. All of the mining water supply needs are expected to be satisfied by water from inland lakes and streams. No water withdrawals for power are anticipated. No thermal or hydroelectric power generating capacity is expected to be developed in this river basin group in the Normal Framework.

(2) Nonwithdrawal Water Uses

NOR includes as a criterion that the 7 day-10 year low flow will be maintained to the maximum extent possible in the streams in the area. NOR meets requirements prior to the Federal Water Pollution Control Act Amendments of 1972. New York State is well along with implementing its pure waters program, having constructed and expanded many municipal wastewater treatment plants in the Great Lakes Basin within the last decade. The framework provides that secondary treatment will be included throughout the entire area with 85 percent BOD removal or better in all cases. New York State has prepared a water quality plan which includes sewage treatment plant projects (construction of new plants or expansion of existing plants) at eighteen locations by 1990. Other waste treatment improvements are also provided for in the New York State plan to 1990 at two locations. New York State has also banned phosphates in detergents.

The Normal Framework does not include advanced waste treatment at any specific locations in RBG 5.3 in any of the specific time periods.

By 1980, with proper management, the existing water resources and fishery resources can readily absorb the increased needs of 712,000 angler days. Management includes:

(a) the development of trout water outside the Adirondacks

(b) pollution abatement

(c) flow regulation, including the setting of minimum stream flows

(d) lake flow regulation

(e) access development for fishery purposes and expansion of the anadromous fish program

(f) development of necessary fish weirs and other structures

(g) modernization of hatchery facilities to insure necessary fish stocks

(h) control of beaver

(i) funds to carry on practical fish research and management related needs.

All of these programs continue through all the time periods.

The Normal Framework includes programs which will not only satisfy all of the boating day needs in all of the time periods but will result in a surplus of boating opportunity in River Basin Group 5.3.

Marinas on inland lakes and access points on Lake Ontario are included in the program in all time periods. No Great Lakes harbor construction is required in this area.

Zoning to meet the boating demand in inland waters could be accomplished by reducing the space standard from six to five acres per boat. Such a program has been included in the Normal Framework.

Commercial fishing and commercial navigation are discussed in Subsection 10.5, Lake Ontario Intrarelationships, and in Section 5.

(3) Related Land Use

The programed agricultural land treatment in RBG 5.3 is essentially a continuation of ongoing programs at a level that has been followed in the past.

The forest land treatment program included in the Normal Framework will treat about three times as much forest acreage as is presently being treated.

Drainage of cropland will improve the productive capacity of these lands and thereby reduce the total land needed for food production. The drainage program will benefit the farmers, water quality, wildlife, and will reduce erosion. Poorly drained agricultural lands in this area are used for pasture. With drainage, lands can be used more intensively with an increase in average net returns of $25 per acre per year. The total drainage that would be accomplished by 2000 is 38,800 acres.

The framework does not include any programs for correction or abatement of shoreline erosion, as there are no reaches subject to critical erosion.

Streambank erosion programs would provide treatment by 2020 on 77 streambank miles subject to severe erosion and reduce annual streambank damages by $18,800 by 2020.

NOR includes a program of flood plain management for the abatement of flood damages and the prevention of flooding. Flood plain zoning measures are included in the program for the reduction of both urban and rural flood damages in each of the time periods. These measures are not expected to be effective in reducing rural damages in upstream watershed areas.

In addition to the program of flood plain zoning or flood plain management, NOR also includes a channel modification construction project in the Sucker Brook watershed for the early action period and an additional channel modification project for the lower portion of the St. Regis River watershed. Programs for flood-proofing and the relocation of damageable property appear to be the most desirable alternatives for the rural flood plains in the Black, Oswegatchie, Grass, Raquette, and St. Regis river basins. In many of the upstream watersheds these programs are desirable in addition to modification of existing building use, emergency measures, and flood warning and evacuation systems.

The Normal Framework for wildlife management includes a continuation of ongoing budgeted programs by State agencies for habitat enhancement, enforcement, and research. Additional programs are included in the framework which would have to be funded through new and presently unidentified sources as follows:

(a) a program of outright acquisition and acquisition of perpetual leases on critical wetland units, totaling 42,500 acres by 1980 in Jefferson and St. Lawrence Counties, to provide 40,000 wildlife user-days annually

(b) the development and rehabilitation of facilities on 3,000 previously acquired acres as well as some additional acquisition to round out public use complexes, to provide an additional 60,000 wildlife user-days annually by 2000.

(c) the continued development, including rehabilitation, of previously constructed facilities on public use areas, totaling 45,000 acres to provide an additional 90,000 user-days annually by 2020.

This would not meet needs at 2020.

NOR provides for outstanding, unusual, and significant aesthetic and cultural values to be acquired in the early action period and preserved for the benefit of future generations.

The framework includes programs not only to meet the recreational needs in RBG 5.3 but also to create a surplus of recreational opportunity, thereby meeting needs from other areas and also perhaps improving the economy of this particular area.

Between the present time and 1980, the following items are included in the Normal Framework for meeting recreational day needs:

(a) two new parks similar to existing State parks, which will require about 2,000 acres of land. Together they would provide the opportunity for an additional 1,364,000 recreation days annually.

(b) acquisition and development of ten miles of river valley. This would require about 3,200 acres of land and provide the opportunity for 800,000 visitor days.

(c) eight new canoe routes, which involve about 150 miles of stream

(d) preservation of some scenic and recreation areas

(e) increased utilization of existing lakes

(f) initiation of a system of scenic, wild rivers and rivers and lakes usable for recreation.

In the period between 1980 and 2000, the Normal Framework includes five regional parks similar to existing State parks. Each of these would require about 2,000 acres of land, and collectively they would provide the opportunity for an additional 3,410,000 annual visitor days. The Normal Framework also includes in this time period increased utilization of existing recreational facilities and additional access sites, although the recreation days that would result from such programs have not been estimated.

No additional recreational development programs are included for the period between 2000 and 2020.

NOR supports the City of Watertown in plans to acquire flood plain land for conservation.

The framework for the Village of Alexandria Bay includes the development and expansion of its existing waterfront park.

The framework also supports assistance for the Village of Massena to concentrate on development of an existing site for a regional park.

(4) Framework Outputs and Costs

Section 12 contains Tables 1–322, 1–323, and 1–324, which provide information on needs, outputs, percent of needs met, and capital and OM&R costs for NOR in RBG 5.3.

10.4.4.2 Proposed Framework (PRO)

PRO was formulated in consultation with State officials in order to reflect State policies and programs, as well as the desires of area residents.

State, regional, and local policy assumptions with respect to population and economic growth do not differ greatly from the OBERS projections used in NOR. PRO Framework programs are discussed only where they differ from NOR.

PRO for RBG 5.3 substantially reflects in generalized programs the comprehensive and ongoing plans of the State and its Black River-St. Lawrence Region.

The State of New York Office of Planning Services (OPS) has prepared and is keeping up to date demographic projections for the entire State. These projections are lower than the NOR projections primarily due to decreasing migration into the New York State portion of the Great Lakes Basin. The recent downward trend in fertility rates has also contributed to the difference between OPS and OBERS projections. Subsequent planning efforts in the RBG 5.3 area by the Great Lakes Basin Commission (GLBC) should utilize OPS projections. The differences in the projections are illustrated in Table 1–185.

TABLE 1–185 Comparison of Population Projections, PSA 5.3

	1000s of People						
		1980		2000		2020	
County	1970	GLBFS	OPS	GLBFS	OPS	GLBFS	OPS
Jefferson	89	89	89	101	92	117	---
Lewis	24	23	24	26	26	30	---
St. Lawrence	112	114	120	130	128	151	---
TOTAL	225	226	233	257	246	298	---

(1) Water Withdrawals

Most of the water supply for irrigation in RBG 5.3 will be from inland lakes and streams, rather than 50 percent from ground water and 50 percent from inland lakes and streams, as was indicated in the NOR Framework. More detailed planning studies by the New York State Department of Environmental Conservation have concluded that, in the period after 1980, agricultural irrigation could become increasingly important in RBG 5.3. All of the constraints which presently limit vegetable production and irrigation use could be overcome, provided there was local desire to increase vegetable production. Because of the substantial soil and water capability for irrigation (an estimated 118,800 acres of land would be physically suitable for irrigation), a growing demand for food, and the positive regional economic benefits that would result from increased basin agricultural production, irrigation represents a promising long-term opportunity. Therefore, the program outputs for irrigation could be increased.

The GLBC municipal water supply costs do not include needed improvements to water supply systems. More detailed studies have concluded that such costs are very substantial in RBG 5.3. Table 1–186 illustrates comparative costs as evaluated by GLBC and the New York State Department of Environmental Conservation, respectively.

A power plant siting study is currently being done in New York State. Initial results confirm NOR expectations that there will be no water withdrawals for thermal power cooling in this area.

(2) Nonwithdrawal Water Uses

A major multiple-purpose reservoir appears desirable as the most probable solution to some of the needs in the Black River basin. This would be needed after the early action period. It would reduce flood damages along the main stem of the Black River, enhance hydroelectric power generation, provide recreational opportunities, and thereby relieve some of the pressure on Adirondack Park, enhance irrigation potential, and produce other land enhancement benefits.

The Proposed Framework includes a recommendation for prompt implementation of the pending waste treatment to meet the standards of the Federal Water Pollution Control Act Amendments of 1972.

(3) Related Land Uses

Ongoing programs of agricultural land treatment should be continued and certain appropriate practices accelerated to treat 324,300 acres of land by 2020. The PRO Framework for RBG 5.3 represents a more than doubling of land treatment over past practices. Additional drainage measures are not recommended at this time. Forest land treatment should also be accelerated over past practices to treat 869,000 acres by 2020. Treatment of 60 percent of this acreage would be provided for in the PRO Framework.

Flood-proofing and the relocation of damageable property do not appear to be particularly appro-

TABLE 1-186 Water Supply Capital Costs, RBG 5.3 (millions of dollars)

	1971-1980		1981-2000		2001-2020	
	GLBC	NYS	GLBC	NYS	GLBC	NYS
Municipal	1.1	14.6	3.0	---	4.2	---

priate flood reduction measures in the Black River basin, as most of the damages are agricultural rather than urban.

(4) Framework Outputs and Costs

Section 12 contains Tables 1-325, 1-326, and 1-327, which provide information on needs, outputs, percent of needs met, and capital and OM&R costs for PRO, indicating by italics where they differ from NOR. Table 1-342 compares land treatment programs.

10.4.4.3 NOR and PRO Framework Costs

Table 1-357 in Section 12 lists the total costs (capital plus OM&R) for NOR and PRO in RBG 5.3 for the periods 1971-1980 and 1971-2020.

10.5 Lake Ontario Intrarelationships

There are a number of uses of Lake Ontario which must be considered with respect to the Lake itself rather than with respect to any river basin group. Those activities which utilize the Lake as a whole are discussed in this subsection. The relationships with the other Great Lakes are discussed in Section 5.

10.5.1 Commercial Navigation

The flow of overseas general commerce on Lake Ontario centers largely at Toronto. However, by 1995 annual shipping is expected to be about 60,000 short tons through the Port of Rochester, and 95,000 short tons through the Port of Oswego. Traffic on the St. Lawrence River through Montreal is projected to be 10,200,000 short tons.

A number of alternatives are being considered for extension of the navigation season and also for improvements in the navigation system. One group of alternatives involves only the upper four Lakes and would have little or no effect on Lake Ontario. Even the alternatives which include Lake Ontario and St. Lawrence River would have minimum impacts, because very little cargo is handled on the U.S. shore of Lake Ontario. Ongoing studies related to modification of the system and extension of the season are discussed in Section 5.

The Normal Framework does not include specific programs for the extension of the Great Lakes navigation season.

Extension of the navigation season is included in PRO as follows:

(1) six weeks for segments of the system from

(a) western Lake Superior through the Soo Locks, St. Marys River, and to southern Lake Michigan

(b) through the St. Clair and Detroit Rivers and Lakes St. Clair and Erie

(c) through the Welland Canal into Lake Ontario

(2) four weeks through the St. Lawrence River system.

Most of the problems associated with the structural and operational changes in the Great Lakes-St. Lawrence navigation system and the Lake Ontario part of that system are being addressed in ongoing studies. The Normal Framework provides for timely completion of ongoing studies, development of new technology, and strong local port promotion policies. Generally speaking, there are very minor changes in port cargo anticipated for the ports in the U.S. portion of Lake Ontario. In future years these ports will take on an even less significant role than they have at the present time.

10.5.2 Recreational Boating

An updated program concerning small boat harbors on Lake Ontario is essential to the expansion of recreational boating on these waters. Such a program is included in the Normal Framework.

In addition to more harbors on the Lake, another urgent need is a better system to inform recreational boaters of weather conditions and forecasts. This item is also included as a special program or study resulting from the Normal Framework. On Lake Ontario a desirable spacing for harbors of refuge should be 15-20 miles. One of the other aspects of recreational boating that pertains to the entire Lake Ontario basin is the possibility of expanding the program of boating in the New York State Barge Canal, perhaps to the exclusion of using the Barge Canal for commercial navigation. An expanded program, including harbors of refuge around Lake Ontario, would make it possible for boaters to boat on the canal and then along the shoreline of Lake Ontario through the Thousand Islands area and back again. That is to say, by sticking to the shoreline of Lake Ontario during the season in which the Lake is open, it is possible to boat for some considerable distances. There is an abundance of sheltered waters for boating, including many areas suitable for the construction of marinas and launching ramps in the Thousand Islands area. An expanded program could be initiated to enhance the economy of the area.

10.5.3 Water Quality

Probably the most serious and perplexing problem in the Lake is the yearly crop of *Cladophora*, a form of filamentous green algae. The largest single source of nutrient input to Lake Ontario is the Niagara River, reflecting the fact that this Lake is downstream from four other Lakes and suffers the consequences of what happens above it in the Basin. Fortunately for the health of the Lake, many of the nutrients going into Lake Erie are retained in that Lake and not carried out by the Niagara River.

Other problems peculiar to Lake Ontario include the invasion of the alewife, which die in enormous numbers within a short period during each summer and drift onto the shores, adding their stench to the windrows of rotting *Cladophora* on the beaches.

In addition to the buildup in nutrient compounds, Lake Ontario waters have deteriorated in chemical quality as measured by such parameters as the sulfate and chloride ions and total dissolved solids.

10.5.4 Levels and Flows

The framework does not include recommendations with respect to greater regulation of levels and flows of Lake Ontario than currently exists. There are trade-offs and conflicts between lake level regulation for various purposes. A scheme to maximize commercial navigation opportunity would not necessarily complement one to generate power. Nor would either of them necessarily agree with a scheme designed to minimize erosion along the shoreline of Lake Ontario or one to maintain waters at specific levels to enhance the wildlife and aesthetic and cultural values. The International Joint Commission study of further regulation of the levels of the Great Lakes is still under consideration.

10.5.5 International Field Year for the Great Lakes

The Normal Framework includes recommendations for completing the data analysis of the International Field Year for the Great Lakes. This is a cooperative study of Lake Ontario, involving many universities and governmental agencies in the United States and Canada. From April 1972 through April 1973 physical, biological, and chemical data were collected systematically for the entire Lake. This is the first time a study of such scope has been undertaken. Hopefully, the information gained from this study will greatly enhance the ability to manage the water quality of Lake Ontario and the other Great Lakes. This study was undertaken because it was generally recognized that data presently available in the Great Lakes system were inadequate for effective planning and management of the basin's resources. The need was also recognized for an adequate amount of data and understanding on which to build for quantitatively predicting the effects on this resource of various management strategies, both structural and nonstructural, now being planned.

Another objective of the study was to gain some additional understanding of the scientific and technical aspects of the complex interrelationships within and among the physical, chemical, and biological subsystems in the Lake environment. Several levels and flows research studies and investigations are included in the Normal Framework as follows:

(1) a study to improve estimates of monthly and annual evaporation from Lake Ontario. This would be in conjunction with a similar study on Lake Erie, and the results of the two studies on these lakes would be extended to other Lakes.

(2) a study of the ice characteristics in the St. Lawrence River to ascertain the vertical and horizontal water diffusion factors

(3) a study to determine the effect of Niagara Falls on the waters of Lake Ontario.

10.5.6 Commercial and Sport Fishery

The New York commercial fishery is separated by legal boundaries and regulations into two areas, Lake Ontario proper and Chaumont Bay. Commercial fishing is of much less consequence than the sport fishery and is valued at less than $100,000 per year to the fishermen. The commercial fishery, therefore, cannot be allowed to jeopardize the million-dollar sport fishery. There should be a tremendous potential for salmonid production in Lake Ontario. It is the primary objective of present management programed for the Lake.

It is doubtful that commercial fishing will regain its prominent position in Lake Ontario unless other sources of food fishes collapse throughout the world. Future commercial fisheries will be strictly controlled and must enhance or at least not endanger the sport fishery. One fact is certain: management of the open lake must be coordinated between Ontario and New York in order to be successful.

The sport fishery is a major factor in the economy of many communities. A multimillion-dollar business complex is supported by smallmouth bass and associated species. In addition, excise taxes on fishing tackle help support much of the State's fish research program. Party or guideboat service would quickly become a major industry again if a good sport fishery is provided. Also of significant economic importance is the sale of bait. There are no reliable figures available on the actual value of the sport fishery in the Lake. More intensive census data are required, and this is included as a high priority management program in the Normal Framework.

The other uses of Lake Ontario also have an effect on fish resources. Of particular concern is the effect of thermal discharges, recreational boating and water skiing, construction dredging, spoil and filling operations, proposed year-round navigation, fluctuations of water levels for hydroelectric power operations, and use of tributary streams and upper Lakes drainage for industrial and domestic waste disposal.

In addition to regulation of these activities, adequate salmonid stocking must be insured. Plans for expansion of existing State hatchery facilities and possible construction of one or two State and/or Federal hatcheries are in the formative stage. Proposed long-range plans call for annual stocking of Lake Ontario with two million salmonids in New York waters, and similar numbers in Canadian waters. Coho and chinook salmon, and rainbow (steelhead), lake, and brown trout are proposed.

Intensive management of fishing streams will require extensive acquisition and development and maintenance funds for public fishing rights. Similar funding will be required for lake-oriented management to provide public access, fishing piers, artificial reefs, safety harbors, adequate work vessels for additional census research, and fish stock monitoring.

Major fishery problems and needs are summarized below in order of priority.

(1) protection and enhancement of the habitat base

(2) development of a major salmon sport fishery through

- (a) lamprey control
- (b) salmonid stocking
- (c) acquisition and development
- (d) promotion

(3) development of a fish stock monitoring system for the open lake and inshore areas

(4) protection and enhancement of the existing inshore warmwater fishery

(5) development of a commercial fishery where compatible with the sport fishery

(6) automated processing of all data

(7) coordination with Ontario and upper Lakes to insure total fish management of the Lake on a sound basis

(8) research to develop management methods to solve present and predicted needs

(9) cost-benefit data to help determine the most justifiable total fishery for the Lake

(10) education of the public as to the potential of the Lake and best methods available to provide the potential and utilize the total fishery.

Of equal or greater importance than State control in Lake Ontario is the need for international and interstate authority to control practices that degrade the fighery throughout the Great Lakes Basin. Comprehensive planning with all water users on a local, State, and international basis will be required.

Section 11

IMPLEMENTATION OF FRAMEWORK PROGRAMS

11.1 General Remarks and Recommendations for Implementing the Framework

The framework is really not a plan in the usual sense of the word. It is an outline of various kinds of programs which, if adopted, will lead to the conservation, development, and use of the water and related land resources of the Basin in a way that will meet the needs and desires of the people of the Basin, and at the same time supply those materials, products, and functions which the Great Lakes Basin can best provide for the nation. Implementing the framework does not mean simply constructing a number of projects, passing a number of laws, or providing for the needs of people. It means exploring ways in which to build upon the general outline or framework; adopting programs out of which will come specific structures, projects, laws, and other devices for meeting the needs; conducting basic research to determine the effects of certain actions; collecting data to provide background information for research and planning; and planning locally in the degree of detail that will lead to the best use of resources in the locality.

The framework does recommend some structural and nonstructural measures. But it is recognized that more detailed studies are needed, and that the recommendation of a particular program carries with it the reservation that additional planning may show that some other alternative may be preferred.

Recognizing these limitations, and with the understanding that conditions, attitudes, and future study results may change, the Commission recommends in general that all necessary steps be taken to implement the structural and nonstructural programs in the framework during the periods indicated in Section 5. While the tables presenting the elements and costs of the programs do not indicate further planning, data collection, or research, these are implicit parts of the adopted framework. The accomplishment of this planning, data collection, and research will refine the programs and estimates of costs, which are now necessarily very general.

The framework implementation will require substantial capital investment by Federal, State, and local governments and by private groups. The Commission believes that this investment will promote and support orderly, economical, and environmentally sound development of Great Lakes resources to serve the well-being of the people. The local unit of government may well be the critical element in implementation. This will vary somewhat by State. An aggressive city, county, or improvement district backed by an informed public will be most effective in accomplishing planning and completing projects. Implementation of the framework programs may require changes in existing public law and policy. The historical patterns of funding limitations on research, data collection, planning, and implementation may have to change to meet the challenges the framework has identified.

This section treats several major components of recommended implementation, including research, data collection and analysis, future planning studies, action programs, institutional arrangements, and a strategy for the continuing development of the Comprehensive Coordinated Joint Plan (CCJP) for the Great Lakes Basin.

11.1.1 Considerations not Included in the Framework

The concern about energy shortages and the desire to conserve raw materials and minimize environmental degradation have intensified interest in recovering both energy and usable materials from waste that is now discarded. These possibilities were not considered in the Framework Study, but application of known processes and their further development will assist in meeting needs projected in the Study by conserving minerals in the Basin through recycling and producing heat energy through incineration of solid waste.

The field of solid waste management and resource recovery has undergone great technological change in recent years. Not only can many materials such as paper, glass, and ferrous and nonferrous metals be reclaimed from municipal refuse and recycled, but many communities are now looking to garbage or organic materials as possible energy supplies. Resource recovery and waste utilization significantly reduce many of the environmental impacts inherent in materials production and residual disposal. The use of recycled materials increases energy efficiency in the production of new materials, and it has been demonstrated that air pollution and water resource requirements are diminished by using recycled materials. Obviously, increasing the use of recycled materials reduces the pressure for exploitation of virgin resources, thus reducing adverse environmental impacts inherent in exploitation. Additionally, resource recovery programs reduce the amount of land resources devoted to land-filling activities, which in turn reduces the possible contamination of surface and ground water. Even in the best-designed sanitary landfill, the potential for leachate contamination of groundwater supplies is still real.

There is a definite trend towards increasing utilization of waste resources, both within the Great Lakes Region and in other areas of the country. This should be part of the framework implementation program. At the present time, however, a number of tax laws and pricing levels present significant obstacles to resource recovery programs. In light of increasing materials and energy shortages, these should be thoroughly reevaluated. Increasing the durability of goods presently produced in the Region and fostering resource recovery programs will reduce the pressures for natural resource exploitation and diminish the potential for environmental degradation resulting from materials production and residual disposal.

11.2 Framework Action Program

Implementation of the Proposed Framework programs will require definition and continual asessment of resource policy, the coordination of organizations to manage Great Lakes resources, and adequate investment by government and private sources. These elements of action program implementation are separately discussed in the following subsections.

11.2.1 Policy Considerations

Policy should establish the means by which financial and institutional resources are directed to the resolution of problems. With respect to water and related land resources, policy is most frequently articulated in legislation at all levels of government and is made operational through interpretative agency guidelines and funding. While policy change is generally evolutionary in nature, it is always a dynamic process and can change rapidly in response to changes in the political as well as the physical environment. Changes in prevailing policy can directly affect the types of programs that are implemented. For example, changes may shift emphasis from structural to nonstructural means of reducing flood damages. Another significant policy change is one in which priorities are altered to such an extent that the timing of various programs is drastically accelerated or delayed. An example of this type of change is the Federal Water Pollution Control Act Amendments of 1972, which provided a substantive change in not only the timing but also the funding arrangements to achieve water quality improvements.

A third type of policy change is one that affects the planning process through which programs are selected to address resource problems. An example of this type of change is provided by the Water Resources Council's *Principles and Standards for Water and Related Land Resources Planning,* which may have a major impact on the planning processes used by government agencies and consequently on the results of those processes. If these principles and standards are fully implemented in their present form, they will require a more rigorous comparison of alternatives, including costs and benefits, than has previously been the case. This impact on the details of the planning process will have a significant effect on the results obtained through that process.

A few issues requiring consideration of changes in policy have been identified in the framework formulation process. Because the basic formulation in NOR is defined as equivalent to the national economical development objective, and because the traditional solutions are essentially those which can accomplish the objective at least cost, these were adopted wherever appropriate in NOR. Thus, not very many changes in policy matters were actually considered by the Commission.

The functional programs included and evaluated in both NOR and PRO Frameworks are based in large measure upon existing policy, funding arrangements, and institutional structures. The Framework Study has drawn upon these realities but has sought to identify needs (informational, institutional, etc.) that are not currently receiving adequate attention under existing structures and procedures. These are further commented upon in Subsection 11.5.

Those matters of policy that did surface during the study were handled in various ways. Generally an issue paper was prepared, considered at committee level (usually the Plan and Program Formulation Committee), and then, depending upon the action of that committee, considered by the Commissioners. Occasionally, the Plan and Program Formulation Committee would adopt a resolution of the issue, particularly if there were no policy change, but only a narrowing of range of formulation activity. However, if a policy change were involved, the committee normally directed the staff to refer the matter to the Commissioners. Usually the issue was presented along with the way in which it was handled in the Normal Framework, possible alternative ways of resolving it in the Proposed Framework, and favorable and unfavorable comments. A method for handling the issue in PRO was then proposed, and a consensus of the Commission developed through discussion. In some instances, following the general resolution of an issue, specific questions were raised for consideration in the formulation process. Often these were handled by the individual plan formulation task forces or the Plan and Program Formulation Committee. Only occasionally did the specific questions reach the full Commission. The specific issues and their resolution are included in more detail in Annex D, and the decisions are incorporated in the framework program selections. (See Introduction for availability of Annex D.)

The general issues stated in the following subsections are in the language adopted except for minor changes to improve wording. Substantial questions raised after an issue statement was adopted are discussed following the issue, with a resolution if one was achieved.

11.2.1.1 Mineral Resource Conservation and Use

It is recommended that as a part of planning programs, particularly in urbanizing areas, due consideration be given to the preservation of known mineral deposits for possible future utilization, and that the Proposed Framework include a recommendation for reclaiming those previously mined lands that have a significant adverse effect on the environment. The extent to which a specific mined area is to be reclaimed would have to be decided on a case-by-case basis. Restoration of lands affected by current and future mining operations should be the responsibility of the land owner and/or operator. States that have not already done so should be encouraged to institute legislation to require restoration of lands as part of all future mining activities. The general principle supported in the Proposed Framework is that the land be reclaimed to abate pollution sources and to provide the opportunity for appropriate future land uses. When location and topography are suitable, high priority consideration should be given to the opportunities of using mined lands for future recreation and open space.

11.2.1.2 Outdoor Recreation

The Great Lakes Basin Commission favors resource utilization that will meet all water-oriented outdoor recreation needs. It is assumed that approximately 60 percent of the outdoor recreation needs will be met with public funds (Federal, State, and local), and it is further assumed that the remainder will be met either by private funding or not at all. It is assumed that the priorities for the use of public funds will be:

(1) urban recreational development and acquisition and retention of unique and natural areas of regional significance
(2) developments on land now publicly owned
(3) other developments.

It is assumed that, to the extent public funds are available for investment in urban land, they may be used where feasible to assist in acquiring flood plain land in rapidly urbanizing areas and in clearing flood plains of damage-prone uses and making them available for recreation use.

During the formulation and review process, some expansion and clarification of this language was recognized. While the objective is to have 60 percent of outdoor recreation needs met with public funds this has not been the case historically. For example, in New York about 20 to 25 percent of the needs have been met with public funding. While the language refers to the need for urban recreation development, it is felt that the problem of meeting the demand for urban recreational opportunities near the centers of population must be emphasized. It is pointed out however, that the unique and natural areas of regional significance to be purchased with public funds may be rural as well as urban.

11.2.1.3 Commercial Navigation

To the extent technically feasible, economically justified, and environmentally acceptable, the Great Lakes Basin Commission favors the maintenance of efficient, low-cost, deep-draft navigation and the provision of incremental improvements to the navigation system in the Great Lakes and St. Lawrence Seaway, including connecting channels, shipping and receiving harbors, compensating works, additional locks, canals, dams, and extension of the navigation season.

11.2.1.4 Shore Use and Erosion

The Commission favors a vigorous program to reduce losses to shore property interests. Such a program should include a combination of protective works; public acquisition of shorelands; and strict zoning based on sound economic analysis, careful environmental evaluation, and a multiple-purpose approach to shoreland management. The Commission recommends implementation of this program with early intensification of programs for data collection, applied research, and engineering applicable to the areas subject to erosion damage.

11.2.1.5 Environmental Setbacks

The Commission recommends a program of shoreland management which recognizes the Great Lakes shoreland as a unique natural resource. To implement this policy, the Proposed Framework should endorse developmental setbacks for all shoreland areas unless public benefits can be shown to outweigh public disadvantages.

The question has been raised as to who should demonstrate that public benefits accruing from shore construction would outweigh public disadvantages. No criteria were enunciated, but the sense of the discussion appeared to be that, although some buildings would be useful only on the shore and others overwhelmingly desirable in shore locations, the responsibility should be on the constructing agency to prove its case for a shore location.

11.2.1.6 Reduction of Power Growth Rate

A factual discussion of power consumption will be contained in the plan formulation without taking a position that a reduction in growth of consumption should be encouraged. It should be noted, however, that improved efficiency would, in effect, reduce the rate of per capita use.

The decision not to take a position favoring a reduction in rate of growth of energy consumption was made before the "energy crisis" and before the public meetings. At the meetings and in discussions with the appropriate plan formulation task forces, the residents of some areas took strong positions favoring education and policies to reduce growth of consumption. These views are stated in the Proposed Framework. On May 20, 1975, the Commission adopted the position that the Commission, in approving the Proposed Framework, endorses the concept of encouraging reduction in the rate of growth of per capita use of power providing that the public health, welfare, economy, and social well-being of the inhabitants are not adversely affected.

11.2.1.7 Great Lakes Levels, Flows, and Diversions

The Great Lakes Basin Commission supports the general concept of variable diversions into and out of the Great Lakes Basin in the interest of a more beneficial range of levels and flows within the Great Lakes. It urges that the appropriate agencies study, plan, and make recommendations on variable diversions with full consideration of environmental impacts and other factors on a broad regional basis.

11.2.1.8 Consumptive Use

In consideration of the complex issue of the increasing consumptive use of the waters of the Great Lakes Basin, and the many issues and interests involved, the Great Lakes Basin Commission recommends that an appropriate study be made of the entire issue of consumptive use of the waters of the Great Lakes Basin.

11.2.2 Coordinated Management

Action programs are those specific recommendations included in the PRO Framework that can be implemented under current policies and authorities. Because of the integrated nature of water and related land resource problems and functions and the many governmental units having jurisdiction in effective resource management, various means of influencing management exist. These means range from information flow to the physical construction of projects, and all have varying degrees of impact on Basin resources. These elements of resource management may be characterized as intervention strategies. They are means by which organizations have an impact on resource utilization of conservation.

Table 1–187 is designed to summarize the means of intervention that are available to the various agencies working on Great Lakes Basin resource matters. For each agency the types of intervention strategies that it may exercise in any given resource category are entered in the table. The intervention strategies are defined below.

(1) information (I)—data collection, research, storage and management of data, and dissemination of all types of information to planners and others

(2) technical assistance (T)—providing technical advice through meetings, consultation, furnishing literature, plans, review, and any other means by which the technical aspects of problems and solutions may be considered

(3) financial assistance ($)—all forms of financial intervention such as grants, cost sharing arrangements, fines, incentives, etc.
(4) regulation (R)—administration of all forms of regulation, standards, permits, licenses, and monitoring, as well as enforcement and the prosecution of violators
(5) planning (P)—design of alternative programs and projects to meet specified goals, objectives, and policy directives
(6) project development (D)—design, construction, operation, and maintenance of projects and services that are the recommendations of planning efforts.

The agencies listed in Table 1–187 include the members of the Great Lakes Basin Commission and are in some cases broken into services or bureaus within member agencies. Also included are agencies that are not members of the Commission, but have a substantive role in resource management. The activities of the private sector are also noted.

The resource use functions in Table 1–187 have been developed by combining the resource use categories described in Section 4. The combinations of various categories are explained below.

(1) Water Withdrawals
(a) municipal—domestic, commercial, and industrial water supply through municipal systems
(b) industrial—self-supplied industrial programs, mining programs, and thermal power cooling programs
(c) rural—rural domestic, livestock, and irrigation programs.

(2) Nonwithdrawal Uses
(a) water quality—programs to manage municipal and industrial wastewater discharges
(b) recreation—water-oriented outdoor recreation programs
(c) fish and wildlife—sport fishing and wildlife management programs
(d) navigation—recreational boating and commercial navigation programs.

(3) Related Land Uses and Problems
(a) agriculture—land treatment and cropland drainage programs
(b) forestry—forest land treatment programs
(c) shorelands—shoreland erosion programs
(d) streambank—streambank erosion programs
(e) flood plains—all flood damage reduction programs
(f) aesthetic and cultural—all conservation and preservation programs not covered in other categories.

Given the many agencies addressing many resource functions, and the variety of intervention strategies available to each of those agencies, the need for continued coordination should be clear. There are instances when an agency provides Basin integration on a specific resource use function, but such integration across all functions is usually lacking. Increasingly, the emphasis in consideration of various action programs needs to be in the context of the total Great Lakes system. It is this type of coordinating, integrating effort that can best be provided by the Great Lakes Basin Commission.

11.2.3 Investment

The programs specified in the Proposed Frameworks (see Section 5 and Sections 6–10) are projected to cost more than $25 billion by 2020, not including interest on the invested capital.

Very important to the implementation of the programs are the arrangements by which the recommended programs and projects can be funded. The division of costs among Federal, public non-Federal, and private interests strongly influences whether a given program will become a reality.

The breakdown used in estimating the costs of the NOR and PRO Frameworks is shown in Table 1–188.

Some water resource functions are of such a scale or are deemed to be of such national importance that significant portions of capital project costs, such as for commercial navigation, have traditionally come from Federal sources. In many instances, the commitment of non-Federal interests must be demonstrated through cost sharing arrangements. In other instances, such as industrial wastewater treatment or thermal power cooling facilities, the private sector must provide financing for development. Private costs should always be considered so that the economic impact of water resource development will be as evident as the impact on physical resources.

In planning for a 50-year time period it is important to evaluate the cost of operation, maintenance, and replacement (OM&R) activities. In some instances, the total of these costs may exceed the initial capital investment for the project. As with capital costs, OM&R costs are often divided among Federal, public non-Federal, and private interests, but the division of these costs may differ from that of capital costs. Frequently the Federal government will contribute a major portion of the capital costs, but expect other interests to operate and maintain the completed facilities. In general, Federal participation in project financing is much more significant for capital costs than for OM&R costs.

The estimated capital and OM&R costs for the programs in the NOR and PRO Frameworks were

TABLE 1–187 Coordinated Management Agencies (see Subsection 11.2.2 for key)

	Functions and Categories												
	Water Withdrawals			Non-Withdrawal Water Uses				Related Land Uses					
Agency	Municipal	Industrial	Rural	Water Quality	Recreation	Fish & Wildlife	Navigation	Agriculture	Forest	Shorelands	Streambanks	Flood Plains	Aesthetic & Cultural
Agriculture													
ERS	---	---	---	---	---	---	---	---	---	---	---	---	---
FHA	---	---	$	$	---	---	---	$	---	---	$	$	---
FS	---	---	---	---	IT$RPD	---	---	---	IT$RPD	---	---	---	IT$RPD
SCS	---	---	ITPD	T	I	---	---	ITRPD	---	I	ITD	ITPD	---
Army--CE	$DP	---	---	$RPD	IT$RPD	---	IT$PD	---	---	IT$RPD	IT$RD	IT$PD	---
Commerce--NOAA	---	---	---	IT	---	---	IT	---	---	IT$P	---	---	---
HEW	ITR	---	---	---	---	---	---	---	---	---	---	---	---
HUD	$	---	---	$	---	---	---	---	---	---	---	I$	$
Interior													
BM	---	IT	---	---	---	---	---	---	---	---	---	---	---
BOR	---	---	---	---	IT$P	---	---	---	---	---	---	---	IT$
BSFW	---	---	---	---	---	IT$RPD	I	---	---	---	---	---	---
GS	I	IT	IT	IT	---	---	---	---	---	---	IT	I	---
NPS	---	---	---	---	I$RD	---	---	---	---	---	---	---	IT$
Justice	---	---	---	R	---	---	R	---	---	---	---	---	---
State--IJC	---	---	---	IRP	---	IRP	---	---	---	I	---	---	---
Transportation													
CG	---	---	---	---	---	---	ITR	---	---	---	---	---	---
SLSDC	---	---	---	---	---	---	IT$RPD	---	---	---	---	---	---
EPA	IP	P	---	IT$RPD	---	---	---	---	---	---	---	---	---
FDC	---	I	---	---	---	---	---	---	---	---	---	---	---
GLC	---	---	---	---	---	---	IP	---	---	---	---	---	---
GLBC	---	---	---	---	---	---	---	---	---	---	---	---	---
States													
Natural	---	---	---	---	---	---	---	---	---	---	---	---	---
Resources	---	---	---	---	IT$RPD	IT$RPD	IT$RPD	---	---	IT$RPD	---	IT$RPD	IT$RPD
Environmental	---	---	---	IT$RPD	---	---	---	---	---	---	---	---	---
Health	IT$RPD	---	---	IT$RPD	---	---	---	---	---	---	---	---	---
Transportation	---	---	---	---	---	---	---	---	---	---	---	---	---
Commerce	---	---	---	---	---	---	---	---	---	---	---	---	---
Counties	---	---	---	---	---	---	---	---	---	---	---	---	---
Regional Entity	---	---	---	---	---	---	---	---	---	---	---	---	---
City	---	---	---	---	---	---	---	---	---	---	---	---	---
SID	I$PD	---	I$PD	I$PD	---	---	---	---	---	I$PD	---	I$PD	---
Private	IT$	IT$PD	I$PD	IT$PD	I$PD	I$PD	I$PD	I$PD	I$PD	I$PD	I$PD	I$PD	I$PD

TABLE 1–188 Allocation of Costs for GLBFS Programs Among Federal, Non-Federal, and Private Sectors (in percent)

	Capital			OM&R		
Resource Use Category	Federal	Non-Federal	Private	Federal	Non-Federal	Private
WATER WITHDRAWALS						
Municipally Supplied	30	70	0	0	100	0
Self-Supplied Industrial	0	0	100	0	0	100
Rural, Domestic, & Livestock	10	0	90	0	0	100
Irrigation	0	0	100	0	0	100
Mining	0	0	100	0	0	100
Thermal Power Cooling	0	5	95	0	5	95
NON-WITHDRAWAL WATER USES						
Municipal Wastewater Discharge	75	25	0	0	100	0
Industrial Wastewater Discharge	0	0	100	0	0	100
Hydroelectric Power[1]	---	---	---	---	---	---
Water Oriented Outdoor Rec.	---	---	---	---	---	---
Sport Fishing[2]	---	---	---	---	---	---
Recreational Boating	35	35	30	0	0	100
Commercial Fishing	---	---	---	---	---	---
Commercial Navigation	100	0	0	100	0	0
RELATED LAND USES AND PROBLEMS						
Agricultural Land Treatment	28	0	72	0	0	100
Cropland Drainage	30	0	70	0	0	100
Forest Land Treatment	80	5	15	10	20	70
Shoreland Erosion	20	0	80	20	0	80
Streambank Erosion	28	0	72	0	0	100
Flood Plains	75	0	25	5	95	0
Wildlife Management	10	90	0	0	100	0
Aesthetic and Cultural	---	---	---	---	---	---
Outdoor Recreation	35	65	0	20	80	0

[1]Either 100 percent State, or 100 percent private (no Federal money)

[2]40 percent of sum of capital plus OM&R is Federal, 60 percent is State (no private money)

allocated among Federal, public non-Federal, and private sectors. The allocation was based on the current cost sharing arrangements and practices of the agencies responsible for implementing the respective programs and was developed through consultation among Commission and agency staff personnel. For categories in which arrangements have flexibility, averages were developed. This was also done where several agencies or States have different program arrangements within a resource category. The intent was to provide uniform cost sharing analysis over the entire Basin and for the entire study period.

The cost estimates included are based upon existing management experience, which can provide a basis for estimating. The development of new approaches to water and related land management could significantly alter the magnitude of the cost. Furthermore, the division of cost is not fixed over time. Legislative change such as the Federal Water Pollution Control Act Amendments of 1972 can substantially alter cost sharing arrangements. The subject of cost sharing is undergoing considerable discussion at the present time, and change in the distribution among various interests can be expected.

Another source of change in the division of cost is the emerging trends in resource management. The trend toward nonstructural flood plain management rather than structural measures may mean that funds could be made available for other projects. Furthermore, the emerging prominence of specific problem areas such as coastal zone management can provide another shift in emphasis and precipitate changes in cost sharing. While it is difficult, if not impossible, to predict or quantify the impact of these potential changes, it is important to acknowledge their existence. The framework costs are not designed to anticipate all such changes, but rather to provide an estimate of the order of magnitude of the investment that will be required to meet needs and objectives in water and related land resource development and conservation.

The Great Lakes Basin Commission and its member agencies and States should monitor regularly the effect of cost distribution on the completion of programs, and make appropriate recommendations for legislative and administrative changes that will insure that funding distribution procedures are not a deterrent to timely execution of high-priority work.

11.3 Future Planning Studies

One of the principal purposes of a framework study is to identify areas requiring further, more detailed study. Usually a limited geographic area is selected, but sometimes one or more specific functions in an area of wide extent are identified. This requirement in the Framework Study comes from policy statements relating to planning, and these in turn have their genesis in Federal and State laws and/or policies. The intent is to carry out planning in sufficient detail to facilitate effective decision-making with respect to investment and resource policy.

The clearest statement of policy comes from Section 201 (2) of Public Law 89–80, the Water Resources Planning Act of 1965, which states that river basin commissions will

> Prepare and keep up to date to the extent practicable a comprehensive, coordinated, joint plan for Federal, State interstate, local, and nongovernmental development of water and related resources . . .

and from Section 209 of Public Law 92–500, the Federal Water Pollution Control Act Amendments of 1972 which states:

> The President, acting through the Water Resources Council, shall, as soon as practicable, prepare a Level B Plan under the Water Resources Planning Act for all basins in the United States. All such plans shall be completed not later than January 1, 1980 . . .

Fulfillment of this later legislative mandate will provide essential input to the formulation of the Comprehensive Coordinated Joint Plan (CCJP) as it is presently conceived (Subsection 11.4).

It is necessary to develop priorities for the conduct of possible Level B studies since not all studies can or should be pursued simultaneously. Recent changes in the concept of Level B studies have emphasized the centrality of State preferences for participation in Level B planning. Section 209 suggests the significance of water quality issues in establishing priorities for Level B studies. Current guidelines for Level B planning also suggest that priorities be given to those areas where water quality issues are closely tied to urban-industrial concentrations, to other water resource functions such as water supply, and to areas where Level B planning will support other types of resource planning such as coastal zone and land-use planning.

Based upon the general criteria outlined above and on consultation with State members of the Great Lakes Basin Commission, the list of studies shown in Table 1–189 was developed as of May, 1975 (see *Great Lakes Basin Framework Study Report* for later Commission action). The studies approved for submission are listed in order of priority and estimated costs are given for each. The Great Lakes Environmental Planning Study (GLEPS) has been under consideration by the Great Lakes Basin Commission for several years. This study is a special Level B effort designed to address water quality management issues regarding the Great Lakes proper, with emphasis on the development of a mathematical modeling tool to evaluate alternative management strategies.

The nature of the Great Lakes Basin with its large expanses of open water makes it unique among river basins of the United States. This unique character requires studies that specifically address lake problems as opposed to traditional comprehensive planning for watershed problems. While no specific guidelines have been developed for the conduct of such studies, several Great Lakes studies have been proposed, and some dealing with specific lakes or parts thereof are underway. The GLEPS will, among other things, coordinate these separate studies. One study not yet undertaken would determine consumptive use in the Basin in order to assess the impact on lake hydrology of the many withdrawals with accompanying consumptive losses. It has been estimated that such a study could be undertaken by the Great Lakes Basin Commission staff for approximately $60,000.

Under Section 201 (b) (1) of P.L. 89–80, each river basin commission shall

> . . . serve as the principal agency for the coordination of Federal, State, interstate, local and nongovernmental plans for the development of water and related land resources in its area, river basin, or group of river basins . . .

This responsibility is acted upon with respect to

TABLE 1-189 Great Lakes Basin Future Planning Studies—Level B

Study	Federal Cost
Maumee River Basin[1]	$1,554,000
Fox-Wolf River Basin[2]	831,000
Energy Policy and Planning Study[2]	794,000
Great Lakes Environmental Planning Study[2]	2,100,000
Great Lakes Regional Lake Levels Study[2-3]	---
Southern Michigan River Basins	---
Western Lake Superior River Basins	---
Northern Indiana River Basins	---
Eastern Lake Erie River Basins	---
Northern Michigan River Basins	---
New York River Basins	---
Southeast Wisconsin River Basin	---
Regional Planning Studies	---

[1]In progress

[2]Approved February 1975, for submission to Water Resources Council

[3]Approval withdrawn May 1975

Level B planning in two ways. The study manager of a given study may be an employee of the Commission, or a Commission staff member may serve as a member of a Level B planning team that is led by a State-appointed study manager. In either case, the role assumed by the Great Lakes Basin Commission participant will emphasize coordination of planning efforts, particularly with respect to funding arrangements for the study. But in the former situation, the Commission participant would have considerably more influence on the plan formulation process. In either case, the Level B study is a Commission study conducted under Commission approval, policy, and procedures.

Other aspects of planning coordination that are part of Commission activities include Commission staff participation in a variety of studies conducted by all levels of government in the Great Lakes Basin. These include participation in efforts by international organizations such as the International Joint Commission, participation in Federal agency studies such as Type IV studies conducted by the U.S. Department of Agriculture, consultation on State planning efforts in a review and advisory capacity, and membership on planning boards conducting special studies, such as the Great Lakes-St. Lawrence Seaway Winter Navigation Board. Coordination is and will be accomplished in the future through consultation with Commission member agencies and States in order to maintain an ongoing inventory of planning efforts in the Great Lakes Basin. This inventory will serve to reduce duplication of efforts among various levels of government and to identify planning needs that are not being met through ongoing programs of Great Lakes Basin Commission members. Through contacts with Canadian counterparts, the Great Lakes Basin Commission seeks to maintain a continuing cognizance of Basin planning that is carried on in the Canadian portion of the Great Lakes drainage basin.

While the water resource planning in the Great Lakes Basin is done under the same general authorities as in other river basins, there are some peculiar aspects of the Great Lakes Basin that affect the way in which studies are carried out and the output results needed. It is important to keep these factors in mind when studies are proposed and initiated, in order to insure that the constraints and requirements are met in each study.

Briefly stated, the critical water problems in the Basin are more problems of pollution than of allocation. For the foreseeable future there is water for all uses which have been given serious consideration, providing the quality of the water can be maintained at suitable levels.

Quality control is exercised more effectively by land use management in addition to water use controls, particularly in an area like the Great Lakes Basin that is more than urban than rural. This means that those elements related to land use management and land use planning, principally urban and regional planning agencies, should be incorporated into the planning process. This was not adequately done in the Framework Study. The basic data for land use and management were oriented toward the agricultural land base, and the framework programs relate primarily to this aspect of land use. The expanding urban and transportation requirement for land was recognized principally as a reduction in resource base and not given adequate treatment in its own right. In Level B and other detailed studies the capability of local, urban-oriented planning entities should be relied on heavily. These studies should identify land-use related problems that can be addressed by the areawide planning agencies.

11.4 The Comprehensive Coordinated Joint Plan (CCJP)

11.4.1 Introduction

Public Law 89–80 is not very explicit about what constitutes a comprehensive coordinated joint plan. Each river basin commission has interpreted its charge to include defining the CCJP, as well as developing and submitting the CCJP to the President and Congress through the Water Resources Council. The CCJP requirement and authority come from Sections 201 (b) (2) and 204 (3) and (4) of P.L. 89–80. Section 201 states that

> (b) Each such commission for an area, river basin, or group of river basins shall, to the extent consistent with section 3 of this Act—. . .
>
> (2) prepare and keep up to date, to the extent practicable, a comprehensive, coordinated, joint plan for Federal, State, interstate, local and nongovernmental development of water and related resources: *Provided,* That the plan shall include an evaluation of all reasonable alternative means of achieving optimum development of water and related land resources of the basin or basins, and it may be prepared in stages, including recommendations with respect to individual projects; . . .

Section 204 states that

> Sec. 204. Each river basin commission shall— . . .
> (3) submit to the Council for transmission to the President and by him to the Congress, and the Governors and the legislatures of the participating States a comprehensive, coordinated, joint plan, or any major portion thereof or necessary revisions thereof, for water and related land resources development in the area, river basin, or group of river basins for which such commission was established. Before the commission submits such a plan or major portion thereof or revision thereof to the Council, it shall transmit the proposed plan or revision to the head of each Federal department or agency, the Governor of each State, and each interstate agency, from which a member of the commission has been appointed, and to the head of the United States section of any international commission if the plan, portion or revision deals with a boundary water or a river crossing a boundary, or any tributary flowing into such a boundary water or river, over which the international commission has jurisdiction or for which it has responsibility. Each such department and agency head, Governor, interstate agency, and United States section of an international commission shall have ninety days from the date of the receipt of the proposed plan, portion, or revision to report its views, comments, and recommendations to the commission. The commission may modify the plan, portion, or revision after considering the reports so submitted. The views, comments, and recommendations submitted by each Federal department or agency head, Governor, interstate agency, and United States section of an international commission shall be transmitted to the Council with the plan, portion, or revision; and
>
> (4) submit to the Council at the time of submitting such plan, any recommendations it may have for continuing the functions of the commission and for implementing the plan, including means of keeping the plan up to date.

11.4.2 Definition of the CCJP

The Great Lakes Basin Commission adopted the following definition on February 26, 1975:

> The Comprehensive Coordinated Joint Plan (CCJP) is a specific document composed of elements approved and adopted by the Great Lakes Basin Commission, identifying those water and related structural and non-structural projects, programs and other measures designed to enhance the economic, environmental, and social conditions of the area, and will include the Level A Study (Framework Study) and revisions through the National Assessment; Level B Studies and revisions to reflect changed conditions; and the results of appropriate Commission, Federal, State, regional, interstate, local and non-governmental planning studies. The CCJP will be developed through a continuous, dynamic procedure, may be prepared in stages, and will be kept current.

11.4.3 Elements of the Comprehensive Coordinated Joint Plan

The CCJP as defined for the Great Lakes Basin consists of the following elements:

(1) a baseline which will consist of existing projects and ongoing nonstructural programs, and projects under construction by both the governmental and private sector

(2) a direction for the future which is determined from the Great Lakes Basin Framework Study and the National Assessment, and further identified by possible alternatives and gaps which should be filled by additional studies (Level B), and may include the selection of alternatives (Level B and/or Level C). Projects and programs will be grouped into short-term, mid-term, and long-term categories.

(3) a concise statement of recommended short- and mid-term actions based on consideration of all existing and anticipated needs and problems and all available information sources.

11.4.4 Procedures for Developing the CCJP

The CCJP will be developed by the following procedures:

(1) The Great Lakes Basin Commission (GLBC) will establish a baseline of projects and programs consisting of completed and underway structural projects and nonstructural programs when the Commission agrees that such projects and programs contribute to meeting the needs and problems of the particular plan area and the Region as a whole. The adoption of baseline projects and programs will not be subject to the 90-day statutory review process, but will be handled internally by Commission action.

(2) The GLBC will adopt the Framework Study as the Level A portion of the CCJP and initiate the 90-day review process.

(3) The GLBC, following review and consideration of appropriate studies made at the local, State, or Federal level, will, through a continuous planning system, select and designate elements to be part of the CCJP, superseding earlier data as appropriate.

(4) The GLBC will also select elements of the CCJP from implementation studies, some of which will be Level C studies and some of which may be State, regional, or private studies that were not previously reviewed or transmitted by the Commission but are processed through agency channels. Through the continuous planning system, each Commissioner will bring to the attention of the Commission those studies in his area which have not had formal Commission review, but which may supersede earlier data.

(5) The GLBC will review the CCJP following each revision of the National Assessment and will update the economic, demographic, and policy information in the CCJP and will insure that the existing situation is accurately stated.

(6) The GLBC will periodically, depending on the number and significance of the changes to be made in the CCJP, document these changes, transmit the document for the statutory review, and then transmit the revised CCJP to the Water Resources Council.

11.4.5 Strategies

The following strategies will be utilized:

(1) The Great Lakes Basin Commission will utilize existing and ongoing studies to secure the intitial CCJP elements.

(2) The Commission will adopt procedures and attempt to secure programs that will result in preparation of the CCJP elements for the Great Lakes Basin at the earliest possible date.

(3) The Commission will insure that Level B, Type 2, State, River basin, and other major regional study efforts will be tailored to provide elements of the CCJP upon their completion.

11.4.6 Policies

The Great Lakes Basin Commission will follow these policies:

(1) GLBC endorses State leadership in development of portions of the CCJP.

(2) State programs and policies will be adequately reflected in portions of the CCJP for particular States.

(3) Through a continuous planning system, the status of the CCJP for all segments of the Basin will be continuously maintained and periodically updated when major changes are appropriate.

(4) Careful consideration will be given to current Principles and Standards as enunciated by the Water Resources Council in developing the CCJP where Federal activities are involved.

(5) Regional preferences will be identified and deviations from national projections and policies will be explained.

11.5 Institutional Arrangements in the Great Lakes Basin

The previous subsections have explored a number of the actions and studies which will be required to implement the framework programs. The nature and size of the Great Lakes Basin and the distinctive characteristics of this interconnected system of lakes and streams make implementation a formidable task. But in addition the jurisdictional authorities and traditional areas of concern of two nations, one Province, eight States, the multiple agencies within each of those entities, a number of intergovernmental relationships, and innumerable substate units of government all make confusion and conflicts inevitable. More than one governmental unit will influence the planning for and management of almost any resource and will be affected by the outcome. Consequently, one cannot avoid addressing the complexities of organizational arrangements when considering the means by which framework programs can be implemented. The ultimate success of the framework programs is dependent upon the existence and functioning of institutions and organizations that are capable of implementing the programs.

As with other parameters in the planning process, existing organizational arrangements should not be taken as absolutes, for they too are amenable to change and restructuring. Thus, the current array of governmental units must not be viewed as immutable constraints on the formulation of alternative courses of action. However, for planning purposes assumptions must be made about the existence of certain relationships during the time frame under consideration. It is always necessary, for the sake of time, cost, and simplicity, to assume that certain conditions (physical, economical, and social, as well as institutional) will prevail. The problem is in deciding which assumptions to embrace and in making those chosen explicit.

In the Great Lakes Basin Framework Study, two major assumptions are implicit: (1) that the fundamental institution of Federalism in the United States, and the Federal-State and inter-State relationships which it engenders, will remain, and (2) that the independent, sovereign status of Canada and the United States mandates that the States and Provinces cannot settle issues of an international nature on their own volition. Although it may seem unnecessary to articulate these well-acknowledged principles, it is important to recognize that in the case of the binational Great Lakes Basin, the influence of nine Provincial and State governments on mechanisms for institutional coordination has been, and will most probably continue to be, of paramount importance. For it is within these "constraints" that all other institutional permutations must be formulated, even though the physical and ecological relationships in the Great Lakes know no such bounds. While new mechanisms may be desirable and possible within the context of the above assumptions, it may also be that fundamental and far-reaching changes in resource planning and management cannot be achieved without abandoning these assumptions. When one explores this subject, one should not lose sight of this possibility.

The subject of the appropriate institutional arrangements for managing water and related land resources is a topic that has received considerable attention, both generally and as specifically applicable to the Great Lakes Basin. In addition, the Commission, during the course of the Great Lakes Basin Framework Study, has attempted through several projects to describe or analyze organizational arrangements in the Basin.

Initially, the Commission, in cooperation with the Great Lakes Panel of the Committee on Multiple Use of the Coastal Zone, National Council on Marine Resources and Engineering Development, published a document entitled *Great Lakes Institutions* (1969), which contained descriptions of the vast array of agencies and organizations in Canada and the United States that had an interest in water and land resources in the Basin. An updated and expanded document, *Great Lakes Directory*, was published in 1976 by the Commission, in cooperation with the Interagency Committee on Marine Science and Engineering, Federal Council for Science and Technology. Two Framework Study volumes, Appendix F20, *Federal Laws, Policies, and Institutional Arrangements*, and Appendix S20, *State Laws, Policies, and Institutional Arrangements*, catalog and briefly describe the legal jurisdiction and authority of those Federal, State, substate, and special purpose governmental agencies that are responsible for resource matters. These appendixes do not, however, attempt to analyze the adequacy of existing arrangements or explore alternatives.

More direct study of this question was accomplished in three other activities. First, the Commission created a Task Force on Organizational Policy, composed of selected Commissioners representing both States and Federal agencies. Second, Dr. Lyle E. Craine of the University of Michigan School of Natural Resources was retained as a consultant to the Commission and produced a *Final Report on Institutional Arrangements for the Great Lakes* (March 15, 1972). Finally, as the Framework Study neared completion, the Commission staff reviewed the previous studies, made an analysis of other pertinent literature, and prepared initial drafts of Section 11 for the Commissioners' consideration.

The Task Force on Organizational Policy was created in 1969 and charged with the responsibility of reviewing the types of organizational arrangements available to manage river basins and of making recommendations to the Commission on the structure that should be adopted. After a series of preliminary meetings that explored a variety of possible mechanisms for organizational coordination, the task force concluded that there was a need to determine what necessary management functions (used in the broadest sense) were not being performed. It was at this point that Dr. Craine was retained.

In his study, Professor Craine addressed the question of the optimum resource management arrangement for the United States portion of the Great Lakes Basin. He adopted a two-pronged operational objective: "(1) to determine what needs to be done that is not now being done; and (2) to make recommendations for institutional changes designed to get done what needs to be done." After stating six ways by which agencies can become involved in Basin management, Dr. Craine reviewed the ability of existing institutions to perform these functions and concluded that no agency "is meeting the need for integration of public authorities relating to resource use and development." This need was felt to be critical since "the primary issues confronting a basin-wide agency stem from conflicting goals based upon various values and public preferences expressed and supported by different political constituencies," which issues can only be solved through the political process. This led Dr. Craine to the further conclusion that the institutional problem for the Great Lakes Region "is intergovernmental rather than just interagency." In order to achieve the desired integration, Dr. Craine outlined a basin-wide agency that would utilize "primary policy controls, together with such planning as reflects and implements the policy determination made." He considered the question of representation on such an agency to be crucial, and suggested that the States, the Federal government, and Basin residents (through specially elected representatives) were the three interests of concern.

Upon the receipt of Professor Craine's report, the Task Force concluded that no action should be taken, and the Commission accepted this recommendation. The Commission foresaw that completion of the Framework Study and possibly the CCJP itself might be required before management adjustments could be sufficiently identified to permit formulation of new organizations or realignment of existing organizations.

In keeping with the Task Force's repeated emphasis on the need to identify problems before attempting to decide upon a particular arrangement and mechanism for resource management, what follows is limited to a discussion of the salient features and problems of the Great Lakes Basin which must be considered in any proposed solution. Agreement on such a framework for inquiry is necessary before efforts to identify a particular organizational structure can be truly fruitful.

Three aspects of the current situation in the Basin stand out as the most critical factors to consider. The first relates to the physical characteristics of the Basin, and the others to the extant governmental situation.

Although the Great Lakes is properly viewed as a single physical system in which activities in one part ultimately affect the system elsewhere, the Framework Study has identified a great diversity of resource values and problems that exist at different places in the Basin. Each of these will require specialized management that is fitted to the circumstances at hand. Thus, to geographically integrate management control would be neither desirable nor practical; that is, management is not the problem.

On the other hand, the fact remains that the Basin is a closed system in which the gains accomplished in one place can be negated by action elsewhere unless a general agreement on mutually acceptable goals and objectives has been reached. This implies more than mere informational coordination. Rather, it will entail an essentially political exchange for which the rules of interaction are agreed to and politically binding. Typically, this would be considered integration at the policy-making or policy-planning level.

To achieve such a political interaction, any proposed institutional arrangement must take into account the second factor; namely, that the integration called for is distinctly intergovernmental in nature, as opposed to simply interagency. The States after all, are sovereign. Thus, barring some greater Federal requirement for concerted action, the general-purpose units of government in the United States are the fundamental building blocks upon which any scheme of policy/planning integration must be based. As a first corollary, the Federal government is but one sovereign entity and its position in the political dialogue should ultimately be voiced by a single spokesman, although it is recognized that the various Federal agencies with an interest in the outcome of any particular policy choice should all be actively involved in formulating a Federal position. A second and equally important corollary is that the States are only a second level of government, and that subsidiary levels within States have planning and management responsibilities and must therefore be involved in decisionmaking, particularly in land use matters which largely control water use and water quality considerations in the Great Lakes Basin. Veritical as well as horizontal coordination is needed, particularly around the individual Lake.

Finally, the international character of the Great Lakes Basin raises the third factor to be considered; namely, that the mutual, daily interest that both the U.S. and Canada have in this unique resource indicates that a special working relationship, unencumbered by the ordinary demands of international protocol, would be appropriate for a major part of the business that the two counties need to conduct relative to the utilization of the Lakes' resources. As currently constituted, the International Joint Commission's prerogatives are not broadly enough drawn to satisfy the requirement for the kind of international cooperation that is needed. This is not to say, however, that they could not be. That question is simply not raised at this time.

Within the context of these three general aspects, there are subsidiary factors that must be considered when developing organizational arrangements. First, any mechanism which purports to deal with Basinwide resources issues must be capable of dealing with the problems of multiple use of the resource base, for that is in fact the manner in which the Great Lakes and their associated land resources are approached.

Second, as Subsection 11.6 reveals, there is a vast range of research and data collection that must be accomplished in order to provide information to the decisionmakers. Any organizational structure that fails to coordinate information generation and planning will necessarily be handicapped in its ability to identify problems and formulate policy goals.

Third, any institution encompassing the Great Lakes must have the authority and political viability to set priorities among competing goals and objectives, in recognition of the fact that the pie is never big enough to satisfy all possible desires. Without such authority, there is a great danger that any agreement on goals and objectives would be a hollow gesture with enough platitudes to satisfy everyone, but with few hard decisions about which programs should proceed first in the face of limiting budgeting.

In sum, the critical deficiency in the Great Lakes Basin is that institutional arrangements for arriving at a political consensus do not exist. At best, current arrangements only facilitate exchanges of information. These are sometimes in the form of planning studies, but are often not even that well organized. Such a situation does not provide the degree of geographical integration which is necessary for resolving basic conflicts in resource utilization.

11.6 Research, Data Collection, and Analysis

11.6.1 Introduction

Up to this point this section has dealt primarily with the responsibilities of the Great Lakes Basin Commission and its agencies for carrying out additional planning, preparation of the CCJP, and the institutional arrangements that will be necessary for planning and action programs. However, in order to provide a background for planning, implementation of plans, and the subsequent operation and management of programs, it is necessary to consider research, data collection, and analysis as an essential part of the planning process. Good planning is dependent on good, timely research and data gathering and interpretation. In the broad sense, the goals of Federal, State, and nongovernmental data collection and research programs are to support the management of water and related land resources so as to meet the needs of people, to minimize damage to life and property, and to establish or preserve a quality environment.

Federal organizations which have significant research, data collection, or data analysis programs in the Great Lakes Basin include the Department of the Interior (Geological Survey, Fish and Wildlife Service, Bureau of Outdoor Recreation, Bureau of Mines, National Park Service, Office of Water Research and Technology), the Department of Commerce (National Ocean Survey, National Weather Service, National Marine Fisheries Service, Maritime Administration, Social and Economic Statistics Administration, and others), the Department of the Army (Corps of Engineers), the Environmental Protection Agency, the National Aeronautics and Space Administration, the Department of Transportation, the Department of Agriculture, the Smithsonian Institution, the National Science Foundation, the Federal Power Commission, the Nuclear Regulatory Commission, and the Energy Research and Development Administration. The latter two organizations formerly comprised the Atomic Energy Commission. In addition, other Federally linked organizations involved in research, data collection, and data analysis in the Great Lakes Basin include the Great Lakes Basin Commission, the Council on Environmental Quality, the International Joint Commission, and the Great Lakes Fishery Commission. A multitude of State, local, university, and private organizations is also involved in research, data collection, and data analysis in the Basin. A directory of Great Lakes institutions including Canadian institutions, is published by the Great Lakes Basin Commission.

11.6.2 Data Collection

The collection of basic data, as indicated above, is essential to planning and evaluation of alternative courses of action. The type, amount, and sensitivity of the basic data needed will obviously depend on the purpose of the data acquisition program. For example, data needs for planning, management, enforcement, or research purposes may vary considerably. A good data program must include data collection, analysis, storage, retrieval, and dissemination, and a means for anticipating probable future needs. In formulating a basic data program, it is especially important to insure that potential users know what are available and where, so that timely retrieval can be accomplished.

Traditionally, Federal and State government basic data collection programs have been oriented to the collection of data for specific missions. There is a need for the coordination of such mission-oriented programs into an environmental data system to avoid unnecessary overlap and to encourage collection and dissemination of usable information for multiple purposes.

Practically every Federal agency and many State and local agencies and private groups collect data that are of interest and potential use to individuals concerned with water and related land resources in the Great Lakes Basin. The principal Federal agencies which collect water data for general use, such as the U.S. Geological Survey, the National Ocean Survey, the National Weather Service, and the Environmental Protection Agency, maintain catalogs of stored data that are available for retrieval.

River stage, precipitation, and other hydrologic and meterologic data collected by National Oceanic and Atmospheric Administration agencies, as well as data on stream discharge, stream water quality, and ground water occurrence and characteristics collected by the U.S. Geological Survey are coordinated as provided in OMB Circulars A-62 (meteorological and climatic data) and A-67 (hydrologic data). Even though coordination among agencies has recently improved, economies of combination and scale have been accomplished only in part. State water data collection agencies tend to be specialized and to range widely in function and the information gathered is generally not readily accessible.

Other Federal agencies, like the Corps of Engineers, Nuclear Regulatory Commission, Energy Research and Development Administration, Federal Power Commission, Department of Agriculture, Department of Housing and Urban Development, several Department of Interior agencies (Fish and Wildlife Service, National Park Service, Bureau of Outdoor Recreation, Bureau of Mines), and Department of Transportation, also collect resource data for agency mission purposes.

Periodic soil and water conservation needs inventories are prepared by the U.S. Department of Agriculture and include data on land capability, land use, conservation practices related to land use, and small watershed projects. At ten-year intervals, the Forest Service conducts forest surveys of the States in the Basin. Cut and growth data and data on the extent of forest land and volume of timber are collected. These data help in planning for a continuing supply of forest products and amenities for the use and enjoyment of the Basin's population. Generally speaking, the responsibility for collection of water and associated land resource data, such as information related to flood control, shore erosion, recreation, mineral resources, and urban growth, is dispersed among agencies and is relatively uncoordinated. Also, while great amounts of resource data have been accumulated, particularly within the Federal and State government agencies, many potential data users do not know what data are available and where to go to get the data.

In order to fill the above gap in coordination, it is recommended that the Great Lakes Basin Commission develop and maintain a Great Lakes Regional Data Referral Center and Clearing House that would direct requests for data and other information to the appropriate Federal or State agency or data system. The referral center would be publicized widely and its services would be available to all. An annual report would provide a systematic review of any changes in referral center activities. The referral center would also make recommendations to promote coordination among agencies, particularly in the area of water quality data collection.

A need exists for continuation and possible expansion of ongoing data collection programs, particularly such broad scale programs as the International Field Year on the Great Lakes. Other basic data collection programs, such as those carried out in recent years by NOAA, EPA, and other organizations, should be coordinated as well as possible, particularly in terms of data reporting formats. More effort is also needed in coordinating U.S. and Canadian programs involving the Great Lakes.

11.6.3 Data Analysis

Although considerable data on the Great Lakes have been accumulated, very few have been utilized to the extent possible. Generally, environmental data collected for a particular purpose are analyzed with regard only to the study purpose. However, such data could be extremely useful as background information to other studies or projects. For example, in recent years a great deal of detailed limnological data have been collected by power companies for the purpose of evaluating the effect of power plants on the Great Lakes. Many of these data have not been analyzed, and the work to date has been directed, in general, toward power plant-induced degradation only. However, these data, if properly analyzed, would probably be extremely useful in the interpretation of the physical, chemical, and biological characteristics of the Lakes.

One data source that has been proven to be extremely useful for purposes other than that for which it was intended is municipal water intake data. Much of the historical, chemical, and biological data, as well as temperature data, that are available for the Great Lakes were obtained from water intake data, although these data were probably taken only for the purpose of insuring an adequate public water supply. Because of the lack of historical data on the Lakes, the water intake data have been carefully analyzed and general historical trends in water quality derived. This example shows the importance of analyzing data from more than one viewpoint.

Unfortunately, very little Federal funding has been provided in the past for data analysis alone. Most projects that are funded involve the collection of new data. There is a great need for increased financial support for interpretation of existing data. More thorough interpretation will mean more efficient new data collection as well as more effective use of existing information on the Great Lakes.

11.6.4 Research

Environmental research is not an end itself, but rather is a basis for sound decisionmaking. The responsibility for identifying needs and conducting research related to water and land resources in the Great Lakes Basin is dispersed and may often be uncoordinated among sectors of the research community. Most of the research sponsored by Federal agencies, either in-house or by contract, is carried out in the context of agency missions. At the State level, water resources research and development is conducted on State-oriented problems and is often cooperatively funded by Federal agencies. At the university level, pure and applied water research is conducted on a broad spectrum ranging from single discipline interests to broad interdisciplinary approaches. Private industry also has a role in water related research, mainly in the context of solving industry problems, such as the development of equipment to improve water-use efficiency and to cope with waste products, and in the development of machinery and equipment for manufacture and sale.

Water quality research in the Lakes can be used as an example of how ongoing programs in the Basin treat one portion of the environmental research picture. The Federal Water Pollution Control Act and its amendments in 1956, 1961, 1970, and 1972 authorize and/or require research and demonstration projects for the Great Lakes. At the U.S. Federal level, the Environmental Protection Agency (EPA) is primarily responsible for water pollution research. Expenditures for this work during fiscal year 1972 were about $4.5 million in the Basin. During this same period about $10.6 million was spent by other Federal departments of seven independent agencies on Great Lakes water pollution research. The agencies were the Atomic Energy Commission (now the Energy Research and Development Administration and the Nuclear Regulatory Commission); the Departments of Commerce, Defense, Interior, and Transportation; the National Aeronautics and Space Administration; and the National Science Foundation. As was pointed out above, these agencies, with the exception of NSF, were engaged in "mission-oriented" research. Nevertheless, the broad interpretation of "mission" inevitably results in some overlap in activities.

11.6.5 Great Lakes Basin Data Collection, Data Analysis, and Research Needs

A list of a wide range of water and related land use functions in the Great Lakes for which data collection, data analysis, and research is needed has been prepared. This list has been organized according to the categories shown below.

(1) Basic Resource Information
   (a) climate and meteorology
   (b) surface water hydrology
   (c) geology and ground water
   (d) limnology of lakes and embayments
   (e) mineral resources

(2) Water Resource Use and Management
   (a) water supply—municipal, industrial, rural
   (b) water quality (pollution control)
   (c) fish
   (d) navigation—commercial and recreational boating
   (e) power
   (f) levels and flows
   (g) shore erosion

(3) Land Resources Use and Management
   (a) land use and management
   (b) flood plains
   (c) irrigation
   (d) drainage
   (e) wildlife
   (f) erosion and sedimentation

(4) Economics/Social/Institutional
   (a) economic and demographic
   (b) Federal and State: laws, policies, and institutional arrangements

(5) Environmental Quality
   (a) outdoor recreation
   (b) aesthetic and cultural resources
   (c) health aspects

The five major categories in the above outline correspond to the general groupings used throughout the Framework Study for classifying the work groups and appendixes. The subdivisions of each of the major categories correspond to the subject matter of Appendixes 2 through 23.

Data collection needs, data analysis needs, and research needs have not been separated. There is often a close relationship among these endeavors, and hence they are difficult to separate. The listing is not intended to be exhaustive, but rather illustrative of general areas needing increased attention in the near future.

Those individual research, data collection, and data analysis needs which are considered to be of particularly high priority have been marked by an asterisk(*). The priority given to an individual item will vary according to needs of different areas of the Basin, the introduction of new problems (for example, PCBs and other chemicals were not known to be environmental hazards until only a few years ago), the results of ongoing research, and the judgment of the individual assigning the priority. Nevertheless, in view of the length of the research needs list and limited amount of funds available to support research projects, it was felt that some priority should be assigned to the individual research needs.

The needs list is presented below.

I. Basic Resource Information
   A. Climate and Meteorology
      (1) identify and refine short- and long-range weather forecasting techniques

(2) establish the relationships between air temperature and relative humidity over the Great Lakes surfaces

(3) evaluate the effectiveness of weather modification as a method of precipitation control in areas of the Great Lakes Region

(4) establish the relationships between meteorological data taken over land and corresponding data over the Lake surfaces and determine desirable locations of meteorological stations on the Lakes

(5) compute reliable estimates of annual, monthly, and weekly evaporation from each of the Great Lakes.

B. Surface Water Hydrology

(1) *investigate methods for deriving improved estimates of tributary runoff from gaged areas and generally expand the hydrologic monitoring network for the Great Lakes Basin

(2) *research the significance of pollutants associated with suspended solids in tributary flow

(3) improve the understanding and ability to predict the movement of suspended sediment in tributaries to the Great Lakes

(4) *develop predictive models for the transport of nutrients, hazardous materials, and other pollutants in streams tributary to the Great Lakes

(5) develop improved methods to forecast freeze-up, break-up, and the spatial extent and thickness of the Great Lakes ice cover

(6) analyze the formation and behavior of ice cover in the Lakes and connecting channels

(7) compare and analyze results of existing snow melt research with information for the Great Lakes Basin, and investigate the peculiarities of the Great Lakes Basin as they might affect snow melt runoff.

C. Geology and Ground Water

(1) *conduct quantitive studies on aquifer parameters and potential stresses on the ground water system in order to evaluate the long-range development potential of critical aquifers throughout the Basin

(2) *evaluate the hydrogeologic effects of artificial ground-water recharge and research the fate of contaminants introduced into aquifers

(3) *develop means to make more accurate appraisals of the direct ground-water inflow or outflow to the Lakes in order to refine the water budget of the Great Lakes system

(4) improve methods of applying systems analysis to ground-water resources development

(5) *research the impact of urbanization on ground-water resources in the Basin

(6) determine the impact on Great Lakes water quality of septic tank disposal systems under different soil conditions in the Basin.

D. Limnology of Lakes and Embayments

(1) *conduct a long-term quantitative inventory of Great Lakes biota for the purpose of developing biological maps of the Great Lakes

(2) *determine the relative importance of sediments as a nutrient source in each of the Great Lakes

(3) *determine the availability to aquatic life of different forms of chemical pollutants contributed to the Great Lakes

(4) *research the synergistic effects of toxicants (e.g., heavy metals, pesticides) on aquatic life in the Great Lakes and determine the ultimate fate of these toxicants in the lake system

(5) *estimate the loading of chemical pollutants to the Great Lakes from atmospheric precipitation and dry fallout

(6) increase taxonomic research and develop detailed keys to the fauna and flora of the Great Lakes

(7) conduct further basic research on chemical transformation processes in the Great Lakes

(8) determine the significance of wind-induced mixing on the uptake or release of substances associated with sedimented material in the nearshore areas of the Great Lakes

(9) survey the frequency and extent of storm-induced mixing of nearshore areas and embayments

(10) investigate the fundamental role of bacteria and fungi in nutrient recycling

(11) intensify the development of remote sensing techniques for the study of limnological characteristics of the Lakes

(12) compile and develop charts showing velocity and direction of currents in connecting channels

(13) conduct further basic research on the physical limnology of the Great Lakes, including studies on lake oscillation, open lake circulation patterns, the relation between open lake circulation and nearshore currents, and stratification phenomena, such as the thermal bar

(14) investigate the role of accumulations of nutrients, pesticides, heavy metals, and refractory organics in snow ice.

E. Mineral Resources

(1) *assess the probable environmental impacts of expanding the mining and refining industries which utilize water resources of the Basin

(2) determine more precisely the quantity and/or quality of the Great Lakes Basin

mineral resources through field examinations, including areas under the Lakes themselves

(3) *determine the potential impact on water quality of alternative mineral extracting methods in the Great Lakes Basin environment

(4) define more definitely long-term requirements for sand and gravel resources, particularly for construction, beach fill, and offshore terminal construction, and investigate the ecological impact of offshore sand mining.

II. Water Use and Management

A. Water Supply—Municipal, Industrial, and Rural

(1) *investigate new ways to optimize the removal of potentially harmful substances (e.g., trace organic compounds, viruses, asbestos) from drinking water

(2) conduct investigations into the development of regional water supply systems including an evaluation of changes required in the present institutional arrangements of service utilities

(3) investigate improvements to the operational efficiency of municipal and industrial wastewater treatment plants

(4) conduct further research and development in modification of industrial unit processes to reduce water withdrawal requirements in the future.

B. Water Quality

(1) *undertake design research to determine the most efficient monitoring program needed to characterize the water quality of the Great Lakes

(2) *expand the network of water quality monitoring stations to include heavy metals, pesticides, refractory organics, and other potentially toxic substances

(3) *develop new cost-effective methods to conserve and/or recycle valuable resources found in wastewater

(4) *develop methods to test new chemicals for possible hazards before they are used in the Great Lakes environment

(5) *continue research on means of disposal of sludges produced in water supply and wastewater treatment processes

(6) determine the economic and technical feasibility of further reductions of point sources of nutrients

(7) demonstrate the feasibility of controlling excessive growths of weeds and algae (e.g., *Cladaphora*) in the Great Lakes

(8) develop methodologies to predict the extent and rate of response of the Great Lakes to reduced nutrient loadings.

C. Fish

(1) *continue to perform fish population assessments in order to evaluate the outcome of fishery management policies and predict the outcome of future management strategies

(2) *continue to conduct basic research on the physiological requirements of fishes of the Great Lakes and the environmental factors affecting them, and further study of bioaccumulation patterns of toxic substances in fish

(3) continue to study means of controlling pest fish species in the Great Lakes (e.g., lampreys) through chemical, biological, and other techniques and evaluate the overall effect of these controls

(4) continue to research methods to improve the sport fishery in the Great Lakes and develop managerial techniques to improve controlled commercial fisheries

(5) assess the reaction of various species to exploitation and/or predation and human decision to effect better management of fisheries

(6) *evaluate the effect of new species introduced to the ecosystem, including their position in the food chain, their competition with other species for food and spawning areas, and their effect on the forage base

(7) demonstrate the feasibility of controlling excessive fish die-offs

(8) investigate the effect of turbidity derived from tributary inputs, shore erosion, or suspension of sedimented material on fish spawning areas.

D. Navigation—Commercial and Recreational Boating

(1) research the potential environmental effects of spills of fuel shipments on the Great Lakes

(2) conduct investigations which will determine how the following factors will affect port facilities for commercial navigation

(a) extension of the season and reduction of stockpile requirements

(b) trend towards supercarriers and resulting large cargo delivery

(c) trend towards increased pelletization and higher iron content in iron ore shipments

(d) *possibility of transmission of coal and/or iron ore via pipeline

(3) determine the feasibility of using heated effluents in extending the length of navigation season, considering the possible adverse environmental effects

(4) analyze the social and economic factors related to water availability for recreational boating

(5) determine the effect of vessel squat in constricted reaches of connecting channels.

E. Power

(1) *conduct an inventory of the types

and quantities of pollutants which enter the Great Lakes that are derived from power plants, both in and out of the Great Lakes Basin

(2) *analyze existing power plant site data to better ascertain physical and biological changes in the Great Lakes and tributaries from power plant discharges

(3) *determine the biological effects of entrainment and impingement of organisms at cooling water intakes, such as the effect of the loss of larval fish on future fish stocks

(4) *develop methods to conserve/recycle water used in energy production, including an assessment of feasibility of using heated water for agriculture, aquaculture, industrial processes, etc.

(5) compile a review of the state-of-the-art on the design of cooling water intake and discharge structures to minimize impingement and entrainment

(6) *conduct analysis of the impacts of power plants in the following areas

(a) methods of ash handling and disposal

(b) fallout of particulate emissions from stacks

(c) effects of biocides and other chemicals in blowdown waters which are discharged to water bodies

(d) methods for the transfer and storage of fuels and power

(7) investigate the near-term and long-term fuel requirements and available reserves to supply existing and future power plants in the Great Lakes Basin and the available alternatives to the use of natural fuels for power generation, including the overall social and economic effects

(8) *research the potential environmental hazards of major nuclear power plant accidents involving large scale releases of radioactive materials to the Great Lakes

(9) research the land/water/air meteorological interactions which affect atmospheric transport to the Great Lakes (e.g., the importance of sea breezes along the Great Lakes coast)

(10) *investigate the environmental impact of fuel (e.g., coal) processing within the Great Lakes Basin

(11) *inventory the environmental hazards to the Great Lakes system from energy-intensive activities not associated with power plants, such as the pollutants emitted by automobiles

(12) investigate the effect of cooling towers upon local and regional weather modification including cloud formation, increase of precipitation, increase of fogging, and icing.

F. Levels and Flows

(1) *continue to study internationally acceptable methods for water level regulation, including a compensation plan for parties adversely affected by level changes

(2) prepare Great Lakes inflow/outflow forecasts both monthly and annually to aid in the operational decisions and management of the hydrologic resources of the Basin

(3) analyze possible effects on Great Lakes levels caused by anticipated changes in ice retardation

(4) evaluate the effects of precipitation and evaporation on lake levels over different periods—day-to-day, month-to-month, year-to-year, and longer

(5) analyze and forecast short period water level changes on the Great Lakes at regulatory structures

(6) further study the effect on lake levels from seiches and other phenomena caused by wind and barometric pressure changes

(7) research deep water wave characteristics and the resulting maximum storm water levels which affect shoreline erosion.

G. Shore Use and Erosion

(1) *determine the magnitude of physical and ecological damages to the Lakes from shoreline erosion processes

(2) *conduct special research studies to assess the effects of shoreline modifications on environmental values in the shoreline zone.

III. Land Use and Management

A. Land Use and Management

(1) *determine the specific sources and means of control of nutrients and other pollutants derived from land runoff

(2) *develop methodologies that can be used to predict the potential impacts of alternative land resource management plans

(3) refine remote sensing techniques for the purpose of land use inventories

(4) *derive guidelines for planning and management at various levels and combinations of land use and establish limitations on land use

(5) continue the development of new pesticides and biological agents that are biodegradable and have a minimum impact on the environment

(6) study nutrient release and water yield from forest areas under different harvesting techniques (e.g., mechanized logging, clear cutting), management techniques (e.g., prescribed burning), and on-site preparation techniques (e.g., on-site debarking)

(7) develop an efficient method for establishing improved pastures by seeding without tillage in rock or stump-covered land.

B. Flood Plains

(1) investigate and determine the rel-

ative costs of various nonstructural measures for flood control purposes

(2) determine ways to reduce flood damages through education of the public

(3) develop new methods for channel improvement and/or streamflow regulation, considering the environmental impact of such action.

C. Irrigation

(1) improve means to identify, assess, and predict the ecological impacts of irrigation and channelization

(2) further investigate the use of treated wastewater for irrigation purposes

(3) determine the practicability of irrigating through using tile drainage water, especially for truck crops and sod farms.

D. Drainage

(1) *further study the ecological and socioeconomic importance of wetlands (marshes) to the Great Lakes, considering, for example, the effect of marsh drainage on water quality

(2) investigate the impact on water quality of draining excess water on land where a naturally high water table, natural precipitation, or seepage limits agricultural production or urban use

(3) study the process of tree root invasion of tile lines to determine

(a) the relative ability of the different tree species to cause a problem

(b) the distance the tile should be from various trees and shrubs

(c) the best means of controlling roots where tile must be near windbreaks, orchards, or other trees

(4) analyze soil profile requirements related to blinding tile after the drain has been installed.

E. Wildlife

(1) conduct further research to determine the status of management needs for nongame wildlife

(2) evaluate the potential for use of shrubs with persistent fruit as a food source for wildlife in critical winter clime habitats in the Great Lakes Region

(3) assess patterns of ingress and egress of Great Lakes Basin wildlife for wildlife management purposes.

F. Erosion and Sedimentation

(1) *devise new methods to control soil erosion in watersheds, and further study the significance of soil erosion on water pollution

(2) *research the effect of dredging on the water quality and ecology of the dredged area and assess the role of dredge spoil in water pollution

(3) conduct basic research into the rate of accumulation, the location of accumulation, the factors controlling accumulation, and the effect on water quality of organic sediment material (as opposed to mineral sediment)

(4) further investigate the use of chemical flocculation for removing suspended solids from desilting basins

(5) conduct research in those areas of agricultural management that involve moisture infiltration, permeability, and resistence to erosion

(6) develop educational programs to promote public awareness of the factors involved in and the importance of programs to reduce erosion and sedimentation problems

(7) *determine the quantity of solids contributed to the Lakes from urban debris, including settled dust from fossil fuel burning, discharge of wastes from industrial processes and sewage treatment, and other miscellaneous sources, such as garden plots, street litter, and wind-scattered trash

(8) conduct field studies in Great Lakes Basin localities to localize and verify empirical formulas for sediment yield, such as the Universal Soil Loss Equation

(9) analyze the trap efficiencies of sediment collection basins and establish guidelines for their design and installation, particularly in urban areas

(10) evaluate stability of channel banks on both natural and constructed channels.

IV. Economics/Social/Institutional

A. Economic and Demographic

(1) compile and evaluate economic data related to the allocation of Great Lakes fishery resources.

B. Federal and State: Laws, Policies, and Institutional Arrangements

(1) *determine how the evaluation of socioeconomic factors in water resource and associated land use planning can be improved

(2) *assess the social, economic, and environmental impacts of complying or not complying with the requirements and goals of the Federal Water Pollution Control Act Amendments of 1972 (P.L. 92–500)

(3) *research new ways to involve and educate the public in water resources and associated land use issues

(4) *establish a centralized clearing house and information service for water quality data to facilitate multi-agency management responsibility for water quality

(5) determine the relationships among Federal, State, regional, and local institutions that will best promote economy and effectiveness in dealing with water resources problems in the Great Lakes Basin

(6) *investigate the environmental, so-

cial, and economic impacts of limiting industrial growth in the Great Lakes Basin.

V. Environmental Quality

A. Outdoor Recreation

(1) expand data collection and analysis programs to determine the extent of private recreational development and the need for public facilities

(2) evaluate the socioeconomic impact of water and air pollution on various water-related recreational activities

(3) evaluate the potential of using railroad rights-of-way to meet a portion of recreational needs, particularly in urban areas

(4) identify, collect, and analyze data defining the recreation carrying capacity of special areas, such as wild and scenic rivers, wilderness areas, and national lakeshore areas

(5) collect and analyze cost/return information on several kinds of private income-producing recreation enterprises being established in the Basin

(6) evaluate the impact of restricted uses of automotive travel on upper Great Lakes recreational areas

(7) *evaluate the direct impact of the use of snowmobiles, off-the-road vehicles, trail bikes, etc., on the natural environment

(8) evaluate the potential of mined areas for recreational use in the Great Lakes Basin.

B. Aesthetic and Cultural Resources

(1) *further develop the use of multiobjective evaluations, including methods to quantitatively assess presently unquantified environmental amenities, in order to facilitate the comparison of alternative water resources objectives

(2) *evaluate the impact of intensified land use, transportation networks, water use, and energy management on the Basin aesthetic and cultural resources

(3) identify and analyze aesthetic factors associated with the siting of power plants as they affect land use and shore access

(6) *conduct detailed resource identification efforts for buffer zones, linkage corridors, shore zones, resource clusters, and other features of the Basin's aesthetic and cultural resources.

C. Health Aspects

(1) *evaluate the short and probable long-term effects on human health of microcontaminants (e.g., carcinogenic organic compounds, asbestos, viruses) found in some drinking water supplies

(2) *develop practicable indices that protect water recreationists from enteric, upper respiratory tract, and fungal infections

(3) *intensify research programs aimed at the study of the nature and occurrence of viruses in the Great Lakes

(4) delineate environmental factors responsible for vector problems

(5) determine the health hazard, if any, from vessel waste discharge in the Great Lakes.

11.7 Addendum

11.7.1 Introduction

In response to a series of questions and issues emerging from the Great Lakes Basin Framework Study, a study was initiated by the Department of Housing and Urban Development, Region V. The study was conducted by Robert C. Einsweiler, Inc. Part IV of this study, dated June 30, 1974 (revised), titled "Planning and Management to Achieve Comprehensive Goals" is presented below.

11.7.2 Planning and Management to Achieve Comprehensive Goals*

THE CASE FOR CHANGE

Recommending changes in current planning and management techniques to achieve comprehensive goals implies dissatisfaction with current methods and results. Change implies further intervention in the ways public agencies, private firms or individuals make decisions today. It probably implies a transfer of authority or sharing of authority between functional agencies or governmental levels. These implications explain why change is slow and why demonstrated need for change is so critical. What is the demonstrated need to alter the planning and management systems in the Great Lakes Basin? The case is not well made in the Great Lakes Basin Framework Study. It requires reading between the lines. Here are a few examples:

(1) The GLBC study approach documented the resource demand to the year 2020. It partially evaluated alternative policies to further accelerate growth or to limit it. The final proposed alternate, PRO, is defined generally in words, but not trans-

Robert C. Einsweiler, Inc., from Relating Water Resource Planning to Comprehensive Development Objectives, Part IV, June 30, 1974 (revised).

lated into programming. Time and money ran out. The program costs that are going to Congress are essentially based on trends.

(2) The planning procedure used rests on massive data collection and untold time of federal agency staff. The two combined to produce a long plan preparation period with the concurrent results that much of the data are already obsolete and the final Framework is not yet in print. The cyclical, successive approximations approach of the new B Level studies should avoid this pitfall.

(3) The program proposed generally reflects attempts to augment supply or demand. Alternative programs to reduce demand, such as land use regulation and pricing of services, rarely appear as recommendations. This is partly true for areawide agencies, too. The selection process to arrive at final programming is documented in only a few cases.

(4) The local government and special districts that will have to implement most of the program recommendations were involved in only a minor way or not at all. The State and local agencies that could exercise preventive strategy also were involved in a very limited way or not at all. They are to be involved more in the new B Level studies.

In spite of these negative remarks, the study did produce a general understanding of water resource problems in the region and made the case for action. The issue is what action by which agency?

"One of the first to recognize the need for greater emphasis on urban and metropolitan aspects of water resources was Lyle Craine of the University of Michigan, Department of Conservation. Speaking before a meeting of sanitary engineers in 1959, Craine pointed to four emerging trends in the U.S. water resource situation.

(1) An increasing emphasis of intensive water resource management in growing metropolitan areas, that would require that water resource planning and management be integrated with overall urban planning.

(2) A changing pattern of water resource use from rural development to municipal and industrial, to urban-oriented recreational, and to recognition of the 'intrinsic visual value of water resource,' thus leading to an 'environmental preservation' purpose.

(3) An increasing desire and requirement for greater local participation in national water management programs, in two ways:

(a) a greater local voice in water management designs

(b) a requirement that localities bear more of the costs of Federal water development programs.

(4) In the field of flood control planning and policy, a changing emphasis from primary reliance on structural measures to management and regulatory measures such as flood plain zoning, flood insurance and flood forecasting, with consignment increase in responsibility of local officials, including urban planners."[1]

In tracing the evolution of water resources planning, Hufschmidt and Elfers comment:[2]

> The striking characteristic of this evolution is that it has dealt with coordination of planning at the national and major river basin levels, and in Federal-State terms. In this evolution there has been no explicit concern for problems of coordination of water resource planning or management at the urban-metropolitan level. Rather, the assumption has been made that urban-metropolitan interests would be represented by the States, and would be accommodated in the detailed planning that would be undertaken by Federal-State commissions on a river basin basis.
> It appears likely that the present pattern of organization and administration of Federal-State water resource planning on a river basin basis will prove inadequate to the solution of the urban-metropolitan water resource problems of the 1970's and 1980's. There must be a more explicit recognition of metropolitan interests in National-State water resource planning. . . .

PLANNING AND MANAGEMENT CONCEPTS

Organizational Role

Three specific problems in decision-making by the present structure have been identified by the Great Lakes Basin Study: (1) spillover effects from private development to public resources, e.g. storm water runoff and siltation and wetland drainage, (2) spillover effects from one functional agency to another, e.g., land drainage for agriculture and resulting loss of habitat for wildlife, (3) spillover effects from one government to another, e.g., upstream community waste release to downstream community recreation or water supply.

Solutions to all these problems require some shift or sharing of authority between private and public sectors, between functional specialists and generalists in government, and between levels of government.

Perhaps the most critical and difficult path will be the phenomena variously described as "hardening of the categories" or "functional feudalism." It is most evident at the Federal level and least at the local level. The phenomena is so pervasive, however, that the areawide comprehensive planning agencies studied for this report frequently admitted that functional funding pushed them into functional plans that did not add up to a consistent comprehensive purpose.

The Intergovernmental Cooperation Act of 1968 with the resultant OMB A–95 circular was one response to the inter-functional, inter-governmental spillover problem. Integrated grants administration (IGA) and OMB circular A–102 are other measures. The National Environmental Policy Act that led to the Environmental Impact Statement and the Council on Environmental Quality is another response to the side effects of single purpose actions. Finally, special revenue sharing, according to the Advisory Commission on Inter-governmental Relations, has this as one of its purposes:

> To build a potential power base for the enactment of broad federal aid programs for strengthening of the role of the responsible locally-elected generalist—the Mayor, the Governor, the County Executive—and diminishing the role of the vertical autocracy—the functional specialist at all governmental levels.[3]

The easy solution when things are not working as desired is to create a new institution. The more difficult approach, but undoubtedly more effective in the long run, is to build new relationships among existing institutions. That is part of the rationale for the proposed "Umbrella Multi-Jurisdictional Organization" (UMJO) for sub-state regions. The intent is to tie together various governmental levels and functions as they play out in one geographic region. A similar purpose is intended by creative use of the Coastal Zone Management Program for example.

Based on the Great Lakes Basin Framework Study findings, the major problems requiring attention occurred in three nongovernmental regions: (1) the multi-state, natural-resource based Lake Region, (2) the sub-state, resource-based production land region—agriculture, forestry and mining, and (3) the sub-state major population concentration or metropolitan regions. The solutions will require Federal-State-Local cooperative efforts, as no single governmental level by itself has full authority to act.

The role of the State is critical for two reasons. The State is the ultimate repository of land use control, though most has been delegated to local government. The State is the creator of local governments. The States are beginning to create decision-making mechanisms to handle functional or interest group conflicts and to go beyond to consider State settlement policy, but much remains to be done. The Federal Government must continue its past catalytic role of solving inter-governmental problems in providing financial and technical wherewithal to do so. The local governments are in the last-but-not-least role. Of all government levels, local government has traditionally established the necessary mechanism and exercised the responsibility required to solve problems like those in the basic trade-off between competing functions, trade-offs between private and public, and controlling demands for public services as well as supply. That the trade-off function has not been performed to everyone's satisfaction is clear. But more effort has gone into it at the local level than at any other level.

The challenge in the near term to implement the Framework is to forge a new federal, state, local planning and management relationship as implied on the GLBFS cover that takes advantage of the unique and complementary advantages of each level of government and to build on existing institutions rather than creating new ones. For the longer term, new arrangements may be needed at the multi-state regional level to handle trade-offs between development and environment and among states. This is discussed more fully later.

Three regions have been identified. (See Part II on Tools to Control both Supply and Demand.) It would be desirable for all three levels of government to actively participate in all three regional planning and management programs. Further attention should be given to the concepts of lead agency in this work. The GLBC is the likely candidate for lead role in the lake region; the State Planning Agency, State Natural Resource Department or non-metropolitan sub-state agency for the production lands regions, and an urban sub-state or metropolitan agency for the urban regions. Because the problem of greatest urgency falls in the urban settings (see Part I) that region will be used for further description of a planning and management system.

Planning Process

The terms planning and management are used together in recognition of the trend away from professionally designed technical solutions to problems and toward the continuing input of planning to short- and long-range decision making, and to policy formation and implementation by duly elected public officials. As water resource management plans are replacing ad hoc single purpose construction projects so are urban development and land use management systems replacing map-oriented, long term land use plans. The shift is toward greater integration with the ongoing management of the public affairs of the nation. Planning and management approaches to implementing the GLBFS should be in the forefront of this trend.

There are many approaches to comprehensive planning. The differences depend on degree of uncertainty, authority of the preparing agency, attitudes about public intervention in private transactions, level of funding, degree of integration with daily decision making and other factors. The two extremes are easily defined.

At one end is the long term map-oriented plan based on the rational planning method, i.e., starting with goals, proceeding through objectives and policies to programs. This process has merit only when the authority to implement is highly centralized, so goals, too, are easily derived. Plans for new towns or major building projects are possible examples. Even with these, however, certainty is likely less than it should be for such long range decisions. The approach is derived in part from the design professions. While the GLBC Framework Study appears to use this approach on first blush, further study places it closer to the Darwin Stuart approach. The *Alternative Frameworks* qualifies the ability to set goals without continuing interaction. Also the material in the various appendixes is more problem solving not goal achieving in its orientation.

At the other end of the spectrum is the incremental decision process based on Lindblom.[4] This approach makes incremental adjustments to operating programs that are not producing satisfactory results. It is geared toward the short term operating decisions of a public manager.

Darwin Stuart in an article in the *Urban Affairs Quarterly*, has challenged both extremes.[5] The rational method is cited for the difficulty or impossibility of weighting goals in order to set priorities. The other end of the spectrum is marked down for being less than what is possible and desirable to solve urban problems. The focus on short term increments can still lead to undesirable long term effects unless the long term consequences are evaluated. That is what an Environmental Impact Statement is supposed to be, the long term effect of an incremental decision. It is expensive as a method of planning and decision making.

Stuart argued for a mid-range problem oriented solution in his article, although he would modify that further today.[6]

Comprehensive planning has never had to face the barbs of public dissatisfaction with side effects because no one has fully implemented a complete plan in a major urban area. When and if the day arrives that such authority is centralized, one can anticipate complaints about unexpected side effects. The recent attempts at sophisticated growth control—"no growth" or "slow growth" systems—have caused concern for side effects.[7] What will happen to land values? What effect will that have on housing choice? If these increase the cost will they be offset by lowered public expenditures? And more.

This suggests a new approach, a modification of what has come to be called guidance systems. The proposed approach combines a number of techniques now frequently used separately. The long term or alternative futures are developed as scenarios, and as probabilities of social and technological change. These can test the consequences of current decisions, provide feedback on what people value, and serve as an acceptable image of the future toward which efforts should move. As a second step, using attitude surveys and other means, an attempt is made to identify what people value in today's environment that they would be reluctant to see changed. Third, existing or potential problems are identified for commencing discussion and debate. Then strategies or programs are proposed to solve the problems without harming those items people value. Finally, a monitoring system is established to check for unwanted change in what people value and to check for programmed improvement in ameliorating or solving problems. Measurement is critical. The measures must be performance or results based, i.e., degree of pollution improvement, congestion relief, etc., not just dollars spent, units built or similar measures although they are necessary too. Finally, the process must recycle, as proposed in the new Level B studies, to move to agreement by a series of approximations.

This is an accommodation to a series of concerns reflected in other processes. First there is a need to look to the future to attempt to design that "better world" and also to be as certain as possible that today's actions lead toward that future. But the difficulties with setting abstract goals and moving toward them in lock-step fashion is well known. It is difficult for individuals to respond to goals separate from the concrete impact of them today. This is acknowledged in the *Alternative Frameworks* report. The recycling process of the B studies, where consequences of pursuing the goals become evident, allows sharper conclusions as to acceptable directions for the future.

Another aspect of this same concern is the impact or side effect of proposed programs. In the case of newer development management systems, a key purpose likely to be achieved is reduction in cost for public facilities. This is a direct response to citizen pressures. However, if the public sector cost reduction leads to private sector cost increases and change in the type of housing that can be built, the citizens may alter their opinion about public service costs. Thus the need to survey and monitor what people value in the existing setting that they would like maintained or improved but not degraded.

A process using monitoring is essential to any development action today. Society has now moved to the point where the questions it can ask about consequences of proposed actions far exceed the ability to respond. The body of knowledge does not exist. As programs are proceeding there is a growing mass of recorded opinion as to what may happen if a project proceeds, but precious little empirical data on what has happened in similar circumstances in the past. The present process enables stopping action when adverse consequences are of such potential magnitude or such great probability that it is best to seek alternatives. The monitoring process would enable action to proceed in projects of considerable benefit where the possibility of adverse consequences is in dispute or where corrective programs could be taken if needed.

Monitoring is equally important for all public expenditures. There is need for more documented results and evaluation of major items to see if the forecasted benefits actually occurred and whether the project performed as planned. It is politically difficult to record mistakes. But concern for the public interest demands that we treat "planning as learning."

Recycling, or approaching a plan by a series of approximations has many points to commend it. It enables early concurrence on what the important problems are, ranges of acceptable solutions, conflicts among solutions or agencies, and pinpointing research and data gathering where they are needed.

It is critical at this juncture to distinguish between plans as an aid to forming policy and plans to implement that policy. The concern, here, is with the former. These are plans of less detail than implementation plans. The parallel is between a Level B and Level C study. Unfortunately, practice has not distinguished and clarified these two separate uses. It is common to use design level detail and approaches to policy level issues with resultant excess costs and time and lack of clarification of the true policy choices. Those policy choices among functions or programs competing for the same scarce dollars, must be made by duly elected officials. There is no professional training that enables a planner to make public value choices.

Another aspect of the planning process is the need to incorporate and integrate all relevant planning programs. For the urban centered regions this should encompass HUD "701" funding for comprehensive planning, open space, sewer, and water facilities, EPA water quality and air pollution control planning, DOT highway and mass transportation, Department of Agriculture Comprehensive Sewer and Water Planning, and B level or Section 209 river basin studies. Integrated Grants Administration procedures ease this process somewhat. Coordination is not achieved by having the federal agencies who dispense these planning funds sit together on a Title II Commission of the Federal Regional Council. It requires integration of the work as produced by the recipient agency or agencies in the urban region.

A final consideration is the tie to budgets. The Great Lakes Basin Framework Study, as most water resource studies, is expressed primarily in Congressional budget dollars. Although these are order-of-magnitude costs, subject to refinement through B and C level or other studies, they are a place of beginning to achieve a budget tie. While non-federal dollars are identified they are not allocated to state and local levels.

Unfortunately, most of the areawide work reviewed was not tied down to capital or operation and maintenance costs. Without such costs the evaluation of feasibility is weak. The Southeastern Wisconsin Regional Planning Commission pinpoints responsibilities by agency in its watershed studies if not identification of program costs. Erie-Niagara has prepared a full list of water resource related projects by priority as information for the State Environmental Board election in November.

Some have suggested that sub-state district organizations not only coordinate the local government budget elements in regional programs, but the state and federal elements as well. Obviously a best fit of state-local programs would occur where the sub-state district area was used by the state as a decentralized service delivery area and as a basic input to state budgets. No state in this region is known to be approaching this level of integration, however. The point is that the more integration of federal-state-local programs that occurs in the geographic area of a major problem identified in the *Alternative Frameworks*, the more likely an effective solution will be found.

Development Management Process

This is distinguished from the policy formation process. It is the management of implementation.

Within the urban area, as described in Part I, three systems would be managed in concert with the hydrological system: protection open space, urban development, and support systems. Land use and hydrology are, in many respects, merely opposite sides of the same coin. The land was in large part formed by water and continues to change its physiographic face based in large part on water. Land uses are frequently sensitive to water availability, to the surface drainage patterns, sub-surface water and soil conditions, and other water-related factors. The support systems—primarily sanitary sewer, water, storm drainage, transportation—enable urban development to free itself or ignore the natural restraints of the land. These systems can be planned in concert with the land and hydrological systems if those who set development policy so choose.

What is suggested is a crude three-part management system that draws on the findings of the *Alternative Frameworks*. The program could be made more sophisticated by noting that each parcel of land has an "intrinsic suitability" for use to achieve maximum social value as McHarg defines it.[8] The program could be vastly sophisticated by plugging in social and economic policy and considerations. These are not meant to be excluded. Rather the proposal is for a bare bones approach that seems to fit together the pieces identified in the *Alternative Frameworks* as either the cause of or solution to pressing problems.

Simply put, the place of beginning is the green space called protection open space that can enable the natural management of the hydrologic system—surface water runoff, flooding, siltation, ground water recharge, water for recreation and aesthetics—while at the same time providing green space for recreation, for wildlife, for a natural order to develop and possibly some air pollution abatement as well.

The *Alternative Frameworks* suggest substantial costs for this approach owing to purchase costs. All the land need not be in public hands. Much of it can remain private and provide the necessary function. This has been a difficulty in the past, but three trends are emerging to alter the past.

First, builders and developers are finding that designing with nature can add value to their remaining lands offsetting costs of preserving the lands or natural processes. Local officials must make this information available.

Second, the courts are deciding cases more stringently on natural resource issues. Some are approaching the point identified in The Rockefeller Report[9] that an owner can do anything on his land that does not alter the public benefits of natural systems now existing, i.e., water purification via marshes.

Third, new development control techniques that are performance in nature, specifying degree of care to be taken, can enable developers to proceed without harm to natural processes. Also new techniques of incentive and development rights transfer enable land owners to meet higher criteria or to not develop land at all and still not lose financially.

The areawide agencies reviewed all have some partial version of this system planned or in process. The Southeastern Wisconsin Planning Commission work appears to be the most advanced and most detailed.

The second part of the system is the land development itself. The practice in the past has been to build public facilities to handle the spillover of new private development, i.e., storm sewers, ponding areas, water control systems for siltation, and the like. One of the newer modes of development management is to require each developer to manage all spillover costs or externalities. That means provide on site for continuation of aquifer recharge, collection of storm water and release at pre-development rates, silt prevention and others. Payment toward control systems—sanitary sewers, parks, schools—is enabled when that is a more reasonable course. In short, the tools are available to prevent many of the forecasted public costs in the *Alternative Frameworks*, if governments are willing to use them.

Performance standards can be set to meet water resource needs. In the most stringent type cases land use performance standards can be tied to natural resources as at Lake Tahoe[10] or the Christina project.[11] Storm water runoff models developed to forecast storm drainage needs can be run in reverse and used to set maximum allowable runoff from parcels, sub-divisions or drainage areas. Again, it appears that the SEWRPC work is the most advanced in this regard although not as rigorous in its requirements on development as the two examples cited.

The third part of the urban system is the support system component, the treatment plants, sewer, storm sewer, water and transportation. These, too, can be used in preventive fashion to reinforce the land use controls by careful coordination with the protection open space.

These systems, in most of the major regions, have been planned by areawide agencies to some degree. They may not have been planned to the sophistication necessary to meet the guidelines of DOT, EPA, NOAA and other agencies under recent legislation. Most of the areawide studies propose using these capital investments to guide development. No sophisticated techniques such as adequate public facilities ordinances were identified, however.

To be effective, the development management system must be operated as a system. That is the tools selected to guide action in the three categories described above must be coordinated. This involves interagency action in the multi-governmental setting of a metropolitan area. It means multi-agency coordination even within a single government. It can be done. It is being done as the NSF study demonstrates.

How does this land development conceptual scheme relate to the GLBFS 23 resource use categories? Do the two tie together? (The categories are listed in Part III and on each chart in Appendix C [of the Einsweiler report]).

The concept, schematically, is as follows:

Urban development
- —land uses
- —support systems

Production lands

Protection lands

The 23 categories can be re-listed in line with this set of headings and as they relate to urban community objectives, land use and growth. (Number in parentheses if from GLBFS list):

Support Systems

1. Municipally supplied water (1)
2. Self-supplied industrial water (2)
3. Municipal waste water (7)
4. Industrial waste water (8)
5. Thermal power (cooling) (6)
6. Hydroelectric power (9)
7. Commercial navigation (14)

Production Lands

8. Agricultural land
   —treatment (15)
   —cropland drainage (16)
   —irrigation (4)
9. Forest land (treatment) (17)
10. Mining (5)

Protection Lands

11. Surface waters
    —water oriented recreation (10)
    —sport fishing (11)
    —recreational boating (12)
    —commercial fishing (13)
12. Floodplains (20)
13. Shoreland (erosion) (18)
14. Streambank (erosion) (19)
15. Wildlife management (21)
16. Aesthetic and cultural (22)
17. Outdoor recreation (23)

The only item excluded is water withdrawal for rural domestic and livestock use. While of direct impact in non-metropolitan areas, it is a more remote impact in metropolitan centers.

The support systems are listed first as a precondition to urban development. These items enable people to live well or poorly. They can be used to shape development as well as serve it. Pricing, extension policies, capital programming are among the ways the items can be used to achieve water resource and comprehensive development objectives. It is obviously necessary to agree on the development objective first, if the action is to be beneficial. Key transportation and nonelectrical energy items are missing.

As with the first set, there would be limited urbanization without these items. The production land items can be viewed several ways. They are land to be protected from urbanization as such needs are agreed upon. They represent products that contribute to urban processing and manufacturing industries. The side effects—drainage, irrigation—can pollute urban waters, particularly as urban waste management is improving more rapidly than the problems of non-point source pollution from these production activities. These lands, by their extent, can be used to shape, restrain, or channel development.

The protection lands category is frequently subdivided into recreation lands and natural process lands. For greater simplicity that was not done. In terms of market intervention, the same requirement holds for either. The shaping effect and contribution to amenity and well-being go without saying.

No urban land use appears here and logically so given the limitations of the water resources act. There is some urban land use related to all support systems, some protection lands, and possibly some production lands particularly if urban forestry is included.

The point of the comparison is to show the true interdependence of areawide comprehensive planning and the water resource planning. A greater attempt to directly relate the two, rather than translate one into the other, should be made at the basin study level. Resources prevented expanding more fully the consequences of unilateral action in any of these resource use categories. Suffice it to say that treating the support systems from their water implications alone could adversely impact development. Contrarily, using the systems solely to shape and serve development while ignoring the water resource impact is equally shortsighted.

The challenge to wed the two is there. It is being pursued partially by some areawide agencies and local governments. It is time to get it together with the natural resource people.

Section 12

FRAMEWORK TABLES

12.1 Introduction

This section contains a family of tables which constitute the numerical reporting of the Framework Study. These tables are referred to in Sections 5 and 6–10, which deal with framework formulation for the Basin and the river basin groups. The tables show the 1970 supply in each of the resource catagories; the needs, outputs, and percent needs met for three time periods for NOR and PRO; the capital costs and operation, maintenance, and replacement costs for each time period for the two frameworks; and comparison of land treatment programs and of costs for NOR and PRO.

The arrangement of the tables is discussed in Subsection 12.2 and remarks on the table entries, somewhat in the form of general footnotes, are given in Section 12.3.

12.2 Table Arrangement

The two major groups of tables are those reflecting the Normal Framework and those reflecting the Proposed Framework. There are also groups of tables comparing NOR and PRO land treatment programs and NOR and PRO costs.

The tables are arranged by geographic areas as follows:

Great Lakes Basin

Lake Superior Basin
Lake Michigan Basin
Lake Huron Basin
Lake Erie Basin
Lake Ontario Basin

RBGs 1.1, 1.2
RBGs 2.1, 2.2, 2.3, 2.4
RBGs 3.1, 3.2
RBGs 4.1, 4.2, 4.3, 4.4
RBGs 5.1, 5.2, 5.3

Illinois
Indiana
Michigan
Minnesota
New York
Ohio
Pennsylvania
Wisconsin

The Great Lakes Basin tables are arranged as shown below:

NOR—needs, outputs, percent needs met
—capital costs
—OM&R costs
PRO—needs, outputs, percent needs met
—capital costs
—OM&R costs
Comparison of NOR and PRO land treatment programs
Comparison of NOR and PRO costs

For the five Lake basins the tables are arranged in the following order:

(1) NOR—needs, outputs, percent needs met
—capital costs
—OM&R costs
PRO—needs, outputs, percent needs met
—capital costs
—OM&R costs

The above block of information is repeated for each of the Lake basins; then follow

(2) comparison of NOR and PRO land treatment programs for each Lake basin

(3) comparison of total costs of the NOR and PRO frameworks for each Lake basin.

The same arrangement is used for the 15 river basin groups and for the 8 States, except that there are no tables comparing land treatment programs by States.

12.3 Table Entries

The stub entries are the same in all of the tables except those comparing land treatment programs. The standard entries are the 23 resource use categories for which needs were estimated and which formed the basis for framework formulation.

The units in which the entries are stated are generally understood or are explained in the glossary. The three entries, 1000 acres W.S., refer to the area of water surface related to water-oriented outdoor recreation, sport fishing, and recreational boating. Data were not available in all cases. The two entries, m-tons/yr, refer to million tons per year of commercial fish catch, and million tons per year of cargo transported in commercial navigation. Data on the fishing catch were not available, and this resource use category is treated only in the text and does not appear in the tables. As discussed in the text, 1000 user days of "wildlife management" includes both consumptive use (hunting) and nonconsumptive use (photography, nature study, bird-watching, etc.). The latter is estimated to equal the former, which is projected by methods described in Appendix 17, *Wildlife.*

12.3.1 1970 Supply

Data in this column were estimated from data provided by the work groups, as described in the appendixes. Information for the Great Lakes Basin is also shown in Table 1–37 in Section 5, and is described in general terms in Subsections 4.4 and 4.5. This table also has footnotes which are applicable to appropriate columns of the tables in this section showing needs, outputs, and percent needs met.

The salient points of the description and footnotes are that the "needs" entries for irrigation, agriculture land treatment, cropland drainage, forest land treatment, and water surface area for recreational boating represent opportunities to enhance the value of the resource rather than needs to be met. Also, for all categories except municipal and industrial wastewater, the needs and opportunities for 1980, 2000, and 2020 represent quantities above the base year. In other words, the supply at 1970 has been subtracted from the requirement at 2000 to obtain the need at year 2000. (Part of this need will be met in 1980 if the needs for that year are satisfied.) For the two exceptions noted, wastewater discharge requirements are entered at each time period, based on the methodology used by the Water Quality Work Group.

12.3.2 Water Withdrawals

It must be kept in mind that the water withdrawals are stated in terms of rate of flow rather than total quantity. Hence, to obtain a quantity a time period must be introduced. Generally, one year is used, and the rates are annual means. However, irrigation and mining are based on seasonal use of water, and the quantities shown are seasonal means. These are numerically larger than would be the case if annual means were used. Therefore the water withdrawal quantities must not be added in an attempt to calculate total withdrawal of water in any area.

FRAMEWORK TABLES

TABLE 1-190 Great Lakes Basin, Needs, Outputs, and Percent Needs Met, Normal Framework

RESOURCE USE CATEGORY	UNIT	1970 SUPPLY	1980 N	1980 O	1980 %	2000 N	2000 O	2000 %	2020 N	2020 O	2020 %
WATER WITHDRAWALS											
MUNICIPALLY SUPPLIED	MILLION GALLONS PER DAY	4,300	870	1,030	over	2,810	2,990	over	5,400	5,550	over
SELF-SUPPLIED INDUSTRIAL	MILLION GALLONS PER DAY	10,600	1,110	695	62	4,670	3,500	75	10,300	8,220	80
RURAL DOMESTIC & LIVESTOCK	MILLION GALLONS PER DAY	471	64.0	58.7	92	179	162	91	267	245	92
IRRIGATION	MILLION GALLONS PER DAY	681	824	684	83	1,570	1,330	85	2,460	2,100	85
MINING	MILLION GALLONS PER DAY	780	148	124	84	450	389	86	965	837	87
THERMAL POWER COOLING		17,200	8,210	8,210	100	38,700	38,700	100	96,500	96,500	100
NON-WITHDRAWAL WATER USES											
MUNICIPAL WASTEWATER DISCHARGES	MILLION GALLONS PER DAY	3,060	3,680	3,680	100	4,940	4,940	100	6,720	6,720	100
INDUSTRIAL WASTEWATER DISCHARGES	MILLION GALLONS PER DAY	8,580	7,330	7,330	100	6,000	6,000	100	9,210	9,210	100
HYDROELECTRIC POWER	MILLION GALLONS PER DAY	NA	47,300	47,300	100	51,300	51,300	100	105,000	105,000	100
WATER ORIENTED OUTDOOR REC.	1000 RECREATION DAYS	100,000	105,000	57,300	55	201,000	132,000	66	324,000	190,000	58
	1000 ACRES WATER SURFACE	NA	---	---	---	---	---	---	---	---	---
SPORT FISHING	1000 ANGLER DAYS	80,700	24,800	20,300	82	52,300	46,700	89	79,200	72,800	92
	1000 ACRES WATER SURFACE		---	---	---	---	---	---	---	---	---
RECREATIONAL BOATING	1000 BOAT DAYS	29,000	6,820	2,470	36	12,500	6,330	51	19,500	10,800	55
	1000 ACRES WATER SURFACE	7,260	7,260	---	---	7,260	---	---	7,260	---	---
COMMERCIAL FISHING	MILLION TONS PER YEAR		---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	MILLION TONS PER YEAR	343	432	432	100	583	583	100	754	754	100
RELATED LAND USES & PROBLEMS											
AGRIC. LAND-TREATMENT	1000 ACRES	20,450	20,450	1,800	9	20,450	5,410	26	20,450	7,570	37
-CROPLAND DRAINAGE	1000 ACRES	6,210	6,210	435	7	6,210	858	14	6,210	1,470	24
FOREST LAND-TREATMENT	1000 ACRES	27,900	27,900	2,830	10	27,900	8,490	28	27,900	14,200	51
SHORELAND EROSION	MILES	1,200	1,200	45.6	4	1,200	125	10	1,200	204	17
STREAMBANK EROSION	MILES	10,900	10,900	585	5	10,900	1,760	16	10,900	2,930	27
	$1000 AVE ANNUAL DAMAGES	1,710	1,710	342	20	1,710	1,026	60	1,710	1,710	100
FLOOD PLAINS-URBAN	1000 ACRES	222	230	78	34	240	139	58	251	199	79
-URBAN	$1000 AVE ANNUAL DAMAGES	46,300	67,100	52,200	78	118,000	103,000	87	190,000	177,000	93
-RURAL	1000 ACRES	2,570	2,560	532	21	2,560	921	36	2,550	1,220	48
-RURAL	$1000 AVE ANNUAL DAMAGES	14,200	18,000	6,580	37	24,200	11,300	47	32,400	18,100	56
WILDLIFE MANAGEMENT	1000 ACRES		2,920	1,170	40	7,990	3,020	38	14,100	4,930	35
	1000 USER DAYS	49,600	15,000	2,250	15	23,900	7,230	30	33,300	12,500	38
AESTHETIC & CULTURAL	1000 ACRES	NA	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	1000 ACRES		30.0	22.2	74	62.0	52.9	84	109	75.3	69
-EXTENSIVE	1000 ACRES	NA	170	151	89	348	319	92	600	453	76

TABLE 1-191 Great Lakes Basin, Capital Costs, Normal Framework (in $1,000,000)

RESOURCE USE CATEGORY	1971-1980 Federal	1971-1980 Non-Fed	1971-1980 Private	1971-1980 Total	1981-2000 Federal	1981-2000 Non-Fed	1981-2000 Private	1981-2000 Total	2001-2020 Federal	2001-2020 Non-Fed	2001-2020 Private	2001-2020 Total	Total
WATER WITHDRAWALS													
MUNICIPALLY SUPPLIED	125.6	293.0	0	418.6	204.0	476.0	0	680.0	274.8	641.1	0	915.9	2,014.5
SELF-SUPPLIED INDUSTRIAL	0	0	57.5	57.5	0	0	232.7	232.7	0	0	391.5	391.5	681.7
RURAL DOMESTIC & LIVESTOCK	0.3	0	2.3	2.6	0.5	0	4.1	4.6	0.4	0	3.4	3.8	11.0
IRRIGATION	0	0	20.1	20.1	0	0	17.4	17.4	0	0	21.3	21.3	58.8
MINING	0	0	6.5	6.5	0	0	13.9	13.9	0	0	25.1	25.1	45.5
THERMAL POWER COOLING	0	14.4	272.7	287.1	0	54.2	1,032.1	1,086.3	0	101.1	1,921.4	2,022.5	3,395.9
NON-WITHDRAWAL WATER USES													
MUNICIPAL WASTEWATER DISCHARGES	1,340.4	446.5	0	1,786.9	1,065.0	354.7	0	1,419.7	1,457.6	485.6	0	1,943.2	5,149.8
INDUSTRIAL WASTEWATER DISCHARGES	---	---	---	---	---	---	---	---	---	---	---	---	---
HYDROELECTRIC POWER	---	---	---	---	---	---	---	---	---	---	---	---	---
WATER ORIENTED OUTDOOR REC.	---	---	---	---	---	---	---	---	---	---	---	---	---
SPORT FISHING	26.7	45.3	0	72.0	19.1	22.1	0	41.2	28.6	33.7	0	62.3	175.5
RECREATIONAL BOATING	95.4	95.4	81.2	272.0	142.8	142.9	122.3	408.0	122.0	121.9	104.5	348.4	1,028.4

COMMERCIAL FISHING	---	---	---	---	---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	0	0	0	0	395.3	0	0	395.3	0	0	0	0	395.3
RELATED LAND USES & PROBLEMS													
AGRIC. LAND-TREATMENT	21.0	0	54.0	75.0	42.1	0	108.3	150.4	25.0	0	64.3	89.3	314.7
-CROPLAND DRAINAGE	34.1	0	79.7	113.8	34.7	0	81.1	115.8	44.5	0	103.8	148.3	377.9
FOREST LAND-TREATMENT	96.8	6.1	18.1	121.0	195.2	12.2	36.6	244.0	193.6	12.1	36.3	242.0	607.0
SHORELAND EROSION	5.7	0	22.1	27.8	9.2	0	36.7	45.9	9.2	0	36.8	46.0	119.7
STREAMBANK EROSION	5.3	0	13.9	19.2	16.3	0	41.4	57.7	26.9	0	69.4	96.3	173.2
FLOOD PLAINS-URBAN	---	---	---	---	---	---	---	---	---	---	---	---	---
-URBAN	410.7	0	136.7	547.4	297.3	0	98.8	396.1	84.8	0	28.4	113.2	1,056.7
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
WILDLIFE MANAGEMENT	12.1	109.1	0	121.2	22.5	202.1	0	224.6	21.2	190.7	0	211.9	557.7
AESTHETIC & CULTURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	252.8	469.6	0	722.4	297.0	551.5	0	848.5	253.9	471.5	0	725.4	2,296.3
-EXTENSIVE	---	---	---	---	---	---	---	---	---	---	---	---	---
TOTAL	2,426.9	1,479.4	764.8	4,671.1	2,741.0	1,315.7	1,825.4	6,382.1	2,542.5	2,057.7	2,806.2	7,406.4	18,459.6

TABLE 1-192 Great Lakes Basin, Operation, Maintenance, and Replacement Costs, Normal Framework (in $1,000,000)

RESOURCE USE CATEGORY	1971-1980				1981-2000				2001-2020				
	Federal	Non-Fed	Private	Total	Federal	Non-Fed	Private	Total	Federal	Non-Fed	Private	Total	Total
WATER WITHDRAWALS													
MUNICIPALLY SUPPLIED	0	192.0	0	192.0	0	1,224.3	0	1,224.3	0	2,713.9	0	2,713.9	4,130.2
SELF-SUPPLIED INDUSTRIAL	0	0	53.5	53.5	0	0	704.7	704.7	0	0	2,015.3	2,015.3	2,773.5
RURAL DOMESTIC & LIVESTOCK	0	0	8.3	8.3	0	0	56.9	56.9	0	0	103.9	103.9	169.1
IRRIGATION	0	0	2.9	2.9	0	0	16.4	16.4	0	0	26.8	26.8	46.1
MINING	0	0	7.7	7.7	0	0	65.7	65.7	0	0	157.0	157.0	230.4
THERMAL POWER COOLING	0	3.7	70.1	73.8	0	42.1	800.6	842.7	0	121.6	2,309.8	2,431.4	3,347.9
NON-WITHDRAWAL WATER USES													
MUNICIPAL WASTEWATER DISCHARGES	0	1,381.0	0	1,381.0	0	3,641.8	0	3,641.8	0	4,760.2	0	4,760.2	9,783.0
INDUSTRIAL WASTEWATER DISCHARGES	---	---	---	---	---	---	---	---	---	---	---	---	---
HYDROELECTRIC POWER	---	---	---	---	---	---	---	---	---	---	---	---	---
WATER ORIENTED OUTDOOR REC.	---	---	---	---	---	---	---	---	---	---	---	---	---
SPORT FISHING	9.4	12.6	0	22.0	21.0	33.2	0	54.2	29.0	42.4	0	71.4	147.6
RECREATIONAL BOATING	0	0	62.9	62.9	0	0	432.0	432.0	0	0	772.5	772.5	1,267.4
COMMERCIAL FISHING	---	---	---	---	---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	0	0	0	0	99.2	0	0	99.2	198.4	0	0	198.4	297.6
RELATED LAND USES & PROBLEMS													
AGRIC. LAND-TREATMENT	0	0	1.9	1.9	0	0	14.9	14.9	0	0	27.1	27.1	43.9
-CROPLAND DRAINAGE	0	0	2.8	2.8	0	0	17.2	17.2	0	0	30.3	30.3	50.3
FOREST LAND-TREATMENT	0.3	0.6	2.3	3.2	2.3	4.7	16.3	23.3	4.5	9.0	31.3	44.8	71.3
SHORELAND EROSION	0.5	0	2.2	2.7	4.0	0	16.3	20.3	7.8	0	31.0	38.8	61.8
STREAMBANK EROSION	0	0	1.8	1.8	0	0	17.8	17.8	0	0	49.8	49.8	69.4
FLOOD PLAINS-URBAN	---	---	---	---	---	---	---	---	---	---	---	---	---
-URBAN	0.1	1.1	0	1.2	0.5	8.9	0	9.4	0.6	11.6	0	12.2	22.8
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
WILDLIFE MANAGEMENT	0	6.0	0	6.0	0	11.2	0	11.2	0	11.2	0	11.2	28.4
AESTHETIC & CULTURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	29.5	117.7	0	147.2	203.3	813.1	0	1,016.4	357.6	1,429.4	0	1,787.0	2,950.6
-EXTENSIVE	---	---	---	---	---	---	---	---	---	---	---	---	---
TOTAL	39.8	1,714.7	216.4	1,970.9	390.3	5,779.3	2,158.8	8,268.4	597.9	9,099.3	5,554.8	15,252.0	25,491.3

TABLE 1–193 Great Lakes Basin, Needs, Outputs, and Percent Needs Met, Proposed Framework

RESOURCE USE CATEGORY	UNIT	1970 SUPPLY	1980 N	1980 O	1980 %	2000 N	2000 O	2000 %	2020 N	2020 O	2020 %
WATER WITHDRAWALS											
MUNICIPALLY SUPPLIED	MILLION GALLONS PER DAY	4,300	870	1,030	over	2,810	2,990	over	5,400	5,550	over
SELF-SUPPLIED INDUSTRIAL	MILLION GALLONS PER DAY	10,600	1,110	695	62	4,670	3,500	75	10,300	8,220	80
RURAL DOMESTIC & LIVESTOCK	MILLION GALLONS PER DAY	471	64.0	58.7	92	179	162	91	267	245	92
IRRIGATION	MILLION GALLONS PER DAY	661	824	684	83	1,570	1,320	84	2,460	2,090	85
MINING	MILLION GALLONS PER DAY	780	148	124	84	450	350	78	965	724	75
THERMAL POWER COOLING		17,200	8,210	8,210	100	38,700	38,700	100	96,500	96,500	100
NON-WITHDRAWAL WATER USES											
MUNICIPAL WASTEWATER DISCHARGES	MILLION GALLONS PER DAY	3,060	3,680	3,680	100	4,940	4,940	100	6,720	6,720	100
INDUSTRIAL WASTEWATER DISCHARGES	MILLION GALLONS PER DAY	8,580	7,330	7,330	100	6,000	6,000	100	9,210	9,210	100
HYDROELECTRIC POWER	MILLION GALLONS PER DAY	NA	47,300	47,300	100	51,300	51,300	100	105,000	105,000	100
WATER ORIENTED OUTDOOR REC.	1000 RECREATION DAYS	100,000	105,000	57,300	55	201,000	132,000	66	324,000	190,000	58
	1000 ACRES WATER SURFACE	NA	---	---	---	---	---	---	---	---	---
SPORT FISHING	1000 ANGLER DAYS	80,700	24,800	20,300	82	52,300	46,700	89	79,200	72,800	92
	1000 ACRES WATER SURFACE		---	---	---	---	---	---	---	---	---
RECREATIONAL BOATING	1000 BOAT DAYS	29,000	6,820	2,470	36	12,500	6,330	51	19,500	10,800	55
	1000 ACRES WATER SURFACE	7,260	7,260	---	---	7,260	---	---	7,260	---	---
COMMERCIAL FISHING	MILLION TONS PER YEAR		---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	MILLION TONS PER YEAR	343	432	432	100	583	583	100	754	754	100
RELATED LAND USES & PROBLEMS											
AGRIC. LAND-TREATMENT	1000 ACRES	20,450	20,450	4,000	20	20,450	11,400	56	20,450	15,500	76
-CROPLAND DRAINAGE	1000 ACRES	6,210	6,210	695	11	6,210	1,810	29	6,210	2,610	42
FOREST LAND-TREATMENT	1000 ACRES	27,900	27,900	4,370	16	27,900	13,100	47	27,900	21,800	78
SHORELAND EROSION	MILES	1,200	1,200	45.6	4	1,200	125	10	1,200	204	17
STREAMBANK EROSION	MILES	10,900	10,900	585	5	10,900	1,760	16	10,900	2,930	27
	$1000 AVE ANNUAL DAMAGES	1,710	1,710	342	20	1,710	1,026	60	1,710	1,710	100
FLOOD PLAINS-URBAN	1000 ACRES	222	230	78	34	240	139	58	251	199	79
-URBAN	$1000 AVE ANNUAL DAMAGES	46,300	67,100	52,200	78	118,000	103,000	87	190,000	177,000	93
-RURAL	1000 ACRES	2,570	2,560	532	21	2,560	921	36	2,550	1,220	48
-RURAL	$1000 AVE ANNUAL DAMAGES	14,200	18,000	6,580	37	24,200	11,300	47	32,400	18,100	56
WILDLIFE MANAGEMENT	1000 ACRES		2,920	1,170	40	7,990	3,020	38	14,100	4,930	35
	1000 USER DAYS	49,600	15,000	2,250	15	23,900	7,230	30	33,300	12,500	38
AESTHETIC & CULTURAL	1000 ACRES	NA	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	1000 ACRES		30.0	22.2	74	62.0	52.9	84	109	75.3	69
-EXTENSIVE	1000 ACRES	NA	170	151	89	348	319	92	600	453	76

TABLE 1–194 Great Lakes Basin, Capital Costs, Proposed Framework (in $1,000,000)

RESOURCE USE CATEGORY	1971-1980 Federal	1971-1980 Non-Fed	1971-1980 Private	1971-1980 Total	1981-2000 Federal	1981-2000 Non-Fed	1981-2000 Private	1981-2000 Total	2001-2020 Federal	2001-2020 Non-Fed	2001-2020 Private	2001-2020 Total	Total
WATER WITHDRAWALS													
MUNICIPALLY SUPPLIED	125.6	293.0	0	418.6	204.0	476.0	0	680.0	274.8	641.1	0	915.9	2,014.5
SELF-SUPPLIED INDUSTRIAL	0	0	57.5	57.5	0	0	232.7	232.7	0	0	391.5	391.5	681.7
RURAL DOMESTIC & LIVESTOCK	0.3	0	2.3	2.6	0.5	0	4.1	4.6	0.4	0	3.4	3.8	11.0
IRRIGATION	0	0	20.1	20.1	0	0	17.0	17.0	0	0	21.4	21.4	58.5
MINING	0	0	6.2	6.2	0	0	11.6	11.6	0	0	20.7	20.7	38.5
THERMAL POWER COOLING	0	14.4	272.7	287.1	0	54.2	1,032.1	1,086.3	0	101.1	1,921.4	2,022.5	3,395.9
NON-WITHDRAWAL WATER USES													
MUNICIPAL WASTEWATER DISCHARGES	3,588.0	1,196.0	0	4,784.0	2,186.2	728.8	0	2,915.0	1,970.2	656.8	0	2,627.0	10,326.0
INDUSTRIAL WASTEWATER DISCHARGES	---	---	---	---	---	---	---	---	---	---	---	---	---
HYDROELECTRIC POWER	---	---	---	---	---	---	---	---	---	---	---	---	---
WATER ORIENTED OUTDOOR REC.	---	---	---	---	---	---	---	---	---	---	---	---	---
SPORT FISHING	26.7	45.3	0	72.0	19.1	22.1	0	41.2	28.6	33.7	0	62.3	175.5
RECREATIONAL BOATING	95.4	95.4	81.2	272.0	142.8	142.9	122.3	408.0	122.0	121.9	104.5	348.4	1,028.4

RESOURCE USE CATEGORY	1971-1980 Federal	Non-Fed	Private	Total	1981-2000 Federal	Non-Fed	Private	Total	2001-2020 Federal	Non-Fed	Private	Total	Total
COMMERCIAL FISHING	---	---	---	---	---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	295.6	0	0	295.6	1,386.6	0	0	1,386.6	0	0	0	0	1,682.2
RELATED LAND USES & PROBLEMS													
AGRIC. LAND-TREATMENT	40.9	0	105.3	146.2	76.9	0	197.6	274.5	46.7	0	120.0	166.7	587.4
-CROPLAND DRAINAGE	36.2	0	84.4	120.6	60.8	0	141.9	202.7	39.0	0	91.0	130.0	453.3
FOREST LAND-TREATMENT	150.4	9.4	28.2	188.0	301.6	18.9	56.5	377.0	300.0	18.8	56.2	375.0	940.0
SHORELAND EROSION	5.7	0	22.1	27.8	9.2	0	36.7	45.9	9.2	0	36.8	46.0	119.7
STREAMBANK EROSION	5.3	0	13.9	19.2	16.3	0	41.4	57.7	26.9	0	69.4	96.3	173.2
FLOOD PLAINS-URBAN	---	---	---	---	---	---	---	---	---	---	---	---	---
-URBAN	410.7	0	136.7	547.4	297.3	0	98.8	396.1	84.8	0	28.4	113.2	1,056.7
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
WILDLIFE MANAGEMENT	12.1	109.1	0	121.2	22.5	202.1	0	224.6	21.2	190.7	0	211.9	557.7
AESTHETIC & CULTURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	252.8	469.6	0	722.4	297.0	551.5	0	848.5	253.9	471.5	0	725.4	2,296.3
-EXTENSIVE	---	---	---	---	---	---	---	---	---	---	---	---	---
TOTAL	5,045.7	2,232.2	830.6	8,108.5	5,020.8	2,196.5	1,992.7	9,210.0	3,177.7	2,235.6	2,864.7	8,278.0	25,596.5

TABLE 1-195 Great Lakes Basin, Operation, Maintenance, and Replacement Costs, Proposed Framework (in $1,000,000)

RESOURCE USE CATEGORY	1971-1980				1981-2000				2001-2020				
	Federal	Non-Fed	Private	Total	Federal	Non-Fed	Private	Total	Federal	Non-Fed	Private	Total	Total
WATER WITHDRAWALS													
MUNICIPALLY SUPPLIED	0	192.0	0	192.0	0	1,224.3	0	1,224.3	0	2,713.9	0	2,713.9	4,130.2
SELF-SUPPLIED INDUSTRIAL	0	0	53.5	53.5	0	0	704.7	704.7	0	0	2,015.3	2,015.3	2,773.5
RURAL DOMESTIC & LIVESTOCK	0	0	8.3	8.3	0	0	56.9	56.9	0	0	103.9	103.9	169.1
IRRIGATION	0	0	2.9	2.9	0	0	16.3	16.3	0	0	26.6	26.6	45.8
MINING	0	0	7.8	7.8	0	0	61.4	61.4	0	0	139.2	139.2	206.4
THERMAL POWER COOLING	0	3.7	70.1	73.8	0	42.1	800.6	842.7	0	121.6	2,309.8	2,431.4	3,347.9
NON-WITHDRAWAL WATER USES													
MUNICIPAL WASTEWATER DISCHARGES	0	4,108.7	0	4,108.7	0	9,955.0	0	9,955.0	0	16,223.9	0	16,223.9	30,287.6
INDUSTRIAL WASTEWATER DISCHARGES	---	---	---	---	---	---	---	---	---	---	---	---	---
HYDROELECTRIC POWER	---	---	---	---	---	---	---	---	---	---	---	---	---
WATER ORIENTED OUTDOOR REC.	---	---	---	---	---	---	---	---	---	---	---	---	---
SPORT FISHING	9.4	12.6	0	22.0	21.0	33.2	0	54.2	29.0	42.4	0	71.4	147.6
RECREATIONAL BOATING	0	0	62.9	62.9	0	0	432.0	432.0	0	0	772.5	772.5	1,267.4
COMMERCIAL FISHING	---	---	---	---	---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	36.0	0	0	36.0	438.2	0	0	438.2	732.4	0	0	732.4	1,206.6
RELATED LAND USES & PROBLEMS													
AGRIC. LAND-TREATMENT	0	0	3.4	3.4	0	0	31.9	31.9	0	0	50.7	50.7	86.0
-CROPLAND DRAINAGE	0	0	3.1	3.1	0	0	25.2	25.2	0	0	38.7	38.7	67.0
FOREST LAND-TREATMENT	0.5	1.0	3.3	4.8	4.3	8.6	30.1	43.0	7.0	14.1	49.3	70.4	118.2
SHORELAND EROSION	0.5	0	2.2	2.7	4.0	0	16.3	20.3	7.8	0	31.0	38.8	61.8
STREAMBANK EROSION	0	0	1.8	1.8	0	0	17.8	17.8	0	0	49.8	49.8	69.4
FLOOD PLAINS-URBAN	---	---	---	---	---	---	---	---	---	---	---	---	---
-URBAN	0.1	1.1	0	1.2	0.5	8.9	0	9.4	0.6	11.6	0	12.2	22.8
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
WILDLIFE MANAGEMENT	0	6.0	0	6.0	0	11.2	0	11.2	0	11.2	0	11.2	28.4
AESTHETIC & CULTURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	29.5	117.7	0	147.2	203.3	813.1	0	1,016.4	357.6	1,429.4	0	1,787.0	2,950.6
-EXTENSIVE	---	---	---	---	---	---	---	---	---	---	---	---	---
TOTAL	76.0	4,442.8	219.3	4,738.1	671.3	12,096.4	2,193.2	14,960.9	1,134.4	20,568.1	4,486.8	27,289.3	46,988.3

TABLE 1-196 Great Lakes Basin, Comparison of PRO and NOR Land Treatment Programs (thousands of acres)

RESOURCE USE CATEGORY	Opportunity	NOR				PRO				Difference PRO Minus NOR			
		By 1980	1981-2000	2001-2020	TOTAL	By 1980	1981-2000	2001-2020	TOTAL	By 1980	1981-2000	2001-2020	TOTAL
AGRICULTURAL LAND TREATMENT	20,450.0	1,800.0	3,610.0	2,160.0	7,570.0	4,000.0	7,400.0	4,100.0	15,500.0	2,200.0	3,790.0	1,940.0	7,930.0
CROPLAND DRAINAGE	6,210.0	435.0	423.0	612.0	1,470.0	695.0	1,115.0	800.0	2,610.0	260.0	692.0	188.0	1,140.0
FORESTED LAND	27,900.0	2,830.0	5,660.0	5,610.0	14,200.0	4,370.0	8,730.0	8,700.0	21,800.0	1,540.0	3,070.0	3,090.0	7,600.0

TABLE 1-197 Great Lakes Basin, Comparison of Total Costs, NOR and PRO Frameworks (in $1,000,000)

RESOURCE USE CATEGORY	1971-1980						1971-2020					
	NORMAL			PROPOSED			NORMAL			PROPOSED		
	Capital	OM&R	TOTAL	Capital	OM&R	TOTAL	Capital	OM&R	TOTAL	Capital	OM&R	TOTAL
WATER WITHDRAWALS												
MUNICIPALLY SUPPLIED	418.6	192.0	610.6	418.6	192.0	610.6	2,014.5	4,130.2	6,144.7	2,014.5	4,130.2	6,144.7
SELF-SUPPLIED INDUSTRIAL	57.5	53.5	111.0	57.5	53.5	111.0	681.7	2,773.5	3,455.2	681.7	2,773.5	3,455.2
RURAL DOMESTIC & LIVESTOCK	2.6	8.3	10.9	2.6	8.3	10.9	11.0	169.1	180.1	11.0	169.1	180.1
IRRIGATION	20.1	2.9	23.0	20.1	2.9	23.0	58.8	46.1	104.9	58.5	45.8	104.3
MINING	6.5	7.7	14.2	6.2	7.8	14.0	45.5	230.4	275.9	38.5	208.4	246.9
THERMAL POWER COOLING	287.1	73.8	360.9	287.1	73.8	360.9	3,395.9	3,347.9	6,743.8	3,395.9	3,347.9	6,743.8
NON-WITHDRAWAL WATER USES												
MUNICIPAL WASTEWATER DISCHARGES	1,786.9	1,381.0	3,167.9	4,784.0	4,108.7	8,892.7	5,149.8	9,783.0	14,932.8	10.326.0	30,287.6	40,613.6
INDUSTRIAL WASTEWATER DISCHARGES	---	---	---	---	---	---	---	---	---	---	---	---
HYDROELECTRIC POWER	---	---	---	---	---	---	---	---	---	---	---	---
WATER ORIENTED OUTDOOR REC.	---	---	---	---	---	---	---	---	---	---	---	---
SPORT FISHING	72.0	22.0	94.0	72.0	22.0	94.0	175.5	147.6	323.1	175.5	147.6	323.1
RECREATIONAL BOATING	272.0	62.9	334.9	272.0	62.9	334.9	1,028.4	1,267.4	2,295.8	1,028.4	1,267.4	2,295.8
COMMERCIAL FISHING	---	---	---	---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	0	0	0	295.6	36.0	331.6	395.3	297.6	692.9	1,682.2	1,206.6	2,888.8
RELATED LAND USES & PROBLEMS												
AGRIC. LAND-TREATMENT	75.0	1.9	76.9	146.2	3.4	149.6	314.7	43.9	358.6	587.4	86.0	673.4
-CROPLAND DRAINAGE	113.8	2.8	116.6	120.6	3.1	123.7	377.9	50.3	428.2	453.3	67.0	520.3
FOREST LAND-TREATMENT	121.0	3.2	124.2	188.0	4.8	192.8	607.0	71.3	678.3	940.0	118.2	1,058.2
SHORELAND EROSION	27.8	2.7	30.5	27.8	2.7	30.5	119.7	61.8	181.5	119.7	61.8	181.5
STREAMBANK EROSION	19.2	1.8	21.0	19.2	1.8	21.0	173.2	69.4	242.6	173.2	69.4	242.6
FLOOD PLAINS-URBAN	---	---	---	---	---	---	---	---	---	---	---	---
-URBAN	547.4	1.2	548.6	547.4	1.2	548.6	1,056.7	22.8	1,079.5	1,056.7	22.8	1,079.5
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---
WILDLIFE MANAGEMENT	121.2	6.0	127.2	121.2	6.0	127.2	557.7	28.4	586.1	557.7	28.4	586.1
AESTHETIC & CULTURAL	---	---	---	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	722.4	147.2	869.6	722.4	147.2	869.6	2,296.3	2,950.6	5,246.9	2,296.3	2,950.6	5,246.9
-EXTENSIVE	---	---	---	---	---	---	---	---	---	---	---	---
TOTAL	4,671.1	1,970.9	6,642.0	8,108.5	4,738.1	12,846.6	18,459.6	25,491.3	43.950.9	25,596.5	46,988.3	72,584.8

TABLE 1–198 Lake Superior, Needs, Outputs, and Percent Needs Met, Normal Framework

RESOURCE USE CATEGORY	UNIT	1970 SUPPLY	1980 N	1980 O	1980 %	2000 N	2000 O	2000 %	2020 N	2020 O	2020 %
WATER WITHDRAWALS											
MUNICIPALLY SUPPLIED	MILLION GALLONS PER DAY	48.5	3.3	3.3	100	13.2	13.2	100	25.3	25.3	100
SELF-SUPPLIED INDUSTRIAL	MILLION GALLONS PER DAY	125.5	2.1	2.1	100	14.9	14.9	100	72.8	72.8	100
RURAL DOMESTIC & LIVESTOCK	MILLION GALLONS PER DAY	12.5	0.3	0.3	100	3.0	3.0	100	4.6	4.6	100
IRRIGATION	MILLION GALLONS PER DAY	10.7	8.0	8.0	100	17.2	17.2	100	27.4	27.4	100
MINING	MILLION GALLONS PER DAY	576.5	38.9	38.9	100	97.3	97.3	100	190	190	100
THERMAL POWER COOLING	MILLION GALLONS PER DAY	516	0	0	---	1,100	1,100	100	2,910	2,910	100
NON-WITHDRAWAL WATER USES											
MUNICIPAL WASTEWATER DISCHARGES	MILLION GALLONS PER DAY	44.7	48.1	48.1	100	55.9	55.9	100	67.3	67.3	100
INDUSTRIAL WASTEWATER DISCHARGES	MILLION GALLONS PER DAY	55.2	44.4	44.4	100	39.7	39.7	100	61.0	61.0	100
HYDROELECTRIC POWER	MILLION GALLONS PER DAY	NA	0.0	---	---	0.0	---	---	0.0	---	---
WATER ORIENTED OUTDOOR REC.	1000 RECREATION DAYS	8,820	+	3,840	over	+	10,400	over	+	15,700	over
	1000 ACRES WATER SURFACE	NA	---	---	---	---	---	---	---	---	---
SPORT FISHING	1000 ANGLER DAYS	7,090	987	677	68	2,170	1,700	78	3,800	3.220	85
	1000 ACRES WATER SURFACE	NA	---	---	---	---	---	---	---	---	---
RECREATIONAL BOATING	1000 BOAT DAYS	2,270	284	271	95	403	501	over	580	755	over
	1000 ACRES WATER SURFACE	1,800	1,800	---	---	1,800	---	---	1,800	---	---
COMMERCIAL FISHING	MILLION TONS PER YEAR	NA	---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	MILLION TONS PER YEAR		99.5	99.5	100	136	136	100	179	179	100
RELATED LAND USES & PROBLEMS											
AGRIC. LAND-TREATMENT	1000 ACRES	473	473	39.0	8	473	117	25	473	163	34
-CROPLAND DRAINAGE	1000 ACRES	117	117	11.1	9	117	15.9	14	117	15.9	14
FOREST LAND-TREATMENT	1000 ACRES	10,000	10,000	1,090	11	10,000	3,270	33	10,000	5,550	56
SHORELAND EROSION	MILES	156	156	5.7	4	156	17.2	11	156	28.7	18
STREAMBANK EROSION	MILES	1,430	1,430	94.2	6	1,430	283	20	1,430	471	33
	$1000 AVE ANNUAL DAMAGES	254	254	51.3	20	254	152	60	254	254	100
FLOOD PLAINS-URBAN	1000 ACRES	5.8	5.8	1.6	28	5.8	2.7	46	5.8	4.7	81
-URBAN	$1000 AVE ANNUAL DAMAGES	706	871	312	36	1,360	829	61	2,200	1,680	76
-RURAL	1000 ACRES	187	187	60.7	32	187	68.3	36	187	75.2	40
-RURAL	$1000 AVE ANNUAL DAMAGES	272	346	60.0	17	511	116	23	638	158	25
WILDLIFE MANAGEMENT	1000 ACRES	---	0.0	731	over	60.0	722	over	200	1,300	over
	1000 USER DAYS	3020.0	82.0	93.2	over	68.4	195	over	120	364	over
AESTHETIC & CULTURAL	1000 ACRES	NA	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	1000 ACRES	---	0.1	2.5	over	0.5	6.6	over	1.0	10.0	over
-EXTENSIVE	1000 ACRES	NA	0.0	34.2	over	0.0	58.0	over	1.1	69.4	over

TABLE 1–199 Lake Superior, Capital Costs, Normal Framework (in $1,000,000)

RESOURCE USE CATEGORY	1971-1980 Federal	1971-1980 Non-Fed	1971-1980 Private	1971-1980 Total	1981-2000 Federal	1981-2000 Non-Fed	1981-2000 Private	1981-2000 Total	2001-2020 Federal	2001-2020 Non-Fed	2001-2020 Private	2001-2020 Total	Total
WATER WITHDRAWALS													
MUNICIPALLY SUPPLIED	0.3	0.6	0	0.9	0.8	1.9	0	2.7	1.0	2.3	0	3.3	6.9
SELF-SUPPLIED INDUSTRIAL	0	0	0.2	0.2	0	0	1.1	1.1	0	0	4.8	4.8	6.1
RURAL DOMESTIC & LIVESTOCK	0	0	0	0	0.0	0	0.2	0.2	0.0	0	0.1	0.1	0.3
IRRIGATION	0	0	0.3	0.3	0	0	0.3	0.3	0	0	0.3	0.3	0.9
MINING	0	0	2.6	2.6	0	0	4.0	4.0	0	0	6.1	6.1	12.7
THERMAL POWER COOLING	0	0	0	0	0	1.9	36.4	38.3	0	3.2	60.2	63.4	101.7
NON-WITHDRAWAL WATER USES													
MUNICIPAL WASTEWATER DISCHARGES	14.9	4.9	0	19.8	9.6	3.2	0	12.8	12.3	4.1	0	16.4	49.0
INDUSTRIAL WASTEWATER DISCHARGES	---	---	---	---	---	---	---	---	---	---	---	---	---
HYDROELECTRIC POWER	---	---	---	---	---	---	---	---	---	---	---	---	---
WATER ORIENTED OUTDOOR REC.	---	---	---	---	---	---	---	---	---	---	---	---	---
SPORT FISHING	2.3	3.4	0	5.7	0.7	1.8	0	2.5	1.2	2.4	0	3.6	11.8
RECREATIONAL BOATING	9.8	9.8	8.4	28.0	7.8	7.8	6.6	22.2	6.5	6.5	5.5	18.5	68.7

COMMERCIAL FISHING	---	---	---	---	---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	0	0	0	0	17.8	0	0	17.8	0	0	0	0	17.8
RELATED LAND USES & PROBLEMS													
AGRIC. LAND-TREATMENT	0.4	0	1.2	1.6	0.9	0	2.2	3.1	0.5	0	1.3	1.8	6.5
-CROPLAND DRAINAGE	0.7	0	1.7	2.4	0.3	0	0.7	1.0	0	0	0	0	3.4
FOREST LAND-TREATMENT	29.6	1.9	5.5	37.0	60.8	3.8	11.4	76.0	60.8	3.8	11.4	76.0	189.0
SHORELAND EROSION	.8	0	3.0	3.8	1.5	0	6.0	7.5	1.5	0	6.1	7.6	18.9
STREAMBANK EROSION	0.9	0	2.2	3.1	2.6	0	6.7	9.3	4.3	0	11.2	15.5	27.9
FLOOD PLAINS-URBAN	---	---	---	---	---	---	---	---	---	---	---	---	---
-URBAN	3.6	0	1.2	4.8	2.2	0	0.7	2.9	0.9	0	0.5	1.4	9.1
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
WILDLIFE MANAGEMENT	0.8	7.5	0	8.3	1.8	16.5	0	18.3	2.3	20.5	0	22.8	49.4
AESTHETIC & CULTURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	18.6	34.5	0	53.1	8.3	15.5	0	23.8	6.0	11.2	0	17.2	94.1
-EXTENSIVE	---	---	---	---	---	---	---	---	---	---	---	---	---
TOTAL	82.6	62.7	26.3	171.6	115.3	52.2	76.3	243.8	97.3	54.0	107.5	258.8	674.2

TABLE 1-200 Lake Superior, Operation, Maintenance, and Replacement Costs, Normal Framework (in $1,000,000)

	1971-1980				1981-2000				2001-2020				
RESOURCE USE CATEGORY	Federal	Non-Fed	Private	Total	Federal	Non-Fed	Private	Total	Federal	Non-Fed	Private	Total	Total
WATER WITHDRAWALS													
MUNICIPALLY SUPPLIED	0	0.5	0	0.5	0	5.4	0	5.4	0	12.6	0	12.6	18.5
SELF-SUPPLIED INDUSTRIAL	0	0	0.2	0.2	0	0	4.0	4.0	0	0	13.3	13.3	17.5
RURAL DOMESTIC & LIVESTOCK	0	0	0.1	0.1	0	0	1.5	1.5	0	0	3.6	3.6	5.2
IRRIGATION	0	0	0.0	0.0	0	0	0.3	0.3	0	0	0.4	0.4	0.7
MINING	0	0	2.3	2.3	0	0	15.0	15.0	0	0	29.8	29.8	47.1
THERMAL POWER COOLING	0	0	0	0	0	1.0	18.7	19.7	0	3.6	68.5	72.1	91.8
NON-WITHDRAWAL WATER USES													
MUNICIPAL WASTEWATER DISCHARGES	0	25.0	0	25.0	0	107.8	0	107.8	0	128.2	0	128.2	261.0
INDUSTRIAL WASTEWATER DISCHARGES	---	---	---	---	---	---	---	---	---	---	---	---	---
HYDROELECTRIC POWER	---	---	---	---	---	---	---	---	---	---	---	---	---
WATER ORIENTED OUTDOOR REC.	---	---	---	---	---	---	---	---	---	---	---	---	---
SPORT FISHING	1.0	1.4	0	2.4	1.4	4.3	0	5.7	2.4	4.6	0	7.0	15.1
RECREATIONAL BOATING	0	0	7.3	7.3	0	0	45.7	45.7	0	0	76.2	76.2	129.2
COMMERCIAL FISHING	---	---	---	---	---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	0	0	0	0	4.0	0	0	4.0	8.0	0	0	8.0	12.0
RELATED LAND USES & PROBLEMS													
AGRIC. LAND-TREATMENT	0	0	0.0	0.0	0	0	0.3	0.3	0	0	0.6	0.6	0.9
-CROPLAND DRAINAGE	0	0	0.1	0.1	0	0	0.3	0.3	0	0	0.3	0.3	0.7
FOREST LAND-TREATMENT	0.1	0.2	0.6	0.9	0.7	1.5	5.2	7.4	1.5	3.0	10.6	15.1	23.4
SHORELAND EROSION	0.0	0	0.4	0.4	.6	0	2.4	3.0	1.2	0	4.9	6.1	9.5
STREAMBANK EROSION	0.0	0	0.3	0.3	0	0	3.0	3.0	0	0	7.9	7.9	11.2
FLOOD PLAINS-URBAN	---	---	---	---	---	---	---	---	---	---	---	---	---
-URBAN	0.0	0.0	0	0.0	0.0	0.6	0	0.6	0.0	0.7	0	0.7	1.3
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
WILDLIFE MANAGEMENT	0	0.4	0	0.4	0	0.9	0	0.9	0	1.2	0	1.2	2.5
AESTHETIC & CULTURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	1.6	6.1	0	7.7	11.1	44.5	0	55.6	20.1	80.1	0	100.2	163.5
-EXTENSIVE	---	---	---	---	---	---	---	---	---	---	---	---	---
TOTAL	2.7	33.6	11.3	47.6	17.8	166.0	96.4	280.2	33.2	234.0	216.1	483.3	811.1

TABLE 1–201 Lake Superior, Needs, Outputs, and Percent Needs Met, Proposed Framework

RESOURCE USE CATEGORY	UNIT	1970 SUPPLY	1980 N	1980 O	1980 %	2000 N	2000 O	2000 %	2020 N	2020 O	2020 %
WATER WITHDRAWALS											
MUNICIPALLY SUPPLIED	MILLION GALLONS PER DAY	48.5	3.3	3.3	100	13.2	13.2	100	25.3	25.3	100
SELF-SUPPLIED INDUSTRIAL	MILLION GALLONS PER DAY	125.5	2.1	2.1	100	14.9	14.9	100	72.8	72.8	100
RURAL DOMESTIC & LIVESTOCK	MILLION GALLONS PER DAY	12.5	0.3	0.3	100	3.0	3.0	100	4.6	4.6	100
IRRIGATION	MILLION GALLONS PER DAY	10.7	8.0	8.0	100	17.2	17.2	100	27.4	27.4	100
MINING	MILLION GALLONS PER DAY	576.5	38.9	38.9	100	97.3	97.3	100	190	190	100
THERMAL POWER COOLING	MILLION GALLONS PER DAY	516	0	0	---	1,100	1,100	100	2,910	2,910	100
NON-WITHDRAWAL WATER USES											
MUNICIPAL WASTEWATER DISCHARGES	MILLION GALLONS PER DAY	44.7	48.1	48.1	100	55.9	55.9	100	67.3	67.3	100
INDUSTRIAL WASTEWATER DISCHARGES	MILLION GALLONS PER DAY	55.2	44.4	44.4	100	39.7	39.7	100	61.0	61.0	100
HYDROELECTRIC POWER	MILLION GALLONS PER DAY	NA	0.0	---	---	0.0	---	---	0.0	---	---
WATER ORIENTED OUTDOOR REC.	1000 RECREATION DAYS	8,820	+	3,840	over	+	10,400	over	+	15,700	over
	1000 ACRES WATER SURFACE	NA	---	---	---	---	---	---	---	---	---
SPORT FISHING	1000 ANGLER DAYS	7,090	987	677	68	2,170	1,700	78	3,800	3.220	85
	1000 ACRES WATER SURFACE	NA	---	---	---	---	---	---	---	---	---
RECREATIONAL BOATING	1000 BOAT DAYS	2,270	284	271	95	403	501	over	580	755	over
	1000 ACRES WATER SURFACE	1,800	1,800	---	---	1,800	---	---	1,800	---	---
COMMERCIAL FISHING	MILLION TONS PER YEAR	NA	---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	MILLION TONS PER YEAR		99.5	99.5	100	136	136	100	179	179	100
RELATED LAND USES & PROBLEMS											
AGRIC. LAND-TREATMENT	1000 ACRES	473	473	*89.2*	*19*	473	*255*	*54*	473	*35.6*	*75*
-CROPLAND DRAINAGE	1000 ACRES	117	117	*0.0*	*0*	117	*0.0*	*0*	117	*0.0*	*0*
FOREST LAND-TREATMENT	1000 ACRES	10,000	10,000	*2,090*	*20*	10,000	*6,020*	*60*	10,000	*10,000*	*100*
SHORELAND EROSION	MILES	156	156	5.7	4	156	17.2	11	156	28.7	18
STREAMBANK EROSION	MILES	1,430	1,430	94.2	6	1,430	283	20	1,430	471	33
	$1000 AVE ANNUAL DAMAGES	254	254	51.3	20	254	152	60	254	254	100
FLOOD PLAINS-URBAN	1000 ACRES	5.8	5.8	1.6	28	5.8	2.7	46	5.8	4.7	81
-URBAN	$1000 AVE ANNUAL DAMAGES	706	871	312	36	1,360	829	61	2,200	1,680	76
-RURAL	1000 ACRES	187	187	60.7	32	187	68.3	36	187	75.2	40
-RURAL	$1000 AVE ANNUAL DAMAGES	272	346	60.0	17	511	116	23	638	158	25
WILDLIFE MANAGEMENT	1000 ACRES	---	0.0	731	over	60.0	722	over	200	1,300	over
	1000 USER DAYS	3020.0	82.0	93.2	over	68.4	195	over	120	364	over
AESTHETIC & CULTURAL	1000 ACRES	NA	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	1000 ACRES	---	0.1	2.5	over	0.5	6.6	over	1.0	10.0	over
-EXTENSIVE	1000 ACRES	NA	0.0	34.2	over	0.0	58.0	over	1.1	69.4	over

TABLE 1–202 Lake Superior, Capital Costs, Proposed Framework (in $1,000,000)

RESOURCE USE CATEGORY	1971-1980 Federal	1971-1980 Non-Fed	1971-1980 Private	1971-1980 Total	1981-2000 Federal	1981-2000 Non-Fed	1981-2000 Private	1981-2000 Total	2001-2020 Federal	2001-2020 Non-Fed	2001-2020 Private	2001-2020 Total	Total
WATER WITHDRAWALS													
MUNICIPALLY SUPPLIED	0.3	0.6	0	0.9	0.8	1.9	0	2.7	1.0	2.3	0	3.3	6.9
SELF-SUPPLIED INDUSTRIAL	0	0	0.2	0.2	0	0	1.1	1.1	0	0	4.8	4.8	6.1
RURAL DOMESTIC & LIVESTOCK	0	0	0	0	0.0	0	0.2	0.2	0.0	0	0.1	0.1	0.3
IRRIGATION	0	0	0.3	0.3	0	0	0.3	0.3	0	0	0.3	0.3	0.9
MINING	0	0	2.6	2.6	0	0	4.0	4.0	0	0	6.1	6.1	12.7
THERMAL POWER COOLING	0	0	0	0	0	1.9	36.4	38.3	0	3.2	60.2	63.4	101.7
NON-WITHDRAWAL WATER USES													
MUNICIPAL WASTEWATER DISCHARGES	*29.2*	*9.8*	*0*	*39.0*	*18.8*	*6.2*	*0*	*25.0*	*17.2*	*5.8*	*0*	*23.0*	*89.0*
INDUSTRIAL WASTEWATER DISCHARGES	---	---	---	---	---	---	---	---	---	---	---	---	---
HYDROELECTRIC POWER	---	---	---	---	---	---	---	---	---	---	---	---	---
WATER ORIENTED OUTDOOR REC.	---	---	---	---	---	---	---	---	---	---	---	---	---
SPORT FISHING	2.3	3.4	0	5.7	0.7	1.8	0	2.5	1.2	2.4	0	3.6	11.8
RECREATIONAL BOATING	9.8	9.8	8.4	28.0	7.8	7.8	6.6	22.2	6.5	6.5	5.5	18.5	68.7

COMMERCIAL FISHING	---	---	---	---	---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	48.0	0	0	48.0	18.0	0	0	18.0	0	0	0	0	66.0
RELATED LAND USES & PROBLEMS													
AGRIC. LAND-TREATMENT	0.3	0	0.9	1.2	0.8	0	1.9	2.7	0.4	0	1.0	1.4	5.3
-CROPLAND DRAINAGE	0	0	0	0	0	0	0	0	0	0	0	0	0
FOREST LAND-TREATMENT	56.8	3.6	10.0	71.0	114.4	7.2	21.4	143.0	114.4	7.2	21.4	143.0	357.0
SHORELAND EROSION	.8	0	3.0	3.8	1.5	0	6.0	7.5	1.5	0	6.1	7.6	18.9
STREAMBANK EROSION	0.9	0	2.2	3.1	2.6	0	6.7	9.3	4.3	0	11.2	15.5	27.9
FLOOD PLAINS-URBAN	---	---	---	---	---	---	---	---	---	---	---	---	---
-URBAN	3.6	0	1.2	4.8	2.2	0	0.7	2.9	0.9	0	0.5	1.4	9.1
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
WILDLIFE MANAGEMENT	0.8	7.5	0	8.3	1.8	16.5	0	18.3	2.3	20.5	0	22.8	49.4
AESTHETIC & CULTURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	18.6	34.5	0	53.1	8.3	15.5	0	23.8	6.0	11.2	0	17.2	94.1
-EXTENSIVE	---	---	---	---	---	---	---	---	---	---	---	---	---
TOTAL	171.4	69.2	29.4	270.0	177.9	58.6	85.3	321.8	155.8	59.0	117.2	332.0	923.8

TABLE 1–203 Lake Superior, Operation, Maintenance, and Replacement Costs, Proposed Framework (in $1,000,000)

	1971-1980				1981-2000				2001-2020				
RESOURCE USE CATEGORY	Federal	Non-Fed	Private	Total	Federal	Non-Fed	Private	Total	Federal	Non-Fed	Private	Total	Total
WATER WITHDRAWALS													
MUNICIPALLY SUPPLIED	0	0.5	0	0.5	0	5.4	0	5.4	0	12.6	0	12.6	18.5
SELF-SUPPLIED INDUSTRIAL	0	0	0.2	0.2	0	0	4.0	4.0	0	0	13.3	13.3	17.5
RURAL DOMESTIC & LIVESTOCK	0	0	0.1	0.1	0	0	1.5	1.5	0	0	3.6	3.6	5.2
IRRIGATION	0	0	0.0	0.0	0	0	0.3	0.3	0	0	0.4	0.4	0.7
MINING	0	0	2.3	2.3	0	0	15.0	15.0	0	0	29.8	29.8	47.1
THERMAL POWER COOLING	0	0	0	0	0	1.0	18.7	19.7	0	3.6	68.5	72.1	91.8
NON-WITHDRAWAL WATER USES													
MUNICIPAL WASTEWATER DISCHARGES	0	108.6	0	108.6	0	221.1	0	221.1	0	271.8	0	271.8	601.5
INDUSTRIAL WASTEWATER DISCHARGES	---	---	---	---	---	---	---	---	---	---	---	---	---
HYDROELECTRIC POWER	---	---	---	---	---	---	---	---	---	---	---	---	---
WATER ORIENTED OUTDOOR REC.	---	---	---	---	---	---	---	---	---	---	---	---	---
SPORT FISHING	1.0	1.4	0	2.4	1.4	4.3	0	5.7	2.4	4.6	0	7.0	15.1
RECREATIONAL BOATING	0	0	7.3	7.3	0	0	45.7	45.7	0	0	76.2	76.2	129.2
COMMERCIAL FISHING	---	---	---	---	---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	6.0	0	0	6.0	28.1	0	0	28.1	32.1	0	0	32.1	66.2
RELATED LAND USES & PROBLEMS													
AGRIC. LAND-TREATMENT	0	0	0	0	0	0	0.3	0.3	0	0	0.5	0.5	0.8
-CROPLAND DRAINAGE	0	0	0	0	0	0	0	0	0	0	0	0	0
FOREST LAND-TREATMENT	0.2	0.4	1.2	1.8	1.6	3.2	1.1	15.9	2.5	4.9	17.3	24.7	42.4
SHORELAND EROSION	0.0	0	0.4	0.4	.6	0	2.4	3.0	1.2	0	4.9	6.1	9.5
STREAMBANK EROSION	0.0	0	0.3	0.3	0	0	3.0	3.0	0	0	7.9	7.9	11.2
FLOOD PLAINS-URBAN	---	---	---	---	---	---	---	---	---	---	---	---	---
-URBAN	0.0	0.0	0	0.0	0.0	0.6	0	0.6	0.0	0.7	0	0.7	1.3
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
WILDLIFE MANAGEMENT	0	0.4	0	0.4	0	0.9	0	0.9	0	1.2	0	1.2	2.5
AESTHETIC & CULTURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	1.6	6.1	0	7.7	11.1	44.5	0	55.6	20.1	80.1	0	100.2	163.5
-EXTENSIVE	---	---	---	---	---	---	---	---	---	---	---	---	---
TOTAL	8.8	117.4	11.8	138.0	42.8	281.0	102.0	425.8	58.3	379.6	222.4	660.2	1224.0

TABLE 1-204 Lake Michigan, Needs, Outputs, and Percent Needs Met, Normal Framework

RESOURCE USE CATEGORY	UNIT	1970 SUPPLY	1980 N	1980 O	1980 %	2000 N	2000 O	2000 %	2020 N	2020 O	2020 %
WATER WITHDRAWALS											
MUNICIPALLY SUPPLIED	MILLION GALLONS PER DAY	2,040	479	635	over	1,400	1,580	over	2,600	2,750	over
SELF-SUPPLIED INDUSTRIAL	MILLION GALLONS PER DAY	5,680	585	169	29	2,190	1,020	47	4,770	2,740	57
RURAL DOMESTIC & LIVESTOCK	MILLION GALLONS PER DAY	234.2	30.9	25.6	83	88.5	71.1	80	128	106	83
IRRIGATION	MILLION GALLONS PER DAY	363	466	326	70	885	641	72	1,340	977	73
MINING	MILLION GALLONS PER DAY	45.9	39.4	14.9	38	111	49.7	45	246	119	48
THERMAL POWER COOLING	MILLION GALLONS PER DAY	5,430	3,160	3,160	100	17,100	17,100	100	42,400	42,400	100
NON-WITHDRAWAL WATER USES											
MUNICIPAL WASTEWATER DISCHARGES	MILLION GALLONS PER DAY	686	965	965	100	1,450	1,450	100	2,170	2,170	100
INDUSTRIAL WASTEWATER DISCHARGES	MILLION GALLONS PER DAY	3,920	3,313	3,313	100	3,130	3,130	100	5,090	5,090	100
HYDROELECTRIC POWER	MILLION GALLONS PER DAY	NA	47,300	47,300	100	47,300	47,300	100	47,300	47,300	100
WATER ORIENTED OUTDOOR REC.	1000 RECREATION DAYS	42,300	49,100	17,300	35	94,200	40,200	43	154,000	60,100	39
	1000 ACRES WATER SURFACE	NA	---	---	---	---	---	---	---	---	---
SPORT FISHING	1000 ANGLER DAYS	27,700	10,500	8,620	82	20,500	18,300	89	30,700	28,500	93
	1000 ACRES WATER SURFACE	NA	---	---	---	---	---	---	---	---	---
RECREATIONAL BOATING	1000 BOAT DAYS	12,800	3,340	1,040	31	6,100	2,726	45	9,480	4,740	50
	1000 ACRES WATER SURFACE	2,620	2,620	---	---	2,620	---	---	2,620	---	---
COMMERCIAL FISHING	MILLION TONS PER YEAR	NA	---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	MILLION TONS PER YEAR	---	111	111	100	151	151	100	197	197	100
RELATED LAND USES & PROBLEMS											
AGRIC. LAND-TREATMENT	1000 ACRES	8,950	8,950	730	8	8,950	2,190	24	8,950	3,060	34
-CROPLAND DRAINAGE	1000 ACRES	1,520	1,520	142	9	1,520	197	13	1,520	375	25
FOREST LAND-TREATMENT	1000 ACRES	9,050	9,050	981	11	9,050	2,940	32	9,050	4,860	54
SHORELAND EROSION	MILES	587	587	26	4	587	78	13	587	130	22
STREAMBANK EROSION	MILES	3,800	3,800	204	5	3,800	612	16	3,800	1,020	27
	$1000 AVE ANNUAL DAMAGES	410	410	82	20	410	246	60	410	410	100
FLOOD PLAINS-URBAN	1000 ACRES	70.8	74.9	21.9	29	78.5	40.2	51	83.1	66.5	80
-URBAN	$1000 AVE ANNUAL DAMAGES	14,100	20,300	14,400	71	40,700	32,700	80	83,500	76,900	92
-RURAL	1000 ACRES	1,100	1,100	154	14	1,100	300	27	1,100	374	34
-RURAL	$1000 AVE ANNUAL DAMAGES	3,570	4,580	1,300	28	5,660	2,070	37	6,560	2,650	40
WILDLIFE MANAGEMENT	1000 ACRES	---	1,710	674	39	4,530	1,620	36	7,970	2,560	32
	1000 USER DAYS	23,700	7,090	709	10	10,900	1,860	17	14,600	2,900	20
AESTHETIC & CULTURAL	1000 ACRES	NA	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	1000 ACRES	---	14.9	5.4	36	31.6	13.6	43	56.1	22.3	40
-EXTENSIVE	1000 ACRES	NA	87.8	37.8	43	183	92.2	50	316	153	48

TABLE 1-205 Lake Michigan, Capital Costs, Normal Framework (in $1,000,000)

RESOURCE USE CATEGORY	1971-1980 Federal	1971-1980 Non-Fed	1971-1980 Private	1971-1980 Total	1981-2000 Federal	1981-2000 Non-Fed	1981-2000 Private	1981-2000 Total	2001-2020 Federal	2001-2020 Non-Fed	2001-2020 Private	2001-2020 Total	Total
WATER WITHDRAWALS													
MUNICIPALLY SUPPLIED	40.1	93.6	0	133.7	79.2	184.9	0	264.1	117.7	274.7	0	392.4	790.2
SELF-SUPPLIED INDUSTRIAL	0	0	14.0	14.0	0	0	70.5	70.5	0	0	142.6	142.6	227.1
RURAL DOMESTIC & LIVESTOCK	0.2	0	1.4	1.6	0.3	0	2.2	2.5	0.2	0	1.8	2.0	6.1
IRRIGATION	0	0	10.0	10.0	0	0	9.8	9.8	0	0	10.0	10.0	29.8
MINING	0	0	0.7	0.7	0	0	2.0	2.0	0	0	4.1	4.1	6.9
THERMAL POWER COOLING	0	5.5	105.0	110.5	0	24.3	462.3	486.6	0	44.3	842.1	886.4	1483.5
NON-WITHDRAWAL WATER USES													
MUNICIPAL WASTEWATER DISCHARGES	385.1	128.3	0	513.4	368.3	122.8	0	491.1	500.3	166.6	0	666.9	1671.4
INDUSTRIAL WASTEWATER DISCHARGES	---	---	---	---	---	---	---	---	---	---	---	---	---
HYDROELECTRIC POWER	---	---	---	---	---	---	---	---	---	---	---	---	---
WATER ORIENTED OUTDOOR REC.	---	---	---	---	---	---	---	---	---	---	---	---	---
SPORT FISHING	6.3	11.0	0	17.3	2.9	5.9	0	8.8	5.2	10.0	0	15.2	41.3
RECREATIONAL BOATING	33.9	33.9	29.1	96.9	60.3	60.3	51.5	172.1	48.1	48.1	41.3	137.5	406.5

COMMERCIAL FISHING													
COMMERCIAL NAVIGATION	0	0	0	0	37.5	0	0	37.5	0	0	0	0	37.5
RELATED LAND USES & PROBLEMS													
AGRIC. LAND-TREATMENT	8.2	0	21.1	29.3	16.6	0	42.4	59.0	9.7	0	25.0	34.7	123.0
-CROPLAND DRAINAGE	10.3	0	24.0	34.3	5.1	0	11.9	17.0	12.0	0	27.9	39.9	91.2
FOREST LAND-TREATMENT	32.8	2.0	6.2	41.0	66.4	4.1	12.5	83.0	64.8	4.0	12.2	81.0	205.0
SHORELAND EROSION	2.7	0	10.6	13.3	5.3	0	21.3	26.6	5.3	0	21.3	26.6	66.5
STREAMBANK EROSION	1.9	0	4.8	6.7	5.7	0	14.4	20.1	9.4	0	24.2	33.6	60.4
FLOOD PLAINS-URBAN	---	---	---	---	---	---	---	---	---	---	---	---	---
-URBAN	121.3	0	40.3	161.6	22.7	0	7.4	30.1	23.3	0	7.7	31.0	222.7
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
WILDLIFE MANAGEMENT	3.3	29.9	0	33.2	5.6	49.8	0	55.4	4.9	44.2	0	49.1	137.7
AESTHETIC & CULTURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	78.0	144.9	0	222.9	96.7	179.4	0	276.1	79.9	148.3	0	228.2	727.2
-EXTENSIVE	---	---	---	---	---	---	---	---	---	---	---	---	---
TOTAL	724.1	449.1	267.2	1440.4	772.6	631.5	708.2	2112.3	880.8	739.2	1161.2	2781.2	6333.9

TABLE 1-206 Lake Michigan, Operation, Maintenance, and Replacement Costs, Normal Framework (in $1,000,000)

	1971-1980				1981-2000				2001-2020				
RESOURCE USE CATEGORY	Federal	Non-Fed	Private	Total	Federal	Non-Fed	Private	Total	Federal	Non-Fed	Private	Total	Total
WATER WITHDRAWALS													
MUNICIPALLY SUPPLIED	0	77.3	0	77.3	0	607.1	0	607.1	0	1366.7	0	1366.7	2051.1
SELF-SUPPLIED INDUSTRIAL	0	0	14.0	14.0	0	0	188.8	188.8	0	0	596.1	596.1	798.9
RURAL DOMESTIC & LIVESTOCK	0	0	3.2	3.2	0	0	23.4	23.4	0	0	42.5	42.5	69.1
IRRIGATION	0	0	1.5	1.5	0	0	8.6	8.6	0	0	14.4	14.4	24.5
MINING	0	0	0.7	0.7	0	0	7.0	7.0	0	0	19.3	19.3	27.0
THERMAL POWER COOLING	0	1.4	27.0	28.4	0	18.2	345.7	363.9	0	53.5	1016.8	1070.3	1462.6
NON-WITHDRAWAL WATER USES													
MUNICIPAL WASTEWATER DISCHARGES	0	352.0	0	352.0	0	1024.0	0	1024.0	0	1388.0	0	1388.0	2764.0
INDUSTRIAL WASTEWATER DISCHARGES	---	---	---	---	---	---	---	---	---	---	---	---	---
HYDROELECTRIC POWER	---	---	---	---	---	---	---	---	---	---	---	---	---
WATER ORIENTED OUTDOOR REC.	---	---	---	---	---	---	---	---	---	---	---	---	---
SPORT FISHING	2.1	3.4	0	5.5	5.9	13.7	0	19.6	8.4	17.8	0	26.2	51.3
RECREATIONAL BOATING	0	0	22.1	22.1	0	0	159.3	159.3	0	0	287.8	287.8	469.2
COMMERCIAL FISHING	---	---	---	---	---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	0	0	0	0	15.2	0	0	15.2	30.4	0	0	30.4	45.6
RELATED LAND USES & PROBLEMS													
AGRIC. LAND-TREATMENT	0	0	0.8	0.8	0	0	5.8	5.8	0	0	10.5	10.5	17.1
-CROPLAND DRAINAGE	0	0	0.8	0.8	0	0	4.3	4.3	0	0	7.1	7.1	12.2
FOREST LAND-TREATMENT	0.1	0.2	0.6	0.9	0.7	1.4	5.0	7.1	1.4	2.9	10.2	14.5	22.5
SHORELAND EROSION	0.3	0	1.0	1.3	2.1	0	8.5	10.6	4.3	0	17.0	21.3	33.2
STREAMBANK EROSION	0	0	0.7	0.7	0	0	6.5	6.5	0	0	17.7	17.7	24.9
FLOOD PLAINS-URBAN	---	---	---	---	---	---	---	---	---	---	---	---	---
-URBAN	0.0	0.3	0	0.3	0	2.0	0	2.0	0.1	2.3	0	2.4	4.7
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
WILDLIFE MANAGEMENT	0	1.7	0	1.7	0	2.8	0	2.8	0	2.5	0	2.5	7.0
AESTHETIC & CULTURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	8.5	33.3	0	41.8	59.2	236.5	0	295.7	105.8	423.2	0	529.0	866.5
-EXTENSIVE	---	---	---	---	---	---	---	---	---	---	---	---	---
TOTAL	11.0	469.6	72.4	553.0	83.1	1905.7	762.9	2751.7	150.4	3256.9	2039.4	5446.7	8751.4

TABLE 1-207 Lake Michigan, Needs, Outputs, and Percent Needs Met, Proposed Framework

RESOURCE USE CATEGORY	UNIT	1970 SUPPLY	1980 N	1980 O	1980 %	2000 N	2000 O	2000 %	2020 N	2020 O	2020 %
WATER WITHDRAWALS											
MUNICIPALLY SUPPLIED	MILLION GALLONS PER DAY	2,040	479	635	over	1,400	1,580	over	2,600	2,750	over
SELF-SUPPLIED INDUSTRIAL	MILLION GALLONS PER DAY	5,680	585	169	29	2,190	1,020	47	4,770	2,740	57
RURAL DOMESTIC & LIVESTOCK	MILLION GALLONS PER DAY	234.2	30.9	25.6	83	88.5	71.1	80	128	106	83
IRRIGATION	MILLION GALLONS PER DAY	363	466	326	70	885	641	72	1,340	977	73
MINING	MILLION GALLONS PER DAY	45.9	39.4	14.9	38	111	49.7	45	246	119	48
THERMAL POWER COOLING	MILLION GALLONS PER DAY	5,430	3,160	3,160	100	17,100	17,100	100	42,400	42,400	100
NON-WITHDRAWAL WATER USES											
MUNICIPAL WASTEWATER DISCHARGES	MILLION GALLONS PER DAY	686	965	965	100	1,450	1,450	100	2,170	2,170	100
INDUSTRIAL WASTEWATER DISCHARGES	MILLION GALLONS PER DAY	3,920	3,313	3,313	100	3,130	3,130	100	5,090	5,090	100
HYDROELECTRIC POWER	MILLION GALLONS PER DAY	NA	47,300	47,300	100	47,300	47,300	100	47,300	47,300	100
WATER ORIENTED OUTDOOR REC.	1000 RECREATION DAYS	42,300	49,100	17,300	35	94,200	40,200	43	154,000	60,100	39
	1000 ACRES WATER SURFACE	NA	---	---	---	---	---	---	---	---	---
SPORT FISHING	1000 ANGLER DAYS	27,700	10,500	8,620	82	20,500	18,300	89	30,700	28,500	93
	1000 ACRES WATER SURFACE	NA	---	---	---	---	---	---	---	---	---
RECREATIONAL BOATING	1000 BOAT DAYS	12,800	3,340	1,040	31	6,100	2,726	45	9,480	4,740	50
	1000 ACRES WATER SURFACE	2,620	2,620	---	---	2,620	---	---	2,620	---	---
COMMERCIAL FISHING	MILLION TONS PER YEAR	NA	---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	MILLION TONS PER YEAR	---	111	111	100	151	151	100	197	197	100
RELATED LAND USES & PROBLEMS											
AGRIC. LAND-TREATMENT	1000 ACRES	8,950	8,950	*1,630*	*18*	8,950	*4,630*	*52*	8,950	*6,140*	*69*
-CROPLAND DRAINAGE	1000 ACRES	1,520	1,520	*275*	*18*	1,520	*686*	*45*	1,520	*958*	*63*
FOREST LAND-TREATMENT	1000 ACRES	9,050	9,050	*1,310*	*14*	9,050	*3,940*	*44*	9,050	*6,530*	*72*
SHORELAND EROSION	MILES	587	587	26	4	587	78	13	587	130	22
STREAMBANK EROSION	MILES	3,800	3,800	204	5	3,800	612	16	3,800	1,020	27
	$1000 AVE ANNUAL DAMAGES	410	410	82	20	410	246	60	410	410	100
FLOOD PLAINS-URBAN	1000 ACRES	70.8	74.9	21.9	29	78.5	40.2	51	83.1	66.5	80
-URBAN	$1000 AVE ANNUAL DAMAGES	14,100	20,300	14,400	71	40,700	32,700	80	83,500	76,900	92
-RURAL	1000 ACRES	1,100	1,100	154	14	1,100	300	27	1,100	374	34
-RURAL	$1000 AVE ANNUAL DAMAGES	3,570	4,580	1,300	28	5,660	2,070	37	6,560	2,650	40
WILDLIFE MANAGEMENT	1000 ACRES	---	1,710	674	39	4,530	1,620	36	7,970	2,560	32
	1000 USER DAYS	23,700	7,090	709	10	10,900	1,860	17	14,600	2,900	20
AESTHETIC & CULTURAL	1000 ACRES	NA	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	1000 ACRES	---	14.9	5.4	36	31.6	13.6	43	56.1	22.3	40
-EXTENSIVE	1000 ACRES	NA	87.8	37.8	43	183	92.2	50	316	153	48

TABLE 1-208 Lake Michigan, Capital Costs, Proposed Framework (in $1,000,000)

RESOURCE USE CATEGORY	1971-1980 Federal	1971-1980 Non-Fed	1971-1980 Private	1971-1980 Total	1981-2000 Federal	1981-2000 Non-Fed	1981-2000 Private	1981-2000 Total	2001-2020 Federal	2001-2020 Non-Fed	2001-2020 Private	2001-2020 Total	Total
WATER WITHDRAWALS													
MUNICIPALLY SUPPLIED	40.1	93.6	0	133.7	79.2	184.9	0	264.1	117.7	274.7	0	392.4	790.2
SELF-SUPPLIED INDUSTRIAL	0	0	14.0	14.0	0	0	70.5	70.5	0	0	142.6	142.6	227.1
RURAL DOMESTIC & LIVESTOCK	0.2	0	1.4	1.6	0.3	0	2.2	2.5	0.2	0	1.8	2.0	6.1
IRRIGATION	0	0	10.0	10.0	0	0	9.8	9.8	0	0	10.0	10.0	29.8
MINING	0	0	0.7	0.7	0	0	2.0	2.0	0	0	4.1	4.1	6.8
THERMAL POWER COOLING	0	5.5	105.0	110.5	0	24.3	462.3	486.6	0	44.3	842.1	886.4	1483.5
NON-WITHDRAWAL WATER USES													
MUNICIPAL WASTEWATER DISCHARGES	*622.5*	*207.5*	*0*	*830.0*	*633.8*	*211.2*	*0*	*845.9*	*681.8*	*227.2*	*0*	*909.0*	*2584.0*
INDUSTRIAL WASTEWATER DISCHARGES	---	---	---	---	---	---	---	---	---	---	---	---	---
HYDROELECTRIC POWER	---	---	---	---	---	---	---	---	---	---	---	---	---
WATER ORIENTED OUTDOOR REC.	---	---	---	---	---	---	---	---	---	---	---	---	---
SPORT FISHING	6.3	11.0	0	17.3	2.9	5.9	0	8.8	5.2	10.0	0	15.2	41.3
RECREATIONAL BOATING	33.9	33.9	29.1	96.9	60.3	60.3	51.5	172.1	48.1	48.1	41.3	137.5	406.5

COMMERCIAL FISHING	---	---	---	---	---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	0	0	0	0	37.5	0	0	37.5	0	0	0	0	37.5
RELATED LAND USES & PROBLEMS													
AGRIC. LAND-TREATMENT	16.6	0	42.5	59.1	30.9	0	79.3	110.2	18.8	0	48.3	67.1	236.4
-CROPLAND DRAINAGE	12.7	0	29.5	42.2	19.9	0	46.3	66.2	12.4	0	29.0	41.4	149.8
FOREST LAND-TREATMENT	44.0	2.8	8.2	55.0	89.6	5.6	16.8	112.0	88.0	5.5	16.5	110.0	277.0
SHORELAND EROSION	2.7	0	10.6	13.3	5.3	0	21.3	26.6	5.3	0	21.3	26.6	66.5
STREAMBANK EROSION	1.9	0	4.8	6.7	5.7	0	14.4	20.1	9.4	0	24.2	33.6	60.4
FLOOD PLAINS-URBAN	---	---	---	---	---	---	---	---	---	---	---	---	---
-URBAN	121.3	0	40.3	161.6	22.7	0	7.4	30.1	23.3	0	7.7	31.0	222.7
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
WILDLIFE MANAGEMENT	3.3	29.9	0	33.2	5.6	49.8	0	55.4	4.9	44.2	0	49.1	137.7
AESTHETIC & CULTURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	78.0	144.9	0	222.9	96.7	179.4	0	276.1	79.9	148.3	0	228.2	727.2
-EXTENSIVE	---	---	---	---	---	---	---	---	---	---	---	---	---
TOTAL	1,028.1	529.1	296.1	1,853.3	1,208.8	721.4	783.8	2,714.0	1,095.0	802.3	1,188.9	3,086.2	7,653.5

TABLE 1-209 Lake Michigan, Operation, Maintenance, and Replacement Costs, Proposed Framework (in $1,000,000)

	1971-1980				1981-2000				2001-2020				
RESOURCE USE CATEGORY	Federal	Non-Fed	Private	Total	Federal	Non-Fed	Private	Total	Federal	Non-Fed	Private	Total	Total
WATER WITHDRAWALS													
MUNICIPALLY SUPPLIED	0	77.3	0	77.3	0	607.1	0	607.1	0	1366.7	0	1366.7	2051.1
SELF-SUPPLIED INDUSTRIAL	0	0	14.0	14.0	0	0	188.8	188.8	0	0	596.1	596.1	798.9
RURAL DOMESTIC & LIVESTOCK	0	0	3.2	3.2	0	0	23.4	23.4	0	0	42.5	42.5	69.1
IRRIGATION	0	0	1.5	1.5	0	0	8.6	8.6	0	0	14.4	14.4	24.5
MINING	0	0	0.7	0.7	0	0	7.0	7.0	0	0	19.3	19.3	27.0
THERMAL POWER COOLING	0	1.4	27.0	28.4	0	18.2	345.7	363.9	0	53.5	1016.8	1070.3	1462.6
NON-WITHDRAWAL WATER USES													
MUNICIPAL WASTEWATER DISCHARGES	0	1,194.7	0	1,194.7	0	2,880.7	0	2,880.7	0	4,491.8	0	4,491.8	8,567.2
INDUSTRIAL WASTEWATER DISCHARGES	---	---	---	---	---	---	---	---	---	---	---	---	---
HYDROELECTRIC POWER	---	---	---	---	---	---	---	---	---	---	---	---	---
WATER ORIENTED OUTDOOR REC.	---	---	---	---	---	---	---	---	---	---	---	---	---
SPORT FISHING	2.1	3.4	0	5.5	5.9	13.7	0	19.6	8.4	17.8	0	26.2	51.3
RECREATIONAL BOATING	0	0	22.1	22.1	0	0	159.3	159.3	0	0	287.8	287.8	469.2
COMMERCIAL FISHING	---	---	---	---	---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	6.0	0	0	6.0	55.2	0	0	55.2	86.4	0	0	86.4	147.6
RELATED LAND USES & PROBLEMS													
AGRIC. LAND-TREATMENT	0	0	1.4	1.4	0	0	12.9	12.9	0	0	20.2	20.2	34.5
-CROPLAND DRAINAGE	0	0	1.1	1.1	0	0	8.5	8.5	0	0	13.0	13.0	22.6
FOREST LAND-TREATMENT	0.1	0.3	0.9	1.3	1.2	2.5	8.8	12.5	2.2	4.4	15.6	22.2	36.0
SHORELAND EROSION	0.3	0	1.0	1.3	2.1	0	8.5	10.6	4.3	0	17.0	21.3	33.2
STREAMBANK EROSION	0	0	0.7	0.7	0	0	6.5	6.5	0	0	17.7	17.7	24.9
FLOOD PLAINS-URBAN	---	---	---	---	---	---	---	---	---	---	---	---	---
-URBAN	0.0	0.3	0	0.3	0	2.0	0	2.0	0.1	2.3	0	2.4	4.7
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
WILDLIFE MANAGEMENT	0	1.7	0	1.7	0	2.8	0	2.8	0	2.5	0	2.5	7.0
AESTHETIC & CULTURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	8.5	33.3	0	41.8	59.2	236.5	0	295.7	105.8	423.2	0	529.0	866.5
-EXTENSIVE	---	---	---	---	---	---	---	---	---	---	---	---	---
TOTAL	17.0	1,312.4	73.6	1,403.0	123.6	3,763.5	778.0	4,665.1	207.2	6,362.2	2,060.4	8,629.8	14697.9

TABLE 1–210 Lake Huron, Needs, Outputs, and Percent Needs Met, Normal Framework

RESOURCE USE CATEGORY	UNIT	1970 SUPPLY	1980 N	1980 O	1980 %	2000 N	2000 O	2000 %	2020 N	2020 O	2020 %
WATER WITHDRAWALS											
MUNICIPALLY SUPPLIED	MILLION GALLONS PER DAY	132.6	33.8	33.8	100	121	121	100	245	245	100
SELF-SUPPLIED INDUSTRIAL	MILLION GALLONS PER DAY	540	107	107	100	354	354	100	861	861	100
RURAL DOMESTIC & LIVESTOCK	MILLION GALLONS PER DAY	39.3	8.3	8.3	100	20.9	20.9	100	32.5	32.5	100
IRRIGATION	MILLION GALLONS PER DAY	23.3	84.9	84.9	100	132	132	100	210	210	100
MINING	MILLION GALLONS PER DAY	24.8	8.6	8.6	100	25.6	25.6	100	55.5	55.5	100
THERMAL POWER COOLING		750	1,130	1,130	100	7,320	7,320	100	18,800	18,800	100
NON-WITHDRAWAL WATER USES											
MUNICIPAL WASTEWATER DISCHARGES	MILLION GALLONS PER DAY	85.0	111	111	100	175	175	100	263	263	100
INDUSTRIAL WASTEWATER DISCHARGES	MILLION GALLONS PER DAY	465	418	418	100	262	262	100	364	364	100
HYDROELECTRIC POWER	MILLION GALLONS PER DAY	NA	0	0	---	0	0	---	0	0	---
WATER ORIENTED OUTDOOR REC.	1000 RECREATION DAYS	5,310	6,650	3,950	55	12,500	9,740	78	19,900	17,000	85
	1000 ACRES WATER SURFACE	NA	---	---	---	---	---	---	---	---	---
SPORT FISHING	1000 ANGLER DAYS	6,140	3,060	2,300	75	5,790	4,760	82	8,800	7,510	85
	1000 ACRES WATER SURFACE	NA	---	---	---	---	---	---	---	---	---
RECREATIONAL BOATING	1000 BOAT DAYS	3,800	1,040	349	34	1,810	936	52	2,700	1,738	64
	1000 ACRES WATER SURFACE	854	854	---	---	854	---	---	854	---	---
COMMERCIAL FISHING	MILLION TONS PER YEAR	NA	---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	MILLION TONS PER YEAR	---	27.5	27.5	100	40.5	40.5	100	58.2	58.2	100
RELATED LAND USES & PROBLEMS											
AGRIC. LAND-TREATMENT	1000 ACRES	2,050	2,050	205	10	2,050	615	30	2,050	861	42
-CROPLAND DRAINAGE	1000 ACRES	572	572	51.7	9	572	65.2	11	572	186	33
FOREST LAND-TREATMENT	1000 ACRES	2,810	2,810	286	10	2,810	858	31	2,810	1,430	51
SHORELAND EROSION	MILES	163	163	1.6	1	163	4.8	3	163	8	5
STREAMBANK EROSION	MILES	1,710	1,710	125	7	1,710	376	22	1,710	626	37
	$1000 AVE ANNUAL DAMAGES	142	142	28.4	20	142	85.2	60	142	142	100
FLOOD PLAINS-URBAN	1000 ACRES	8.1	8.9	2.1	24	9.9	4.4	44	10.9	9.1	5
-URBAN	$1000 AVE ANNUAL DAMAGES	622	856	300	35	1,380	722	52	2,530	2,000	79
-RURAL	1000 ACRES	294	292	71	24	292	118	40	291	200	69
-RURAL	$1000 AVE ANNUAL DAMAGES	1,110	1,300	437	34	1,510	598	40	1,770	1,290	73
WILDLIFE MANAGEMENT	1000 ACRES	---	239	49	21	771	136	18	1,400	196	14
	1000 USER DAYS	6,800	825	308	37	1,710	1,040	61	2,670	1,710	64
AESTHETIC & CULTURAL	1000 ACRES	NA	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	1000 ACRES	---	1.7	1.3	76	3.2	3.4	over	5.8	6.2	over
-EXTENSIVE	1000 ACRES	NA	9.6	5.6	58	18.3	12.1	66	33.1	23.2	70

TABLE 1–211 Lake Huron, Capital Costs, Normal Framework (in $1,000,000)

RESOURCE USE CATEGORY	1971-1980 Federal	1971-1980 Non-Fed	1971-1980 Private	1971-1980 Total	1981-2000 Federal	1981-2000 Non-Fed	1981-2000 Private	1981-2000 Total	2001-2020 Federal	2001-2020 Non-Fed	2001-2020 Private	2001-2020 Total	Total
WATER WITHDRAWALS													
MUNICIPALLY SUPPLIED	4.3	10.1	0	14.4	11.6	27.2	0	38.8	16.1	37.6	0	53.7	106.9
SELF-SUPPLIED INDUSTRIAL	0	0	8.9	8.9	0	0	20.5	20.5	0	0	42.1	42.1	71.5
RURAL DOMESTIC & LIVESTOCK	0.0	0	0.3	0.3	0.0	0	0.5	0.5	0	0	0.4	0.4	1.2
IRRIGATION	0	0	2.3	2.3	0	0	1.4	1.4	0	0	2.2	2.2	5.9
MINING	0	0	0.5	0.5	0	0	1.1	1.1	0	0	1.9	1.9	3.5
THERMAL POWER COOLING	0	2.0	37.5	39.5	0	10.8	206	216.8	0	20.0	380.6	400.6	656.9
NON-WITHDRAWAL WATER USES													
MUNICIPAL WASTEWATER DISCHARGES	52.6	17.5	0	70.1	59.4	19.7	0	79.1	81.1	27.0	0	108.1	257.3
INDUSTRIAL WASTEWATER DISCHARGES	---	---	---	---	---	---	---	---	---	---	---	---	---
HYDROELECTRIC POWER	---	---	---	---	---	---	---	---	---	---	---	---	---
WATER ORIENTED OUTDOOR REC.	---	---	---	---	---	---	---	---	---	---	---	---	---
SPORT FISHING	0.8	1.2	0	2.0	0.8	1.7	0	2.5	3.7	6.4	0	10.1	14.6
RECREATIONAL BOATING	10.6	10.6	9.0	30.2	12.2	12.2	10.5	34.9	20.0	20.0	17.0	57.0	122.1

COMMERCIAL FISHING	---	---	---	---	---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	0	0	0	0	340.0	0	0	340.0	0	0	0	0	340.0
RELATED LAND USES & PROBLEMS													
AGRIC. LAND-TREATMENT	2.5	0	6.4	8.9	4.9	0	12.6	17.5	3.0	0	7.6	10.6	37.0
-CROPLAND DRAINAGE	4.6	0	10.9	15.5	1.0	0	2.4	3.4	8.5	0	19.7	28.2	47.1
FOREST LAND-TREATMENT	11.2	0.7	2.1	14.0	21.6	1.3	4.1	27.0	21.6	1.3	4.1	27.0	68.0
SHORELAND EROSION	0.2	0	1.0	1.2	0.5	0	2.1	2.6	.5	0	2.1	2.6	6.4
STREAMBANK EROSION	1.1	0	3.0	4.1	3.5	0	8.8	12.3	5.7	0	14.8	20.5	36.9
FLOOD PLAINS-URBAN	---	---	---	---	---	---	---	---	---	---	---	---	---
-URBAN	20.7	0	6.9	27.6	16.0	0	5.3	21.3	26.7	0	8.9	35.6	84.5
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
WILDLIFE MANAGEMENT	2.8	25.0	0	27.8	5.1	45.4	0	50.5	3.1	28.5	0	31.6	109.9
AESTHETIC & CULTURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	14.0	26.0	0	40.0	20.0	37.2	0	57.2	23.3	43.3	0	66.6	163.8
-EXTENSIVE	---	---	---	---	---	---	---	---	---	---	---	---	---
TOTAL	125.4	93.1	88.8	307.3	496.6	155.5	275.3	927.4	213.3	184.1	501.4	898.8	2133.5

TABLE 1-212 Lake Huron, Operation, Maintenance, and Replacement Costs, Normal Framework (in $1,000,000)

	1971-1980				1981-2000				2001-2020				
RESOURCE USE CATEGORY	Federal	Non-Fed	Private	Total	Federal	Non-Fed	Private	Total	Federal	Non-Fed	Private	Total	Total
WATER WITHDRAWALS													
MUNICIPALLY SUPPLIED	0	5.8	0	5.8	0	66.1	0	66.1	0	138.3	0	138.3	210.2
SELF-SUPPLIED INDUSTRIAL	0	0	8.2	8.2	0	0	134.1	134.1	0	0	410.6	410.6	552.9
RURAL DOMESTIC & LIVESTOCK	0	0	2.5	2.5	0	0	14.3	14.3	0	0	26.0	26.0	42.8
IRRIGATION	0	0	0.3	0.3	0	0	1.5	1.5	0	0	2.3	2.3	4.1
MINING	0	0	0.8	0.8	0	0	6.4	6.4	0	0	14.5	14.5	21.7
THERMAL POWER COOLING	0	.5	9.7	10.2	0	7.6	144.5	152.1	0	23.5	446.7	470.2	632.5
NON-WITHDRAWAL WATER USES													
MUNICIPAL WASTEWATER DISCHARGES	0	42.0	0	42.0	0	166.0	0	166.0	0	228.0	0	228.0	436.0
INDUSTRIAL WASTEWATER DISCHARGES	---	---	---	---	---	---	---	---	---	---	---	---	---
HYDROELECTRIC POWER	---	---	---	---	---	---	---	---	---	---	---	---	---
WATER ORIENTED OUTDOOR REC.	---	---	---	---	---	---	---	---	---	---	---	---	---
SPORT FISHING	0.7	1.1	0	1.8	2.4	5.5	0	7.9	4.2	7.2	0	11.4	21.1
RECREATIONAL BOATING	0	0	7.7	7.7	0	0	49.5	49.5	0	0	90.0	90.0	147.2
COMMERCIAL FISHING	---	---	---	---	---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	0	0	0	0	80.0	0	0	80.0	160.0	0	0	160.0	240.0
RELATED LAND USES & PROBLEMS													
AGRIC. LAND-TREATMENT	0	0	0.2	0.2	0	0	1.8	1.8	0	0	3.2	3.2	5.2
-CROPLAND DRAINAGE	0	0	0.4	0.4	0	0	1.7	1.7	0	0	3.3	3.3	5.4
FOREST LAND-TREATMENT	0.0	0.1	0.3	0.4	0.3	0.6	1.9	2.8	0.3	0.7	2.4	3.4	6.6
SHORELAND EROSION	0.0	0	0.1	0.1	0.2	0	0.8	1.0	0.4	0	1.7	2.1	3.2
STREAMBANK EROSION	0	0	0.5	0.5	0	0	4.1	4.1	0	0	10.7	10.7	15.3
FLOOD PLAINS-URBAN	---	---	---	---	---	---	---	---	---	---	---	---	---
-URBAN	0.0	0.1	0	0.1	0.0	0.5	0	0.5	0.1	0.9	0	1.0	1.6
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
WILDLIFE MANAGEMENT	0	1.4	0	1.4	0	2.5	0	2.5	0	1.6	0	1.6	5.5
AESTHETIC & CULTURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	1.9	7.7	0	9.6	13.1	52.7	0	65.8	25.8	103.3	0	129.1	204.5
-EXTENSIVE	---	---	---	---	---	---	---	---	---	---	---	---	---
TOTAL	2.6	58.7	30.7	92.0	96.0	301.5	360.6	758.1	190.8	503.5	1011.4	1705.7	2555.8

TABLE 1-213 Lake Huron, Needs, Outputs, and Percent Needs Met, Proposed Framework

RESOURCE USE CATEGORY	UNIT	1970 SUPPLY	1980 N	1980 O	1980 %	2000 N	2000 O	2000 %	2020 N	2020 O	2020 %
WATER WITHDRAWALS											
MUNICIPALLY SUPPLIED	MILLION GALLONS PER DAY	132.6	33.8	33.8	100	121	121	100	245	245	100
SELF-SUPPLIED INDUSTRIAL	MILLION GALLONS PER DAY	540	107	107	100	354	354	100	861	861	100
RURAL DOMESTIC & LIVESTOCK	MILLION GALLONS PER DAY	39.3	8.3	8.3	100	20.9	20.9	100	32.5	32.5	100
IRRIGATION	MILLION GALLONS PER DAY	23.3	84.9	84.9	100	132	132	100	210	210	100
MINING	MILLION GALLONS PER DAY	24.8	8.6	8.6	100	25.6	25.6	100	55.5	55.5	100
THERMAL POWER COOLING	MILLION GALLONS PER DAY	750	1,130	1,130	100	7,320	7,320	100	18,800	18,800	100
NON-WITHDRAWAL WATER USES											
MUNICIPAL WASTEWATER DISCHARGES	MILLION GALLONS PER DAY	85.0	111	111	100	175	175	100	263	263	100
INDUSTRIAL WASTEWATER DISCHARGES	MILLION GALLONS PER DAY	465	418	418	100	262	262	100	364	364	100
HYDROELECTRIC POWER	MILLION GALLONS PER DAY	NA	0	0	---	0	0	---	0	0	---
WATER ORIENTED OUTDOOR REC.	1000 RECREATION DAYS	5,310	6,650	3,950	55	12,500	9,740	78	19,900	17,000	85
	1000 ACRES WATER SURFACE	NA	---	---	---	---	---	---	---	---	---
SPORT FISHING	1000 ANGLER DAYS	6,140	3,060	2,300	75	5,790	4,760	82	8,800	7,510	85
	1000 ACRES WATER SURFACE	NA	---	---	---	---	---	---	---	---	---
RECREATIONAL BOATING	1000 BOAT DAYS	3,800	1,040	349	34	1,810	936	52	2,700	1,738	64
	1000 ACRES WATER SURFACE	854	854	---	---	854	---	---	854	---	---
COMMERCIAL FISHING	MILLION TONS PER YEAR	NA	---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	MILLION TONS PER YEAR	---	27.5	27.5	100	40.5	40.5	100	58.2	58.2	100
RELATED LAND USES & PROBLEMS											
AGRIC. LAND-TREATMENT	1000 ACRES	2,050	2,050	*449*	*22*	2,050	*1,250*	*61*	2,050	*1,750*	*85*
-CROPLAND DRAINAGE	1000 ACRES	572	572	*76.3*	*13*	572	*190*	*33*	572	*305*	*53*
FOREST LAND-TREATMENT	1000 ACRES	2,810	2,810	*343*	*12*	2,810	*1,030*	*37*	2,810	*1,720*	*61*
SHORELAND EROSION	MILES	163	163	1.6	1	163	4.8	3	163	8	5
STREAMBANK EROSION	MILES	1,710	1,710	125	7	1,710	376	22	1,710	626	37
	$1000 AVE ANNUAL DAMAGES	142	142	28.4	20	142	85.2	60	142	142	100
FLOOD PLAINS-URBAN	1000 ACRES	8.1	8.9	2.1	24	9.9	4.4	44	10.9	9.1	5
-URBAN	$1000 AVE ANNUAL DAMAGES	622	856	300	35	1,380	722	52	2,530	2,000	79
-RURAL	1000 ACRES	294	292	71	24	292	118	40	291	200	69
-RURAL	$1000 AVE ANNUAL DAMAGES	1,110	1,300	437	34	1,510	598	40	1,770	1,290	73
WILDLIFE MANAGEMENT	1000 ACRES	---	239	49	21	771	136	18	1,400	196	14
	1000 USER DAYS	6,800	825	308	37	1,710	1,040	61	2,670	1,710	64
AESTHETIC & CULTURAL	1000 ACRES	NA	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	1000 ACRES	---	1.7	1.3	76	3.2	3.4	over	5.8	6.2	over
-EXTENSIVE	1000 ACRES	NA	9.6	5.6	58	18.3	12.1	66	33.1	23.2	70

TABLE 1-214 Lake Huron, Capital Costs, Proposed Framework (in $1,000,000)

RESOURCE USE CATEGORY	1971-1980 Federal	1971-1980 Non-Fed	1971-1980 Private	1971-1980 Total	1981-2000 Federal	1981-2000 Non-Fed	1981-2000 Private	1981-2000 Total	2001-2020 Federal	2001-2020 Non-Fed	2001-2020 Private	2001-2020 Total	Total
WATER WITHDRAWALS													
MUNICIPALLY SUPPLIED	4.3	10.1	0	14.4	11.6	27.2	0	38.8	16.1	37.6	0	53.7	106.9
SELF-SUPPLIED INDUSTRIAL	0	0	8.9	8.9	0	0	20.5	20.5	0	0	42.1	42.1	71.5
RURAL DOMESTIC & LIVESTOCK	0.0	0	0.3	0.3	0.0	0	0.5	0.5	0	0	0.4	0.4	1.2
IRRIGATION	0	0	2.3	2.3	0	0	1.4	1.4	0	0	2.2	2.2	5.9
MINING	0	0	0.5	0.5	0	0	1.1	1.1	0	0	1.9	1.9	3.5
THERMAL POWER COOLING	0	2.0	37.5	39.5	0	10.8	206	216.8	0	20.0	380.6	400.6	656.9
NON-WITHDRAWAL WATER USES													
MUNICIPAL WASTEWATER DISCHARGES	*130.5*	*43.5*	*0*	*174.0*	*115.5*	*38.5*	*0*	*154.0*	*115.5*	*38.5*	*0*	*154.0*	*482.0*
INDUSTRIAL WASTEWATER DISCHARGES	---	---	---	---	---	---	---	---	---	---	---	---	---
HYDROELECTRIC POWER	---	---	---	---	---	---	---	---	---	---	---	---	---
WATER ORIENTED OUTDOOR REC.	---	---	---	---	---	---	---	---	---	---	---	---	---
SPORT FISHING	0.8	1.2	0	2.0	0.8	1.7	0	2.5	3.7	6.4	0	10.1	14.6
RECREATIONAL BOATING	10.6	10.6	9.0	30.2	12.2	12.2	10.5	34.9	20.0	20.0	17.0	57.0	122.1

COMMERCIAL FISHING	---	---	---	---	---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	76.0	0	0	76.0	363.0	0	0	363.0	0	0	0	0	439.0
RELATED LAND USES & PROBLEMS													
AGRIC. LAND-TREATMENT	4.8	0	12.1	16.9	8.8	0	22.5	31.3	5.4	0	13.8	19.2	67.4
-CROPLAND DRAINAGE	4.3	0	9.9	14.2	7.0	0	16.5	23.5	4.5	0	10.4	14.9	52.6
FOREST LAND-TREATMENT	12.8	0.8	2.4	16.0	27.2	1.7	5.1	34.0	27.2	1.7	5.1	34.0	84.0
SHORELAND EROSION	0.2	0	1.0	1.2	0.5	0	2.1	2.6	.5	0	2.1	2.6	6.4
STREAMBANK EROSION	1.1	0	3.0	4.1	3.5	0	8.8	12.3	5.7	0	14.8	20.5	36.9
FLOOD PLAINS-URBAN	---	---	---	---	---	---	---	---	---	---	---	---	---
-URBAN	20.7	0	6.9	27.6	16.0	0	5.3	21.3	26.7	0	8.9	35.6	84.5
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
WILDLIFE MANAGEMENT	2.8	25.0	0	27.8	5.1	45.4	0	50.5	3.1	28.5	0	31.6	109.9
AESTHETIC & CULTURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	14.0	26.0	0	40.0	20.0	37.2	0	57.2	23.3	43.3	0	66.6	163.8
-EXTENSIVE	---	---	---	---	---	---	---	---	---	---	---	---	---
TOTAL	282.9	119.2	93.8	195.9	591.2	174.7	300.3	1,066.2	251.7	196.0	499.3	947.0	2,509.1

TABLE 1-215 Lake Huron, Operation, Maintenance, and Replacement Costs, Proposed Framework (in $1,000,000)

RESOURCE USE CATEGORY	1971-1980 Federal	1971-1980 Non-Fed	1971-1980 Private	1971-1980 Total	1981-2000 Federal	1981-2000 Non-Fed	1981-2000 Private	1981-2000 Total	2001-2020 Federal	2001-2020 Non-Fed	2001-2020 Private	2001-2020 Total	Total
WATER WITHDRAWALS													
MUNICIPALLY SUPPLIED	0	5.8	0	5.8	0	66.1	0	66.1	0	138.3	0	138.3	210.2
SELF-SUPPLIED INDUSTRIAL	0	0	8.2	8.2	0	0	134.1	134.1	0	0	410.6	410.6	552.9
RURAL DOMESTIC & LIVESTOCK	0	0	2.5	2.5	0	0	14.3	14.3	0	0	26.0	26.0	42.8
IRRIGATION	0	0	0.3	0.3	0	0	1.5	1.5	0	0	2.3	2.3	4.1
MINING	0	0	0.8	0.8	0	0	6.4	6.4	0	0	14.5	14.5	21.7
THERMAL POWER COOLING	0	.5	9.7	10.2	0	7.6	144.5	152.1	0	23.5	446.7	470.2	632.5
NON-WITHDRAWAL WATER USES													
MUNICIPAL WASTEWATER DISCHARGES	0	332.3	0	332.3	0	570.7	0	570.7	0	851.9	0	851.9	1,654.9
INDUSTRIAL WASTEWATER DISCHARGES	---	---	---	---	---	---	---	---	---	---	---	---	---
HYDROELECTRIC POWER	---	---	---	---	---	---	---	---	---	---	---	---	---
WATER ORIENTED OUTDOOR REC.	---	---	---	---	---	---	---	---	---	---	---	---	---
SPORT FISHING	0.7	1.1	0	1.8	2.4	5.5	0	7.9	4.2	7.2	0	11.4	21.1
RECREATIONAL BOATING	0	0	7.7	7.7	0	0	49.5	49.5	0	0	90.0	90.0	147.2
COMMERCIAL FISHING	---	---	---	---	---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	9.0	0	0	9.0	127.0	0	0	127.0	218.0	0	0	218.0	354.0
RELATED LAND USES & PROBLEMS													
AGRIC. LAND-TREATMENT	0	0	0.4	0.4	0	0	3.7	3.7	0	0	5.8	5.8	9.9
-CROPLAND DRAINAGE	0	0	0.4	0.4	0	0	2.9	2.9	0	0	4.5	4.5	7.8
FOREST LAND-TREATMENT	0		0.3	0.4	0.4	0.7	2.5	3.6	0.7	1.4	4.7	6.8	10.8
SHORELAND EROSION	0.0	0	0.1	0.1	0.2	0	0.8	1.0	0.4	0	1.7	2.1	3.2
STREAMBANK EROSION	0	0	0.5	0.5	0	0	4.1	4.1	0	0	10.7	10.7	15.3
FLOOD PLAINS-URBAN	---	---	---	---	---	---	---	---	---	---	---	---	---
-URBAN	0.0	0.1	0	0.1	0.0	0.5	0	0.5	0.1	0.9	0	1.0	1.6
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
WILDLIFE MANAGEMENT	0	1.4	0	1.4	0	2.5	0	2.5	0	1.6	0	1.6	5.5
AESTHETIC & CULTURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	1.9	7.7	0	9.6	13.1	52.7	0	65.8	25.8	103.3	0	129.1	204.5
-EXTENSIVE	---	---	---	---	---	---	---	---	---	---	---	---	---
TOTAL	11.6	249.0	30.9	291.5	143.1	706.3	364.3	1,213.7	249.2	1,128.1	1,017.5	2,394.8	3,900.0

TABLE 1-216 Lake Erie, Needs, Outputs, and Percent Needs Met, Normal Framework

RESOURCE USE CATEGORY	UNIT	1970 SUPPLY	1980 N	1980 O	1980 %	2000 N	2000 O	2000 %	2020 N	2020 O	2020 %
WATER WITHDRAWALS											
MUNICIPALLY SUPPLIED	MILLION GALLONS PER DAY	1,770	307	307	100	1,060	1,060	100	2,110	2,110	100
SELF-SUPPLIED INDUSTRIAL	MILLION GALLONS PER DAY	3,870	356	356	100	1,930	1,930	100	4,030	4,030	100
RURAL DOMESTIC & LIVESTOCK	MILLION GALLONS PER DAY	133.1	15.1	15.1	100	48.8	48.8	100	75.9	75.9	100
IRRIGATION	MILLION GALLONS PER DAY	237	215	215	100	414	414	100	667	667	100
MINING	MILLION GALLONS PER DAY	115.1	48.3	48.3	100	180	180	100	398	398	100
THERMAL POWER COOLING	MILLION GALLONS PER DAY	8,760	0	0	---	9,020	9,020	100	26,200	26,200	100
NON-WITHDRAWAL WATER USES											
MUNICIPAL WASTEWATER DISCHARGES	MILLION GALLONS PER DAY	1,880	2,130	2,130	100	2,670	2,670	100	3,450	3,450	100
INDUSTRIAL WASTEWATER DISCHARGES	MILLION GALLONS PER DAY	3,490	2,980	2,980	100	2,080	2,080	100	2,690	2,690	100
HYDROELECTRIC POWER	MILLION GALLONS PER DAY	NA	0	0	---	0	0	---	0	0	---
WATER ORIENTED OUTDOOR REC.	1000 RECREATION DAYS	30,700	38,900	23,600	61	73,100	48,600	66	119,000	65,000	55
	1000 ACRES WATER SURFACE	NA	---	---	---	---	---	---	---	---	---
SPORT FISHING	1000 ANGLER DAYS	27,900	4,880	4,540	93	14,100	13,500	96	20,700	19,800	96
	1000 ACRES WATER SURFACE	NA	---	---	---	---	---	---	---	---	---
RECREATIONAL BOATING	1000 BOAT DAYS	6,110	1,520	413	27	3,000	1,133	38	4,830	1,794	37
	1000 ACRES WATER SURFACE	1,240	1,240	---	---	1,240	---	---	1,240	---	---
COMMERCIAL FISHING	MILLION TONS PER YEAR	NA	---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	MILLION TONS PER YEAR	---	192	192	100	254	254	100	318	318	100
RELATED LAND USES & PROBLEMS											
AGRIC. LAND-TREATMENT	1000 ACRES	6,380	6,380	615	10	6,380	1,840	29	6,380	2,580	40
-CROPLAND DRAINAGE	1000 ACRES	3,400	3,400	152	4	3,400	436	13	3,400	750	22
FOREST LAND-TREATMENT	1000 ACRES	2,230	2,230	172	8	2,230	516	23	2,230	860	39
SHORELAND EROSION	MILES	105	105	8.9	8	105	14.8	14	105	20.6	20
STREAMBANK EROSION	MILES	2,490	2,490	116	5	2,490	349	14	2,490	582	23
	$1000 AVE ANNUAL DAMAGES	579	579	115.8	20	579	347.4	60	579	579	100
FLOOD PLAINS-URBAN	1000 ACRES	121	124	49.4	40	128	85.9	67	133	109	82
-URBAN	$1000 AVE ANNUAL DAMAGES	30,600	44,600	37,000	83	74,100	68,500	92	100,200	94,900	95
-RURAL	1000 ACRES	735	733	208	28	728	365	50	723	467	65
-RURAL	$1000 AVE ANNUAL DAMAGES	7,740	9,650	4,080	42	13,100	7,230	55	17,600	10,800	61
WILDLIFE MANAGEMENT	1000 ACRES	---	888	95.4	11	2,080	275	13	3,460	457	13
	1000 USER DAYS	13,900	6,490	1,020	16	10,200	3,670	36	14,400	6,980	48
AESTHETIC & CULTURAL	1000 ACRES	NA	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	1000 ACRES	---	11.9	7.3	61	22.5	15.3	68	38.2	20.2	53
-EXTENSIVE	1000 ACRES	NA	67.9	39.2	58	127	78.6	62	209	107	51

TABLE 1-217 Lake Erie, Capital Costs, Normal Framework (in $1,000,000)

RESOURCE USE CATEGORY	1971-1980 Federal	1971-1980 Non-Fed	1971-1980 Private	1971-1980 Total	1981-2000 Federal	1981-2000 Non-Fed	1981-2000 Private	1981-2000 Total	2001-2020 Federal	2001-2020 Non-Fed	2001-2020 Private	2001-2020 Total	Total
WATER WITHDRAWALS													
MUNICIPALLY SUPPLIED	76.7	178.8	0	255.5	97.0	226.2	0	323.2	122.2	285.1	0	407.3	986.0
SELF-SUPPLIED INDUSTRIAL	0	0	29.5	29.5	0	0	130.6	130.6	0	0	173.8	173.8	333.9
RURAL DOMESTIC & LIVESTOCK	0.0	0	0.4	0.4	0.1	0	1.0	1.1	0.1	0	0.9	1.0	2.5
IRRIGATION	0	0	6.4	6.4	0	0	4.4	4.4	0	0	6.8	6.8	17.6
MINING	0	0	2.0	2.0	0	0	5.7	5.7	0	0	9.8	9.8	17.5
THERMAL POWER COOLING	0	0.0	0.0	0.0	0	15.8	299.9	315.7	0	30.0	570.3	600.3	916.0
NON-WITHDRAWAL WATER USES													
MUNICIPAL WASTEWATER DISCHARGES	797.7	265.9	0	1063.6	566.9	188.8	0	755.7	753.6	251.2	0	1004.8	2824.1
INDUSTRIAL WASTEWATER DISCHARGES	---	---	---	---	---	---	---	---	---	---	---	---	---
HYDROELECTRIC POWER	---	---	---	---	---	---	---	---	---	---	---	---	---
WATER ORIENTED OUTDOOR REC.	---	---	---	---	---	---	---	---	---	---	---	---	---
SPORT FISHING	10.1	22.4	0	32.5	5.4	8.4	0	13.8	8.4	9.9	0	18.3	64.6
RECREATIONAL BOATING	29.2	29.2	24.6	83.0	50.4	50.4	43.1	143.9	36.0	36.0	31.0	103.0	329.9

COMMERCIAL FISHING	---	---	---	---	---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	0	0	0	0	0	0	0	0	0	0	0	0	0
RELATED LAND USES & PROBLEMS													
AGRIC. LAND-TREATMENT	7.5	0	19.0	26.5	14.9	0	38.3	53.2	8.9	0	22.8	31.7	111.4
-CROPLAND DRAINAGE	13.3	0	31.0	44.3	24.2	0	56.4	80.6	24.1	0	56.1	80.2	205.1
FOREST LAND-TREATMENT	9.6	0.6	1.8	12.0	19.2	1.2	3.6	24.0	19.2	1.2	3.6	24.0	60.0
SHORELAND EROSION	1.3	0	5.0	6.3	0.6	0	2.3	2.9	0.6	0	2.3	2.9	12.1
STREAMBANK EROSION	1.0	0	2.8	3.8	3.2	0	8.3	11.5	5.4	0	13.8	19.2	34.5
FLOOD PLAINS-URBAN	---	---	---	---	---	---	---	---	---	---	---	---	---
-URBAN	245.5	0	81.7	327.2	153.3	0	51.0	204.3	33.6	0	11.2	44.8	576.3
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
WILDLIFE MANAGEMENT	3.8	34.0	0	37.8	6.4	57.8	0	64.2	8.5	76.6	0	85.1	187.1
AESTHETIC & CULTURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	111.2	206.5	0	317.7	140.3	260.7	0	401.0	116.6	216.2	0	332.8	1051.5
-EXTENSIVE	---	---	---	---	---	---	---	---	---	---	---	---	---
TOTAL	1306.9	737.4	204.2	2248.5	1081.9	809.3	644.6	2535.8	1137.2	906.2	902.4	2945.8	7730.1

TABLE 1–218 Lake Erie, Operation, Maintenance, and Replacement Costs, Normal Framework (in $1,000,000)

	1971-1980				1981-2000				2001-2020				
RESOURCE USE CATEGORY	Federal	Non-Fed	Private	Total	Federal	Non-Fed	Private	Total	Federal	Non-Fed	Private	Total	Total
WATER WITHDRAWALS													
MUNICIPALLY SUPPLIED	0	101.5	0	101.5	0	466.1	0	466.1	0	1005.3	0	1005.3	1572.9
SELF-SUPPLIED INDUSTRIAL	0	0	26.7	26.7	0	0	342.4	342.4	0	0	891.8	891.8	1260.9
RURAL DOMESTIC & LIVESTOCK	0	0	1.7	1.7	0	0	13.1	13.1	0	0	24.4	24.4	39.2
IRRIGATION	0	0	0.9	0.9	0	0	4.9	4.9	0	0	7.9	7.9	13.7
MINING	0	0	3.3	3.3	0	0	32.4	32.4	0	0	82.0	82.0	117.7
THERMAL POWER COOLING	0	0.0	0.0	0.0	0	8.1	154.3	162.4	0	31.7	602.3	634.0	796.4
NON-WITHDRAWAL WATER USES													
MUNICIPAL WASTEWATER DISCHARGES	0	899.0	0	899.0	0	2176.0	0	2176.0	0	2840.0	0	2840.0	5915.0
INDUSTRIAL WASTEWATER DISCHARGES	---	---	---	---	---	---	---	---	---	---	---	---	---
HYDROELECTRIC POWER	---	---	---	---	---	---	---	---	---	---	---	---	---
WATER ORIENTED OUTDOOR REC.	---	---	---	---	---	---	---	---	---	---	---	---	---
SPORT FISHING	3.5	4.3	0	7.8	3.9	5.9	0	9.8	5.9	8.8	0	14.7	32.3
RECREATIONAL BOATING	0	0	16.7	16.7	0	0	119.6	119.6	0	0	218.4	218.4	354.7
COMMERCIAL FISHING	---	---	---	---	---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	0	0	0	0	0	0	0	0	0	0	0	0	0
RELATED LAND USES & PROBLEMS													
AGRIC. LAND-TREATMENT	0	0	0.7	0.7	0	0	5.2	5.2	0	0	9.6	9.6	15.5
-CROPLAND DRAINAGE	0	0	1.1	1.1	0	0	8.5	8.5	0	0	16.5	16.5	26.1
FOREST LAND-TREATMENT	0.0	0.1	0.4	0.5	0.2	0.5	1.8	2.5	0.5	1.0	3.4	4.9	7.9
SHORELAND EROSION	0.1	0	0.5	0.6	0.6	0	2.5	3.1	0.9	0	3.4	4.3	8.0
STREAMBANK EROSION	0	0	0.3	0.3	0	0	2.8	2.8	0	0	9.8	9.8	12.9
FLOOD PLAINS-URBAN	---	---	---	---	---	---	---	---	---	---	---	---	---
-URBAN	0.0	0.7	0	0.7	0.2	4.9	0	5.1	0.2	6.1	0	6.3	12.1
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
WILDLIFE MANAGEMENT	0	1.8	0	1.8	0	3.2	0	3.2	0	4.7	0	4.7	9.7
AESTHETIC & CULTURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	11.4	45.7	0	57.1	83.2	333.1	0	416.3	146.9	587.1	0	734.0	1207.4
-EXTENSIVE	---	---	---	---	---	---	---	---	---	---	---	---	---
TOTAL	15.0	1053.1	52.3	1120.4	88.1	2997.8	687.5	3773.4	154.4	4484.7	1869.5	6508.6	11402.4

TABLE 1-219 Lake Erie, Needs, Outputs, and Percent Needs Met, Proposed Framework

RESOURCE USE CATEGORY	UNIT	1970 SUPPLY	1980 N	1980 O	1980 %	2000 N	2000 O	2000 %	2020 N	2020 O	2020 %
WATER WITHDRAWALS											
MUNICIPALLY SUPPLIED	MILLION GALLONS PER DAY	1,770	307	307	100	1,060	1,060	100	2,110	2,110	100
SELF-SUPPLIED INDUSTRIAL	MILLION GALLONS PER DAY	3,870	356	356	100	1,930	1,930	100	4,030	4,030	100
RURAL DOMESTIC & LIVESTOCK	MILLION GALLONS PER DAY	133.1	15.1	15.1	100	48.8	48.8	100	75.9	75.9	100
IRRIGATION	MILLION GALLONS PER DAY	237	215	215	100	414	402	97	667	653	98
MINING	MILLION GALLONS PER DAY	115.1	48.3	48.3	100	180	141	78	398	285	72
THERMAL POWER COOLING	MILLION GALLONS PER DAY	8,760	0	0	---	9,020	9,020	100	26,200	26,200	100
NON-WITHDRAWAL WATER USES											
MUNICIPAL WASTEWATER DISCHARGES	MILLION GALLONS PER DAY	1,880	2,130	2,130	100	2,670	2,670	100	3,450	3,450	100
INDUSTRIAL WASTEWATER DISCHARGES	MILLION GALLONS PER DAY	3,490	2,980	2,980	100	2,080	2,080	100	2,690	2,690	100
HYDROELECTRIC POWER	MILLION GALLONS PER DAY	NA	0	0	---	0	0	---	0	0	---
WATER ORIENTED OUTDOOR REC.	1000 RECREATION DAYS	30,700	38,900	23,600	61	73,100	48,600	66	119,000	65,000	55
	1000 ACRES WATER SURFACE	NA	---	---	---	---	---	---	---	---	---
SPORT FISHING	1000 ANGLER DAYS	27,900	4,880	4,540	93	14,100	13,500	96	20,700	19,800	96
	1000 ACRES WATER SURFACE	NA	---	---	---	---	---	---	---	---	---
RECREATIONAL BOATING	1000 BOAT DAYS	6,110	1,520	413	27	3,000	1,133	38	4,830	1,794	37
	1000 ACRES WATER SURFACE	1,240	1,240	---	---	1,240	---	---	1,240	---	---
COMMERCIAL FISHING	MILLION TONS PER YEAR	NA	---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	MILLION TONS PER YEAR	---	192	192	100	254	254	100	318	318	100
RELATED LAND USES & PROBLEMS											
AGRIC. LAND-TREATMENT	1000 ACRES	6,380	6,390	1,340	21	6,390	3,820	60	3,690	5,340	84
-CROPLAND DRAINAGE	1000 ACRES	3,400	3,400	302	9	3,400	812	24	3,400	1,180	35
FOREST LAND-TREATMENT	1000 ACRES	2,230	2,230	313	14	2,230	934	42	2,230	1,560	70
SHORELAND EROSION	MILES	105	105	8.9	8	105	14.8	14	105	20.6	20
STREAMBANK EROSION	MILES	2,490	2,490	116	5	2,490	349	14	2,490	582	23
	$1000 AVE ANNUAL DAMAGES	579	579	115.8	20	579	347.4	60	579	579	100
FLOOD PLAINS-URBAN	1000 ACRES	121	124	49.4	40	128	85.9	67	133	109	82
-URBAN	$1000 AVE ANNUAL DAMAGES	30,600	44,600	37,000	83	74,100	68,500	92	100,200	94,900	95
-RURAL	1000 ACRES	735	733	208	28	728	365	50	723	467	65
-RURAL	$1000 AVE ANNUAL DAMAGES	7,740	9,650	4,080	42	13,100	7,230	55	17,600	10,800	61
WILDLIFE MANAGEMENT	1000 ACRES	---	888	95.4	11	2,080	275	13	3,460	457	13
	1000 USER DAYS	13,900	6,490	1,020	16	10,200	3,670	36	14,400	6,980	48
AESTHETIC & CULTURAL	1000 ACRES	NA	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	1000 ACRES	---	11.9	7.3	61	22.5	15.3	68	38.2	20.2	53
-EXTENSIVE	1000 ACRES	NA	67.9	39.2	58	127	78.6	62	209	107	51

TABLE 1-220 Lake Erie, Capital Costs, Proposed Framework (in $1,000,000)

RESOURCE USE CATEGORY	1971-1980 Federal	1971-1980 Non-Fed	1971-1980 Private	1971-1980 Total	1981-2000 Federal	1981-2000 Non-Fed	1981-2000 Private	1981-2000 Total	2001-2020 Federal	2001-2020 Non-Fed	2001-2020 Private	2001-2020 Total	Total
WATER WITHDRAWALS													
MUNICIPALLY SUPPLIED	76.7	178.8	0	255.5	97.0	226.2	0	323.2	122.2	285.1	0	407.3	986.0
SELF-SUPPLIED INDUSTRIAL	0	0	29.5	29.5	0	0	130.6	130.6	0	0	173.8	173.8	333.9
RURAL DOMESTIC & LIVESTOCK	0.0	0	0.4	0.4	0.1	0	1.0	1.1	0.1	0	0.9	1.0	2.5
IRRIGATION	0	0	6.4	6.4	0	0	4.0	4.0	0	0	6.9	6.9	17.3
MINING	0	0	1.7	1.7	0	0	3.4	3.4	0	0	5.4	5.4	10.5
THERMAL POWER COOLING	0	0.0	0.0	0.0	0	15.8	299.9	315.7	0	30.0	570.3	600.3	916.0
NON-WITHDRAWAL WATER USES													
MUNICIPAL WASTEWATER DISCHARGES	1,831.5	610.5	0	2,442.0	1,195.5	398.5	0	1,594.0	1,010.2	336.8	0	1,347.0	5,383.0
INDUSTRIAL WASTEWATER DISCHARGES	---	---	---	---	---	---	---	---	---	---	---	---	---
HYDROELECTRIC POWER	---	---	---	---	---	---	---	---	---	---	---	---	---
WATER ORIENTED OUTDOOR REC.	---	---	---	---	---	---	---	---	---	---	---	---	---
SPORT FISHING	10.1	22.4	0	32.5	5.4	8.4	0	13.8	8.4	9.9	0	18.3	64.6
RECREATIONAL BOATING	29.2	29.2	24.6	83.0	50.4	50.4	43.1	143.9	36.0	36.0	31.0	103.0	329.9

COMMERCIAL FISHING	---	---	---	---	---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	54.0	0	0	54.0	544.5	0	0	544.5	0	0	0	0	598.5
RELATED LAND USES & PROBLEMS													
AGRIC. LAND-TREATMENT	15.5	0	39.5	55.0	29.1	0	74.8	103.9	17.6	0	45.3	62.9	221.6
-CROPLAND DRAINAGE	17.3	0	40.4	57.7	30.2	0	70.6	200.8	19.9	0	46.4	66.3	224.6
FOREST LAND-TREATMENT	17.6	1.1	3.3	22.0	34.4	2.2	6.4	43.0	34.4	2.2	6.4	43.0	108.0
SHORELAND EROSION	1.3	0	5.0	6.3	0.6	0	2.3	2.9	0.6	0	2.3	2.9	12.1
STREAMBANK EROSION	1.0	0	2.8	3.8	3.2	0	8.3	11.5	5.4	0	13.8	19.2	34.5
FLOOD PLAINS-URBAN	---	---	---	---	---	---	---	---	---	---	---	---	---
-URBAN	245.5	0	81.7	327.2	153.3	0	51.0	204.3	33.6	0	11.2	44.8	576.3
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
WILDLIFE MANAGEMENT	3.8	34.0	0	37.8	6.4	57.8	0	64.2	8.5	76.6	0	85.1	187.1
AESTHETIC & CULTURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	111.2	206.5	0	317.7	140.3	260.7	0	401.0	116.6	216.2	0	332.8	1051.5
-EXTENSIVE	---	---	---	---	---	---	---	---	---	---	---	---	---
TOTAL	2,414.7	1,082.5	235.3	3,732.5	2,290.4	1,020.0	695.4	4,005.8	1,413.5	992.8	913.7	3,320.0	1,158.3

TABLE 1-221 Lake Erie, Operation, Maintenance, and Replacement Costs, Proposed Framework (in $1,000,000)

RESOURCE USE CATEGORY	1971-1980				1981-2000				2001-2020				
	Federal	Non-Fed	Private	Total	Federal	Non-Fed	Private	Total	Federal	Non-Fed	Private	Total	Total
WATER WITHDRAWALS													
MUNICIPALLY SUPPLIED	0	101.5	0	101.5	0	466.1	0	466.1	0	1005.3	0	1005.3	1572.9
SELF-SUPPLIED INDUSTRIAL	0	0	26.7	26.7	0	0	342.4	342.4	0	0	891.8	891.8	1260.9
RURAL DOMESTIC & LIVESTOCK	0	0	1.7	1.7	0	0	13.1	13.1	0	0	24.4	24.4	39.2
IRRIGATION	0	0	0.9	0.9	0	0	4.8	4.8	0	0	7.7	7.7	13.4
MINING	0	0	3.4	3.4	0	0	28.1	28.1	0	0	64.2	64.2	95.7
THERMAL POWER COOLING	0	0.0	0.0	0.0	0	8.1	154.3	162.4	0	31.7	602.3	634.0	796.4
NON-WITHDRAWAL WATER USES													
MUNICIPAL WASTEWATER DISCHARGES	0	2,133.7	0	2,133.7	0	5,242.2	0	5,242.2	0	8,894.4	0	8,894.4	16270.3
INDUSTRIAL WASTEWATER DISCHARGES	---	---	---	---	---	---	---	---	---	---	---	---	---
HYDROELECTRIC POWER	---	---	---	---	---	---	---	---	---	---	---	---	---
WATER ORIENTED OUTDOOR REC.	---	---	---	---	---	---	---	---	---	---	---	---	---
SPORT FISHING	3.5	4.3	0	7.8	3.9	5.9	0	9.8	5.9	8.8	0	14.7	32.3
RECREATIONAL BOATING	0	0	16.7	16.7	0	0	119.6	119.6	0	0	218.4	218.4	354.7
COMMERCIAL FISHING	---	---	---	---	---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	6.0	0	0	6.0	154.0	0	0	154.0	284.0	0	0	284.0	444.0
RELATED LAND USES & PROBLEMS													
AGRIC. LAND-TREATMENT	0	0	1.3	1.3	0	0	12.0	12.0	0	0	19.2	19.2	32.5
-CROPLAND DRAINAGE	0	0	1.4	1.4	0	0	12.4	12.4	0	0	19.0	19.0	32.8
FOREST LAND-TREATMENT	0.1	0.1	0.4	0.6	0.6	1.2	4.0	5.8	0.8	1.5	5.3	7.6	14.0
SHORELAND EROSION	0.1	0	0.5	0.6	0.6	0	2.5	3.1	0.9	0	3.4	4.3	8.0
STREAMBANK EROSION	0	0	0.3	0.3	0	0	2.8	2.8	0	0	9.8	9.8	12.9
FLOOD PLAINS-URBAN	---	---	---	---	---	---	---	---	---	---	---	---	---
-URBAN	0.0	0.7	0	0.7	0.2	4.9	0	5.1	0.2	6.1	0	6.3	12.1
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
WILDLIFE MANAGEMENT	0	1.8	0	1.8	0	3.2	0	3.2	0	4.7	0	4.7	9.7
AESTHETIC & CULTURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	11.4	45.7	0	57.1	83.2	333.1	0	416.3	146.9	587.1	0	734.0	1207.4
-EXTENSIVE	---	---	---	---	---	---	---	---	---	---	---	---	---
TOTAL	21.1	2,287.8	53.3	2,362.2	242.5	6,064.7	696.0	7,003.2	438.7	10,539.6	1,865.5	12,843.5	22209.2

TABLE 1-222 Lake Ontario, Needs, Outputs, and Percent Needs Met, Normal Framework

RESOURCE USE CATEGORY	UNIT	1970 SUPPLY	1980 N	1980 O	1980 %	2000 N	2000 O	2000 %	2020 N	2020 O	2020 %
WATER WITHDRAWALS											
MUNICIPALLY SUPPLIED	MILLION GALLONS PER DAY	362	47.3	47.3	100	220	220	100	424	424	100
SELF-SUPPLIED INDUSTRIAL	MILLION GALLONS PER DAY	388	59	59	100	180	180	100	519	519	100
RURAL DOMESTIC & LIVESTOCK	MILLION GALLONS PER DAY	52.2	9.4	9.4	100	17.7	17.7	100	25.9	25.9	100
IRRIGATION	MILLION GALLONS PER DAY	48.1	50.5	50.5	100	126	126	100	214	214	100
MINING	MILLION GALLONS PER DAY	17.7	13.2	13.2	100	36	36	100	75.4	75.4	100
THERMAL POWER COOLING	MILLION GALLONS PER DAY	1,780	3,920	3,920	100	4,110	4,110	100	6,160	6,160	100
NON-WITHDRAWAL WATER USES											
MUNICIPAL WASTEWATER DISCHARGES	MILLION GALLONS PER DAY	368	427	427	100	585	585	100	773	773	100
INDUSTRIAL WASTEWATER DISCHARGES	MILLION GALLONS PER DAY	631	572	572	100	490	490	100	1,000	1,000	100
HYDROELECTRIC POWER	MILLION GALLONS PER DAY	NA	0	0	100	4,000	4,000	100	57,900	57,900	100
WATER ORIENTED OUTDOOR REC.	1000 RECREATION DAYS	12,700	10,100	8,590	85	21,200	23,000	over	35,600	32,200	90
	1000 ACRES WATER SURFACE	NA	---	---	---	---	---	---	---	---	---
SPORT FISHING	1000 ANGLER DAYS	11,800	5,350	4,210	79	9,700	8,390	86	15,200	13,800	91
	1000 ACRES WATER SURFACE	NA	---	---	---	---	---	---	---	---	---
RECREATIONAL BOATING	1000 BOAT DAYS	4,030	636	401	63	1,210	1,037	86	1,940	1,813	93
	1000 ACRES WATER SURFACE	750	750	---	---	750	---	---	750	---	---
COMMERCIAL FISHING	MILLION TONS PER YEAR	NA	---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	MILLION TONS PER YEAR	---	1.5	1.5	100	1.8	1.8	100	2.1	2.1	100
RELATED LAND USES & PROBLEMS											
AGRIC. LAND-TREATMENT	1000 ACRES	2,600	2,600	215	8	2,600	647	25	2,600	907	35
-CROPLAND DRAINAGE	1000 ACRES	604	604	78.1	13	604	144	24	604	144	24
FOREST LAND-TREATMENT	1000 ACRES	3,840	3,840	300	8	3,840	903	24	3,840	1,510	39
SHORELAND EROSION	MILES	186	186	3.4	2	186	10.1	5	186	16.8	9
STREAMBANK EROSION	MILES	1,510	1,510	46.2	3	1,510	139	9	1,510	231	15
	$1000 AVE ANNUAL DAMAGES	326	326	65	20	326	195.6	60	326	326	100
FLOOD PLAINS-URBAN	1000 ACRES	16.4	16.8	2.6	15	17.3	5.9	34	17.8	9.7	54
-URBAN	$1000 AVE ANNUAL DAMAGES	339	473	179	38	948	492	52	1,910	1,250	65
-RURAL	1000 ACRES	249	249	38.3	15	249	69.8	28	249	101	41
-RURAL	$1000 AVE ANNUAL DAMAGES	1,520	2,170	702	32	3,440	1,330	39	5,840	3,160	54
WILDLIFE MANAGEMENT	1000 ACRES	---	78	123	over	544	265	49	1,050	414	39
	1000 USER DAYS	2,110	491	180	37	983	580	59	1,510	773.0	51
AESTHETIC & CULTURAL	1000 ACRES	NA	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	1000 ACRES	---	1.4	5.7	over	4.2	13	over	8.2	16.6	over
-EXTENSIVE	1000 ACRES	NA	4.3	33.8	over	19.3	78.3	over	40.7	100	over

TABLE 1-223 Lake Ontario, Capital Costs, Normal Framework (in $1,000,000)

RESOURCE USE CATEGORY	1971-1980 Federal	1971-1980 Non-Fed	1971-1980 Private	1971-1980 Total	1981-2000 Federal	1981-2000 Non-Fed	1981-2000 Private	1981-2000 Total	2001-2020 Federal	2001-2020 Non-Fed	2001-2020 Private	2001-2020 Total	Total
WATER WITHDRAWALS													
MUNICIPALLY SUPPLIED	4.2	9.9	0	14.1	15.4	35.8	0	51.2	17.8	41.4	0	59.2	124.5
SELF-SUPPLIED INDUSTRIAL	0	0	4.9	4.9	0	0	10.0	10.0	0	0	28.2	28.2	43.1
RURAL DOMESTIC & LIVESTOCK	0.0	0	0.3	0.3	0.0	0	0.3	0.3	0.0	0	0.3	0.3	0.9
IRRIGATION	0	0	1.1	1.1	0	0	1.5	1.5	0	0	2.0	2.0	4.6
MINING	0	0	0.7	0.7	0	0	1.1	1.1	0	0	3.2	3.2	5.0
THERMAL POWER COOLING	0	6.9	130.2	137.1	0	1.4	27.5	28.9	0	3.6	68.2	71.8	237.8
NON-WITHDRAWAL WATER USES													
MUNICIPAL WASTEWATER DISCHARGES	90.1	29.9	0	120.0	60.8	20.2	0	81.0	110.3	36.7	0	147.0	348.0
INDUSTRIAL WASTEWATER DISCHARGES	---	---	---	---	---	---	---	---	---	---	---	---	---
HYDROELECTRIC POWER	---	---	---	---	---	---	---	---	---	---	---	---	---
WATER ORIENTED OUTDOOR REC.	---	---	---	---	---	---	---	---	---	---	---	---	---
SPORT FISHING	7.2	7.3	0	14.5	9.1	4.5	0	13.6	10.1	5.0	0	15.1	43.2
RECREATIONAL BOATING	11.9	11.9	10.1	33.9	12.2	12.2	10.5	34.9	11.4	11.3	9.7	32.4	101.2

COMMERCIAL FISHING	---	---	---	---	---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	0	0	0	0	0	0	0	0	0	0	0	0	0
RELATED LAND USES & PROBLEMS													
AGRIC. LAND-TREATMENT	2.4	0	6.3	8.7	4.9	0	12.7	17.6	2.9	0	7.6	10.5	36.8
-CROPLAND DRAINAGE	5.2	0	12.1	17.3	4.1	0	9.7	13.8	0	0	0	0	31.1
FOREST LAND-TREATMENT	13.6	0.8	2.6	17.0	27.2	1.7	5.1	34.0	27.2	1.7	5.1	34.0	85.0
SHORELAND EROSION	0.7	0	2.5	3.2	1.3	0	5.0	6.3	1.3	0	5.0	6.3	15.8
STREAMBANK EROSION	0.4	0	1.1	1.5	1.3	0	3.2	4.5	2.1	0	5.4	7.5	13.5
FLOOD PLAINS-URBAN	---	---	---	---	---	---	---	---	---	---	---	---	---
-URBAN	19.6	0	6.6	26.2	103.2	0	34.3	137.5	0.3	0	0.1	0.4	164.1
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
WILDLIFE MANAGEMENT	1.4	12.6	0	14.0	3.6	32.6	0	36.2	2.3	21.0	0	23.3	73.5
AESTHETIC & CULTURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	31.0	57.7	0	88.7	31.6	58.8	0	90.4	28.2	52.4	0	80.6	259.7
-EXTENSIVE	---	---	---	---	---	---	---	---	---	---	---	---	---
TOTAL	187.7	157.0	178.5	503.2	274.7	167.2	120.9	562.8	213.9	173.1	134.8	521.8	1587.8

TABLE 1–224 Lake Ontario, Operation, Maintenance, and Replacement Costs, Normal Framework (in $1,000,000)

RESOURCE USE CATEGORY	1971-1980				1981-2000				2001-2020				
	Federal	Non-Fed	Private	Total	Federal	Non-Fed	Private	Total	Federal	Non-Fed	Private	Total	Total
WATER WITHDRAWALS													
MUNICIPALLY SUPPLIED	0	6.9	0	6.9	0	79.6	0	79.6	0	191.0	0	191.0	277.5
SELF-SUPPLIED INDUSTRIAL	0	0	4.4	4.4	0	0	35.4	35.4	0	0	103.5	103.5	143.3
RURAL DOMESTIC & LIVESTOCK	0	0	0.8	0.8	0	0	4.6	4.6	0	0	7.4	7.4	12.8
IRRIGATION	0	0	0.2	0.2	0	0	1.1	1.1	0	0	1.8	1.8	3.1
MINING	0	0	0.6	0.6	0	0	4.9	4.9	0	0	11.4	11.4	16.9
THERMAL POWER COOLING	0	1.8	33.4	35.2	0	7.3	137.3	144.6	0	9.3	175.5	184.8	364.6
NON-WITHDRAWAL WATER USES													
MUNICIPAL WASTEWATER DISCHARGES	0	63.0	0	63.0	0	168.0	0	168.0	0	176.0	0	176.0	407.0
INDUSTRIAL WASTEWATER DISCHARGES	---	---	---	---	---	---	---	---	---	---	---	---	---
HYDROELECTRIC POWER	---	---	---	---	---	---	---	---	---	---	---	---	---
WATER ORIENTED OUTDOOR REC.	---	---	---	---	---	---	---	---	---	---	---	---	---
SPORT FISHING	2.1	2.4	0	4.5	7.4	3.7	0	11.1	8.1	4.0	0	12.1	27.7
RECREATIONAL BOATING	0	0	9.1	9.1	0	0	57.9	57.9	0	0	100.1	100.1	167.1
COMMERCIAL FISHING	---	---	---	---	---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	0	0	0	0	0	0	0	0	0	0	0	0	0
RELATED LAND USES & PROBLEMS													
AGRIC. LAND-TREATMENT	0	0	0.2	0.2	0	0	1.8	1.8	0	0	3.2	3.2	5.2
-CROPLAND DRAINAGE	0	0	0.4	0.4	0	0	2.4	2.4	0	0	3.1	3.1	5.9
FOREST LAND-TREATMENT	0.0	0.1	0.4	0.5	0.3	0.7	2.5	3.5	0.7	1.4	4.8	6.9	10.9
SHORELAND EROSION	0.1	0	0.2	0.3	0.5	0	2.1	2.6	1.0	0	4.0	5.0	7.9
STREAMBANK EROSION	0	0	0.0	0.0	0	0	1.4	1.4	0	0	3.7	3.7	5.1
FLOOD PLAINS-URBAN	---	---	---	---	---	---	---	---	---	---	---	---	---
-URBAN	0.0	0.1	0	0.1	0.0	1.2	0	1.2	0.1	1.7	0	1.8	3.1
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
WILDLIFE MANAGEMENT	0	0.7	0	0.7	0	1.8	0	1.8	0	1.2	0	1.2	3.7
AESTHETIC & CULTURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	6.1	24.9	0	31.0	36.7	146.3	0	183.0	59.0	235.7	0	294.7	508.7
-EXTENSIVE	---	---	---	---	---	---	---	---	---	---	---	---	---
TOTAL	8.3	99.9	49.7	157.9	44.9	408.6	251.4	704.9	68.9	620.3	418.5	1107.7	1970.5

TABLE 1–225 Lake Ontario, Needs, Outputs, and Percent Needs Met, Proposed Framework

RESOURCE USE CATEGORY	UNIT	1970 SUPPLY	1980 N	1980 O	1980 %	2000 N	2000 O	2000 %	2020 N	2020 O	2020 %
WATER WITHDRAWALS											
MUNICIPALLY SUPPLIED	MILLION GALLONS PER DAY	362	47.3	47.3	100	220	220	100	424	424	100
SELF-SUPPLIED INDUSTRIAL	MILLION GALLONS PER DAY	388	59	59	100	180	180	100	519	519	100
RURAL DOMESTIC & LIVESTOCK	MILLION GALLONS PER DAY	52.2	9.4	9.4	100	17.7	17.7	100	25.9	25.9	100
IRRIGATION	MILLION GALLONS PER DAY	48.1	50.5	50.5	100	126	126	100	214	214	100
MINING	MILLION GALLONS PER DAY	17.7	13.2	13.2	100	36	36	100	75.4	75.4	100
THERMAL POWER COOLING	MILLION GALLONS PER DAY	1,780	3,920	3,920	100	4,110	4,110	100	6,160	6,160	100
NON-WITHDRAWAL WATER USES											
MUNICIPAL WASTEWATER DISCHARGES	MILLION GALLONS PER DAY	368	427	427	100	585	585	100	773	773	100
INDUSTRIAL WASTEWATER DISCHARGES	MILLION GALLONS PER DAY	631	572	572	100	490	490	100	1,000	1,000	100
HYDROELECTRIC POWER	MILLION GALLONS PER DAY	NA	0	0	100	4,000	4,000	100	57,900	57,900	100
WATER ORIENTED OUTDOOR REC.	1000 RECREATION DAYS	12,700	10,100	8,590	85	21,200	23,000	over	35,600	32,200	90
	1000 ACRES WATER SURFACE	NA	---	---	---	---	---	---	---	---	---
SPORT FISHING	1000 ANGLER DAYS	11,800	5,350	4,210	79	9,700	8,390	86	15,200	13,800	91
	1000 ACRES WATER SURFACE	NA	---	---	---	---	---	---	---	---	---
RECREATIONAL BOATING	1000 BOAT DAYS	4,030	636	401	63	1,210	1,037	86	1,940	1,813	93
	1000 ACRES WATER SURFACE	750	750	---	---	750	---	---	750	---	---
COMMERCIAL FISHING	MILLION TONS PER YEAR	NA	---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	MILLION TONS PER YEAR	---	1.5	1.5	100	1.8	1.8	100	2.1	2.1	100
RELATED LAND USES & PROBLEMS											
AGRIC. LAND-TREATMENT	1000 ACRES	2,600	2,600	485	19	2,600	1,390	53	2,600	1,940	75
-CROPLAND DRAINAGE	1000 ACRES	604	604	41.5	7	604	119	20	604	166	27
FOREST LAND-TREATMENT	1000 ACRES	3,840	3,840	392	10	3,840	1,180	31	3,840	1,960	51
SHORELAND EROSION	MILES	186	186	3.4	2	186	10.1	5	186	16.8	9
STREAMBANK EROSION	MILES	1,510	1,510	46.2	3	1,510	139	9	1,510	231	15
	$1000 AVE ANNUAL DAMAGES	326	326	65	20	326	195.6	60	326	326	100
FLOOD PLAINS-URBAN	1000 ACRES	16.4	16.8	2.6	15	17.3	5.9	34	17.8	9.7	54
-URBAN	$1000 AVE ANNUAL DAMAGES	339	473	179	38	948	492	52	1,910	1,250	65
-RURAL	1000 ACRES	249	249	38.3	15	249	69.8	28	249	101	41
-RURAL	$1000 AVE ANNUAL DAMAGES	1,520	2,170	702	32	3,440	1,330	39	5,840	3,160	54
WILDLIFE MANAGEMENT	1000 ACRES	---	78	123	over	544	265	49	1,050	414	39
	1000 USER DAYS	2,110	491	180	37	983	580	59	1,510	773.0	51
AESTHETIC & CULTURAL	1000 ACRES	NA	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	1000 ACRES	---	1.4	5.7	over	4.2	13	over	8.2	16.6	over
-EXTENSIVE	1000 ACRES	NA	4.3	33.8	over	19.3	78.3	over	40.7	100	over

TABLE 1–226 Lake Ontario, Capital Costs, Proposed Framework (in $1,000,000)

RESOURCE USE CATEGORY	1971-1980 Federal	1971-1980 Non-Fed	1971-1980 Private	1971-1980 Total	1981-2000 Federal	1981-2000 Non-Fed	1981-2000 Private	1981-2000 Total	2001-2020 Federal	2001-2020 Non-Fed	2001-2020 Private	2001-2020 Total	Total
WATER WITHDRAWALS													
MUNICIPALLY SUPPLIED	4.2	9.9	0	14.1	15.4	35.8	0	51.2	17.8	41.4	0	59.2	124.5
SELF-SUPPLIED INDUSTRIAL	0	0	4.9	4.9	0	0	10.0	10.0	0	0	28.2	28.2	43.1
RURAL DOMESTIC & LIVESTOCK	0.0	0	0.3	0.3	0.0	0	0.3	0.3	0.0	0	0.3	0.3	0.9
IRRIGATION	0	0	1.1	1.1	0	0	1.5	1.5	0	0	2.0	2.0	4.6
MINING	0	0	0.7	0.7	0	0	1.1	1.1	0	0	3.2	3.2	5.0
THERMAL POWER COOLING	0	6.9	130.2	137.1	0	1.4	27.5	28.9	0	3.6	68.2	71.8	237.8
NON-WITHDRAWAL WATER USES													
MUNICIPAL WASTEWATER DISCHARGES	974.2	324.8	0	1,299.0	222.8	74.2	0	297.0	145.5	48.5	0	194.0	1,790.0
INDUSTRIAL WASTEWATER DISCHARGES	---	---	---	---	---	---	---	---	---	---	---	---	---
HYDROELECTRIC POWER	---	---	---	---	---	---	---	---	---	---	---	---	---
WATER ORIENTED OUTDOOR REC.	---	---	---	---	---	---	---	---	---	---	---	---	---
SPORT FISHING	7.2	7.3	0	14.5	9.1	4.5	0	13.6	10.1	5.0	0	15.1	43.2
RECREATIONAL BOATING	11.9	11.9	10.1	33.9	12.2	12.2	10.5	34.9	11.4	11.3	9.7	32.4	101.2

RESOURCE USE CATEGORY	1971-1980 Federal	Non-Fed	Private	Total	1981-2000 Federal	Non-Fed	Private	Total	2001-2020 Federal	Non-Fed	Private	Total	Total
COMMERCIAL FISHING	---	---	---	---	---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	73.0	0	0	73.0	305.2	0	0	305.2	0	0	0	0	378.2
RELATED LAND USES & PROBLEMS													
AGRIC. LAND-TREATMENT	3.9	0	10.1	14.0	7.4	0	19.0	26.4	4.5	0	11.6	16.1	56.5
-CROPLAND DRAINAGE	2.0	0	4.5	6.5	3.7	0	8.5	12.2	2.2	0	5.2	7.4	26.1
FOREST LAND-TREATMENT	19.2	1.2	3.6	24.0	36.0	2.3	6.7	45.0	36.0	2.3	6.7	45.0	114.0
SHORELAND EROSION	0.7	0	2.5	3.2	1.3	0	5.0	6.3	1.3	0	5.0	6.3	15.8
STREAMBANK EROSION	0.4	0	1.1	1.5	1.3	0	3.2	4.5	2.1	0	5.4	7.5	13.5
FLOOD PLAINS-URBAN	---	---	---	---	---	---	---	---	---	---	---	---	---
-URBAN	19.6	0	6.6	26.2	103.2	0	34.3	137.5	0.3	0	0.1	0.4	164.1
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
WILDLIFE MANAGEMENT	1.4	12.6	0	14.0	3.6	32.6	0	36.2	2.3	21.0	0	23.3	73.5
AESTHETIC & CULTURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	31.0	57.7	0	88.7	31.6	58.8	0	90.4	28.2	52.4	0	80.6	259.7
-EXTENSIVE	---	---	---	---	---	---	---	---	---	---	---	---	---
TOTAL	1,148.7	432.3	175.7	1,756.7	752.8	221.8	127.6	1,102.2	261.7	185.5	145.6	592.8	3,451.7

TABLE 1-227 Lake Ontario, Operation, Maintenance, and Replacement Costs, Proposed Framework (in $1,000,000)

RESOURCE USE CATEGORY	1971-1980 Federal	Non-Fed	Private	Total	1981-2000 Federal	Non-Fed	Private	Total	2001-2020 Federal	Non-Fed	Private	Total	Total
WATER WITHDRAWALS													
MUNICIPALLY SUPPLIED	0	6.9	0	6.9	0	79.6	0	79.6	0	191.0	0	191.0	277.5
SELF-SUPPLIED INDUSTRIAL	0	0	4.4	4.4	0	0	35.4	35.4	0	0	103.5	103.5	143.3
RURAL DOMESTIC & LIVESTOCK	0	0	0.8	0.8	0	0	4.6	4.6	0	0	7.4	7.4	12.8
IRRIGATION	0	0	0.2	0.2	0	0	1.1	1.1	0	0	1.8	1.8	3.1
MINING	0	0	0.6	0.6	0	0	4.9	4.9	0	0	11.4	11.4	16.9
THERMAL POWER COOLING	0	1.8	33.4	35.2	0	7.3	137.3	144.6	0	9.3	175.5	184.8	364.6
NON-WITHDRAWAL WATER USES													
MUNICIPAL WASTEWATER DISCHARGES	0	439.4	0	439.4	0	1,040.3	0	1,040.3	0	1,714.0	0	1,714.0	3,193.7
INDUSTRIAL WASTEWATER DISCHARGES	---	---	---	---	---	---	---	---	---	---	---	---	---
HYDROELECTRIC POWER	---	---	---	---	---	---	---	---	---	---	---	---	---
WATER ORIENTED OUTDOOR REC.	---	---	---	---	---	---	---	---	---	---	---	---	---
SPORT FISHING	2.1	2.4	0	4.5	7.4	3.7	0	11.1	8.1	4.0	0	12.1	27.7
RECREATIONAL BOATING	0	0	9.1	9.1	0	0	57.9	57.9	0	0	100.1	100.1	167.1
COMMERCIAL FISHING	---	---	---	---	---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	0	0	0	0	0	0	0	0	0	0	0	0	0
RELATED LAND USES & PROBLEMS													
AGRIC. LAND-TREATMENT	0	0	0.3	0.3	0	0	3.0	3.0	0	0	5.0	5.0	8.3
-CROPLAND DRAINAGE	0	0	0.2	0.2	0	0	1.4	1.4	0	0	2.2	2.2	3.8
FOREST LAND-TREATMENT	0.1	0.1	0.5	0.7	0.5	1.0	3.7	5.2	0.9	1.8	6.4	9.1	15.0
SHORELAND EROSION	0.1	0	0.2	0.3	0.5	0	2.1	2.6	1.0	0	4.0	5.0	7.9
STREAMBANK EROSION	0	0	0.0	0.0	0	0	1.4	1.4	0	0	3.7	3.7	5.1
FLOOD PLAINS-URBAN	---	---	---	---	---	---	---	---	---	---	---	---	---
-URBAN	0.0	0.1	0	0.1	0.0	1.2	0	1.2	0.1	1.7	0	1.8	3.1
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
WILDLIFE MANAGEMENT	0	0.7	0	0.7	0	1.8	0	1.8	0	1.2	0	1.2	3.7
AESTHETIC & CULTURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	6.1	24.9	0	31.0	36.7	146.3	0	183.0	59.0	235.7	0	294.7	508.7
-EXTENSIVE	---	---	---	---	---	---	---	---	---	---	---	---	---
TOTAL	17.4	476.3	49.7	543.4	110.1	1,281.2	252.8	1,653.1	181.1	1,258.7	421.0	2,780.8	4,957.3

TABLE 1–228 Lake Superior, Comparison of PRO and NOR Land Treatment Programs (thousands of acres)

RESOURCE USE CATEGORY	Opportunity	NOR				PRO				Difference PRO Minus NOR			
		By 1980	1981-2000	2001-2020	TOTAL	By 1980	1981-2000	2001-2020	TOTAL	By 1980	1981-2000	2001-2020	TOTAL
AGRICULTURAL LAND TREATMENT	473	39	78	46	163	89.2	165.8	101.0	356.0	50.2	87.8	55.0	193.0
CROPLAND DRAINAGE	117	11.1	4.8	0	15.9	0.0	0.0	0.0	0.0	-11.1	-4.8	0	-15.9
FORESTED LAND	10,000	1,090	2,180.0	2,280.0	5,550.0	2,010.0	4,010.0	3,980.0	10,000.0	920.0	1,830.0	1,700.0	4,450.0

TABLE 1–229 Lake Michigan, Comparison of PRO and NOR Land Treatment Programs (thousands of acres)

RESOURCE USE CATEGORY	Opportunity	NOR				PRO				Difference PRO Minus NOR			
		By 1980	1981-2000	2001-2020	TOTAL	By 1980	1981-2000	2001-2020	TOTAL	By 1980	1981-2000	2001-2020	TOTAL
AGRICULTURAL LAND TREATMENT	8,950.0	730.0	1,460.0	870.0	3,060.0	1,630.0	3,000.0	1,510.0	6,140.0	900.0	1,540.0	640.0	3,080.0
CROPLAND DRAINAGE	1,520.0	142.0	55.0	178.0	375.0	275.0	411.0	272.0	958.0	133.0	356.0	94.0	583.0
FORESTED LAND	9,050.0	981	1,959.0	1,920.0	4,860.0	1,310.0	2,630.0	2,590.0	6,530.0	329.0	671.0	670.0	1,670.0

TABLE 1–230 Lake Huron, Comparison of PRO and NOR Land Treatment Programs (thousands of acres)

RESOURCE USE CATEGORY	Opportunity	NOR				PRO				Difference PRO Minus NOR			
		By 1980	1981-2000	2001-2020	TOTAL	By 1980	1981-2000	2001-2020	TOTAL	By 1980	1981-2000	2001-2020	TOTAL
AGRICULTURAL LAND TREATMENT	2,050.0	205.0	410.0	246.0	861.0	449.0	801.0	500.0	1,750.0	244.0	391.0	254.0	889.0
CROPLAND DRAINAGE	572.0	51.7	13.5	120.8	186.0	76.3	113.7	115.0	305.0	24.6	100.2	-5.8	119.0
FORESTED LAND	2,810.0	286.0	572.0	572.0	1,430.0	343.0	687.0	690.0	1,720.0	57.0	115.0	118.0	290.0

TABLE 1–231 Lake Erie, Comparison of PRO and NOR Land Treatment Programs (thousands of acres)

RESOURCE USE CATEGORY	Opportunity	NOR				PRO				Difference PRO Minus NOR			
		By 1980	1981-2000	2001-2020	TOTAL	By 1980	1981-2000	2001-2020	TOTAL	By 1980	1981-2000	2001-2020	TOTAL
AGRICULTURAL LAND TREATMENT	6,380.0	615.0	1,225.0	740.0	2,580.0	1,340.0	2,480.0	1,520.0	5,340.0	725.0	1,255.0	780.0	2,760.0
CROPLAND DRAINAGE	3,400.0	152.0	284.0	314.0	750.0	302.0	510.0	368.0	1,180.0	150.0	226.0	54.0	430.0
FORESTED LAND	2,230.0	172.0	344.0	344.0	860.0	313.0	621.0	626.0	1,560.0	141.0	277.0	282.0	700.0

TABLE 1–232 Lake Ontario, Comparison of PRO and NOR Land Treatment Programs (thousands of acres)

RESOURCE USE CATEGORY	Opportunity	NOR				PRO				Difference PRO Minus NOR			
		By 1980	1981-2000	2001-2020	TOTAL	By 1980	1981-2000	2001-2020	TOTAL	By 1980	1981-2000	2001-2020	TOTAL
AGRICULTURAL LAND TREATMENT	2,660.0	215.0	432.0	260.0	907.0	485.0	905.0	550.0	1,940.0	270.0	473.0	290.0	1,033.0
CROPLAND DRAINAGE	604.0	78.1	65.9	0.0	144.0	41.5	77.5	47.0	166.0	-36.6	11.6	47.0	22.0
FORESTED LAND	3,840.0	300.0	603.0	607.0	1,510.0	392.0	788.0	780.0	1,960.0	92.0	185.0	173.0	450.0

TABLE 1-233 Lake Superior, Comparison of Total Costs, NOR and PRO Frameworks (in $1,000,000)

	1971-1980						1971-2020					
	NORMAL			PROPOSED			NORMAL			PROPOSED		
RESOURCE USE CATEGORY	Capital	OM&R	TOTAL	Capital	OM&R	TOTAL	Capital	OM&R	TOTAL	Capital	OM&R	TOTAL
WATER WITHDRAWALS												
MUNICIPALLY SUPPLIED	0.9	0.5	1.4	0.9	0.5	1.4	6.9	18.5	25.4	6.9	18.5	25.4
SELF-SUPPLIED INDUSTRIAL	0.2	0.2	0.4	0.2	0.2	0.4	6.1	17.5	23.6	6.1	17.5	23.6
RURAL DOMESTIC & LIVESTOCK	0	0.1	0.1	0	0.1	0.1	0.3	5.2	5.5	0.3	5.2	5.5
IRRIGATION	0.3	0.0	0.3	0.3	0.0	0.3	0.9	0.7	1.6	0.9	0.7	1.6
MINING	2.6	2.3	4.9	2.6	2.3	4.9	12.7	47.1	59.8	12.7	47.1	59.8
THERMAL POWER COOLING	0	0	0	0	0	0	101.7	91.8	193.5	101.7	91.8	193.5
NON-WITHDRAWAL WATER USES												
MUNICIPAL WASTEWATER DISCHARGES	19.8	25.0	44.8	39.0	108.6	147.6	49.0	261.0	310.0	87.0	601.5	688.5
INDUSTRIAL WASTEWATER DISCHARGES	---	---	---	---	---	---	---	---	---	---	---	---
HYDROELECTRIC POWER	---	---	---	---	---	---	---	---	---	---	---	---
WATER ORIENTED OUTDOOR REC.	---	---	---	---	---	---	---	---	---	---	---	---
SPORT FISHING	5.7	2.4	8.1	5.7	2.4	8.1	11.8	15.1	26.9	11.8	15.1	26.9
RECREATIONAL BOATING	28.0	7.3	35.3	28.0	7.3	35.3	68.7	129.2	197.9	68.7	129.2	197.9
COMMERCIAL FISHING	---	---	---	---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	0	0	0	48.0	6.0	54.0	17.8	12.0	29.8	66.0	66.2	132.2
RELATED LAND USES & PROBLEMS												
AGRIC. LAND-TREATMENT	1.6	0.0	1.6	1.2	0.0	1.2	6.5	0.9	7.4	5.3	0.8	6.1
-CROPLAND DRAINAGE	2.4	0.1	2.5	0	0	0	3.4	0.7	4.1	0	0	0
FOREST LAND-TREATMENT	37.0	0.9	37.9	71.0	1.8	72.8	189.0	23.4	212.4	357.0	42.4	399.4
SHORELAND EROSION	3.8	0.4	4.2	3.8	0.4	4.2	18.9	9.5	28.4	18.9	9.5	28.4
STREAMBANK EROSION	3.1	0.3	3.4	3.1	0.3	3.4	27.9	11.2	39.1	27.9	11.2	39.1
FLOOD PLAINS--URBAN	---	---	---	---	---	---	---	---	---	---	---	---
--URBAN	4.8	0.0	4.8	4.8	0.0	4.8	9.1	1.3	10.4	9.1	1.3	10.4
--RURAL	---	---	---	---	---	---	---	---	---	---	---	---
--RURAL	---	---	---	---	---	---	---	---	---	---	---	---
WILDLIFE MANAGEMENT	8.3	0.4	8.7	8.3	0.4	8.7	49.4	2.5	51.9	49.4	2.5	51.9
AESTHETIC & CULTURAL	---	---	---	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION--INTENSIVE	53.1	7.7	60.8	53.1	7.7	60.8	94.1	163.5	257.6	94.1	163.5	257.6
-EXTENSIVE	---	---	---	---	---	---	---	---	---	---	---	---
TOTAL	171.6	47.6	219.2	270.0	138.0	408.0	674.2	811.1	1,485.3	923.8	1,224.0	2,147.8

TABLE 1-234 Lake Michigan, Comparison of Total Costs, NOR and PRO Frameworks (in $1,000,000)

	1971-1980						1971-2020					
	NORMAL			PROPOSED			NORMAL			PROPOSED		
RESOURCE USE CATEGORY	Capital	OM&R	TOTAL	Capital	OM&R	TOTAL	Capital	OM&R	TOTAL	Capital	OM&R	TOTAL
WATER WITHDRAWALS												
MUNICIPALLY SUPPLIED	133.7	77.3	211.0	133.7	77.3	211.0	790.2	2,051.1	2,841.3	790.2	2,051.1	2,841.3
SELF-SUPPLIED INDUSTRIAL	14.0	14.0	28.0	14.0	14.0	28.0	227.1	798.9	1,026.0	227.1	798.9	1,026.0
RURAL DOMESTIC & LIVESTOCK	1.6	3.2	4.8	1.6	3.2	4.8	6.1	69.1	75.2	6.1	69.1	75.2
IRRIGATION	10.0	1.5	11.5	10.0	1.5	11.5	29.8	24.5	54.3	29.8	24.5	54.3
MINING	0.7	0.7	1.4	0.7	0.7	1.4	6.8	27.0	33.8	6.8	27.0	33.8
THERMAL POWER COOLING	110.5	28.4	138.9	110.5	28.4	138.9	1,483.5	1,462.6	2,946.1	1,483.5	1,462.6	2,946.1
NON-WITHDRAWAL WATER USES												
MUNICIPAL WASTEWATER DISCHARGES	513.4	352.0	865.4	830.0	1,194.7	2,024.7	1,671.4	2,764.0	4,435.4	2,584.0	8,567.2	11,151.2
INDUSTRIAL WASTEWATER DISCHARGES	---	---	---	---	---	---	---	---	---	---	---	---
HYDROELECTRIC POWER	---	---	---	---	---	---	---	---	---	---	---	---
WATER ORIENTED OUTDOOR REC.	---	---	---	---	---	---	---	---	---	---	---	---
SPORT FISHING	17.3	5.5	22.8	17.3	5.5	22.8	41.3	51.3	92.6	41.3	51.3	92.6
RECREATIONAL BOATING	96.9	22.1	119.0	96.9	22.1	119.0	406.5	469.2	875.7	406.5	469.2	875.7

COMMERCIAL FISHING	---	---	---	---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	0	0	0	44.6	6.0	50.6	37.5	45.6	83.1	200.5	147.6	348.1
RELATED LAND USES & PROBLEMS												
AGRIC. LAND-TREATMENT	29.3	0.8	30.1	59.1	1.4	60.5	123.0	17.1	140.1	236.4	34.5	270.9
-CROPLAND DRAINAGE	34.3	0.8	35.1	42.2	1.1	43.3	91.2	12.2	103.4	149.8	22.6	172.4
FOREST LAND-TREATMENT	41.0	0.9	41.9	55.0	1.3	56.3	205.0	22.5	227.5	277.0	36.0	313.0
SHORELAND EROSION	13.3	1.3	14.6	13.3	1.3	14.6	66.5	33.2	99.7	66.5	33.2	99.7
STREAMBANK EROSION	6.7	0.7	7.4	6.7	0.7	7.4	60.4	24.9	85.3	60.4	24.9	85.3
FLOOD PLAINS-URBAN	---	---	---	---	---	---	---	---	---	---	---	---
-URBAN	161.6	0.3	161.9	161.6	0.3	161.9	222.7	4.7	227.4	222.7	4.7	227.4
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---
WILDLIFE MANAGEMENT	33.2	1.7	34.9	33.2	1.7	34.9	137.7	7.0	144.7	137.7	7.0	144.7
AESTHETIC & CULTURAL	---	---	---	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	222.9	41.8	264.7	222.9	41.8	264.7	727.2	866.5	1,593.7	727.2	866.5	1,593.7
-EXTENSIVE	---	---	---	---	---	---	---	---	---	---	---	---
TOTAL	1,440.4	553.0	1,993.4	1,853.3	1,403.0	3,256.3	6,333.9	8,751.4	15,085.3	7,653.5	14,697.9	22,351.4

TABLE 1-235 Lake Huron, Comparison of Total Costs, NOR and PRO Frameworks (in $1,000,000)

RESOURCE USE CATEGORY	1971-1980						1971-2020					
	NORMAL			PROPOSED			NORMAL			PROPOSED		
	Capital	OM&R	TOTAL	Capital	OM&R	TOTAL	Capital	OM&R	TOTAL	Capital	OM&R	TOTAL
WATER WITHDRAWALS												
MUNICIPALLY SUPPLIED	14.4	5.8	20.2	14.4	5.8	20.2	106.9	210.2	317.1	106.9	210.2	317.1
SELF-SUPPLIED INDUSTRIAL	8.9	8.2	17.1	8.9	8.2	17.1	71.5	552.9	624.4	71.5	552.9	624.4
RURAL DOMESTIC & LIVESTOCK	0.3	2.5	2.8	0.3	2.5	2.8	1.2	42.8	44.0	1.2	42.8	44.0
IRRIGATION	2.3	0.3	2.6	2.3	0.3	2.6	5.9	4.1	10.0	5.9	4.1	10.0
MINING	0.5	0.8	1.3	0.5	0.8	1.3	3.5	21.7	25.2	3.5	21.7	25.2
THERMAL POWER COOLING	39.5	10.2	49.7	39.5	10.2	49.7	656.9	632.5	1,289.4	656.9	632.5	1,289.4
NON-WITHDRAWAL WATER USES												
MUNICIPAL WASTEWATER DISCHARGES	70.1	42.0	112.1	174.0	232.3	406.3	257.3	436.0	693.3	482.0	1,654.9	2,136.9
INDUSTRIAL WASTEWATER DISCHARGES	---	---	---	---	---	---	---	---	---	---	---	---
HYDROELECTRIC POWER	---	---	---	---	---	---	---	---	---	---	---	---
WATER ORIENTED OUTDOOR REC.	---	---	---	---	---	---	---	---	---	---	---	---
SPORT FISHING	2.0	1.8	3.8	2.0	1.8	3.8	14.6	21.1	35.7	14.6	21.1	35.7
RECREATIONAL BOATING	30.2	7.7	37.9	30.2	7.7	37.9	122.1	147.2	269.3	122.1	147.2	269.3
COMMERCIAL FISHING	---	---	---	---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	0	0	0	76.0	9.0	85.0	340.0	240.0	580.0	439.0	354.0	793.0
RELATED LAND USES & PROBLEMS												
AGRIC. LAND-TREATMENT	8.9	0.2	9.1	16.9	0.4	17.3	37.0	5.2	42.2	67.4	9.9	77.3
-CROPLAND DRAINAGE	15.5	0.4	15.9	14.2	0.4	14.6	47.1	5.4	52.5	52.6	7.8	60.4
FOREST LAND-TREATMENT	14.0	0.4	14.4	16.0	0.4	16.4	68.0	6.6	74.6	84.0	10.8	94.8
SHORELAND EROSION	1.2	0.1	1.3	1.2	0.1	1.3	6.4	3.2	9.6	6.4	3.2	9.6
STREAMBANK EROSION	4.1	0.5	4.6	4.1	0.5	4.6	36.9	15.3	52.2	36.9	15.3	52.2
FLOOD PLAINS-URBAN	---	---	---	---	---	---	---	---	---	---	---	---
-URBAN	27.6	0.1	27.7	27.6	0.1	27.7	84.5	1.6	86.1	84.5	1.6	86.1
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---
WILDLIFE MANAGEMENT	27.8	1.4	29.2	27.8	1.4	29.2	109.9	5.5	115.4	109.9	5.5	115.4
AESTHETIC & CULTURAL	---	---	---	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	40.0	9.6	49.6	40.0	9.6	49.6	163.8	204.5	368.3	163.8	204.5	368.3
-EXTENSIVE	---	---	---	---	---	---	---	---	---	---	---	---
TOTAL	307.3	92.0	399.3	495.9	291.5	787.4	2,133.5	2,555.8	4,689.3	2,509.1	3,900.0	6,409.1

TABLE 1-236 Lake Erie, Comparison of Total Costs, NOR and PRO Frameworks (in $1,000,000)

RESOURCE USE CATEGORY	1971-1980						1971-2020					
	NORMAL			PROPOSED			NORMAL			PROPOSED		
	Capital	OM&R	TOTAL	Capital	OM&R	TOTAL	Capital	OM&R	TOTAL	Capital	OM&R	TOTAL
WATER WITHDRAWALS												
MUNICIPALLY SUPPLIED	255.5	101.5	357.0	255.5	101.5	357.0	986.0	1,572.9	2,558.9	986.0	1,572.9	2,558.9
SELF-SUPPLIED INDUSTRIAL	29.5	26.7	56.2	29.5	26.7	56.2	333.9	1,260.9	1,594.8	333.9	1,260.9	1,594.8
RURAL DOMESTIC & LIVESTOCK	0.4	1.7	2.1	0.4	1.7	2.1	2.5	39.2	41.7	2.5	39.2	41.7
IRRIGATION	6.4	0.9	7.3	6.4	0.9	7.3	17.6	13.7	31.3	17.3	13.4	30.7
MINING	2.0	3.3	5.3	1.7	3.4	5.1	17.5	117.7	135.2	10.5	95.7	106.2
THERMAL POWER COOLING	0.0	0.0	0.0	0.0	0.0	0.0	916.0	796.4	1,712.4	916.0	796.4	1,712.4
NON-WITHDRAWAL WATER USES												
MUNICIPAL WASTEWATER DISCHARGES	1,063.6	899.0	1,962.6	2,442.0	2,133.7	4,575.7	2,824.1	5,915.0	8,739.1	5,383.0	16,270.3	21,653.3
INDUSTRIAL WASTEWATER DISCHARGES	---	---	---	---	---	---	---	---	---	---	---	---
HYDROELECTRIC POWER	---	---	---	---	---	---	---	---	---	---	---	---
WATER ORIENTED OUTDOOR REC.	---	---	---	---	---	---	---	---	---	---	---	---
SPORT FISHING	32.5	7.8	40.3	32.5	7.8	40.3	64.6	32.3	96.9	64.6	32.3	96.9
RECREATIONAL BOATING	83.0	16.7	99.7	83.0	16.7	99.7	329.9	354.7	684.6	329.9	354.7	684.6
COMMERCIAL FISHING	---	---	---	---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	0	0	0	54.0	6.0	60.0	0	0	0	598.5	444.0	1,042.5
RELATED LAND USES & PROBLEMS												
AGRIC. LAND-TREATMENT	26.5	0.7	27.2	55.0	1.3	56.3	111.4	15.5	126.9	221.8	32.5	254.3
-CROPLAND DRAINAGE	44.3	1.1	45.4	57.7	1.4	59.1	205.1	26.1	231.2	224.8	32.8	257.6
FOREST LAND-TREATMENT	12.0	0.5	12.5	22.0	0.6	22.6	60.0	7.9	67.9	108.0	14.0	122.0
SHORELAND EROSION	6.3	0.6	6.9	6.3	0.6	6.9	12.1	8.0	20.1	12.1	8.0	20.1
STREAMBANK EROSION	3.8	0.3	4.1	3.8	0.3	4.1	34.5	12.9	47.4	34.5	12.9	47.4
FLOOD PLAINS--URBAN	---	---	---	---	---	---	---	---	---	---	---	---
-URBAN	327.2	0.7	327.9	327.2	0.7	327.9	576.3	12.1	588.4	576.3	12.1	588.4
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---
WILDLIFE MANAGEMENT	37.8	1.8	39.6	37.8	1.8	39.6	187.1	9.7	196.8	187.1	9.7	196.8
AESTHETIC & CULTURAL	---	---	---	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	317.7	57.1	374.8	317.7	57.1	374.8	1,051.5	1,207.4	2,258.9	1,051.5	1,207.4	2,258.9
-EXTENSIVE	---	---	---	---	---	---	---	---	---	---	---	---
TOTAL	2,248.5	1,120.4	3,368.9	3,732.5	2,362.2	6,094.7	7,730.1	11,402.4	19,132.5	11,058.3	22,209.2	33,267.5

TABLE 1-237 Lake Ontario, Comparison of Total Costs, NOR and PRO Frameworks (in $1,000,000)

RESOURCE USE CATEGORY	1971-1980						1971-2020					
	NORMAL			PROPOSED			NORMAL			PROPOSED		
	Capital	OM&R	TOTAL	Capital	OM&R	TOTAL	Capital	OM&R	TOTAL	Capital	OM&R	TOTAL
WATER WITHDRAWALS												
MUNICIPALLY SUPPLIED	14.1	6.9	21.0	14.1	6.9	21.0	124.5	277.5	402.0	124.5	277.5	402.0
SELF-SUPPLIED INDUSTRIAL	4.9	4.4	9.3	4.9	4.4	9.3	43.1	143.3	186.4	43.1	143.3	186.4
RURAL DOMESTIC & LIVESTOCK	0.3	0.8	1.1	0.3	0.8	1.1	0.9	12.8	13.7	0.9	12.8	13.7
IRRIGATION	1.1	0.2	1.3	1.1	0.2	1.3	4.6	3.1	7.7	4.6	3.1	7.7
MINING	0.7	0.6	1.3	0.7	0.6	1.3	5.0	16.9	21.9	5.0	16.9	21.9
THERMAL POWER COOLING	137.1	35.2	172.3	137.1	35.2	172.3	237.8	364.6	602.4	237.8	364.6	602.4
NON-WITHDRAWAL WATER USES												
MUNICIPAL WASTEWATER DISCHARGES	120.0	63.0	183.0	1,299.0	439.4	1,733.4	348.0	407.0	755.0	1,790.0	3,193.7	4,983.7
INDUSTRIAL WASTEWATER DISCHARGES	---	---	---	---	---	---	---	---	---	---	---	---
HYDROELECTRIC POWER	---	---	---	---	---	---	---	---	---	---	---	---
WATER ORIENTED OUTDOOR REC.	---	---	---	---	---	---	---	---	---	---	---	---
SPORT FISHING	14.5	4.5	19.0	14.5	4.5	19.0	43.2	27.7	70.9	43.2	27.7	70.9
RECREATIONAL BOATING	33.9	9.1	43.0	33.9	9.1	43.0	101.2	167.1	268.3	101.2	167.1	268.3

COMMERCIAL FISHING	---	---	---	---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	0	0	0	73.0	9.0	82.0	0	0	0	378.2	195.0	573.2
RELATED LAND USES & PROBLEMS												
AGRIC. LAND-TREATMENT	8.7	0.2	8.9	14.0	0.3	14.3	36.8	5.2	42.0	56.5	8.3	64.8
-CROPLAND DRAINAGE	17.3	0.4	17.7	6.5	0.2	6.7	31.1	5.9	37.0	26.1	3.8	29.9
FOREST LAND-TREATMENT	17.0	0.5	17.5	24.0	0.7	24.7	85.0	10.9	95.9	114.0	15.0	129.0
SHORELAND EROSION	3.2	0.3	3.5	3.2	0.3	3.5	15.8	7.9	23.7	15.8	7.9	23.7
STREAMBANK EROSION	1.5	0.0	1.5	1.5	0.0	1.5	13.5	5.1	18.6	13.5	5.1	18.6
FLOOD PLAINS-URBAN	---	---	---	---	---	---	---	---	---	---	---	---
-URBAN	26.2	0.1	26.3	26.2	0.1	26.3	164.1	3.1	167.2	164.1	3.1	167.2
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---
WILDLIFE MANAGEMENT	14.0	0.7	14.7	14.0	0.7	14.7	73.5	3.7	77.2	73.5	3.7	77.2
AESTHETIC & CULTURAL	---	---	---	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	88.7	31.0	119.7	88.7	31.0	119.7	259.7	508.7	768.4	259.7	508.7	768.4
-EXTENSIVE	---	---	---	---	---	---	---	---	---	---	---	---
TOTAL	503.2	157.9	661.1	1,756.7	543.4	2,300.1	1,587.8	1,970.5	3,558.3	3,451.7	4,957.3	8,409.0

TABLE 1-238 RBG 1.1, Needs, Outputs, and Percent Needs Met, Normal Framework

RESOURCE USE CATEGORY	UNIT	1970 SUPPLY	1980 N	1980 O	1980 %	2000 N	2000 O	2000 %	2020 N	2020 O	2020 %
WATER WITHDRAWALS											
MUNICIPALLY SUPPLIED	MILLION GALLONS PER DAY	33.2	3.3	3.3	100	13.2	13.2	100	25.3	25.3	100
SELF-SUPPLIED INDUSTRIAL	MILLION GALLONS PER DAY	94	+	---	---	+	---	---	20.0	20.0	100
RURAL DOMESTIC & LIVESTOCK	MILLION GALLONS PER DAY	7.5	0.3	0.3	100	1.9	1.9	100	2.5	2.5	100
IRRIGATION	MILLION GALLONS PER DAY	7.3	5.0	5.0	100	12.5	12.5	100	19.7	19.7	100
MINING	MILLION GALLONS PER DAY	512	30.0	30.0	100	62.0	62.0	100	107.0	107.0	100
THERMAL POWER COOLING	MILLION GALLONS PER DAY	312	0.0	0.0	---	849.5	849.5	100	2,038	2,038	100
NON-WITHDRAWAL WATER USES											
MUNICIPAL WASTEWATER DISCHARGES	MILLION GALLONS PER DAY	32.7	37.1	37.1	100	43.7	43.7	100	52.3	52.3	100
INDUSTRIAL WASTEWATER DISCHARGES	MILLION GALLONS PER DAY	31.5	23.6	23.6	100	23.6	23.6	100	34.9	34.9	100
HYDROELECTRIC POWER	MILLION GALLONS PER DAY	NA	0.0	---	---	0.0	---	---	0.0	---	---
WATER ORIENTED OUTDOOR REC.	1000 RECREATION DAYS	6,547	+	2,870	over	+	7,480	over	+	10,830	over
	1000 ACRES WATER SURFACE	NA	---	---	---	---	---	---	---	---	---
SPORT FISHING	1000 ANGLER DAYS	4,391	773	463	60	1,627	1,161	71	2,561	1,985	78
	1000 ACRES WATER SURFACE	NA	---	---	---	---	---	---	---	---	---
RECREATIONAL BOATING	1000 BOAT DAYS	1,759	250	230	92	397	410	over	550	623	over
	1000 ACRES WATER SURFACE	1,028	1,028	---	---	1,028	---	---	1,028	---	---
COMMERCIAL FISHING	MILLION TONS PER YEAR	NA	---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	MILLION TONS PER YEAR	---	89.3	89.3	100	121.8	121.8	100	159.9	159.9	100
RELATED LAND USES & PROBLEMS											
AGRIC. LAND--TREATMENT	1000 ACRES	317.6	317.6	27.6	9	317.6	83.0	26	317.6	116.4	37
-CROPLAND DRAINAGE	1000 ACRES	84.6	84.6	11.1	13	84.6	15.9	19	84.6	15.9	19
FOREST LAND--TREATMENT	1000 ACRES	5,640	5,640	616	11	5,640	1,848	33	5,640	3,180	56
SHORELAND EROSION	MILES	117.3	117.3	2.7	2	117.3	8.1	7	117.3	13.5	12
STREAMBANK EROSION	MILES	482	482	30.8	6	482	92.4	19	482	154.0	32
	$1000 AVE ANNUAL DAMAGES	32.7	32.7	6.5	20	32.7	19.6	60	32.7	32.7	100
FLOOD PLAINS--URBAN	1000 ACRES	1.1	1.1	0.5	45	1.1	0.8	72	1.1	0.9	82
-URBAN	$1000 AVE ANNUAL DAMAGES	320.8	409.5	166.6	41	610.4	484.0	79	954.5	814.2	85
-RURAL	1000 ACRES	131.9	131.9	51.3	39	131.9	55.8	42	131.9	61.2	46
-RURAL	$1000 AVE ANNUAL DAMAGES	54.4	69.2	36.3	52	117.7	46.0	39	199.7	56.5	28
WILDLIFE MANAGEMENT	1000 ACRES	----	0.0	202.0	over	60.0	667.0	over	150.0	1,214	over
	1000 USER DAYS	1,616	52.0	47.2	91	54.0	110.2	over	64.0	179.2	over
AESTHETIC & CULTURAL	1000 ACRES	NA	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	1000 ACRES	----	0.1	1.9	over	0.5	4.8	over	1.0	7.0	over
-EXTENSIVE	1000 ACRES	NA	0.0	3.5	over	0.0	16.0	over	1.1	16.0	over

TABLE 1-239 RBG 1.1, Capital Costs, Normal Framework (in $1,000,000)

RESOURCE USE CATEGORY	1971-1980 Federal	1971-1980 Non-Fed	1971-1980 Private	1971-1980 Total	1981-2000 Federal	1981-2000 Non-Fed	1981-2000 Private	1981-2000 Total	2001-2020 Federal	2001-2020 Non-Fed	2001-2020 Private	2001-2020 Total	Total
WATER WITHDRAWALS													
MUNICIPALLY SUPPLIED	0.3	0.6	0	0.9	0.8	1.9	0	2.7	1.0	2.3	0	3.3	6.9
SELF-SUPPLIED INDUSTRIAL	0	0	0	0	0	0	0	0	0	0	1.7	1.7	1.7
RURAL DOMESTIC & LIVESTOCK	0.0	0	0.0	0.0	0.0	0	0.1	0.1	0.0	0	0.0	0.0	0.1
IRRIGATION	0	0	0.2	0.2	0	0	0.2	0.2	0	0	0.2	0.2	0.6
MINING	0	0	2.0	2.0	0	0	2.2	2.2	0	0	2.9	2.9	7.1
THERMAL POWER COOLING	0	0	0	.0	0	1.5	28.2	29.7	0	2.1	39.5	41.6	71.3
NON-WITHDRAWAL WATER USES													
MUNICIPAL WASTEWATER DISCHARGES	9.6	3.2	0	12.8	5.5	1.8	0	7.3	6.8	2.3	0	9.1	29.2
INDUSTRIAL WASTEWATER DISCHARGES	---	---	---	---	---	---	---	---	---	---	---	---	---
HYDROELECTRIC POWER	---	---	---	---	---	---	---	---	---	---	---	---	---
WATER ORIENTED OUTDOOR REC.	---	---	---	---	---	---	---	---	---	---	---	---	---
SPORT FISHING	1.7	2.5	0	4.2	0.5	0.8	0	1.3	0.5	0.8	0	1.3	6.8
RECREATIONAL BOATING	8.7	8.7	7.4	24.8	6.6	6.6	5.7	18.9	5.9	5.9	5.1	16.9	60.6

COMMERCIAL FISHING	---	---	---	---	---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	0	0	0	0	17.8	0	0	17.8	0	0	0	0	17.8
RELATED LAND USES & PROBLEMS													
AGRIC. LAND-TREATMENT	0.3	0	0.8	1.1	0.6	0	1.6	2.2	0.4	0	1.0	1.4	4.7
-CROPLAND DRAINAGE	0.7	0	1.7	2.4	0.3	0	0.7	1.0	0	0	0	0	3.4
FOREST LAND-TREATMENT	16.8	1.0	3.2	21.0	34.4	2.1	6.5	43.0	34.4	2.1	6.5	43.0	107.0
SHORELAND EROSION	0.4	0	1.4	1.8	0.7	0	2.8	3.5	0.7	0	2.9	3.6	8.9
STREAMBANK EROSION	0.3	0	0.7	1.0	0.8	0	2.2	3.0	1.4	0	3.6	5.0	9.0
FLOOD PLAINS-URBAN	---	---	---	---	---	---	---	---	---	---	---	---	---
-URBAN	2.6	0	0.8	3.4	2.2	0	0.7	2.9	0.9	0.5	0	1.4	7.7
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
WILDLIFE MANAGEMENT	0.5	4.9	0	5.4	1.4	12.9	0	14.3	1.9	17.4	0	19.3	39.0
AESTHETIC & CULTURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	14.9	27.7	0	42.6	5.8	10.8	0	16.6	3.5	6.5	0	10.0	69.2
-EXTENSIVE	---	---	---	---	---	---	---	---	---	---	---	---	---
TOTAL	56.8	48.6	18.2	123.6	77.4	38.4	50.9	166.7	57.4	39.9	63.4	160.7	451.0

TABLE 1–240 RBG 1.1, Operation, Maintenance, and Replacement Costs, Normal Framework (in $1,000,000)

	1971-1980				1981-2000				2001-2020				
RESOURCE USE CATEGORY	Federal	Non-Fed	Private	Total	Federal	Non-Fed	Private	Total	Federal	Non-Fed	Private	Total	Total
WATER WITHDRAWALS													
MUNICIPALLY SUPPLIED	0	0.5	0	0.5	0	5.4	0	5.4	0	12.6	0	12.6	18.5
SELF-SUPPLIED INDUSTRIAL	0	0	0	0	0	0	0	0	0	0	3.3	3.3	3.3
RURAL DOMESTIC & LIVESTOCK	0	0	0.1	0.1	0	0	0.8	0.8	0	0	1.5	1.5	2.4
IRRIGATION	0	0	0.0	0.0	0	0	0.2	0.2	0	0	0.3	0.3	0.5
MINING	0	0	2.0	2.0	0	0	12.4	12.4	0	0	22.8	22.8	37.2
THERMAL POWER COOLING	0	0	0	0	0	0.8	14.5	15.3	0	2.6	49.4	52.0	67.3
NON-WITHDRAWAL WATER USES													
MUNICIPAL WASTEWATER DISCHARGES	0	16.2	0	16.2	0	87.8	0	87.8	0	103.2	0	103.2	207.2
INDUSTRIAL WASTEWATER DISCHARGES	---	---	---	---	---	---	---	---	---	---	---	---	---
HYDROELECTRIC POWER	---	---	---	---	---	---	---	---	---	---	---	---	---
WATER ORIENTED OUTDOOR REC.	---	---	---	---	---	---	---	---	---	---	---	---	---
SPORT FISHING	0.8	1.2	0	2.0	0.5	2.5	0	3.0	1.2	2.4	0	3.6	8.6
RECREATIONAL BOATING	0	0	6.7	6.7	0	0	41.7	41.7	0	0	70.2	70.2	118.6
COMMERCIAL FISHING	---	---	---	---	---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	0	0	0	0	4.0	0	0	4.0	8.0	0	0	8.0	12.0
RELATED LAND USES & PROBLEMS													
AGRIC. LAND-TREATMENT	0	0	0.0	0.0	0	0	0.2	0.2	0	0	0.4	0.4	0.6
-CROPLAND DRAINAGE	0	0	0.1	0.1	0	0	0.3	0.3	0	0	0.3	0.3	0.7
FOREST LAND-TREATMENT	0.0	0.1	0.4	0.5	0.4	0.8	3.0	4.2	0.8	1.7	6.0	8.5	13.2
SHORELAND EROSION	0.0	0	0.2	0.2	0.3	0	1.1	1.4	0.6	0	2.3	2.9	4.5
STREAMBANK EROSION	0	0	0.1	0.1	0	0	0.9	0.9	0	0	2.5	2.5	3.5
FLOOD PLAINS-URBAN	---	---	---	---	---	---	---	---	---	---	---	---	---
-URBAN	0.0	0.0	0	0.0	0.0	0.4	0	0.4	0.0	0.5	0	0.5	0.9
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
WILDLIFE MANAGEMENT	0	0.3	0	0.3	0	0.7	0	0.7	0	1.0	0	1.0	2.0
AESTHETIC & CULTURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	1.2	4.7	0	5.9	8.3	33.1	0	41.4	14.4	57.4	0	71.8	119.1
-EXTENSIVE	---	---	---	---	---	---	---	---	---	---	---	---	---
TOTAL	2.0	23.0	9.6	34.6	13.5	131.5	75.1	220.1	25.0	181.4	159.0	365.4	620.1

TABLE 1-241 RBG 1.1, Needs, Outputs, and Percent Needs Met, Proposed Framework

RESOURCE USE CATEGORY	UNIT	1970 SUPPLY	1980 N	1980 O	1980 %	2000 N	2000 O	2000 %	2020 N	2020 O	2020 %
WATER WITHDRAWALS											
MUNICIPALLY SUPPLIED	MILLION GALLONS PER DAY	33.2	3.3	3.3	100	13.2	13.2	100	25.3	25.3	100
SELF-SUPPLIED INDUSTRIAL	MILLION GALLONS PER DAY	94	+	---	---	+	---	---	20.0	20.0	100
RURAL DOMESTIC & LIVESTOCK	MILLION GALLONS PER DAY	7.5	0.3	0.3	100	1.9	1.9	100	2.5	2.5	100
IRRIGATION	MILLION GALLONS PER DAY	7.3	5.0	5.0	100	12.5	12.5	100	19.7	19.7	100
MINING	MILLION GALLONS PER DAY	542	30.0	30.0	100	62.0	62.0	100	107.0	107.0	100
THERMAL POWER COOLING	MILLION GALLONS PER DAY	312	0.0	0.0	---	849.5	849.5	100	2,038	2,038	100
NON-WITHDRAWAL WATER USES											
MUNICIPAL WASTEWATER DISCHARGES	MILLION GALLONS PER DAY	32.7	37.1	37.1	100	43.7	43.7	100	52.3	52.3	100
INDUSTRIAL WASTEWATER DISCHARGES	MILLION GALLONS PER DAY	31.5	23.6	23.6	100	23.6	23.6	100	34.9	34.9	100
HYDROELECTRIC POWER	MILLION GALLONS PER DAY	NA	0.0	---	---	0.0	---	---	0.0	---	---
WATER ORIENTED OUTDOOR REC.	1000 RECREATION DAYS	6,547	+	2,870	over	+	7,480	over	+	10,830	over
	1000 ACRES WATER SURFACE	NA	---	---	---	---	---	---	---	---	---
SPORT FISHING	1000 ANGLER DAYS	4,391	773	463	60	1,627	1,161	71	2,561	1,985	78
	1000 ACRES WATER SURFACE	NA	---	---	---	---	---	---	---	---	---
RECREATIONAL BOATING	1000 BOAT DAYS	1,759	250	230	92	397	410	over	550	623	over
	1000 ACRES WATER SURFACE	1,028	1,028	---	---	1,028	---	---	1,028	---	---
COMMERCIAL FISHING	MILLION TONS PER YEAR	NA	---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	MILLION TONS PER YEAR	---	89.3	89.3	100	121.8	121.8	100	159.9	159.9	100
RELATED LAND USES & PROBLEMS											
AGRIC. LAND-TREATMENT	1000 ACRES	317.6	317.6	58.5	18	317.6	167.2	53	317.6	233.0	73
-CROPLAND DRAINAGE	1000 ACRES	84.6	84.6	0.0	0	84.6	0.0	0	84.6	0.0	0
FOREST LAND-TREATMENT	1000 ACRES	5,640	5,640	1,129	20	5,640	3,385	60	5,640	5,640	100
SHORELAND EROSION	MILES	117.3	117.3		2	117.3	8.1	7	117.3	13.5	12
STREAMBANK EROSION	MILES	482	482	30.8	6	482	92.4	19	482	154.0	32
	$1000 AVE ANNUAL DAMAGES	32.7	32.7	6.5	20	32.7	19.6	60	32.7	32.7	100
FLOOD PLAINS-URBAN	1000 ACRES	1.1	1.1	0.5	45	1.1	0.8	72	1.1	0.9	82
-URBAN	$1000 AVE ANNUAL DAMAGES	320.8	409.5	166.6	41	610.4	484.0	79	954.5	814.2	85
-RURAL	1000 ACRES	131.9	131.9	51.3	39	131.9	55.8	42	131.9	61.2	46
-RURAL	$1000 AVE ANNUAL DAMAGES	54.4	69.2	36.3	52	117.7	46.0	39	199.7	56.5	28
WILDLIFE MANAGEMENT	1000 ACRES	---	0.0	202.0	over	60.0	667.0	over	150.0	1,214	over
	1000 USER DAYS	1,616	52.0	47.2	91	54.0	110.2	over	64.0	179.2	over
AESTHETIC & CULTURAL	1000 ACRES	NA	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	1000 ACRES	---	0.1	1.9	over	0.5	4.8	over	1.0	7.0	over
-EXTENSIVE	1000 ACRES	NA	0.0	3.5	over	0.0	16.0	over	1.1	16.0	over

TABLE 1-242 RBG 1.1, Capital Costs, Proposed Framework (in $1,000,000)

RESOURCE USE CATEGORY	1971-1980 Federal	1971-1980 Non-Fed	1971-1980 Private	1971-1980 Total	1981-2000 Federal	1981-2000 Non-Fed	1981-2000 Private	1981-2000 Total	2001-2020 Federal	2001-2020 Non-Fed	2001-2020 Private	2001-2020 Total	Total
WATER WITHDRAWALS													
MUNICIPALLY SUPPLIED	0.3	0.6	0	0.9	0.8	1.9	0	2.7	1.0	2.3	0	3.3	6.9
SELF-SUPPLIED INDUSTRIAL	0	0	0	0	0	0	0	0	0	0	1.7	1.7	1.7
RURAL DOMESTIC & LIVESTOCK	0.0	0	0.0	0.0	0.0	0	0.1	0.1	0.0	0	0.0	0.0	0.1
IRRIGATION	0	0	0.2	0.2	0	0	0.2	0.2	0	0	0.2	0.2	0.6
MINING	0	0	2.0	2.0	0	0	2.2	2.2	0	0	2.9	2.9	7.1
THERMAL POWER COOLING	0	0	0	0	0	1.5	28.2	29.7	0	2.1	39.5	41.6	71.3
NON-WITHDRAWAL WATER USES													
MUNICIPAL WASTEWATER DISCHARGES	27.0	9.0	0	36.0	17.3	5.7	0	23.0	13.5	4.5	0	18.0	77.0
INDUSTRIAL WASTEWATER DISCHARGES	---	---	---	---	---	---	---	---	---	---	---	---	---
HYDROELECTRIC POWER	---	---	---	---	---	---	---	---	---	---	---	---	---
WATER ORIENTED OUTDOOR REC.	---	---	---	---	---	---	---	---	---	---	---	---	---
SPORT FISHING	1.7	2.5	0	4.2	0.5	0.8	0	1.3	0.5	0.8	0	1.3	6.8
RECREATIONAL BOATING	8.7	8.7	7.4	24.8	6.6	6.6	5.7	18.9	5.9	5.9	5.1	16.9	60.6

COMMERCIAL FISHING	---	---	---	---	---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	48.0	0	0	48.0	17.8	0	0	17.8	0	0	0	0	65.8
RELATED LAND USES & PROBLEMS													
AGRIC. LAND-TREATMENT	0.2	0	0.5	0.7	0.5	0	1.3	1.8	0.3	0	0.6	0.9	3.4
-CROPLAND DRAINAGE	0	0	0	0	0	0	0	0	0	0	0	0	0
FOREST LAND-TREATMENT	31.2	2.0	5.8	39.0	64.0	4.0	12.0	80.0	64.0	4.0	12.0	80.0	199.0
SHORELAND EROSION	0.4	0	1.4	1.8	0.7	0	2.8	3.5	0.7	0	2.9	3.6	8.9
STREAMBANK EROSION	0.3	0	0.7	1.0	0.8	0	2.2	3.0	1.4	0	3.6	5.0	9.0
FLOOD PLAINS-URBAN	---	---	---	---	---	---	---	---	---	---	---	---	---
-URBAN	2.6	0	0.8	3.4	2.2	0	0.7	2.9	0.9	0.5	0	1.4	7.7
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
WILDLIFE MANAGEMENT	0.5	4.9	0	5.4	1.4	12.9	0	14.3	1.9	17.4	0	19.3	39.0
AESTHETIC & CULTURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	14.9	27.7	0	42.6	5.8	10.8	0	16.6	3.5	6.5	0	10.0	69.2
-EXTENSIVE	---	---	---	---	---	---	---	---	---	---	---	---	---
TOTAL	135.8	55.4	18.8	210.0	118.4	44.2	55.4	218.0	93.6	44.0	68.5	206.1	634.1

TABLE 1–243 RBG 1.1, Operation, Maintenance, and Replacement Costs, Proposed Framework (in $1,000,000)

	1971-1980				1981-2000				2001-2020				
RESOURCE USE CATEGORY	Federal	Non-Fed	Private	Total	Federal	Non-Fed	Private	Total	Federal	Non-Fed	Private	Total	Total
WATER WITHDRAWALS													
MUNICIPALLY SUPPLIED	0	0.5	0	0.5	0	5.4	0	5.4	0	12.6	0	12.6	18.5
SELF-SUPPLIED INDUSTRIAL	0	0	0	0	0	0	0	0	0	0	3.3	3.3	3.3
RURAL DOMESTIC & LIVESTOCK	0	0	0.1	0.1	0	0	0.8	0.8	0	0	1.5	1.5	2.4
IRRIGATION	0	0	0.0	0.0	0	0	0.2	0.2	0	0	0.3	0.3	0.5
MINING	0	0	2.0	2.0	0	0	12.4	12.4	0	0	22.8	22.8	37.2
THERMAL POWER COOLING	0	0	0	0	0	0.8	14.5	15.3	0	2.6	49.4	52.0	67.3
NON-WITHDRAWAL WATER USES													
MUNICIPAL WASTEWATER DISCHARGES	0	88.6	0	88.6	0	183.1	0	183.1	0	231.0	0	231.0	502.7
INDUSTRIAL WASTEWATER DISCHARGES	---	---	---	---	---	---	---	---	---	---	---	---	---
HYDROELECTRIC POWER	---	---	---	---	---	---	---	---	---	---	---	---	---
WATER ORIENTED OUTDOOR REC.	---	---	---	---	---	---	---	---	---	---	---	---	---
SPORT FISHING	0.8	1.2	0	2.0	0.5	2.5	0	3.0	1.2	2.4	0	3.6	8.6
RECREATIONAL BOATING	0	0	6.7	6.7	0	0	41.7	41.7	0	0	70.2	70.2	118.6
COMMERCIAL FISHING	---	---	---	---	---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	6.0	0	0	6.0	28.0	0	0	28.0	32.0	0	0	32.0	66.0
RELATED LAND USES & PROBLEMS													
AGRIC. LAND-TREATMENT	0	0	0	0	0	0	0.2	0.2	0	0	0.3	0.3	0.5
-CROPLAND DRAINAGE	0	0	0	0	0	0	0	0	0	0	0	0	0
FOREST LAND-TREATMENT	0	0.2	0.4	1.0	0.9	1.8	6.1	8.8	1.2	2.4	8.4	12.0	21.8
SHORELAND EROSION	0.0	0	0.2	0.2	0.3	0	1.1	1.4	0.6	0	2.3	2.9	4.5
STREAMBANK EROSION	0	0	0.1	0.1	0	0	0.9	0.9	0	0	2.5	2.5	3.5
FLOOD PLAINS-URBAN	---	---	---	---	---	---	---	---	---	---	---	---	---
-URBAN	0.0	0.0	0	0.0	0.0	0.4	0	0.4	0.0	0.5	0	0.5	0.9
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
WILDLIFE MANAGEMENT	0	0.3	0	0.3	0	0.7	0	0.7	0	1.0	0	1.0	2.0
AESTHETIC & CULTURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	1.2	4.7	0	5.9	8.3	33.1	0	41.4	14.4	57.4	0	71.8	119.1
-EXTENSIVE	---	---	---	---	---	---	---	---	---	---	---	---	---
TOTAL	8.1	95.5	9.3	113.4	38.0	227.8	77.9	343.7	49.4	309.9	161.0	520.3	977.4

TABLE 1–244 RBG 1.2, Needs, Outputs, and Percent Needs Met, Normal Framework

RESOURCE USE CATEGORY	UNIT	1970 SUPPLY	1980 N	1980 O	1980 %	2000 N	2000 O	2000 %	2020 N	2020 O	2020 %
WATER WITHDRAWALS											
MUNICIPALLY SUPPLIED	MILLION GALLONS PER DAY	15.3	+	---	---	+	---	---	+	---	---
SELF-SUPPLIED INDUSTRIAL	MILLION GALLONS PER DAY	31.5	2.1	2.1	100	14.9	14.9	100	52.8	52.8	100
RURAL DOMESTIC & LIVESTOCK	MILLION GALLONS PER DAY	5.0	0.0	0.0	100	1.1	1.1	100	2.1	2.1	100
IRRIGATION	MILLION GALLONS PER DAY	3.4	3.0	3.0	100	4.7	4.7	100	7.7	7.7	100
MINING	MILLION GALLONS PER DAY	34.5	8.9	8.9	100	35.3	35.3	100	82.7	82.7	100
THERMAL POWER COOLING	MILLION GALLONS PER DAY	204	0.0	0.0	---	246.2	246.2	100	869.8	869.8	100
NON-WITHDRAWAL WATER USES											
MUNICIPAL WASTEWATER DISCHARGES	MILLION GALLONS PER DAY	12.0	11.0	11.0	100	12.2	12.2	100	15.0	15.0	100
INDUSTRIAL WASTEWATER DISCHARGES	MILLION GALLONS PER DAY	23.7	20.8	20.8	100	16.1	16.1	100	26.1	26.1	100
HYDROELECTRIC POWER	MILLION GALLONS PER DAY	NA	0.0	---	---	0.0	---	---	0.0	---	---
WATER ORIENTED OUTDOOR REC.	1000 RECREATION DAYS	2,276	+	974	over	+	2,914	over	+	4,854	over
	1000 ACRES WATER SURFACE	NA	---	---	---	---	---	---	---	---	---
SPORT FISHING	1000 ANGLER DAYS	2,701	214	214	100	538	538	100	1,234	1,234	100
	1000 ACRES WATER SURFACE	NA	---	---	---	---	---	---	---	---	---
RECREATIONAL BOATING	1000 BOAT DAYS	512	34	41	over	6	91	over	30	132	over
	1000 ACRES WATER SURFACE	769	769	---	---	769	---	---	769	---	---
COMMERCIAL FISHING	MILLION TONS PER YEAR	NA	---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	MILLION TONS PER YEAR	---	10.2	10.2	100	14.2	14.2	100	19.0	19.0	100
RELATED LAND USES & PROBLEMS											
AGRIC. LAND-TREATMENT	1000 ACRES	155.3	155.3	11.4	7	155.3	34.3	22	155.3	47.0	30
-CROPLAND DRAINAGE	1000 ACRES	32.5	32.5	0.0	0	32.5	0.0	0	32.5	0.0	0
FOREST LAND-TREATMENT	1000 ACRES	4,390	4,390	475	11	4,390	1,422	32	4,390	2,369	54
SHORELAND EROSION	MILES	38.4	38.4	3.0	8	38.4	9.1	24	38.4	15.2	40
STREAMBANK EROSION	MILES	948	948	63.4	7	948	190.2	20	948	317.0	33
	$1000 AVE ANNUAL DAMAGES	221.1	221.1	44.8	20	221.1	132.6	60	221.1	221.1	100
FLOOD PLAINS-URBAN	1000 ACRES	4.7	4.7	1.1	23	4.7	1.9	40	4.7	3.8	81
-URBAN	$1000 AVE ANNUAL DAMAGES	385	46.7	145.8	32	751.3	345.4	46	1,248	868.0	70
-RURAL	1000 ACRES	55.2	55.2	9.4	17	55.2	12.5	23	55.2	14.0	25
-RURAL	$1000 AVE ANNUAL DAMAGES	217.6	277.0	23.7	8	393.2	69.8	18	437.8	101.6	23
WILDLIFE MANAGEMENT	1000 ACRES	---	0.0	28.5	over	0.0	54.5	over	50.0	84.5	over
	1000 USER DAYS	1,405	30.0	46.0	over	14.4	84.4	over	55.8	184.4	90
AESTHETIC & CULTURAL	1000 ACRES	NA	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	1000 ACRES	---	0.0	0.6	over	0.0	1.8	over	0.0	3.0	over
-EXTENSIVE	1000 ACRES	NA	0.0	30.7	over	0.0	42.0	over	0.0	53.4	over

TABLE 1–245 RBG 1.2, Capital Costs, Normal Framework (in $1,000,000)

RESOURCE USE CATEGORY	1971-1980 Federal	1971-1980 Non-Fed	1971-1980 Private	1971-1980 Total	1981-2000 Federal	1981-2000 Non-Fed	1981-2000 Private	1981-2000 Total	2001-2020 Federal	2001-2020 Non-Fed	2001-2020 Private	2001-2020 Total	Total
WATER WITHDRAWALS													
MUNICIPALLY SUPPLIED	0	0	0	0	0	0	0	0	0	0	0	0	0
SELF-SUPPLIED INDUSTRIAL	0	0	0.2	0.2	0	0	1.1	1.1	0	0	3.1	3.1	4.4
RURAL DOMESTIC & LIVESTOCK	0	0	0	0	0.0	0	0.1	0.1	0.0	0	0.1	0.1	0.2
IRRIGATION	0	0	0.1	0.1	0	0	0.1	0.1	0	0	0.1	0.1	0.3
MINING	0	0	0.6	0.6	0	0	1.8	1.8	0	0	3.2	3.2	5.6
THERMAL POWER COOLING	0	0	0	0	0	0.4	8.2	8.6	0	1.1	20.7	21.8	30.4
NON-WITHDRAWAL WATER USES													
MUNICIPAL WASTEWATER DISCHARGES	5.2	1.8	0	7.0	4.1	1.4	0	5.5	5.5	1.8	0	0	19.8
INDUSTRIAL WASTEWATER DISCHARGES	---	---	---	---	---	---	---	---	---	---	---	---	---
HYDROELECTRIC POWER	---	---	---	---	---	---	---	---	---	---	---	---	---
WATER ORIENTED OUTDOOR REC.	---	---	---	---	---	---	---	---	---	---	---	---	---
SPORT FISHING	0.6	0.9	0	1.5	0.4	0.8	0	1.2	0.8	1.5	0	0	5.0
RECREATIONAL BOATING	1.1	1.1	1.0	3.2	1.2	1.2	0.9	3.3	0.6	0.6	0.4	0.4	8.1

COMMERCIAL FISHING	---	---	---	---	---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	0	0	0	0	0	0	0	0	0	0	0	0	0
RELATED LAND USES & PROBLEMS													
AGRIC. LAND-TREATMENT	0.1	0	0.4	0.5	0.3	0	0.6	0.9	0.1	0	0.3	0.4	1.8
-CROPLAND DRAINAGE	0	0	0	0	0	0	0	0	0	0	0	0	0
FOREST LAND-TREATMENT	12.8	0.8	2.4	16.0	26.4	1.6	5.0	33.0	26.4	1.6	5.0	33.0	82.0
SHORELAND EROSION	0.4	0	1.6	2.0	0.8	0	3.2	4.0	0.8	0	3.2	4.0	10.0
STREAMBANK EROSION	0.6	0	1.5	2.1	1.8	0	4.5	6.3	2.9	0	7.6	10.5	18.9
FLOOD PLAINS-URBAN	---	---	---	---	---	---	---	---	---	---	---	---	---
-URBAN	1.0	0	0.4	1.4	0	0	0	0	0	0	0	0	1.4
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
WILDLIFE MANAGEMENT	0.3	2.6	0	2.9	0.4	3.6	0	4.0	0.4	3.1	0	3.5	10.4
AESTHETIC & CULTURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	3.7	6.8	0	10.5	2.5	4.7	0	7.2	2.5	4.7	0	7.2	24.9
-EXTENSIVE	---	---	---	---	---	---	---	---	---	---	---	---	---
TOTAL	25.8	14.0	8.2	48.0	37.9	13.7	25.5	77.1	40.0	14.4	43.7	98.1	223.2

TABLE 1-246 RBG 1.2, Operation, Maintenance, and Replacement Costs, Normal Framework (in $1,000,000)

RESOURCE USE CATEGORY	1971-1980				1981-2000				2001-2020				
	Federal	Non-Fed	Private	Total	Federal	Non-Fed	Private	Total	Federal	Non-Fed	Private	Total	Total
WATER WITHDRAWALS													
MUNICIPALLY SUPPLIED	0	0	0	0	0	0	0	0	0	0	0	0	0
SELF-SUPPLIED INDUSTRIAL	0	0	0.2	0.2	0	0	4.0	4.0	0	0	10.0	10.0	14.2
RURAL DOMESTIC & LIVESTOCK	0	0	0	0	0	0	0.7	0.7	0	0	2.1	2.1	2.8
IRRIGATION	0	0	0.0	0.0	0	0	0.1	0.1	0	0	0.1	0.1	0.2
MINING	0	0	0.3	0.3	0	0	2.6	2.6	0	0	7.0	7.0	9.9
THERMAL POWER COOLING	0	0	0	0	0	0.2	4.2	4.4	0	1.0	19.1	20.1	24.5
NON-WITHDRAWAL WATER USES													
MUNICIPAL WASTEWATER DISCHARGES	0	8.8	0	8.8	0	20.0	0	20.0	0	25.0	0	25.0	53.8
INDUSTRIAL WASTEWATER DISCHARGES	---	---	---	---	---	---	---	---	---	---	---	---	---
HYDROELECTRIC POWER	---	---	---	---	---	---	---	---	---	---	---	---	---
WATER ORIENTED OUTDOOR REC.	---	---	---	---	---	---	---	---	---	---	---	---	---
SPORT FISHING	0.2	0.2	0	0.4	0.9	1.8	0	2.7	1.2	2.2	0	3.4	6.5
RECREATIONAL BOATING	0.0	0	0.6	0.6	0	0	4.0	4.0	0	0	6.0	6.0	10.6
COMMERCIAL FISHING	---	---	---	---	---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	0	0	0	0	0	0	0	0	0	0	0	0	0
RELATED LAND USES & PROBLEMS													
AGRIC. LAND-TREATMENT	0	0	0.0	0.0	0	0	0.1	0.1	0	0	0.2	0.2	0.3
-CROPLAND DRAINA	0	0	0	0	0	0	0	0	0	0	0	0	0
FOREST LAND-TREATMENT	0.0	0.1	0.3	0.4	0.3	0.6	2.3	3.2	0.7	1.3	4.6	6.6	10.2
SHORELAND EROSION	0.0	0	0.2	0.2	0.3	0	1.3	1.6	0.6	0	2.6	3.2	5.0
STREAMBANK EROSION	0	0	0.2	0.2	0	0	2.1	2.1	0	0	5.4	5.4	7.7
FLOOD PLAINS-URBAN	---	---	---	---	---	---	---	---	---	---	---	---	---
-URBAN	0.0	0.0	0	0.0	0.0	0.2	0	0.2	0.0	0.2	0	0.2	0.4
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
WILDLIFE MANAGEMENT	0	0.1	0	0.1	0	0.2	0	0.2	0	0.2	0	0.2	0.5
AESTHETIC & CULTURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	0.4	1.4	0	1.8	2.8	11.4	0	14.2	5.7	22.7	0	28.4	44.4
-EXTENSIVE	---	---	---	---	---	---	---	---	---	---	---	---	---
TOTAL	0.6	10.6	1.8	13.0	4.3	34.4	21.4	60.1	8.2	52.6	57.1	117.9	191.0

TABLE 1-247 RBG 1.2, Needs, Outputs, and Percent Needs Met, Proposed Framework

RESOURCE USE CATEGORY	UNIT	1970 SUPPLY	1980 N	1980 O	1980 %	2000 N	2000 O	2000 %	2020 N	2020 O	2020 %
WATER WITHDRAWALS											
MUNICIPALLY SUPPLIED	MILLION GALLONS PER DAY	15.3	+	---	---	+	---	---	+	---	---
SELF-SUPPLIED INDUSTRIAL	MILLION GALLONS PER DAY	31.5	2.1	2.1	100	14.9	14.9	100	52.8	52.8	100
RURAL DOMESTIC & LIVESTOCK	MILLION GALLONS PER DAY	5.0	0.0	0.0	100	1.1	1.1	100	2.1	2.1	100
IRRIGATION	MILLION GALLONS PER DAY	3.4	3.0	3.0	100	4.7	4.7	100	7.7	7.7	100
MINING	MILLION GALLONS PER DAY	34.5	8.9	8.9	100	35.3	35.3	100	82.7	82.7	100
THERMAL POWER COOLING	MILLION GALLONS PER DAY	204	0.0	0.0	---	246.2	246.2	100	869.8	869.8	100
NON-WITHDRAWAL WATER USES											
MUNICIPAL WASTEWATER DISCHARGES	MILLION GALLONS PER DAY	12.0	11.0	11.0	100	12.2	12.2	100	15.0	15.0	100
INDUSTRIAL WASTEWATER DISCHARGES	MILLION GALLONS PER DAY	23.7	20.8	20.8	100	16.1	16.1	100	26.1	26.1	100
HYDROELECTRIC POWER	MILLION GALLONS PER DAY	NA	0.0	---	---	0.0	---	---	0.0	---	---
WATER ORIENTED OUTDOOR REC.	1000 RECREATION DAYS	2,276	+	974	over	+	2,914	over	+	4,854	over
	1000 ACRES WATER SURFACE	NA	---	---	---	---	---	---	---	---	---
SPORT FISHING	1000 ANGLER DAYS	2,701	214	214	100	538	538	100	1,234	1,234	100
	1000 ACRES WATER SURFACE	NA	---	---	---	---	---	---	---	---	---
RECREATIONAL BOATING	1000 BOAT DAYS	512	34	41	over	6	91	over	30	132	over
	1000 ACRES WATER SURFACE	769	769	---	---	769	---	---	769	---	---
COMMERCIAL FISHING	MILLION TONS PER YEAR	NA	---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	MILLION TONS PER YEAR	---	10.2	10.2	100	14.2	14.2	100	19.0	19.0	100
RELATED LAND USES & PROBLEMS											
AGRIC. LAND-TREATMENT	1000 ACRES	155.3	155.3	30.7	20	155.3	88.0	57	155.3	122.8	79
-CROPLAND DRAINAGE	1000 ACRES	32.5	32.5	0	0	32.5	0	0	32.5	0	0
FOREST LAND-TREATMENT	1000 ACRES	4,390	4,390	878	20	4,390	2,634	60	4,390	4,390	100
SHORELAND EROSION	MILES	38.4	38.4	3.0	8	38.4	9.1	24	38.4	15.2	40
STREAMBANK EROSION	MILES	948	948	63.4	7	948	190.2	20	948	317.0	33
	$1000 AVE ANNUAL DAMAGES	221.1	221.1	44.8	20	221.1	132.6	60	221.1	221.1	100
FLOOD PLAINS-URBAN	1000 ACRES	4.7	4.7	1.1	23	4.7	1.9	40	4.7	3.8	81
-URBAN	$1000 AVE ANNUAL DAMAGES	385	46.7	145.8	32	751.3	345.4	46	1,248	868.0	70
-RURAL	1000 ACRES	55.2	55.2	9.4	17	55.2	12.5	23	55.2	14.0	25
-RURAL	$1000 AVE ANNUAL DAMAGES	217.6	277.0	23.7	8	393.2	69.8	18	437.8	101.6	23
WILDLIFE MANAGEMENT	1000 ACRES	---	0.0	28.5	over	0.0	54.5	over	50.0	84.5	over
	1000 USER DAYS	1,405	30.0	46.0	over	14.4	84.4	over	55.8	184.4	90
AESTHETIC & CULTURAL	1000 ACRES	NA	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	1000 ACRES	---	0.0	0.6	over	0.0	1.8	over	0.0	3.0	over
-EXTENSIVE	1000 ACRES	NA	0.0	30.7	over	0.0	42.0	over	0.0	53.4	over

TABLE 1-248 RBG 1.2, Capital Costs, Proposed Framework (in $1,000,000)

RESOURCE USE CATEGORY	1971-1980 Federal	1971-1980 Non-Fed	1971-1980 Private	1971-1980 Total	1981-2000 Federal	1981-2000 Non-Fed	1981-2000 Private	1981-2000 Total	2001-2020 Federal	2001-2020 Non-Fed	2001-2020 Private	2001-2020 Total	Total
WATER WITHDRAWALS													
MUNICIPALLY SUPPLIED	0	0	0	0	0	0	0	0	0	0	0	0	0
SELF-SUPPLIED INDUSTRIAL	0	0	0.2	0.2	0	0	1.1	1.1	0	0	3.1	3.1	4.4
RURAL DOMESTIC & LIVESTOCK	0	0	0	0	0.0	0	0.1	0.1	0.0	0	0.1	0.1	0.2
IRRIGATION	0	0	0.1	0.1	0	0	0.1	0.1	0	0	0.1	0.1	0.3
MINING	0	0	0.6	0.6	0	0	1.8	1.8	0	0	3.2	3.2	5.6
THERMAL POWER COOLING	0	0	0	0	0	0.4	8.2	8.6	0	1.1	20.7	21.8	30.4
NON-WITHDRAWAL WATER USES													
MUNICIPAL WASTEWATER DISCHARGES	2.3	0.7	0	3.0	1.5	0.5	0	2.0	3.7	1.3	5.0	0	10.0
INDUSTRIAL WASTEWATER DISCHARGES	---	---	---	---	---	---	---	---	---	---	---	---	---
HYDROELECTRIC POWER	---	---	---	---	---	---	---	---	---	---	---	---	---
WATER ORIENTED OUTDOOR REC.	---	---	---	---	---	---	---	---	---	---	---	---	---
SPORT FISHING	0.6	0.9	0	1.5	0.4	0.8	0	1.2	0.8	1.5	0	0	5.0
RECREATIONAL BOATING	1.1	1.1	1.0	3.2	1.2	1.2	0.9	3.3	0.6	0.6	0.4	0.4	8.1

COMMERCIAL FISHING	---	---	---	---	---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	0	0	0	0	0.2	0	0	0.2	0	0	0	0	0.2
RELATED LAND USES & PROBLEMS													
AGRIC. LAND-TREATMENT	0.1	0	0.4	0.5	0.3	0	0.6	0.9	0.1	0	0.4	0.5	1.9
-CROPLAND DRAINAGE	0	0	0	0	0	0	0	0	0	0	0	0	0
FOREST LAND-TREATMENT	25.6	1.6	4.8	32.0	50.4	3.1	9.5	63.0	50.4	3.1	9.5	63.0	158.0
SHORELAND EROSION	0.4	0	1.6	2.0	0.8	0	3.2	4.0	0.8	0	3.2	4.0	10.0
STREAMBANK EROSION	0.6	0	1.5	2.1	1.8	0	4.5	6.3	2.9	0	7.6	10.5	18.9
FLOOD PLAINS--URBAN	---	---	---	---	---	---	---	---	---	---	---	---	---
--URBAN	1.0	0	0.4	1.4	0	0	0	0	0	0	0	0	1.4
--RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
--RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
WILDLIFE MANAGEMENT	0.3	2.6	0	2.9	0.4	3.6	0	4.0	0.4	3.1	0	3.5	10.4
AESTHETIC & CULTURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION--INTENSIVE	3.7	6.8	0	10.5	2.5	4.7	0	7.2	2.5	4.7	0	7.2	24.9
-EXTENSIVE	---	---	---	---	---	---	---	---	---	---	---	---	---
TOTAL	33.4	13.7	10.6	60.0	59.5	14.3	30.0	103.8	62.2	15.4	48.3	125.9	289.7

TABLE 1-249 RBG 1.2, Operation, Maintenance, and Replacement Costs, Proposed Framework ($1,000,000)

	1971-1980				1981-2000				2001-2020				
RESOURCE USE CATEGORY	Federal	Non-Fed	Private	Total	Federal	Non-Fed	Private	Total	Federal	Non-Fed	Private	Total	Total
WATER WITHDRAWALS													
MUNICIPALLY SUPPLIED	0	0	0	0	0	0	0	0	0	0	0	0	0
SELF-SUPPLIED INDUSTRIAL	0	0	0.2	0.2	0	0	4.0	4.0	0	0	10.0	10.0	14.2
RURAL DOMESTIC & LIVESTOCK	0	0	0	0	0	0	0.7	0.7	0	0	2.1	2.1	2.8
IRRIGATION	0	0	0.0	0.0	0	0	0.1	0.1	0	0	0.1	0.1	0.2
MINING	0	0	0.3	0.3	0	0	2.6	2.6	0	0	7.0	7.0	9.9
THERMAL POWER COOLING	0	0	0	0	0	0.2	4.2	4.4	0	1.0	19.1	20.1	24.5
NON-WITHDRAWAL WATER USES													
MUNICIPAL WASTEWATER DISCHARGES	0	20.0	0	20.0	0	38.0	0	38.0	0	40.8	0	40.8	98.8
INDUSTRIAL WASTEWATER DISCHARGES	---	---	---	---	---	---	---	---	---	---	---	---	---
HYDROELECTRIC POWER	---	---	---	---	---	---	---	---	---	---	---	---	---
WATER ORIENTED OUTDOOR REC.	---	---	---	---	---	---	---	---	---	---	---	---	---
SPORT FISHING	0.2	0.2	0	0.4	0.9	1.8	0	2.7	1.2	2.2	0	3.4	6.5
RECREATIONAL BOATING	0.0	0	0.6	0.6	0	0	4.0	4.0	0	0	6.0	6.0	10.6
COMMERCIAL FISHING	---	---	---	---	---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	0	0	0	0	0	0	0	0	0	0	0	0	0
RELATED LAND USES & PROBLEMS													
AGRIC. LAND-TREATMENT	0	0	0.0	0.0	0	0	0.1	0.1	0	0	0.2	0.2	0.3
--CROPLAND DRAINAGE	0	0	0	0	0	0	0	0	0	0	0	0	0
FOREST LAND-TREATMENT	0.7	0.2	2.0	0.8	4.8	1.4	24.1	7.1	8.9	2.5	61.4	12.7	20.6
SHORELAND EROSION	0.0	0	0.2	0.2	0.3	0	1.3	1.6	0.6	0	2.6	3.2	5.0
STREAMBANK EROSION	0	0	0.2	0.2	0	0	2.1	2.1	0	0	5.4	5.4	7.7
FLOOD PLAINS--URBAN	---	---	---	---	---	---	---	---	---	---	---	---	---
--URBAN	0.0	0.0	0	0.0	0.0	0.2	0	0.2	0.0	0.2	0	0.2	0.4
--RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
WILDLIFE MANAGEMENT	0	0.1	0	0.1	0	0.2	0	0.2	0	0.2	0	0.2	0.5
AESTHETIC & CULTURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	0.4	1.4	0	1.8	2.8	11.4	0	14.2	5.7	22.7	0	28.4	44.4
--EXTENSIVE	---	---	---	---	---	---	---	---	---	---	---	---	---
TOTAL	0.7	21.9	2.0	24.6	4.8	53.2	24.1	82.1	8.9	69.6	61.4	139.9	246.6

TABLE 1–250 RBG 2.1, Needs, Outputs, and Percent Needs Met, Normal Framework

RESOURCE USE CATEGORY	UNIT	1970	1980			2000			2020		
		SUPPLY	N	O	%	N	O	%	N	O	%
WATER WITHDRAWALS											
MUNICIPALLY SUPPLIED	MILLION GALLONS PER DAY	92.8	34.2	34.2	100	102.7	102.7	100	202.4	202.4	100
SELF-SUPPLIED INDUSTRIAL	MILLION GALLONS PER DAY	320	105	105	100	159	159	100	346	346	100
RURAL DOMESTIC & LIVESTOCK	MILLION GALLONS PER DAY	47.5	9.9	9.9	100	23.0	23.0	100	35.2	35.2	100
IRRIGATION	MILLION GALLONS PER DAY	77.4	71.4	71.4	100	142.8	142.8	100	226.9	226.9	100
MINING	MILLION GALLONS PER DAY	2.6	0.6	0.6	100	3.2	3.2	100	7.9	7.9	100
THERMAL POWER COOLING	MILLION GALLONS PER DAY	669.2	777	777	100	2,108	2,108	100	4,526	4,526	100
NON-WITHDRAWAL WATER USES											
MUNICIPAL WASTEWATER DISCHARGES	MILLION GALLONS PER DAY	92.4	128.4	128.4	100	192.3	192.3	100	280	280	100
INDUSTRIAL WASTEWATER DISCHARGES	MILLION GALLONS PER DAY	319	291	291	100	254	254	100	425	425	100
HYDROELECTRIC POWER	MILLION GALLONS PER DAY	NA	0	0	---	0	0	---	0	0	---
WATER ORIENTED OUTDOOR REC.	1000 RECREATION DAYS	8,763	2,464	2,260	92	7,977	6,460	81	15,510	11,660	75
	1000 ACRES WATER SURFACE	NA	---	---	---	---	---	---	---	---	---
SPORT FISHING	1000 ANGLER DAYS	11,010	3,107	3,107	100	6,743	6,618	98	10,765	10,630	99
	1000 ACRES WATER SURFACE	NA	---	---	---	---	---	---	---	---	---
RECREATIONAL BOATING	1000 BOAT DAYS	4,440	750	270	36	1,620	709	44	2,790	1,220	44
	1000 ACRES WATER SURFACE	950	951	---	---	951	---	---	951	---	---
COMMERCIAL FISHING	MILLION TONS PER YEAR	NA	---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	MILLION TONS PER YEAR	---	3.8	3.8	100	4.7	4.7	100	5.0	5.0	100
RELATED LAND USES & PROBLEMS											
AGRIC. LAND-TREATMENT	1000 ACRES	2,225	2,225	222.5	10	2,225	667.6	30	2,225	934.7	42
-CROPLAND DRAINAGE	1000 ACRES	451	451	111	25	451	135	30	451	154	34
FOREST LAND-TREATMENT	1000 ACRES	3,046	3,046	405	13	3,046	1,214	40	3,046	2,023	66
SHORELAND EROSION	MILES	137.6	137.6	0	0	137.6	0	0	137.6	0	0
STREAMBANK EROSION	MILES	1,358	1,358	32	2	1,358	96	7	1,358	160	12
	$1000 AVE ANNUAL DAMAGES	195.7	195.7	39.1	20	195.7	117.4	60	195.7	195.7	100
FLOOD PLAINS-URBAN	1000 ACRES	13.6	14	1.0	7	14	3.9	28	14	8.0	57
-URBAN	$1000 AVE ANNUAL DAMAGES	2,335	3,007	146.7	5	5,317	1,190	22	10,260	7,743	75
-RURAL	1000 ACRES	648	648	74.6	12	648	164.9	25	648	198.4	31
-RURAL	$1000 AVE ANNUAL DAMAGES	1,199	1,600	312.8	20	1,991	625.3	31	2,140	733.3	34
WILDLIFE MANAGEMENT	1000 ACRES	---	0	470	over	495	1,190	over	1,125	1,901	over
	1000 USER DAYS	5,169	660	80.6	12	1,265	162.2	13	1,793	317.6	18
AESTHETIC & CULTURAL	1000 ACRES	NA	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	1000 ACRES	---	1.7	1.0	59	5.0	3.7	74	9.9	6.9	70
-EXTENSIVE	1000 ACRES	NA	7.3	3.5	48	23.7	16.6	70	47.5	40.7	86

TABLE 1–251 RBG 2.1, Capital Costs, Normal Framework (in $1,000,000)

RESOURCE USE CATEGORY	1971-1980				1981-2000				2001-2020				
	Federal	Non-Fed	Private	Total	Federal	Non-Fed	Private	Total	Federal	Non-Fed	Private	Total	Total
WATER WITHDRAWALS													
MUNICIPALLY SUPPLIED	2.9	6.9	0	9.8	5.3	12.4	0	17.7	7.7	17.9	0	25.6	53.1
SELF-SUPPLIED INDUSTRIAL	0	0	8.7	8.7	0	0	4.5	4.5	0	0	15.5	15.5	28.7
RURAL DOMESTIC & LIVESTOCK	0.1	0	0.4	0.5	0.1	0	0.5	0.6	0.1	0	0.5	0.6	1.7
IRRIGATION	0	0	2.5	2.5	0	0	2.4	2.4	0	0	2.6	2.6	7.5
MINING	0	0	0	0	0	0	0.1	0.1	0	0	0.2	0.2	0.3
THERMAL POWER COOLING	0	1.4	25.9	27.3	0	2.3	44.2	46.5	0	4.2	80.4	84.6	158.4
NON-WITHDRAWAL WATER USES													
MUNICIPAL WASTEWATER DISCHARGES	54.7	18.2	0	72.9	74.8	24.9	0	99.7	98.9	33.0	0	131.9	304.5
INDUSTRIAL WASTEWATER DISCHARGES	---	---	---	---	---	---	---	---	---	---	---	---	---
HYDROELECTRIC POWER	---	---	---	---	---	---	---	---	---	---	---	---	---
WATER ORIENTED OUTDOOR REC.	---	---	---	---	---	---	---	---	---	---	---	---	---
SPORT FISHING	0.3	0.5	0	0.8	0.2	0.7	0	0.9	0.5	0.9	0	1.4	3.1
RECREATIONAL BOATING	14.3	14.3	12.2	40.8	16.4	16.4	14.0	46.8	7.1	7.1	6.0	20.2	107.8

COMMERCIAL FISHING	---	---	---	---	---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	0	0	0	0	0	0	0	0	0	0	0	0	0
RELATED LAND USES & PROBLEMS													
AGRIC. LAND-TREATMENT	2.5	0	6.5	9.0	5.0	0	12.9	17.9	3.0	0	7.7	10.7	37.6
-CROPLAND DRAINAGE	7.3	0	17.0	24.3	1.8	0	4.3	6.1	1.4	0	3.2	4.6	35.0
FOREST LAND-TREATMENT	12.8	0.8	2.4	16.0	25.6	1.6	4.8	32.0	25.6	1.6	4.8	32.0	80.0
SHORELAND EROSION	0	0	0	0	0	0	0	0	0	0	0	0	0
STREAMBANK EROSION	0.3	0	0.8	1.1	0.9	0	2.3	3.2	1.5	0	3.8	5.3	9.6
FLOOD PLAINS-URBAN	---	---	---	---	---	---	---	---	---	---	---	---	---
-URBAN	5.4	0	1.8	7.2	3.1	0	1.0	4.1	14.6	0	4.9	19.5	30.8
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
WILDLIFE MANAGEMENT	1.5	13.9	0	15.4	2.8	24.8	0	27.6	2.2	19.5	0	21.7	64.7
AESTHETIC & CULTURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	7.4	13.6	0	21.0	11.1	20.5	0	31.6	20.9	38.7	0	59.6	112.2
-EXTENSIVE	---	---	---	---	---	---	---	---	---	---	---	---	---
TOTAL	109.5	69.6	78.2	257.3	147.1	103.6	91.0	341.7	183.5	122.9	129.6	436.0	1035.0

TABLE 1–252 RBG 2.1, Operation, Maintenance, and Replacement Costs, Normal Framework (in $1,000,000)

	1971-1980				1981-2000				2001-2020				
RESOURCE USE CATEGORY	Federal	Non-Fed	Private	Total	Federal	Non-Fed	Private	Total	Federal	Non-Fed	Private	Total	Total
WATER WITHDRAWALS													
MUNICIPALLY SUPPLIED	0	5.2	0	5.2	0	42.9	0	42.9	0	96.8	0	96.8	144.9
SELF-SUPPLIED INDUSTRIAL	0	0	8.8	8.8	0	0	46.8	46.8	0	0	94.8	94.8	150.4
RURAL DOMESTIC & LIVESTOCK	0	0	1.5	1.5	0	0	9.7	9.7	0	0	17.2	17.2	28.4
IRRIGATION	0	0	0.3	0.3	0	0	2.1	2.1	0	0	3.7	3.7	6.1
MINING	0	0	0	0	0	0	0.5	0.5	0	0	2.3	2.3	2.8
THERMAL POWER COOLING	0	0.4	6.6	7.0	0	2.6	49.2	49.2	0	6.0	113.9	119.9	178.7
NON-WITHDRAWAL WATER USES													
MUNICIPAL WASTEWATER DISCHARGES	0	74.0	0	74.0	0	208.0	0	208.0	0	286.0	0	286.0	568.0
INDUSTRIAL WASTEWATER DISCHARGES	---	---	---	---	---	---	---	---	---	---	---	---	---
HYDROELECTRIC POWER	---	---	---	---	---	---	---	---	---	---	---	---	---
WATER ORIENTED OUTDOOR REC.	---	---	---	---	---	---	---	---	---	---	---	---	---
SPORT FISHING	0.2	0.4	0	0.6	0.4	1.3	0	1.7	1.0	2.1	0	3.1	5.4
RECREATIONAL BOATING	0	0	7.2	7.2	0	0	45.8	45.8	0	0	72.0	72.0	125.0
COMMERCIAL FISHING	---	---	---	---	---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	0	0	0	0	0	0	0	0	0	0	0	0	0
RELATED LAND USES & PROBLEMS													
AGRIC. LAND-TREATMENT	0	0	0.2	0.2	0	0	1.8	1.8	0	0	3.2	3.2	5.2
-CROPLAND DRAINAGE	0	0	0.6	0.6	0	0	2.7	2.7	0	0	3.3	3.3	6.6
FOREST LAND-TREATMENT	0.3	0.1	0	0.4	0.3	0.6	1.9	2.8	0.6	1.1	4.0	5.7	8.9
SHORELAND EROSION	0	0	0	0	0	0	0	0	0	0	0	0	0
STREAMBANK EROSION	0	0	0.1	0.1	0	0	0.9	0.9	0	0	2.6	2.6	3.6
FLOOD PLAINS-URBAN	---	---	---	---	---	---	---	---	---	---	---	---	---
-URBAN	0	0	0	0	0.0	0.2	0	0.2	0.0	0.4	0	0.4	0.6
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
WILDLIFE MANAGEMENT	0	0.8	0	0.8	0	1.4	0	1.4	0	1.1	0	1.1	3.3
AESTHETIC & CULTURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	1.1	4.2	0	5.3	8.2	32.7	0	40.9	17.6	70.3	0	87.9	134.1
-EXTENSIVE	---	---	---	---	---	---	---	---	---	---	---	---	---
TOTAL	1.3	85.1	25.6	112.0	8.9	289.7	161.4	460.0	19.2	463.8	317.0	800.0	1372.0

TABLE 1–253 RBG 2.1, Needs, Outputs, and Percent Needs Met, Proposed Framework

RESOURCE USE CATEGORY	UNIT	1970 SUPPLY	1980 N	1980 O	1980 %	2000 N	2000 O	2000 %	2020 N	2020 O	2020 %
WATER WITHDRAWALS											
MUNICIPALLY SUPPLIED	MILLION GALLONS PER DAY	92.8	34.2	34.2	100	102.7	102.7	100	202.4	202.4	100
SELF-SUPPLIED INDUSTRIAL	MILLION GALLONS PER DAY	320	105	105	100	159	159	100	346	346	100
RURAL DOMESTIC & LIVESTOCK	MILLION GALLONS PER DAY	47.5	9.9	9.9	100	23.0	23.0	100	35.2	35.2	100
IRRIGATION	MILLION GALLONS PER DAY	77.4	71.4	71.4	100	142.8	142.8	100	226.9	226.9	100
MINING	MILLION GALLONS PER DAY	2.6	0.6	0.6	100	3.2	3.2	100	7.9	7.9	100
THERMAL POWER COOLING	MILLION GALLONS PER DAY	669.2	777	777	100	2,108	2,108	100	4,526	4,526	100
NON-WITHDRAWAL WATER USES											
MUNICIPAL WASTEWATER DISCHARGES	MILLION GALLONS PER DAY	92.4	128.4	128.4	100	192.3	192.3	100	280	280	100
INDUSTRIAL WASTEWATER DISCHARGES	MILLION GALLONS PER DAY	319	291	291	100	254	254	100	425	425	100
HYDROELECTRIC POWER	MILLION GALLONS PER DAY	NA	0	0	---	0	0	---	0	0	---
WATER ORIENTED OUTDOOR REC.	1000 RECREATION DAYS	8,763	2,464	2,260	92	7,977	6,460	81	15,510	11,660	75
	1000 ACRES WATER SURFACE	NA	---	---	---	---	---	---	---	---	---
SPORT FISHING	1000 ANGLER DAYS	11,010	3,107	3,107	100	6,743	6,618	98	10,765	10,630	99
	1000 ACRES WATER SURFACE	NA	---	---	---	---	---	---	---	---	---
RECREATIONAL BOATING	1000 BOAT DAYS	4,440	750	270	36	1,620	709	44	2,790	1,220	44
	1000 ACRES WATER SURFACE	950	951	---	---	951	---	---	951	---	---
COMMERCIAL FISHING	MILLION TONS PER YEAR	NA	---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	MILLION TONS PER YEAR	---	3.8	3.8	100	4.7	4.7	100	5.0	5.0	100
RELATED LAND USES & PROBLEMS											
AGRIC. LAND-TREATMENT	1000 ACRES	2,225	2,225	*489.5*	*22*	2,225	*1,402*	*63*	2,225	*1,958*	*88*
-CROPLAND DRAINAGE	1000 ACRES	451	451	*111*	*25*	451	*215*	*48*	451	*300*	*67*
FOREST LAND-TREATMENT	1000 ACRES	3,046	3,046	*609*	*20*	3,046	*1,828*	*60*	3,046	*3,046*	*100*
SHORELAND EROSION	MILES	137.6	137.6	0	0	137.6	0	0	137.6	0	0
STREAMBANK EROSION	MILES	1,358	1,358	32	2	1,358	96	7	1,358	160	12
	$1000 AVE ANNUAL DAMAGES	195.7	195.7	39.1	20	195.7	117.4	60	195.7	195.7	100
FLOOD PLAINS-URBAN	1000 ACRES	13.6	14	1.0	7	14	3.9	28	14	8.0	57
-URBAN	$1000 AVE ANNUAL DAMAGES	2,335	3,007	146.7	5	5,317	1,190	22	10,260	7,743	75
-RURAL	1000 ACRES	648	648	74.6	12	648	164.9	25	648	198.4	31
-RURAL	$1000 AVE ANNUAL DAMAGES	1,199	1,600	312.8	20	1,991	625.3	31	2,140	733.3	34
WILDLIFE MANAGEMENT	1000 ACRES	---	0	470	over	495	1,190	over	1,125	1,901	over
	1000 USER DAYS	5,169	660	80.6	12	1,265	162.2	13	1,793	317.6	18
AESTHETIC & CULTURAL	1000 ACRES	NA	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	1000 ACRES	---	1.7	1.0	59	5.0	3.7	74	9.9	6.9	70
-EXTENSIVE	1000 ACRES	NA	7.3	3.5	48	23.7	16.6	70	47.5	40.7	86

TABLE 1–254 RBG 2.1, Capital Costs, Proposed Framework (in $1,000,000)

RESOURCE USE CATEGORY	1971-1980 Federal	1971-1980 Non-Fed	1971-1980 Private	1971-1980 Total	1981-2000 Federal	1981-2000 Non-Fed	1981-2000 Private	1981-2000 Total	2001-2020 Federal	2001-2020 Non-Fed	2001-2020 Private	2001-2020 Total	Total
WATER WITHDRAWALS													
MUNICIPALLY SUPPLIED	2.9	6.9	0	9.8	5.3	12.4	0	17.7	7.7	17.9	0	25.6	53.1
SELF-SUPPLIED INDUSTRIAL	0	0	8.7	8.7	0	0	4.5	4.5	0	0	15.5	15.5	28.7
RURAL DOMESTIC & LIVESTOCK	0.1	0	0.4	0.5	0.1	0	0.5	0.6	0.1	0	0.5	0.6	1.7
IRRIGATION	0	0	2.5	2.5	0	0	2.4	2.4	0	0	2.6	2.6	7.5
MINING	0	0	0	0	0	0	0.1	0.1	0	0	0.2	0.2	0.3
THERMAL POWER COOLING	0	1.4	25.9	27.3	0	2.3	44.2	46.5	0	4.2	80.4	84.6	158.4
NON-WITHDRAWAL WATER USES													
MUNICIPAL WASTEWATER DISCHARGES	*76.5*	*25.5*	*0*	*102.0*	*75.0*	*25.0*	*0*	*100.0*	*83.2*	*27.8*	*0*	*111.0*	*313.0*
INDUSTRIAL WASTEWATER DISCHARGES	---	---	---	---	---	---	---	---	---	---	---	---	---
HYDROELECTRIC POWER	---	---	---	---	---	---	---	---	---	---	---	---	---
WATER ORIENTED OUTDOOR REC.	---	---	---	---	---	---	---	---	---	---	---	---	---
SPORT FISHING	0.3	0.5	0	0.8	0.2	0.7	0	0.9	0.5	0.9	0	1.4	3.1
RECREATIONAL BOATING	14.3	14.3	12.2	40.8	16.4	16.4	14.0	46.8	7.1	7.1	6.0	20.2	107.8

COMMERCIAL FISHING	---	---	---	---	---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	*7.0*	*0*	*0*	*7.0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*7.0*
RELATED LAND USES & PROBLEMS													
AGRIC. LAND-TREATMENT	*5.5*	*0*	*14.2*	*19.7*	*10.3*	*0*	*26.5*	*36.8*	*6.2*	*0*	*16.1*	*22.3*	*78.8*
-CROPLAND DRAINAGE	*4.4*	*0*	*10.2*	*14.6*	*4.3*	*0*	*10.1*	*14.4*	*3.4*	*0*	*7.8*	*11.2*	*40.2*
FOREST LAND-TREATMENT	*20.0*	*1.2*	*3.8*	*25.0*	*39.2*	*2.4*	*7.4*	*49.0*	*39.2*	*2.4*	*7.4*	*49.0*	*123.0*
SHORELAND EROSION	0	0	0	0	0	0	0	0	0	0	0	0	0
STREAMBANK EROSION	0.3	0	0.8	1.1	0.9	0	2.3	3.2	1.5	0	3.8	5.3	9.6
FLOOD PLAINS-URBAN	---	---	---	---	---	---	---	---	---	---	---	---	---
-URBAN	5.4	0	1.8	7.2	3.1	0	1.0	4.1	14.6	0	4.9	19.5	30.8
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
WILDLIFE MANAGEMENT	1.5	13.9	0	15.4	2.8	24.8	0	27.6	2.2	19.5	0	21.7	64.7
AESTHETIC & CULTURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	7.4	13.6	0	21.0	11.1	20.5	0	31.6	20.9	38.7	0	59.6	112.2
-EXTENSIVE	---	---	---	---	---	---	---	---	---	---	---	---	---
TOTAL	*145.6*	*77.3*	*80.5*	*303.4*	*168.7*	*104.5*	*113.0*	*386.2*	*186.6*	*118.5*	*145.2*	*450.3*	*1,139.9*

TABLE 1-255 RBG 2.1, Operation, Maintenance, and Replacement Costs, Proposed Framework (in $1,000,000)

	1971-1980				1981-2000				2001-2020				
RESOURCE USE CATEGORY	Federal	Non-Fed	Private	Total	Federal	Non-Fed	Private	Total	Federal	Non-Fed	Private	Total	Total
WATER WITHDRAWALS													
MUNICIPALLY SUPPLIED	0	5.2	0	5.2	0	42.9	0	42.9	0	96.8	0	96.8	144.9
SELF-SUPPLIED INDUSTRIAL	0	0	8.8	8.8	0	0	46.8	46.8	0	0	94.8	94.8	150.4
RURAL DOMESTIC & LIVESTOCK	0	0	1.5	1.5	0	0	9.7	9.7	0	0	17.2	17.2	28.4
IRRIGATION	0	0	0.3	0.3	0	0	2.1	2.1	0	0	3.7	3.7	6.1
MINING	0	0	0	0	0	0	0.5	0.5	0	0	2.3	2.3	2.8
THERMAL POWER COOLING	0	0.4	6.6	7.0	0	2.6	49.2	51.8	0	6.0	113.9	119.9	178.7
NON-WITHDRAWAL WATER USES													
MUNICIPAL WASTEWATER DISCHARGES	*0*	*159.3*	*0*	*159.3*	*0*	*370.0*	*0*	*370.0*	*0*	*577.4*	*0*	*577.4*	*1,106.7*
INDUSTRIAL WASTEWATER DISCHARGES	---	---	---	---	---	---	---	---	---	---	---	---	---
HYDROELECTRIC POWER	---	---	---	---	---	---	---	---	---	---	---	---	---
WATER ORIENTED OUTDOOR REC.	---	---	---	---	---	---	---	---	---	---	---	---	---
SPORT FISHING	0.2	0.4	0	0.6	0.4	1.3	0	1.7	1.0	2.1	0	3.1	5.4
RECREATIONAL BOATING	0	0	7.2	7.2	0	0	45.8	45.8	0	0	72.0	72.0	125.0
COMMERCIAL FISHING	---	---	---	---	---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	*1.0*	*0*	*0*	*1.0*	*4.0*	*0*	*0*	*4.0*	*4.0*	*0*	*0*	*4.0*	*9.0*
RELATED LAND USES & PROBLEMS													
AGRIC. LAND-TREATMENT	*0*	*0*	*0.5*	*0.5*	*0*	*0*	*4.3*	*4.3*	*0*	*0*	*6.7*	*6.7*	*11.5*
-CROPLAND DRAINAGE	*0*	*0*	*0.4*	*0.4*	*0*	*0*	*2.5*	*2.5*	*0*	*0*	*3.5*	*3.5*	*6.4*
FOREST LAND-TREATMENT	*0.1*	*0.1*	*0.4*	*0.6*	*0.6*	*1.1*	*3.9*	*5.6*	*1.0*	*2.0*	*6.8*	*9.8*	*16.0*
SHORELAND EROSION	0	0	0	0	0	0	0	0	0	0	0	0	0
STREAMBANK EROSION	0	0	0.1	0.1	0	0	0.9	0.9	0	0	2.6	2.6	3.6
FLOOD PLAINS-URBAN	---	---	---	---	---	---	---	---	---	---	---	---	---
-URBAN	0	0	0	0	0.0	0.2	0	0.2	0.0	0.4	0	0.4	0.6
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
WILDLIFE MANAGEMENT	0	0.8	0	0.8	0	1.4	0	1.4	0	1.1	0	1.1	3.3
AESTHETIC & CULTURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	1.1	4.2	0	5.3	8.2	32.7	0	40.9	17.6	70.3	0	87.9	134.1
-EXTENSIVE	---	---	---	---	---	---	---	---	---	---	---	---	---
TOTAL	*2.4*	*170.4*	*25.8*	*198.6*	*13.2*	*452.2*	*165.7*	*631.1*	*23.6*	*756.1*	*323.5*	*1,103.2*	*1,932.9*

TABLE 1–256 RBG 2.2, Needs, Outputs, and Percent Needs Met, Normal Framework

RESOURCE USE CATEGORY	UNIT	1970 SUPPLY	1980 N	1980 O	1980 %	2000 N	2000 O	2000 %	2020 N	2020 O	2020 %
WATER WITHDRAWALS											
MUNICIPALLY SUPPLIED	MILLION GALLONS PER DAY	1,645	355	511	over	986	1,170	over	1,770	1,920	over
SELF-SUPPLIED INDUSTRIAL	MILLION GALLONS PER DAY	4,790	440	24	5	1,890	721	38	4,020	1,990	50
RURAL DOMESTIC & LIVESTOCK	MILLION GALLONS PER DAY	87.6	6.6	1.3	20	21.7	4.3	20	27.3	5.5	20
IRRIGATION	MILLION GALLONS PER DAY	94	175	35	20	305	61	20	454	91	20
MINING	MILLION GALLONS PER DAY	21.9	26.6	2.1	8	66.7	5.3	8	140	11.2	8
THERMAL POWER COOLING	MILLION GALLONS PER DAY	3,208	1,312	1,312	100	8,915	8,915	100	25,240	25,240	100
NON-WITHDRAWAL WATER USES											
MUNICIPAL WASTEWATER DISCHARGES	MILLION GALLONS PER DAY	324.7	475.2	475.2	100	695.2	695.2	100	1,049	1,049	100
INDUSTRIAL WASTEWATER DISCHARGES	MILLION GALLONS PER DAY	3,274	2,793	2,793	100	2,685	2,685	100	4,349	4,349	100
HYDROELECTRIC POWER	MILLION GALLONS PER DAY	NA	0	0	---	0	0	---	0	0	---
WATER ORIENTED OUTDOOR REC.	1000 RECREATION DAYS	17,820	32,610	7,055	22	56,930	14,820	26	88,930	16,690	19
	1000 ACRES WATER SURFACE	NA	---	---	---	---	---	---	---	---	---
SPORT FISHING	1000 ANGLER DAYS	2,654	2,596	2,325	90	4,196	3,925	94	4,546	4,275	94
	1000 ACRES WATER SURFACE	NA	---	---	---	---	---	---	---	---	---
RECREATIONAL BOATING	1000 BOAT DAYS	1,280	384	164	43	632	315	50	909	498	55
	1000 ACRES WATER SURFACE	470	470	---	---	470	---	---	470	---	---
COMMERCIAL FISHING	MILLION TONS PER YEAR	NA	---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	MILLION TONS PER YEAR	---	79.9	79.9	100	108.4	108.4	100	140.1	140.1	100
RELATED LAND USES & PROBLEMS											
AGRIC. LAND-TREATMENT	1000 ACRES	2,170	2,170	52.1	2	2,170	155.9	7	2,170	208.0	10
-CROPLAND DRAINAGE	1000 ACRES	442	442	4.5	1	442	7.9	2	442	21.6	5
FOREST LAND-TREATMENT	1000 ACRES	212	212	19.7	9	212	51.4	24	212	51.4	24
SHORELAND EROSION	MILES	129.7	129.7	9.9	8	129.7	29.7	23	129.7	49.5	38
STREAMBANK EROSION	MILES	91	91	0.6	1	91	1.8	2	91	3.0	3
	$1000 AVE ANNUAL DAMAGES	32.2	32.2	6.4	20	32.2	19.3	60	32.2	32.2	100
FLOOD PLAINS-URBAN	1000 ACRES	4.4	5.8	2.4	41	7.5	4.2	56	9.8	8.8	90
-URBAN	$1000 AVE ANNUAL DAMAGES	8,700	13,060	12,050	92	27,100	25,325	93	56,050	54,290	97
-RURAL	1000 ACRES	58.3	56.9	27.8	49	55.2	38.1	69	52.9	45.4	86
-RURAL	$1000 AVE ANNUAL DAMAGES	230.4	296.6	156.5	53	456.6	304.6	67	679.2	501.4	74
WILDLIFE MANAGEMENT	1000 ACRES	---	1,384	164.6	12	2,730	334.3	12	4,406	527.9	12
	1000 USER DAYS	7,681	5,015	82.5	2	7,508	193.9	3	9,892	348.7	4
AESTHETIC & CULTURAL	1000 ACRES	NA	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	1000 ACRES	---	8.0	1.7	21	16	3.7	23	27	4.3	16
-EXTENSIVE	1000 ACRES	NA	51	9.9	19	98.5	20.9	21	162	24.6	15

TABLE 1–257 RBG 2.2, Capital Costs, Normal Framework (in $1,000,000)

RESOURCE USE CATEGORY	1971-1980 Federal	1971-1980 Non-Fed	1971-1980 Private	1971-1980 Total	1981-2000 Federal	1981-2000 Non-Fed	1981-2000 Private	1981-2000 Total	2001-2020 Federal	2001-2020 Non-Fed	2001-2020 Private	2001-2020 Total	Total
WATER WITHDRAWALS													
MUNICIPALLY SUPPLIED	29.1	67.8	0	96.9	51.2	119.4	0	170.6	62.4	145.5	0	207.9	475.4
SELF-SUPPLIED INDUSTRIAL	0	0	2.0	2.0	0	0	57.8	57.8	0	0	105.0	105.0	164.8
RURAL DOMESTIC & LIVESTOCK	0.0	0	0.1	0.1	0.0	0	0.1	0.1	0.0	0	0.1	0.1	0.3
IRRIGATION	0	0	1.2	1.2	0	0	0.9	0.9	0	0	1.0	1.0	3.1
MINING	0	0	0.1	0.1	0	0	0.1	0.1	0	0	0.3	0.3	0.5
THERMAL POWER COOLING	0	2.3	43.6	45.9	0	13.3	252.8	266.1	0	28.6	542.8	571.4	883.4
NON-WITHDRAWAL WATER USES													
MUNICIPAL WASTEWATER DISCHARGES	190.1	63.3	0	253.4	105.2	35.1	0	140.3	154.1	51.3	0	205.4	599.1
INDUSTRIAL WASTEWATER DISCHARGES	---	---	---	---	---	---	---	---	---	---	---	---	---
HYDROELECTRIC POWER	---	---	---	---	---	---	---	---	---	---	---	---	---
WATER ORIENTED OUTDOOR REC.	---	---	---	---	---	---	---	---	---	---	---	---	---
SPORT FISHING	3.0	6.3	0	9.3	1.5	2.6	0	4.1	1.4	2.7	0	4.1	17.5
RECREATIONAL BOATING	9.0	9.0	7.9	25.9	8.8	8.8	7.5	25.1	8.8	8.8	7.6	25.2	76.2

COMMERCIAL FISHING	---	---	---	---	---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	0	0	0	0	36.9	0	0	36.9	0	0	0	0	36.9
RELATED LAND USES & PROBLEMS													
AGRIC. LAND-TREATMENT	0.6	0	1.5	2.1	1.2	0	3.0	4.2	0.6	0	1.5	2.1	8.4
-CROPLAND DRAINAGE	0.5	0	1.0	1.5	0.6	0	1.5	2.1	1.9	0	4.3	6.2	9.8
FOREST LAND-TREATMENT	0.8	0.0	0.2	1.0	1.6	0.1	0.3	2.0	0	0	0	0	3.0
SHORELAND EROSION	1.4	0	5.5	6.9	2.8	0	11.0	13.8	2.8	0	11.0	13.8	34.5
STREAMBANK EROSION	0	0	0	0	0	0	0	0	0	0	0.1	0.1	0.1
FLOOD PLAINS-URBAN	---	---	---	---	---	---	---	---	---	---	---	---	---
-URBAN	76.3	0	25.4	101.7	0.4	0	0.1	0.5	5.8	0	1.9	7.7	109.9
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
WILDLIFE MANAGEMENT	0.4	3.8	0	4.2	0.8	7.4	0	8.2	1.0	8.9	0	9.9	22.3
AESTHETIC & CULTURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	31.7	58.9	0	90.6	40.0	74.2	0	114.2	6.8	12.5	0	19.3	224.1
-EXTENSIVE	---	---	---	---	---	---	---	---	---	---	---	---	---
TOTAL	342.9	211.4	88.5	642.8	251.0	260.9	335.1	847.0	245.6	258.3	675.6	1179.5	2669.3

TABLE 1–258 RBG 2.2, Operation, Maintenance, and Replacement Costs, Normal Framework (in $1,000,000)

	1971-1980				1981-2000				2001-2020				
RESOURCE USE CATEGORY	Federal	Non-Fed	Private	Total	Federal	Non-Fed	Private	Total	Federal	Non-Fed	Private	Total	Total
WATER WITHDRAWALS													
MUNICIPALLY SUPPLIED	0	55.0	0	55.0	0	417.0	0	417.0	0	859.0	0	859.0	1331.0
SELF-SUPPLIED INDUSTRIAL	0	0	1.8	1.8	0	0	110.2	110.2	0	0	400.6	400.6	512.6
RURAL DOMESTIC & LIVESTOCK	0	0	0.3	0.3	0	0	2.6	2.6	0	0	4.6	4.6	7.5
IRRIGATION	0	0	0.2	0.2	0	0	0.9	0.9	0	0	1.5	1.5	2.6
MINING	0	0	0.1	0.1	0	0	1.3	1.3	0	0	2.9	2.9	4.3
THERMAL POWER COOLING	0	0.6	11.2	11.8	0	9.2	174.9	184.1	0	30.7	584.1	614.8	810.7
NON-WITHDRAWAL WATER USES													
MUNICIPAL WASTEWATER DISCHARGES	0	104.0	0	104.0	0	290.0	0	290.0	0	382.0	0	382.0	776.0
INDUSTRIAL WASTEWATER DISCHARGES	---	---	---	---	---	---	---	---	---	---	---	---	---
HYDROELECTRIC POWER	---	---	---	---	---	---	---	---	---	---	---	---	---
WATER ORIENTED OUTDOOR REC.	---	---	---	---	---	---	---	---	---	---	---	---	---
SPORT FISHING	0.2	0.7	0	0.9	1.3	2.3	0	3.6	1.6	3.5	0	5.1	9.6
RECREATIONAL BOATING	0	0	5.9	5.9	0	0	35.6	35.6	0	0	59.0	59.0	100.5
COMMERCIAL FISHING	---	---	---	---	---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	0	0	0	0	9.0	0	0	9.0	18.0	0	0	18.0	27.0
RELATED LAND USES & PROBLEMS													
AGRIC. LAND-TREATMENT	0	0	0.1	0.1	0	0	0.4	0.4	0	0	0.7	0.7	1.2
-CROPLAND DRAINAGE	0.0	0	0.0	0.0	0.1	0	0.2	0.3	0.2	0	0.5	0.7	1.0
FOREST LAND-TREATMENT	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.2	0.0	0.0	0.2	0.2	0.4
SHORELAND EROSION	0.1	0	0.6	0.7	1.1	0	4.4	5.5	2.2	0	8.8	11.0	17.2
STREAMBANK EROSION	0	0	0.0	0.0	0	0	0.0	0.0	0	0	0.5	0.5	0.5
FLOOD PLAINS-URBAN	---	---	---	---	---	---	---	---	---	---	---	---	---
-URBAN	0.0	0.2	0	0.2	0.1	0.9	0	1.0	0.1	1.0	0	1.1	2.3
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
WILDLIFE MANAGEMENT	0	0.2	0	0.2	0	0.4	0	0.4	0	0.5	0	0.5	1.1
AESTHETIC & CULTURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	3.4	13.4	0	16.8	24.3	97.0	0	121.3	37.1	148.3	0	185.4	323.5
-EXTENSIVE	---	---	---	---	---	---	---	---	---	---	---	---	---
TOTAL	3.7	174.1	20.2	198.0	35.9	816.8	330.7	1183.4	59.2	1425.0	1063.4	2547.6	3929.0

TABLE 1-259 RBG 2.2, Needs, Outputs, and Percent Needs Met, Proposed Framework

RESOURCE USE CATEGORY	UNIT	1970	1980			2000			2020		
		SUPPLY	N	O	%	N	O	%	N	O	%
WATER WITHDRAWALS											
MUNICIPALLY SUPPLIED	MILLION GALLONS PER DAY	1,645	355	511	over	986	1,170	over	1,770	1,920	over
SELF-SUPPLIED INDUSTRIAL	MILLION GALLONS PER DAY	4,790	440	24	5	1,890	721	38	4,020	1,990	50
RURAL DOMESTIC & LIVESTOCK	MILLION GALLONS PER DAY	87.6	6.6	1.3	20	21.7	4.3	20	27.3	5.5	20
IRRIGATION	MILLION GALLONS PER DAY	94	175	35	20	305	61	20	454	91	20
MINING	MILLION GALLONS PER DAY	21.9	26.6	2.1	8	66.7	5.3	8	140	11.2	8
THERMAL POWER COOLING	MILLION GALLONS PER DAY	3,208	1,312	1,312	100	8,915	8,915	100	25,240	25,240	100
NON-WITHDRAWAL WATER USES											
MUNICIPAL WASTEWATER DISCHARGES	MILLION GALLONS PER DAY	324.7	475.2	475.2	100	695.2	695.2	100	1,049	1,049	100
INDUSTRIAL WASTEWATER DISCHARGES	MILLION GALLONS PER DAY	3,274	2,793	2,793	100	2,685	2,685	100	4,349	4,349	100
HYDROELECTRIC POWER	MILLION GALLONS PER DAY	NA	0	0	---	0	0	---	0	0	---
WATER ORIENTED OUTDOOR REC.	1000 RECREATION DAYS	17,820	32,610	7,055	22	56,930	14,820	26	88,930	16,690	19
	1000 ACRES WATER SURFACE	NA	---	---	---	---	---	---	---	---	---
SPORT FISHING	1000 ANGLER DAYS	2,654	2,596	2,325	90	4,196	3,925	94	4,546	4,275	94
	1000 ACRES WATER SURFACE	NA	---	---	---	---	---	---	---	---	---
RECREATIONAL BOATING	1000 BOAT DAYS	1,280	384	164	43	632	315	50	909	498	55
	1000 ACRES WATER SURFACE	470	470	---	---	470	---	---	470	---	---
COMMERCIAL FISHING	MILLION TONS PER YEAR	NA	---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	MILLION TONS PER YEAR	---	79.9	79.9	100	108.4	108.4	100	140.1	140.1	100
RELATED LAND USES & PROBLEMS											
AGRIC. LAND-TREATMENT	1000 ACRES	2,170	2,170	114.5	5	2,170	328.0	15	2,170	458.1	21
-CROPLAND DRAINAGE	1000 ACRES	442	442	19.9	5	442	57.0	13	442	79.6	18
FOREST LAND-TREATMENT	1000 ACRES	212	212	19.7	9	212	51.4	24	212	51.4	24
SHORELAND EROSION	MILES	129.7	129.7	9.9	8	129.7	29.7	23	129.7	49.5	38
STREAMBANK EROSION	MILES	91	91	0.6	1	91	1.8	2	91	3.0	3
	$1000 AVE ANNUAL DAMAGES	32.2	32.2	6.4	20	32.2	19.3	60	32.2	32.2	100
FLOOD PLAINS-URBAN	1000 ACRES	4.4	5.8	2.4	41	7.5	4.2	56	9.8	8.8	90
-URBAN	$1000 AVE ANNUAL DAMAGES	8,700	13,060	12,050	92	27,100	25,325	93	56,050	54,290	97
-RURAL	1000 ACRES	58.3	56.9	27.8	49	55.2	38.1	69	52.9	45.4	86
-RURAL	$1000 AVE ANNUAL DAMAGES	230.4	296.6	156.5	53	456.6	304.6	67	679.2	501.4	74
WILDLIFE MANAGEMENT	1000 ACRES	---	1,384	164.6	12	2,730	334.3	12	4,406	527.9	12
	1000 USER DAYS	7,681	5,015	82.5	2	7,508	193.9	3	9,892	348.7	4
AESTHETIC & CULTURAL	1000 ACRES	NA	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	1000 ACRES	---	8.0	1.7	21	16	3.7	23	27	4.3	16
-EXTENSIVE	1000 ACRES	NA	51	9.9	19	98.5	20.9	21	162	24.6	15

TABLE 1-260 RBG 2.2, Capital Costs, Proposed Framework (in $1,000,000)

RESOURCE USE CATEGORY	1971-1980				1981-2000				2001-2020				
	Federal	Non-Fed	Private	Total	Federal	Non-Fed	Private	Total	Federal	Non-Fed	Private	Total	Total
WATER WITHDRAWALS													
MUNICIPALLY SUPPLIED	29.1	67.8	0	96.9	51.2	119.4	0	170.6	62.4	145.5	0	207.9	475.4
SELF-SUPPLIED INDUSTRIAL	0	0	2.0	2.0	0	0	57.8	57.8	0	0	105.0	105.0	164.8
RURAL DOMESTIC & LIVESTOCK	0.0	0	0.1	0.1	0.0	0	0.1	0.1	0.0	0	0.1	0.1	0.3
IRRIGATION	0	0	1.2	1.2	0	0	0.9	0.9	0	0	1.0	1.0	3.1
MINING	0	0	0.1	0.1	0	0	0.1	0.1	0	0	0.3	0.3	0.5
THERMAL POWER COOLING	0	2.3	43.6	45.9	0	13.3	252.8	266.1	0	28.6	542.8	571.4	883.4
NON-WITHDRAWAL WATER USES													
MUNICIPAL WASTEWATER DISCHARGES	303.0	101.0	0	404.0	297.0	99.0	0	396.0	312.0	104.0	0	416.0	1216.0
INDUSTRIAL WASTEWATER DISCHARGES	---	---	---	---	---	---	---	---	---	---	---	---	---
HYDROELECTRIC POWER	---	---	---	---	---	---	---	---	---	---	---	---	---
WATER ORIENTED OUTDOOR REC.	---	---	---	---	---	---	---	---	---	---	---	---	---
SPORT FISHING	3.0	6.3	0	9.3	1.5	2.6	0	4.1	1.4	2.7	0	4.1	17.5
RECREATIONAL BOATING	9.0	9.0	7.9	25.9	8.8	8.8	7.5	25.1	8.8	8.8	7.6	25.2	76.2

COMMERCIAL FISHING	---	---	---	---	---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	22.0	0	0	22.0	132.3	0	0	132.3	0	0	0	0	154.3
RELATED LAND USES & PROBLEMS													
AGRIC. LAND-TREATMENT	1.3	0	3.3	4.6	2.4	0	6.2	8.6	1.5	0	3.7	5.2	18.4
-CROPLAND DRAINAGE	0.9	0	2.1	3.0	1.7	0	3.9	5.6	1.0	0	2.4	3.4	12.0
FOREST LAND-TREATMENT	0.8	0.0	0.2	1.0	1.6	0.1	0.3	2.0	0	0.0	0	0	3.0
SHORELAND EROSION	1.4	0	5.5	6.9	2.8	0	11.0	13.8	2.8	0	11.0	13.8	34.5
STREAMBANK EROSION	0	0	0	0	0	0	0	0	0	0	0.1	0.1	0.1
FLOOD PLAINS-URBAN	---	---	---	---	---	---	---	---	---	---	---	---	---
-URBAN	76.3	0	25.4	101.7	0.4	0	0.1	0.5	5.8	0	1.9	7.7	109.9
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
WILDLIFE MANAGEMENT	0.4	3.8	0	4.2	0.8	7.4	0	8.2	1.0	8.9	0	9.9	22.3
AESTHETIC & CULTURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	31.7	58.9	0	90.6	40.0	74.2	0	114.2	6.8	12.5	0	19.3	224.1
-EXTENSIVE	---	---	---	---	---	---	---	---	---	---	---	---	---
TOTAL	478.9	249.1	91.5	819.4	540.5	324.8	340.7	1,206.0	403.5	311.0	675.9	1,390.4	3,415.8

TABLE 1-261 RBG 2.2, Operation, Maintenance, and Replacement Costs, Proposed Framework (in $1,000,000)

	1971-1980				1981-2000				2001-2020				
RESOURCE USE CATEGORY	Federal	Non-Fed	Private	Total	Federal	Non-Fed	Private	Total	Federal	Non-Fed	Private	Total	Total
WATER WITHDRAWALS													
MUNICIPALLY SUPPLIED	0	55.0	0	55.0	0	417.0	0	417.0	0	859.0	0	859.0	1331.0
SELF-SUPPLIED INDUSTRIAL	0	0	1.8	1.8	0	0	110.2	110.2	0	0	400.6	400.6	512.6
RURAL DOMESTIC & LIVESTOCK	0	0	0.3	0.3	0	0	2.6	2.6	0	0	4.6	4.6	7.5
IRRIGATION	0	0	0.2	0.2	0	0	0.9	0.9	0	0	1.5	1.5	2.6
MINING	0	0	0.1	0.1	0	0	1.3	1.3	0	0	2.9	2.9	4.3
THERMAL POWER COOLING	0	0.6	11.2	11.8	0	9.2	174.9	184.1	0	30.7	584.1	614.8	810.7
NON-WITHDRAWAL WATER USES													
MUNICIPAL WASTEWATER DISCHARGES	0	491.4	0	491.4	0	1,223.1	0	1,223.1	0	1,971.3	0	1,971.3	3685.8
INDUSTRIAL WASTEWATER DISCHARGES	---	---	---	---	---	---	---	---	---	---	---	---	---
HYDROELECTRIC POWER	---	---	---	---	---	---	---	---	---	---	---	---	---
WATER ORIENTED OUTDOOR REC.	---	---	---	---	---	---	---	---	---	---	---	---	---
SPORT FISHING	0.2	0.7	0	0.9	1.3	2.3	0	3.6	1.6	3.5	0	5.1	9.6
RECREATIONAL BOATING	0	0	5.9	5.9	0	0	35.6	35.6	0	0	59.0	59.0	100.5
COMMERCIAL FISHING	---	---	---	---	---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	3.0	0	0	3.0	37.0	0	0	37.0	62.0	0	0	62.0	102.0
RELATED LAND USES & PROBLEMS													
AGRIC. LAND-TREATMENT	0	0	0.1	0.1	0	0	1.0	1.0	0	0	1.6	1.6	2.7
-CROPLAND DRAINAGE	0.0	0	0.1	0.1	0	0	0.6	0.6	0	0	1.1	1.1	1.8
FOREST LAND-TREATMENT	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.2	0.0	0.1	0.3	0.4	0.6
SHORELAND EROSION	0.1	0	0.6	0.7	1.1	0	4.4	5.5	2.2	0	8.8	11.0	17.2
STREAMBANK EROSION	0	0	0.0	0.0	0	0	0.0	0.0	0	0	0.5	0.5	0.5
FLOOD PLAINS-URBAN	---	---	---	---	---	---	---	---	---	---	---	---	---
-URBAN	0.0	0.2	0	0.2	0.1	0.9	0	1.0	0.1	1.0	0	1.1	2.3
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
WILDLIFE MANAGEMENT	0	0.2	0	0.2	0	0.4	0	0.4	0	0.5	0	0.5	1.1
AESTHETIC & CULTURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	3.4	13.4	0	16.8	24.3	97.0	0	121.3	37.1	148.3	0	185.4	323.5
-EXTENSIVE	---	---	---	---	---	---	---	---	---	---	---	---	---
TOTAL	6.7	561.5	20.3	588.5	63.8	174.9	331.7	2,145.4	103.0	3,014.4	1,065.0	4,182.4	6,916.3

TABLE 1–262 RBG 2.3, Needs, Outputs, and Percent Needs Met, Normal Framework

RESOURCE USE CATEGORY	UNIT	1970 SUPPLY	1980 N	1980 O	1980 %	2000 N	2000 O	2000 %	2020 N	2020 O	2020 %
WATER WITHDRAWALS											
MUNICIPALLY SUPPLIED	MILLION GALLONS PER DAY	265.9	81	81	100	281	281	100	560.3	560.3	100
SELF-SUPPLIED INDUSTRIAL	MILLION GALLONS PER DAY	454	40	40	100	139	139	100	328	328	100
RURAL DOMESTIC & LIVESTOCK	MILLION GALLONS PER DAY	82.3	11.5	11.5	100	35.8	35.8	100	52.2	52.2	100
IRRIGATION	MILLION GALLONS PER DAY	140.8	190.8	190.8	100	368	368	100	553.9	553.9	100
MINING	MILLION GALLONS PER DAY	16.3	10.6	10.6	100	38.9	38.9	100	91.4	91.4	100
THERMAL POWER COOLING	MILLION GALLONS PER DAY	1,079	1,069	1,069	100	6,038	6,038	100	11,560	11,560	100
NON-WITHDRAWAL WATER USES											
MUNICIPAL WASTEWATER DISCHARGES	MILLION GALLONS PER DAY	241.9	324.9	324.9	100	509.6	509.6	100	753.4	753.4	100
INDUSTRIAL WASTEWATER DISCHARGES	MILLION GALLONS PER DAY	245.8	161.5	161.5	100	140.8	140.8	100	237.3	237.3	100
HYDROELECTRIC POWER	MILLION GALLONS PER DAY	NA	0	0	---	0	0	---	0	0	---
WATER ORIENTED OUTDOOR REC.	1000 RECREATION DAYS	10,360	13,380	6,067	45	25,640	14,570	57	42,170	22,930	54
	1000 ACRES WATER SURFACE	NA	---	---	---	---	---	---	---	---	---
SPORT FISHING	1000 ANGLER DAYS	5,400	3,202	1,988	62	5,761	4,547	79	8,839	7,625	86
	1000 ACRES WATER SURFACE	NA	---	---	---	---	---	---	---	---	---
RECREATIONAL BOATING	1000 BOAT DAYS	3,516	1,524	168	11	2,604	601	23	3,954	1,086	27
	1000 ACRES WATER SURFACE	262	262	---	---	262	---	---	262	---	---
COMMERCIAL FISHING	MILLION TONS PER YEAR	NA	---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	MILLION TONS PER YEAR	---	4.6	4.6	100	5.8	5.8	100	6.9	6.9	100
RELATED LAND USES & PROBLEMS											
AGRIC. LAND-TREATMENT	1000 ACRES	3,540	3,540	354	10	3,540	1,062	30	3,540	1,487	42
-CROPLAND DRAINAGE	1000 ACRES	577.9	578	15.6	3	578	32.0	6	578	175	30
FOREST LAND-TREATMENT	1000 ACRES	1,230	1,230	96	8	1,230	289	23	1,230	482	39
SHORELAND EROSION	MILES	83.8	84	7.7	9	84	23.2	28	84	38.6	46
STREAMBANK EROSION	MILES	1,065	1,070	60.6	6	1,070	181.8	17	1,070	303	28
	$1000 AVE ANNUAL DAMAGES	91.4	91.4	18.3	20	91.4	54.8	60	91.4	91.4	100
FLOOD PLAINS-URBAN	1000 ACRES	49.6	51.6	17.3	34	53.3	30.2	57	55.3	46.5	84
-URBAN	$1000 AVE ANNUAL DAMAGES	2,941	4,130	2,216	54	8,038	6,116	76	16,740	14,690	88
-RURAL	1000 ACRES	281.3	279	41.9	15	278	70.7	25	276	95.2	34
-RURAL	$1000 AVE ANNUAL DAMAGES	1,990	2,496	796.9	32	2,976	1,055	35	3,447	1,289	37
WILDLIFE MANAGEMENT	1000 ACRES	---	299	18.7	6	986	41.3	4	1,730	55.8	3
	1000 USER DAYS	7,004	1,009	320.5	32	1,507	976.5	65	1,930	1,391	72
AESTHETIC & CULTURAL	1000 ACRES	NA	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	1000 ACRES	---	4.2	1.6	38	8.1	3.8	47	14	6.2	44
-EXTENSIVE	1000 ACRES	NA	24	9.4	39	45.9	22.8	50	77.6	37.6	48

TABLE 1–263 RBG 2.3, Capital Costs, Normal Framework (in $1,000,000)

RESOURCE USE CATEGORY	1971-1980 Federal	1971-1980 Non-Fed	1971-1980 Private	1971-1980 Total	1981-2000 Federal	1981-2000 Non-Fed	1981-2000 Private	1981-2000 Total	2001-2020 Federal	2001-2020 Non-Fed	2001-2020 Private	2001-2020 Total	Total
WATER WITHDRAWALS													
MUNICIPALLY SUPPLIED	7.4	17.2	0	24.6	21.0	49.0	0	70.0	45.0	104.9	0	149.9	244.5
SELF-SUPPLIED INDUSTRIAL	0	0	3.3	3.3	0	0	8.2	8.2	0	0	15.7	15.7	27.2
RURAL DOMESTIC & LIVESTOCK	0.1	0	0.7	0.8	0.2	0	1.4		0.1	0	1.0	1.1	3.5
IRRIGATION	0	0	5.3	5.3	0	0	4.9	4.9	0	0	5.1	5.1	15.3
MINING	0	0	0.6	0.6	0	0	1.8	1.8	0	0	3.3	3.3	5.7
THERMAL POWER COOLING	0	1.9	35.5	37.4	0	8.7	165.2	173.9	0	9.7	183.6	193.3	404.6
NON-WITHDRAWAL WATER USES													
MUNICIPAL WASTEWATER DISCHARGES	90.8	30.3	0	121.1	159.1	53.0	0	212.1	210.5	70.1	0	280.6	613.8
INDUSTRIAL WASTEWATER DISCHARGES	---	---	---	---	---	---	---	---	---	---	---	---	---
HYDROELECTRIC POWER	---	---	---	---	---	---	---	---	---	---	---	---	---
WATER ORIENTED OUTDOOR REC.	---	---	---	---	---	---	---	---	---	---	---	---	---
SPORT FISHING	1.5	2.0	0	3.5	0.8	1.7	0	2.5	1.7	3.3	0	5.0	11.0
RECREATIONAL BOATING	3.0	3.0	2.6	8.6	23.8	23.8	20.3	67.9	22.0	21.9	18.8	62.7	139.2

COMMERCIAL FISHING	---	---	---	---	---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	0	0	0	0	0	0	0	0	0	0	0	0	0
RELATED LAND USES & PROBLEMS													
AGRIC. LAND-TREATMENT	4.0	0	10.2	14.2	8.0	0	20.5	28.5	4.8	0	12.3	17.1	59.8
-CROPLAND DRAINAGE	1.6	0	3.8	5.4	1.7	0	3.8	5.5	8.5	0	19.9	28.4	39.3
FOREST LAND-TREATMENT	4.8	0.3	0.9	6.0	9.6	0.6	1.8	12.0	9.6	0.6	1.8	12.0	30.0
SHORELAND EROSION	0.6	0	2.4	3.0	1.2	0	4.9	6.1	1.2	0	4.9	6.1	15.2
STREAMBANK EROSION	0.6	0	1.4	2.0	1.7	0	4.3	6.0	2.8	0	7.2	10.0	18.0
FLOOD PLAINS-URBAN	---	---	---	---	---	---	---	---	---	---	---	---	---
-URBAN	38.3	0	12.7	51.0	15.4	0	5.1	20.5	2.9	0	0.9	3.8	75.3
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
WILDLIFE MANAGEMENT	0.9	8.1	0	9.0	1.3	11.8	0	13.1	1.1	10.2	0	11.3	33.4
AESTHETIC & CULTURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	24.7	45.9	0	70.6	33.3	61.9	0	95.2	36.2	67.3	0	103.5	269.3
-EXTENSIVE	---	---	---	---	---	---	---	---	---	---	---	---	---
TOTAL	178.3	108.7	79.4	366.4	277.1	210.5	242.2	729.8	346.4	288.0	274.5	908.9	2005.1

TABLE 1-264 RBG 2.3, Operation, Maintenance, and Replacement Costs, Normal Framework (in $1,000,000)

	1971-1980				1981-2000				2001-2020				
RESOURCE USE CATEGORY	Federal	Non-Fed	Private	Total	Federal	Non-Fed	Private	Total	Federal	Non-Fed	Private	Total	Total
WATER WITHDRAWALS													
MUNICIPALLY SUPPLIED	0	15.7	0	15.7	0	135.0	0	135.0	0	381.9	0	381.9	532.6
SELF-SUPPLIED INDUSTRIAL	0	0	3.4	3.4	0	0	31.8	31.8	0	0	83.7	83.7	118.9
RURAL DOMESTIC & LIVESTOCK	0	0	1.0	1.0	0	0	8.1	8.1	0	0	14.9	14.9	24.0
IRRIGATION	0	0	0.8	0.8	0	0	4.3	4.3	0	0	7.3	7.3	12.4
MINING	0	0	0.5	0.5	0	0	4.9	4.9	0	0	12.9	12.9	18.3
THERMAL POWER COOLING	0	0.5	9.1	9.6	0	6.4	121.6	128.0	0	15.8	300.7	316.5	454.1
NON-WITHDRAWAL WATER USES													
MUNICIPAL WASTEWATER DISCHARGES	0	136	0	136	0	438	0	438	0	612	0	612	1186
INDUSTRIAL WASTEWATER DISCHARGES	---	---	---	---	---	---	---	---	---	---	---	---	---
HYDROELECTRIC POWER	---	---	---	---	---	---	---	---	---	---	---	---	---
WATER ORIENTED OUTDOOR REC.	---	---	---	---	---	---	---	---	---	---	---	---	---
SPORT FISHING	0.6	1.0	0	1.6	2.1	5.0	0	7.1	2.6	5.6	0	8.2	16.9
RECREATIONAL BOATING	0	0	1.7	1.7	0	0	26.1	26.1	0	0	62.6	62.6	90.4
COMMERCIAL FISHING	---	---	---	---	---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	0	0	0	0	0	0	0	0	0	0	0	0	0
RELATED LAND USES & PROBLEMS													
AGRIC. LAND-TREATMENT	0	0	0.4	0.4	0	0	2.8	2.8	0	0	5.1	5.1	8.3
-CROPLAND DRAINAGE	0	0	0.1	0.1	0	0	0.8	0.8	0	0	2.5	2.5	3.4
FOREST LAND-TREATMENT	0.0	0.0	0.1	0.1	0.1	0.2	0.7	1.0	0.2	0.4	1.6	2.2	3.3
SHORELAND EROSION	0.1	0	0.2	0.3	0.5	0	1.9	2.4	1.0	0	3.9	4.9	7.6
STREAMBANK EROSION	0	0	0.2	0.2	0	0	2.0	2.0	0	0	5.2	5.2	7.4
FLOOD PLAINS-URBAN	---	---	---	---	---	---	---	---	---	---	---	---	---
-URBAN	0.0	0.1	0	0.1	0.0	0.7	0	0.7	0.0	0.8	0	0.8	1.6
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
WILDLIFE MANAGEMENT	0	0.5	0	0.5	0	0.7	0	0.7	0	0.6	0	0.6	1.8
AESTHETIC & CULTURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	3.0	11.9	0	14.9	20.2	80.7	0	100.9	37.6	150.4	0	188.0	303.8
-EXTENSIVE	---	---	---	---	---	---	---	---	---	---	---	---	---
TOTAL	3.7	165.7	17.5	186.9	22.9	666.7	205.0	894.6	41.4	1167.5	500.4	1709.3	2790.8

TABLE 1–265 RBG 2.3, Needs, Outputs, and Percent Needs Met, Proposed Framework

RESOURCE USE CATEGORY	UNIT	1970 SUPPLY	1980 N	1980 O	1980 %	2000 N	2000 O	2000 %	2020 N	2020 O	2020 %
WATER WITHDRAWALS											
MUNICIPALLY SUPPLIED	MILLION GALLONS PER DAY	265.9	81	81	100	281	281	100	560.3	560.3	100
SELF-SUPPLIED INDUSTRIAL	MILLION GALLONS PER DAY	454	40	40	100	139	139	100	328	328	100
RURAL DOMESTIC & LIVESTOCK	MILLION GALLONS PER DAY	82.3	11.5	11.5	100	35.8	35.8	100	52.2	52.2	100
IRRIGATION	MILLION GALLONS PER DAY	140.8	190.8	190.8	100	368	368	100	553.9	553.9	100
MINING	MILLION GALLONS PER DAY	16.3	10.6	10.6	100	38.9	38.9	100	91.4	91.4	100
THERMAL POWER COOLING	MILLION GALLONS PER DAY	1,079	1,069	1,069	100	6,038	6,038	100	11,560	11,560	100
NON-WITHDRAWAL WATER USES											
MUNICIPAL WASTEWATER DISCHARGES	MILLION GALLONS PER DAY	241.9	324.9	324.9	100	509.6	509.6	100	753.4	753.4	100
INDUSTRIAL WASTEWATER DISCHARGES	MILLION GALLONS PER DAY	245.8	161.5	161.5	100	140.8	140.8	100	237.3	237.3	100
HYDROELECTRIC POWER	MILLION GALLONS PER DAY	NA	0	0	---	0	0	---	0	0	---
WATER ORIENTED OUTDOOR REC.	1000 RECREATION DAYS	10,360	13,380	6,067	45	25,640	14,570	57	42,170	22,930	54
	1000 ACRES WATER SURFACE	NA	---	---	---	---	---	---	---	---	---
SPORT FISHING	1000 ANGLER DAYS	5,400	3,202	1,988	62	5,761	4,547	79	8,839	7,625	86
	1000 ACRES WATER SURFACE	NA	---	---	---	---	---	---	---	---	---
RECREATIONAL BOATING	1000 BOAT DAYS	3,516	1,524	168	11	2,604	601	23	3,954	1,086	27
	1000 ACRES WATER SURFACE	262	262	---	---	262	---	---	262	---	---
COMMERCIAL FISHING	MILLION TONS PER YEAR	NA	---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	MILLION TONS PER YEAR	---	4.6	4.6	100	5.8	5.8	100	6.9	6.9	100
RELATED LAND USES & PROBLEMS											
AGRIC. LAND-TREATMENT	1000 ACRES	3,540	3,540	*778.8*	*22*	3,540	*2,235*	*63*	3,540	*2,791*	*79*
-CROPLAND DRAINAGE	1000 ACRES	577.9	577.9	*144.5*	*25*	577.9	*413.8*	*72*	577.9	*577.9*	*100*
FOREST LAND-TREATMENT	1000 ACRES	1,230	1,230	*125*	*10*	1,230	*377*	*31*	1,230	*629*	*51*
SHORELAND EROSION	MILES	83.8	84	7.7	9	84	23.2	28	84	38.6	46
STREAMBANK EROSION	MILES	1,065	1,070	60.6	6	1,070	181.8	17	1,070	303	28
	$1000 AVE ANNUAL DAMAGES	91.4	91.4	18.3	20	91.4	54.8	60	91.4	91.4	100
FLOOD PLAINS--URBAN	1000 ACRES	49.6	51.6	17.3	34	53.3	30.2	57	55.3	46.5	84
-URBAN	$1000 AVE ANNUAL DAMAGES	2,941	4,130	2,216	54	8,038	6,116	76	16,740	14,690	88
-RURAL	1000 ACRES	281.3	279	41.9	15	278	70.7	25	276	95.2	34
-RURAL	$1000 AVE ANNUAL DAMAGES	1,990	2,496	796.9	32	2,976	1,055	35	3,447	1,289	37
WILDLIFE MANAGEMENT	1000 ACRES	---	299	18.7	6	986	41.3	4	1,730	55.8	3
	1000 USER DAYS	7,004	1,009	320.5	32	1,507	976.5	65	1,930	1,391	72
AESTHETIC & CULTURAL	1000 ACRES	NA	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	1000 ACRES	---	4.2	1.6	38	8.1	3.8	47	14	6.2	44
-EXTENSIVE	1000 ACRES	NA	24	9.4	39	45.9	22.8	50	77.6	37.6	48

TABLE 1–266 RBG 2.3, Capital Costs, Proposed Framework (in $1,000,000)

RESOURCE USE CATEGORY	1971-1980 Federal	1971-1980 Non-Fed	1971-1980 Private	1971-1980 Total	1981-2000 Federal	1981-2000 Non-Fed	1981-2000 Private	1981-2000 Total	2001-2020 Federal	2001-2020 Non-Fed	2001-2020 Private	2001-2020 Total	Total
WATER WITHDRAWALS													
MUNICIPALLY SUPPLIED	7.4	17.2	0	24.6	21.0	49.0	0	70.0	45.0	104.9	0	149.9	244.5
SELF-SUPPLIED INDUSTRIAL	0	0	3.3	3.3	0	0	8.2	8.2	0	0	15.7	15.7	27.2
RURAL DOMESTIC & LIVESTOCK	0.1	0	0.7	0.8	0.2	0	1.4	1.6	0.1	0	1.0	1.1	3.5
IRRIGATION	0	0	5.3	5.3	0	0	4.9	4.9	0	0	5.1	5.1	15.3
MINING	0	0	0.6	0.6	0	0	1.8	1.8	0	0	3.3	3.3	5.7
THERMAL POWER COOLING	0	1.9	35.5	37.4	0	8.7	165.2	173.9	0	9.7	183.6	193.3	404.6
NON-WITHDRAWAL WATER USES													
MUNICIPAL WASTEWATER DISCHARGES	*227.2*	*75.8*	*0*	*303.0*	*230.2*	*76.8*	*0*	*307.0*	*248.2*	*82.8*	*0*	*331.0*	*941.0*
INDUSTRIAL WASTEWATER DISCHARGES	---	---	---	---	---	---	---	---	---	---	---	---	---
HYDROELECTRIC POWER	---	---	---	---	---	---	---	---	---	---	---	---	---
WATER ORIENTED OUTDOOR REC.	---	---	---	---	---	---	---	---	---	---	---	---	---
SPORT FISHING	1.5	2.0	0	3.5	0.8	1.7	0	2.5	1.7	3.3	0	5.0	11.0
RECREATIONAL BOATING	3.0	3.0	2.6	8.6	23.8	23.8	20.3	67.9	22.0	21.9	18.8	62.7	139.2

COMMERCIAL FISHING	---	---	---	---	---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	*8.0*	*0*	*8.0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*8.0*
RELATED LAND USES & PROBLEMS													
AGRIC. LAND-TREATMENT	*8.8*	*0*	*22.5*	*31.3*	*16.3*	*0*	*41.9*	*58.2*	*10.0*	*0*	*25.6*	*35.6*	*125.1*
-CROPLAND DRAINAGE	*7.4*	*0*	*17.2*	*24.6*	*13.9*	*0*	*32.3*	*46.2*	*8.0*	*0*	*18.8*	*26.8*	*97.6*
FOREST LAND-TREATMENT	*5.6*	*0.3*	*1.1*	*7.0*	*12.0*	*0.7*	*2.3*	*15.0*	*12.0*	*0.7*	*2.3*	*15.0*	*37.0*
SHORELAND EROSION	0.6	0	2.4	3.0	1.2	0	4.9	6.1	1.2	0	4.9	6.1	15.2
STREAMBANK EROSION	0.6	0	1.4	2.0	1.7	0	4.3	6.0	2.8	0	7.2	10.0	18.0
FLOOD PLAINS-URBAN	---	---	---	---	---	---	---	---	---	---	---	---	---
-URBAN	38.3	0	12.7	51.0	15.4	0	5.1	20.5	2.9	0	0.9	3.8	75.3
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
WILDLIFE MANAGEMENT	0.9	8.1	0	9.0	1.3	11.8	0	13.1	1.1	10.2	0	11.3	33.4
AESTHETIC & CULTURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	24.7	45.9	0	70.6	33.3	61.9	0	95.2	36.2	67.3	0	103.5	269.3
-EXTENSIVE	---	---	---	---	---	---	---	---	---	---	---	---	---
TOTAL	*334.1*	*154.2*	*105.3*	*593.6*	*371.0*	*234.4*	*292.7*	*898.1*	*391.2*	*300.8*	*287.2*	*979.2*	*2,470.9*

TABLE 1-267 RBG 2.3, Operation, Maintenance, and Replacement Costs, Proposed Framework (in $1,000,000)

RESOURCE USE CATEGORY	1971-1980				1981-2000				2001-2020				
	Federal	Non-Fed	Private	Total	Federal	Non-Fed	Private	Total	Federal	Non-Fed	Private	Total	Total
WATER WITHDRAWALS													
MUNICIPALLY SUPPLIED	0	15.7	0	15.7	0	135.0	0	135.0	0	381.9	0	381.9	532.6
SELF-SUPPLIED INDUSTRIAL	0	0	3.4	3.4	0	0	31.8	31.8	0	0	83.7	83.7	118.9
RURAL DOMESTIC & LIVESTOCK	0	0	1.0	1.0	0	0	8.1	8.1	0	0	14.9	14.9	24.0
IRRIGATION	0	0	0.8	0.8	0	0	4.3	4.3	0	0	7.3	7.3	12.4
MINING	0	0	0.5	0.5	0	0	4.9	4.9	0	0	12.9	12.9	18.3
THERMAL POWER COOLING	0	0.5	9.1	9.6	0	6.4	121.6	128.0	0	15.8	300.7	316.5	454.1
NON-WITHDRAWAL WATER USES													
MUNICIPAL WASTEWATER DISCHARGES	*0*	*456.8*	*0*	*456.8*	*0*	*1,093.1*	*0*	*1,093.1*	*0*	*1,685.4*	*0*	*1,685.4*	*3,235.3*
INDUSTRIAL WASTEWATER DISCHARGES	---	---	---	---	---	---	---	---	---	---	---	---	---
HYDROELECTRIC POWER	---	---	---	---	---	---	---	---	---	---	---	---	---
WATER ORIENTED OUTDOOR REC.	---	---	---	---	---	---	---	---	---	---	---	---	---
SPORT FISHING	0.6	1.0	0	1.6	2.1	5.0	0	7.1	2.6	5.6	0	8.2	16.9
RECREATIONAL BOATING	0	0	1.7	1.7	0	0	26.1	26.1	0	0	62.6	62.6	90.4
COMMERCIAL FISHING	---	---	---	---	---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	*1.0*	*0*	*0*	*1.0*	*4.0*	*0*	*0*	*4.0*	*4.0*	*0*	*0*	*4.0*	*9.0*
RELATED LAND USES & PROBLEMS													
AGRIC. LAND-TREATMENT	*0*	*0*	*0.8*	*0.8*	*0*	*0*	*6.8*	*6.8*	*0*	*0*	*10.7*	*10.7*	*18.3*
-CROPLAND DRAINAGE	*0*	*0*	*0.6*	*0.6*	*0*	*0*	*5.4*	*5.4*	*0*	*0*	*8.4*	*8.4*	*14.4*
FOREST LAND-TREATMENT	*0*	*0*	*0.2*	*0.2*	*0.2*	*0.3*	*1.1*	*1.6*	*0.3*	*0.6*	*2.0*	*2.9*	*4.7*
SHORELAND EROSION	0.1	0	0.2	0.3	0.5	0	1.9	2.4	1.0	0	3.9	4.9	7.6
STREAMBANK EROSION	0	0	0.2	0.2	0	0	2.0	2.0	0	0	5.2	5.2	7.4
FLOOD PLAINS-URBAN	---	---	---	---	---	---	---	---	---	---	---	---	---
-URBAN	0.0	0.1	0	0.1	0.0	0.7	0	0.7	0.0	0.8	0	0.8	1.6
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
WILDLIFE MANAGEMENT	0	0.5	0	0.5	0	0.7	0	0.7	0	0.6	0	0.6	1.8
AESTHETIC & CULTURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	3.0	11.9	0	14.9	20.2	80.7	0	100.9	37.6	150.4	0	188.0	303.8
-EXTENSIVE	---	---	---	---	---	---	---	---	---	---	---	---	---
TOTAL	*4.7*	*486.5*	*18.5*	*509.7*	*27.0*	*1,321.9*	*214.0*	*1,562.9*	*45.5*	*2,241.1*	*512.3*	*2,798.9*	*4,871.5*

TABLE 1-268 RBG 2.4, Needs, Outputs, and Percent Needs Met, Normal Framework

RESOURCE USE CATEGORY	UNIT	1970 SUPPLY	1980 N	1980 O	1980 %	2000 N	2000 O	2000 %	2020 N	2020 O	2020 %
WATER WITHDRAWALS											
MUNICIPALLY SUPPLIED	MILLION GALLONS PER DAY	39.1	8.9	8.9	100	30.8	30.8	100	63.0	63.0	100
SELF-SUPPLIED INDUSTRIAL	MILLION GALLONS PER DAY	89.6	+	+	over	+	+	over	77.5	77.5	100
RURAL DOMESTIC & LIVESTOCK	MILLION GALLONS PER DAY	16.8	2.9	2.9	100	8.0	8.0	100	13.0	13.0	100
IRRIGATION	MILLION GALLONS PER DAY	50.4	28.7	28.7	100	68.7	68.7	100	105	105	100
MINING	MILLION GALLONS PER DAY	5.1	1.6	1.6	100	2.3	2.3	100	7.1	7.1	100
THERMAL POWER COOLING	MILLION GALLONS PER DAY	471.3	0	0	---	0	0	---	1,060	1,060	100
NON-WITHDRAWAL WATER USES											
MUNICIPAL WASTEWATER DISCHARGES	MILLION GALLONS PER DAY	27	36	36	100	56	56	100	86	86	100
INDUSTRIAL WASTEWATER DISCHARGES	MILLION GALLONS PER DAY	82.3	68	68	100	50	50	100	78	78	100
HYDROELECTRIC POWER	MILLION GALLONS PER DAY	NA	47,300	47,300	100	47,300	47,300	100	47,300	47,300	100
WATER ORIENTED OUTDOOR REC.	1000 RECREATION DAYS	5,348	646	1,950	over	3,646	4,310	over	7,690	8,850	over
	1000 ACRES WATER SURFACE	NA	---	---	---	---	---	---	---	---	---
SPORT FISHING	1000 ANGLER DAYS	8,678	1,642	1,200	73	3,833	3,200	83	6,549	5,916	90
	1000 ACRES WATER SURFACE	NA	---	---	---	---	---	---	---	---	---
RECREATIONAL BOATING	1000 BOAT DAYS	3,543	678	433	64	1,215	1,101	91	1,830	1,940	over
	1000 ACRES WATER SURFACE	940	941	---	---	941	---	---	941	---	---
COMMERCIAL FISHING	MILLION TONS PER YEAR	NA	---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	MILLION TONS PER YEAR	---	22.5	22.5	100	32.0	32.0	100	44.7	44.7	100
RELATED LAND USES & PROBLEMS											
AGRIC. LAND-TREATMENT	1000 ACRES	1,018	1,018	101.8	10	1,018	305.4	30	1,018	427.6	42
-CROPLAND DRAINAGE	1000 ACRES	47.6	47.6	10.8	23	47.6	21.8	46	47.6	24.5	51
FOREST LAND-TREATMENT	1000 ACRES	4,563	4,560	460	10	4,560	1,381	30	4,560	2,302	50
SHORELAND EROSION	MILES	236.4	236	8.4	4	236	25.2	11	236	42.0	18
STREAMBANK EROSION	MILES	1,276	1,276	110.8	9	1,276	332.4	26	1,276	554.0	43
	$1000 AVE ANNUAL DAMAGES	90.2	90.2	18.0	20	90.2	54.1	60	90.2	90.2	100
FLOOD PLAINS-URBAN	1000 ACRES	3.2	3.5	1.2	34	3.7	1.9	51	4.0	3.2	80
-URBAN	$1000 AVE ANNUAL DAMAGES	98.8	131	12.6	10	230	63.7	28	425.0	213.9	50
-RURAL	1000 ACRES	112.6	112	9.8	9	112	25.9	23	112	35.4	32
-RURAL	$1000 AVE ANNUAL DAMAGES	147.1	190	32.9	17	238	85.1	36	288.9	123.6	43
WILDLIFE MANAGEMENT	1000 ACRES	---	26	21	81	316	50.5	16	708	74.0	10
	1000 USER DAYS	3894.4	404.6	225.0	56	664.8	525.0	79	1,029	845	82
AESTHETIC & CULTURAL	1000 ACRES	NA	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	1000 ACRES	---	1.0	1.1	over	2.5	2.4	96	5.2	4.9	94
-EXTENSIVE	1000 ACRES	NA	5.5	15	over	14.5	31.9	over	29.2	49.9	over

TABLE 1-269 RBG 2.4, Capital Costs, Normal Framework (in $1,000,000)

RESOURCE USE CATEGORY	1971-1980 Federal	1971-1980 Non-Fed	1971-1980 Private	1971-1980 Total	1981-2000 Federal	1981-2000 Non-Fed	1981-2000 Private	1981-2000 Total	2001-2020 Federal	2001-2020 Non-Fed	2001-2020 Private	2001-2020 Total	Total
WATER WITHDRAWALS													
MUNICIPALLY SUPPLIED	0.7	1.7	0	2.4	1.7	4.1	0	5.8	2.7	6.3	0	9.0	17.2
SELF-SUPPLIED INDUSTRIAL	0	0	0	0	0	0	0	0	0	0	6.4	6.4	6.4
RURAL DOMESTIC & LIVESTOCK	0.0	0	0.2	0.2	0.0	0	0.2	0.2	0.0	0	0.2	0.2	0.6
IRRIGATION	0	0	1.0	1.0	0	0	1.6	1.6	0	0	1.3	1.3	3.9
MINING	0	0	0.0	0.0	0	0	0.0	0.0	0	0	0.3	0.3	0.3
THERMAL POWER COOLING	0	0	0	0	0	0	0	0	0	1.9	35.2	37.1	37.1
NON-WITHDRAWAL WATER USES													
MUNICIPAL WASTEWATER DISCHARGES	49.5	16.5	0	66.0	29.2	9.8	0	39.0	36.8	12.2	0	49.0	154.0
INDUSTRIAL WASTEWATER DISCHARGES	---	---	---	---	---	---	---	---	---	---	---	---	---
HYDROELECTRIC POWER	---	---	---	---	---	---	---	---	---	---	---	---	---
WATER ORIENTED OUTDOOR REC.	---	---	---	---	---	---	---	---	---	---	---	---	---
SPORT FISHING	1.5	2.2	0	3.7	0.4	0.9	0	1.3	1.6	3.1	0	4.7	9.7
RECREATIONAL BOATING	7.6	7.6	6.4	21.6	11.3	11.3	9.7	32.3	10.3	10.3	8.8	29.4	83.3

COMMERCIAL FISHING	---	---	---	---	---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	0	0	0	0	0.6	0	0	0.6	0	0	0	0	0.6
RELATED LAND USES & PROBLEMS													
AGRIC. LAND-TREATMENT	1.1	0	2.9	4.0	2.4	0	6.0	8.4	1.3	0	3.5	4.8	17.2
-CROPLAND DRAINAGE	0.9	0	2.2	3.1	1.0	0	2.3	3.3	0.2	0	0.5	0.7	7.1
FOREST LAND-TREATMENT	14.4	0.9	2.7	18.0	29.6	1.8	5.6	37.0	29.6	1.8	5.6	37.0	92.1
SHORELAND EROSION	0.7	0	2.7	3.4	1.3	0	5.4	6.7	1.3	0	5.4	6.7	16.8
STREAMBANK EROSION	1.0	0	2.6	3.6	3.1	0	7.8	10.9	5.1	0	13.1	18.2	32.7
FLOOD PLAINS-URBAN	---	---	---	---	---	---	---	---	---	---	---	---	---
-URBAN	1.3	0	0.4	1.7	3.8	0	1.2	5.0	0	0	0	0	6.7
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
WILDLIFE MANAGEMENT	0.5	4.1	0	4.6	0.7	5.8	0	6.5	0.6	5.6	0	6.2	17.3
AESTHETIC & CULTURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	14.2	26.5	0	40.7	12.3	22.8	0	35.1	16.0	29.8	0	45.8	121.6
-EXTENSIVE	---	---	---	---	---	---	---	---	---	---	---	---	---
TOTAL	93.4	59.5	21.1	174.0	97.4	56.5	39.8	193.7	105.5	70.8	80.3	256.8	624.5

TABLE 1-270 RBG 2.4, Operation, Maintenance, and Replacement Costs, Normal Framework (in $1,000,000)

RESOURCE USE CATEGORY	1971-1980				1981-2000				2001-2020				
	Federal	Non-Fed	Private	Total	Federal	Non-Fed	Private	Total	Federal	Non-Fed	Private	Total	Total
WATER WITHDRAWALS													
MUNICIPALLY SUPPLIED	0	1.4	0	1.4	0	12.2	0	12.2	0	29.0	0	29.0	42.6
SELF-SUPPLIED INDUSTRIAL	0	0	0	0	0	0	0	0	0	0	17.0	17.0	17.0
RURAL DOMESTIC & LIVESTOCK	0	0	0.4	0.4	0	0	3.0	3.0	0	0	5.8	5.8	9.2
IRRIGATION	0	0	0.2	0.2	0	0	1.3	1.3	0	0	1.9	1.9	3.4
MINING	0	0	0.1	0.1	0	0	0.3	0.3	0	0	1.2	1.2	1.6
THERMAL POWER COOLING	0	0	0	0	0	0	0	0	0	1.0	18.1	19.1	19.1
NON-WITHDRAWAL WATER USES													
MUNICIPAL WASTEWATER DISCHARGES	0	38.0	0	38.0	0	88.0	0	88.0	0	108.0	0	108.0	234.0
INDUSTRIAL WASTEWATER DISCHARGES	---	---	---	---	---	---	---	---	---	---	---	---	---
HYDROELECTRIC POWER	---	---	---	---	---	---	---	---	---	---	---	---	---
WATER ORIENTED OUTDOOR REC.	---	---	---	---	---	---	---	---	---	---	---	---	---
SPORT FISHING	1.0	1.4	0	2.4	2.1	5.1	0	7.2	3.2	6.6	0	9.8	19.4
RECREATIONAL BOATING	0	0	7.3	7.3	0	0	51.8	51.8	0	0	94.2	94.2	153.3
COMMERCIAL FISHING	---	---	---	---	---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	0	0	0	0	6.2	0	0	6.2	12.4	0	0	12.4	18.6
RELATED LAND USES & PROBLEMS													
AGRIC. LAND-TREATMENT	0	0	0.1	0.1	0	0	0.8	0.8	0	0	1.5	1.5	2.4
-CROPLAND DRAINAGE	0	0	0.1	0.1	0	0	0.5	0.5	0	0	0.6	0.6	1.2
FOREST LAND-TREATMENT	0.0	0.1	0.3	0.4	0.3	0.6	22	3.1	0.6	1.3	4.5	6.4	9.9
SHORELAND EROSION	0.1	0	0.2	0.3	0.5	0	2.2	2.7	1.1	0	4.3	5.4	8.4
STREAMBANK EROSION	0	0	0.4	0.4	0	0	3.6	3.6	0	0	9.4	9.4	13.4
FLOOD PLAINS-URBAN	---	---	---	---	---	---	---	---	---	---	---	---	---
-URBAN	0.0	0.0	0	0.0	0.0	0.1	0	0.1	0.0	0.1	0	0.1	0.2
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
WILDLIFE MANAGEMENT	0	0.2	0	0.2	0	0.3	0	0.3	0	0.3	0	0.3	0.8
AESTHETIC & CULTURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	1.0	3.8	0	4.8	6.5	26.1	0	32.6	13.5	54.2	0	67.7	105.1
-EXTENSIVE	---	---	---	---	---	---	---	---	---	---	---	---	---
TOTAL	2.4	44.9	8.8	56.1	15.6	132.4	65.7	213.7	30.8	200.5	158.5	389.8	659.6

TABLE 1-271 RBG 2.4, Needs, Outputs, and Percent Needs Met, Proposed Framework

RESOURCE USE CATEGORY	UNIT	1970 SUPPLY	1980 N	1980 O	1980 %	2000 N	2000 O	2000 %	2020 N	2020 O	2020 %
WATER WITHDRAWALS											
MUNICIPALLY SUPPLIED	MILLION GALLONS PER DAY	39.1	8.9	8.9	100	30.8	30.8	100	63.0	63.0	100
SELF-SUPPLIED INDUSTRIAL	MILLION GALLONS PER DAY	89.6	+	+	over	+	+	over	77.5	77.5	100
RURAL DOMESTIC & LIVESTOCK	MILLION GALLONS PER DAY	16.8	2.9	2.9	100	8.0	8.0	100	13.0	13.0	100
IRRIGATION	MILLION GALLONS PER DAY	50.4	28.7	28.7	100	68.7	68.7	100	105	105	100
MINING	MILLION GALLONS PER DAY	5.1	1.6	1.6	100	2.3	2.3	100	7.1	7.1	100
THERMAL POWER COOLING	MILLION GALLONS PER DAY	471.3	0	0	---	0	0	---	1,060	1,060	100
NON-WITHDRAWAL WATER USES											
MUNICIPAL WASTEWATER DISCHARGES	MILLION GALLONS PER DAY	27	36	36	100	56	56	100	86	86	100
INDUSTRIAL WASTEWATER DISCHARGES	MILLION GALLONS PER DAY	82.3	68	68	100	50	50	100	78	78	100
HYDROELECTRIC POWER	MILLION GALLONS PER DAY	NA	47,300	47,300	100	47,300	47,300	100	47,300	47,300	100
WATER ORIENTED OUTDOOR REC.	1000 RECREATION DAYS	5,348	646	1,950	over	3,646	4,310	over	7,690	8,850	over
	1000 ACRES WATER SURFACE	NA	---	---	---	---	---	---	---	---	---
SPORT FISHING	1000 ANGLER DAYS	8,678	1,642	1,200	73	3,833	3,200	83	6,549	5,916	90
	1000 ACRES WATER SURFACE	NA	---	---	---	---	---	---	---	---	---
RECREATIONAL BOATING	1000 BOAT DAYS	3,543	678	433	64	1,215	1,101	91	1,830	1,940	over
	1000 ACRES WATER SURFACE	940	941	---	---	941	---	---	941	---	---
COMMERCIAL FISHING	MILLION TONS PER YEAR	NA	---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	MILLION TONS PER YEAR	---	22.5	22.5	100	32.0	32.0	100	44.7	44.7	100
RELATED LAND USES & PROBLEMS											
AGRIC. LAND-TREATMENT	1000 ACRES	1,018	1,018	*243.3*	*24*	1,018	*660.7*	*65*	1,018	*934.8*	*92*
-CROPLAND DRAINAGE	1000 ACRES	47.6	47.6	*0*	*0*	47.6	*0*	*0*	47.6	*0*	*0*
FOREST LAND-TREATMENT	1000 ACRES	4,563	4,563	*561*	*12*	4,563	*1,682*	*37*	4,563	*2,803*	*61*
SHORELAND EROSION	MILES	236.4	236	8.4	4	236	25.2	11	236	42.0	18
STREAMBANK EROSION	MILES	1,276	1,276	110.8	9	1,276	332.4	26	1,276	554.0	43
	$1000 AVE ANNUAL DAMAGES	90.2	90.2	18.0	20	90.2	54.1	60	90.2	90.2	100
FLOOD PLAINS-URBAN	1000 ACRES	3.2	3.5	1.2	34	3.7	1.9	51	4.0	3.2	80
-URBAN	$1000 AVE ANNUAL DAMAGES	98.8	131	12.6	10	230	63.7	28	425.0	213.9	50
-RURAL	1000 ACRES	112.6	112	9.8	9	112	25.9	23	112	35.4	32
-RURAL	$1000 AVE ANNUAL DAMAGES	147.1	190	32.9	17	238	85.1	36	288.9	123.6	43
WILDLIFE MANAGEMENT	1000 ACRES	---	26	21	81	316	50.5	16	708	74.0	10
	1000 USER DAYS	3894.4	404.6	225.0	56	664.8	525.0	79	1,029	845	82
AESTHETIC & CULTURAL	1000 ACRES	NA	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	1000 ACRES	---	1.0	1.1	over	2.5	2.4	96	5.2	4.9	94
-EXTENSIVE	1000 ACRES	NA	5.5	15	over	14.5	31.9	over	29.2	49.9	over

TABLE 1-272 RBG 2.4, Capital Costs, Proposed Framework (in $1,000,000)

RESOURCE USE CATEGORY	1971-1980 Federal	1971-1980 Non-Fed	1971-1980 Private	1971-1980 Total	1981-2000 Federal	1981-2000 Non-Fed	1981-2000 Private	1981-2000 Total	2001-2020 Federal	2001-2020 Non-Fed	2001-2020 Private	2001-2020 Total	Total
WATER WITHDRAWALS													
MUNICIPALLY SUPPLIED	0.7	1.7	0	2.4	1.7	4.1	0	5.8	2.7	6.3	0	9.0	17.2
SELF-SUPPLIED INDUSTRIAL	0	0	0	0	0	0	0	0	0	0	6.4	6.4	6.4
RURAL DOMESTIC & LIVESTOCK	0.0	0	0.2	0.2	0.0	0	0.2	0.2	0.0	0	0.2	0.2	0.6
IRRIGATION	0	0	1.0	1.0	0	0	1.6	1.6	0	0	1.3	1.3	3.9
MINING	0	0	0.0	0.0	0	0	0.0	0.0	0	0	0.3	0.3	0.3
THERMAL POWER COOLING	0	0	0	0	0	0	0	0	0	1.9	35.2	37.1	37.1
NON-WITHDRAWAL WATER USES													
MUNICIPAL WASTEWATER DISCHARGES	*15.8*	*5.2*	*0*	*21.0*	*31.5*	*10.5*	*0*	*42.0*	*38.2*	*12.8*	*0*	*51.0*	*114.0*
INDUSTRIAL WASTEWATER DISCHARGES	---	---	---	---	---	---	---	---	---	---	---	---	---
HYDROELECTRIC POWER	---	---	---	---	---	---	---	---	---	---	---	---	---
WATER ORIENTED OUTDOOR REC.	---	---	---	---	---	---	---	---	---	---	---	---	---
SPORT FISHING	1.5	2.2	0	3.7	0.4	0.9	0	1.3	1.6	3.1	0	4.7	9.7
RECREATIONAL BOATING	7.6	7.6	6.4	21.6	11.3	11.3	9.7	32.3	10.3	10.3	8.8	29.4	83.3

COMMERCIAL FISHING	---	---	---	---	---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	7.6	0	0	7.6	23.6	0	0	23.6	0	0	0	0	31.2
RELATED LAND USES & PROBLEMS													
AGRIC. LAND-TREATMENT	1.0	0	2.5	3.5	1.9	0	4.7	6.6	1.1	0	2.9	4.0	14.1
-CROPLAND DRAINAGE	0	0	0	0	0	0	0	0	0	0	0	0	0
FOREST LAND-TREATMENT	17.6	1.1	3.3	22.0	36.8	2.3	6.9	46.0	36.8	2.3	6.9	46.0	114.0
SHORELAND EROSION	0.7	0	2.7	3.4	1.3	0	5.4	6.7	1.3	0	5.4	6.7	16.8
STREAMBANK EROSION	1.0	0	2.6	3.6	3.1	0	7.8	10.9	5.1	0	13.1	18.2	32.7
FLOOD PLAINS-URBAN	---	---	---	---	---	---	---	---	---	---	---	---	---
-URBAN	1.3	0	0.4	1.7	3.8	0	1.2	5.0	0	0	0	0	6.7
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
WILDLIFE MANAGEMENT	0.5	4.1	0	4.6	0.7	5.8	0	6.5	0.6	5.6	0	6.2	17.3
AESTHETIC & CULTURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	14.2	26.5	0	40.7	12.3	22.8	0	35.1	16.0	29.8	0	45.8	121.6
-EXTENSIVE	---	---	---	---	---	---	---	---	---	---	---	---	---
TOTAL	69.5	48.4	19.1	137.0	128.4	57.7	37.5	223.6	113.7	72.1	80.5	266.3	626.9

TABLE 1–273 RBG 2.4, Operation, Maintenance, and Replacement Costs, Proposed Framework (in $1,000,000)

RESOURCE USE CATEGORY	1971-1980				1981-2000				2001-2020				
	Federal	Non-Fed	Private	Total	Federal	Non-Fed	Private	Total	Federal	Non-Fed	Private	Total	Total
WATER WITHDRAWALS													
MUNICIPALLY SUPPLIED	0	1.4	0	1.4	0	12.2	0	12.2	0	29.0	0	29.0	42.6
SELF-SUPPLIED INDUSTRIAL	0	0	0	0	0	0	0	0	0	0	17.0	17.0	17.0
RURAL DOMESTIC & LIVESTOCK	0	0	0.4	0.4	0	0	3.0	3.0	0	0	5.8	5.8	9.2
IRRIGATION	0	0	0.2	0.2	0	0	1.3	1.3	0	0	1.9	1.9	3.4
MINING	0	0	0.1	0.1	0	0	0.3	0.3	0	0	1.2	1.2	1.6
THERMAL POWER COOLING	0	0	0	0	0	0	0	0	0	1.0	18.1	19.1	19.1
NON-WITHDRAWAL WATER USES													
MUNICIPAL WASTEWATER DISCHARGES	0	87.2	0	87.2	0	194.5	0	194.5	0	257.7	0	257.7	539.4
INDUSTRIAL WASTEWATER DISCHARGES	---	---	---	---	---	---	---	---	---	---	---	---	---
HYDROELECTRIC POWER	---	---	---	---	---	---	---	---	---	---	---	---	---
WATER ORIENTED OUTDOOR REC.	---	---	---	---	---	---	---	---	---	---	---	---	---
SPORT FISHING	1.0	1.4	0	2.4	2.1	5.1	0	7.2	3.2	6.6	0	9.8	19.4
RECREATIONAL BOATING	0	0	7.3	7.3	0	0	51.8	51.8	0	0	94.2	94.2	153.3
COMMERCIAL FISHING	---	---	---	---	---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	1.0	0	0	1.0	10.2	0	0	10.2	16.4	0	0	16.4	27.6
RELATED LAND USES & PROBLEMS													
AGRIC. LAND-TREATMENT	0	0	0.0	0.0	0	0	0.8	0.8	0	0	1.2	1.2	2.0
-CROPLAND DRAINAGE	0	0	0	0	0	0	0	0	0	0	0	0	0
FOREST LAND-TREATMENT	0.0	0.1	0.4	0.5	0.5	1.0	3.6	5.1	0.9	1.8	6.4	9.1	14.7
SHORELAND EROSION	0.1	0	0.2	0.3	0.5	0	2.2	2.7	1.1	0	4.3	5.4	8.4
STREAMBANK EROSION	0	0	0.4	0.4	0	0	3.6	3.6	0	0	9.4	9.4	13.4
FLOOD PLAINS-URBAN	---	---	---	---	---	---	---	---	---	---	---	---	---
-URBAN	0.0	0.0	0	0.0	0.0	0.1	0	0.1	0.0	0.1	0	0.1	0.2
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
WILDLIFE MANAGEMENT	0	0.2	0	0.2	0	0.3	0	0.3	0	0.3	0	0.3	0.8
AESTHETIC & CULTURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	1.0	3.8	0	4.8	6.5	26.1	0	32.6	13.5	54.2	0	67.7	105.1
-EXTENSIVE	---	---	---	---	---	---	---	---	---	---	---	---	---
TOTAL	3.1	94.1	9.0	106.2	19.8	239.3	66.6	325.7	35.1	350.7	159.5	545.3	977.2

TABLE 1–274 RBG 3.1, Needs, Outputs, and Percent Needs Met, Normal Framework

RESOURCE USE CATEGORY	UNIT	1970 SUPPLY	1980 N	1980 O	1980 %	2000 N	2000 O	2000 %	2020 N	2020 O	2020 %
WATER WITHDRAWALS											
MUNICIPALLY SUPPLIED	MILLION GALLONS PER DAY	7.0	1.7	1.7	100	5.9	5.9	100	12.6	12.6	100
SELF-SUPPLIED INDUSTRIAL	MILLION GALLONS PER DAY	25	+	+	100	5.0	5.0	100	36.0	36.0	100
RURAL DOMESTIC & LIVESTOCK	MILLION GALLONS PER DAY	6.8	2.5	2.5	100	5.6	5.6	100	10.0	10.0	100
IRRIGATION	MILLION GALLONS PER DAY	3.5	5.5	5.5	100	11.8	11.8	100	18.3	18.3	100
MINING	MILLION GALLONS PER DAY	20.9	7.0	7.0	100	19.4	19.4	100	40.4	40.4	100
THERMAL POWER COOLING	MILLION GALLONS PER DAY	0	0	0	---	0	0	---	0	0	---
NON-WITHDRAWAL WATER USES											
MUNICIPAL WASTEWATER DISCHARGES	MILLION GALLONS PER DAY	5.0	7.2	7.2	100	12.0	12.0	100	18.2	18.2	100
INDUSTRIAL WASTEWATER DISCHARGES	MILLION GALLONS PER DAY	12	9.7	9.7	100	9.8	9.8	100	17.8	17.8	100
HYDROELECTRIC POWER	MILLION GALLONS PER DAY	NA	0	0	---	0	0	---	0	0	---
WATER ORIENTED OUTDOOR REC.	1000 RECREATION DAYS	2,630	+	720	over	774	2,430	over	2,277	4,960	over
	1000 ACRES WATER SURFACE	NA	---	---	---	---	---	---	---	---	---
SPORT FISHING	1000 ANGLER DAYS	3,800	1,881	1,400	74	3,339	2,858	86	4,892	4,411	90
	1000 ACRES WATER SURFACE	NA	---	---	---	---	---	---	---	---	---
RECREATIONAL BOATING	1000 BOAT DAYS	1,431	492	240	49	792	744	94	1,095	1,362	over
	1000 ACRES WATER SURFACE	592	592	---	---	592	---	---	592	---	---
COMMERCIAL FISHING	MILLION TONS PER YEAR	NA	---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	MILLION TONS PER YEAR	---	22.3	22.3	100	33.3	33.3	100	48.8	48.8	100
RELATED LAND USES & PROBLEMS											
AGRIC. LAND--TREATMENT	1000 ACRES	435	435.6	43.6	10	435.6	130.7	30	435.6	183.0	42
--CROPLAND DRAINAGE	1000 ACRES	63	63.3	4.7	7	63.3	10.2	16	63.3	15.7	25
FOREST LAND--TREATMENT	1000 ACRES	2,030	2,030	228	11	2,030	685	34	2,030	1,142	56
SHORELAND EROSION	MILES	70.7	71	1.6	2	71	4.7	7	71	7.8	11
STREAMBANK EROSION	MILES	642	642	45.8	7	642	137	21	642	229	36
	$1000 AVE ANNUAL DAMAGES	62.7	62.7	12.5	20	62.7	37.6	60	62.7	62.7	100
FLOOD PLAINS--URBAN	1000 ACRES	0.7	0.7	0	0	0.8	0.1	13	0.8	0.5	63
-URBAN	$1000 AVE ANNUAL DAMAGES	29.6	40.0	1.0	3	74.9	13.6	18	146	58.4	40
-RURAL	1000 ACRES	39.3	39.3	14.5	37	39.3	19.2	49	39.2	21.7	55
-RURAL	$1000 AVE ANNUAL DAMAGES	214.1	256.6	230.2	90	302.7	271.4	90	379.2	355.7	94
WILDLIFE MANAGEMENT	1000 ACRES	---	22	25	over	152	74	49	316	120	38
	1000 USER DAYS	1,601	32.2	43.0	over	133	176.3	over	264	488.3	over
AESTHETIC & CULTURAL	1000 ACRES	NA	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	1000 ACRES	---	0	0.4	over	0	1.3	over	0.5	2.7	over
-EXTENSIVE	1000 ACRES	NA	0	0.5	over	0	1.9	over	2.8	6.4	over

TABLE 1–275 RBG 3.1, Capital Costs, Normal Framework (in $1,000,000)

RESOURCE USE CATEGORY	1971-1980 Federal	1971-1980 Non-Fed	1971-1980 Private	1971-1980 Total	1981-2000 Federal	1981-2000 Non-Fed	1981-2000 Private	1981-2000 Total	2001-2020 Federal	2001-2020 Non-Fed	2001-2020 Private	2001-2020 Total	Total
WATER WITHDRAWALS													
MUNICIPALLY SUPPLIED	0.1	0.3	0	0.4	0.3	0.7	0	1.0	0.4	1.1	0	1.5	2.9
SELF-SUPPLIED INDUSTRIAL	0	0	0	0	0	0	0.4	0.4	0	0	2.6	2.6	3.0
RURAL DOMESTIC & LIVESTOCK	0.0	0	0.1	0.1	0.0	0	0.2	0.2	0	0	0.2	0.2	0.5
IRRIGATION	0	0	0.2	0.2	0	0	0.3	0.3	0	0	0.3	0.3	0.8
MINING	0	0	0.4	0.4	0	0	0.8	0.8	0	0	1.4	1.4	2.6
THERMAL POWER COOLING	0	0	0	0	0	0	0	0	0	0	0	0	0
NON-WITHDRAWAL WATER USES													
MUNICIPAL WASTEWATER DISCHARGES	4.6	1.5	0	6.1	6.1	2.0	0	8.1	7.6	2.5	0	10.1	24.3
INDUSTRIAL WASTEWATER DISCHARGES	---	---	---	---	---	---	---	---	---	---	---	---	---
HYDROELECTRIC POWER	---	---	---	---	---	---	---	---	---	---	---	---	---
WATER ORIENTED OUTDOOR REC.	---	---	---	---	---	---	---	---	---	---	---	---	---
SPORT FISHING	0.7	1.1	0	1.8	0.2	0.5	0	0.7	1.8	3.2	0	5.0	7.5
RECREATIONAL BOATING	4.3	4.3	3.7	12.3	7.8	7.8	6.7	22.3	7.1	7.0	6.0	20.1	54.7

COMMERCIAL FISHING	---	---	---	---	---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	0	0	0	0	340.0	0	0	340.0	0	0	0	0	340.0
RELATED LAND USES & PROBLEMS													
AGRIC. LAND-TREATMENT	0.5	0	1.3	1.8	1.0	0	2.5	3.5	0.6	0	1.5	2.1	7.4
-CROPLAND DRAINAGE	0.3	0	0.8	1.1	0.8	0	1.8	2.6	0.6	0	1.3	1.9	5.6
FOREST LAND-TREATMENT	8.8	0.5	1.7	11.0	16.8	1.0	3.2	21.0	16.8	1.0	3.2	21.0	53.0
SHORELAND EROSION	0.2	0	1.0	1.2	0.5	0	2.0	2.5	0.5	0	2.0	2.5	6.2
STREAMBANK EROSION	0.4	0	1.1	1.5	1.3	0	3.2	4.5	2.1	0	5.4	7.5	13.5
FLOOD PLAINS-URBAN	---	---	---	---	---	---	---	---	---	---	---	---	---
-URBAN	3.3	0	1.1	4.4	1.3	0	0.4	1.7	1.1	0	0.4	1.5	7.6
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
-RURAL			---	---	---	---	---	---	---	---	---		---
WILDLIFE MANAGEMENT	0.9	8.3	0	9.2	1.6	13.9	0	15.5	1.4	13.1	0	14.5	39.2
AESTHETIC & CULTURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	2.7	5.1	0	7.8	6.6	12.3	0	18.9	8.4	15.6	0	24	50.7
-EXTENSIVE	---	---	---	---	---	---	---	---	---	---	---	---	---
TOTAL	26.8	21.1	11.4	59.3	384.3	38.2	21.5	444.0	48.4	43.5	24.3	116.2	619.5

TABLE 1–276 RBG 3.1, Operation, Maintenance, and Replacement Costs, Normal Framework (in $1,000,000)

	1971-1980				1981-2000				2001-2020				
RESOURCE USE CATEGORY	Federal	Non-Fed	Private	Total	Federal	Non-Fed	Private	Total	Federal	Non-Fed	Private	Total	Total
WATER WITHDRAWALS													
MUNICIPALLY SUPPLIED	0	0.3	0	0.3	0	2.7	0	2.7	0	6.6	0	6.6	9.6
SELF-SUPPLIED INDUSTRIAL	0	0	0	0	0	0	1.3	1.3	0	0	10.3	10.3	11.6
RURAL DOMESTIC & LIVESTOCK	0	0	0.9	0.9	0	0	2.9	2.9	0	0	5.5	5.5	5.5
IRRIGATION	0	0	0.0	0.0	0	0	0.1	0.1	0	0	0.2	0.2	0.3
MINING	0	0	0.6	0.6	0	0	4.7	4.7	0	0	10.4	10.4	15.7
THERMAL POWER COOLING	0	0	0	0	0	0	0	0	0	0	0	0	0
NON-WITHDRAWAL WATER USES													
MUNICIPAL WASTEWATER DISCHARGES	0	6.0	0	6.0	0	20.0	0	20.0	0	24.0	0	24.0	50
INDUSTRIAL WASTEWATER DISCHARGES	---	---	---	---	---	---	---	---	---	---	---	---	---
HYDROELECTRIC POWER	---	---	---	---	---	-----	---	---	---	---	---	---	---
WATER ORIENTED OUTDOOR REC.	---	---	---	---	---	---	---	---	---	---	---	---	---
SPORT FISHING	0.6	0.9	0	1.5	1.3	3.4	0	4.7	2.4	4.4	0	6.8	13.0
RECREATIONAL BOATING	0	0	3.6	3.6	0	0	27.0	27.0	0	0	51.1	51.1	81.7
COMMERCIAL FISHING	---	---	---	---	---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	0	0	0	0	80.0	0	0	80.0	160.0	0	0	160.0	240.0
RELATED LAND USES & PROBLEMS													
AGRIC. LAND-TREATMENT	0	0	0.0	0.0	0	0	0.4	0.4	0	0	0.7	0.7	1.1
-CROPLAND DRAINAGE	0	0	0	0	0	0	0.2	0.2	0	0	0.5	0.5	0.7
FOREST LAND-TREATMENT	0.0	0.1	0.2	0.3	0.2	0.4	1.6	2.2	0.2	0.4	1.6	2.2	4.7
SHORELAND EROSION	0.0	0	0.1	0.1	0.2	0	0.80	1.0	0.4	0	1.6	2.0	3.1
STREAMBANK EROSION	0	0	0.2	0.2	0	0	1.5	1.5	0	0	4.0	4.0	5.7
FLOOD PLAINS-URBAN	---	---	---	---	---	---	---	---	---	---	---	---	---
-URBAN	0	0	0	0	0.0	0.2	0	0.2	0.0	0.3	0	0.3	0.5
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
WILDLIFE MANAGEMENT	0	0.5	0	0.5	0	0.8	0	0.8	0	0.7	0	0.7	2.0
AESTHETIC & CULTURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	0.3	1.1	0	1.4	2.4	9.7	0	12.1	6.1	24.4	0	30.5	44.0
-EXTENSIVE	---	---	---	---	---	---	---	---	---	---	---	---	---
TOTAL	0.9	8.9	5.6	15.4	84.1	37.2	40.5	161.8	169.1	60.8	85.9	315.8	493.0

TABLE 1-277 RBG 3.1, Needs, Outputs, and Percent Needs Met, Proposed Framework

RESOURCE USE CATEGORY	UNIT	1970 SUPPLY	1980 N	1980 O	1980 %	2000 N	2000 O	2000 %	2020 N	2020 O	2020 %
WATER WITHDRAWALS											
MUNICIPALLY SUPPLIED	MILLION GALLONS PER DAY	7.0	1.7	1.7	100	5.9	5.9	100	12.6	12.6	100
SELF-SUPPLIED INDUSTRIAL	MILLION GALLONS PER DAY	25	+	+	100	5.0	5.0	100	36.0	36.0	100
RURAL DOMESTIC & LIVESTOCK	MILLION GALLONS PER DAY	6.8	2.5	2.5	100	5.6	5.6	100	10.0	10.0	100
IRRIGATION	MILLION GALLONS PER DAY	3.5	5.5	5.5	100	11.8	11.8	100	18.3	18.3	100
MINING	MILLION GALLONS PER DAY	20.9	7.0	7.0	100	19.4	19.4	100	40.4	40.4	100
THERMAL POWER COOLING	MILLION GALLONS PER DAY	0	0	0	---	0	0	---	0	0	---
NON-WITHDRAWAL WATER USES											
MUNICIPAL WASTEWATER DISCHARGES	MILLION GALLONS PER DAY	5.0	7.2	7.2	100	12.0	12.0	100	18.2	18.2	100
INDUSTRIAL WASTEWATER DISCHARGES	MILLION GALLONS PER DAY	12	9.7	9.7	100	9.8	9.8	100	17.8	17.8	100
HYDROELECTRIC POWER	MILLION GALLONS PER DAY	NA	0	0	---	0	0	---	0	0	---
WATER ORIENTED OUTDOOR REC.	1000 RECREATION DAYS	2,630	+	720	over	774	2,430	over	2,277	4,960	over
	1000 ACRES WATER SURFACE	NA	---	---	---	---	---	---	---	---	---
SPORT FISHING	1000 ANGLER DAYS	3,800	1,881	1,400	74	3,339	2,858	86	4,892	4,411	90
	1000 ACRES WATER SURFACE	NA	---	---	---	---	---	---	---	---	---
RECREATIONAL BOATING	1000 BOAT DAYS	1,431	492	240	49	792	744	94	1,095	1,362	over
	1000 ACRES WATER SURFACE	592	592	---	---	592	---	---	592	---	---
COMMERCIAL FISHING	MILLION TONS PER YEAR	NA	---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	MILLION TONS PER YEAR	---	22.3	22.3	100	33.3	33.3	100	48.8	48.8	100
RELATED LAND USES & PROBLEMS											
AGRIC. LAND-TREATMENT	1000 ACRES	435	435.6	*93.4*	*21*	435.6	*227.1*	*52*	435.6	*332.3*	*76*
-CROPLAND DRAINAGE	1000 ACRES	63	63.3	*0*	*0*	63.3	*0*	*0*	63.3	*0*	*0*
FOREST LAND-TREATMENT	1000 ACRES	2,030	2,030	*66*	*13*	2,030	*799*	*39*	2,030	*1,332*	*66*
SHORELAND EROSION	MILES	70.7	71	1.6	2	71	4.7	7	71	7.8	11
STREAMBANK EROSION	MILES	642	642	45.8	7	642	137	21	642	229	36
	$1000 AVE ANNUAL DAMAGES	62.7	62.7	12.5	20	62.7	37.6	60	62.7	62.7	100
FLOOD PLAINS-URBAN	1000 ACRES	0.7	0.7	0	0	0.8	0.1	13	0.8	0.5	63
-URBAN	$1000 AVE ANNUAL DAMAGES	29.6	40.0	1.0	3	74.9	13.6	18	146	58.4	40
-RURAL	1000 ACRES	39.3	39.3	14.5	37	39.3	19.2	49	39.2	21.7	55
-RURAL	$1000 AVE ANNUAL DAMAGES	214.1	256.6	230.2	90	302.7	271.4	90	379.2	355.7	94
WILDLIFE MANAGEMENT	1000 ACRES	---	22	25	over	152	74	49	316	120	38
	1000 USER DAYS	1,601	32.2	43.0	over	133	176.3	over	264	488.3	over
AESTHETIC & CULTURAL	1000 ACRES	NA	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	1000 ACRES	---	0	0.4	over	0	1.3	over	0.5	2.7	over
-EXTENSIVE	1000 ACRES	NA	0	0.5	over	0	1.9	over	2.8	6.4	over

TABLE 1-278 RBG 3.1, Capital Costs, Proposed Framework (in $1,000,000)

RESOURCE USE CATEGORY	1971-1980 Federal	1971-1980 Non-Fed	1971-1980 Private	1971-1980 Total	1981-2000 Federal	1981-2000 Non-Fed	1981-2000 Private	1981-2000 Total	2001-2020 Federal	2001-2020 Non-Fed	2001-2020 Private	2001-2020 Total	Total
WATER WITHDRAWALS													
MUNICIPALLY SUPPLIED	0.1	0.3	0	0.4	0.3	0.7	0	1.0	0.4	1.1	0	1.5	2.9
SELF-SUPPLIED INDUSTRIAL	0	0	0	0	0	0	0.4	0.4	0	0	2.6	2.6	3.0
RURAL DOMESTIC & LIVESTOCK	0.0	0	0.1	0.1	0.0	0	0.2	0.2	0	0	0.2	0.2	0.5
IRRIGATION	0	0	0.2	0.2	0	0	0.3	0.3	0	0	0.3	0.3	0.8
MINING	0	0	0.4	0.4	0	0	0.8	0.8	0	0	1.4	1.4	2.6
THERMAL POWER COOLING	0	0	0	0	0	0	0	0	0	0	0	0	0
NON-WITHDRAWAL WATER USES													
MUNICIPAL WASTEWATER DISCHARGES	*9.8*	*3.2*	*0*	*13.0*	*12.0*	*4.0*	*0*	*16.0*	*12.8*	*4.2*	*0*	*17.0*	*46.0*
INDUSTRIAL WASTEWATER DISCHARGES	---	---	---	---	---	---	---	---	---	---	---	---	---
HYDROELECTRIC POWER	---	---	---	---	---	---	---	---	---	---	---	---	---
WATER ORIENTED OUTDOOR REC.	---	---	---	---	---	---	---	---	---	---	---	---	---
SPORT FISHING	0.7	1.1	0	1.8	0.2	0.5	0	0.7	1.8	3.2	0	5.0	7.5
RECREATIONAL BOATING	4.3	4.3	3.7	12.3	7.8	7.8	6.7	22.3	7.1	7.0	6.0	20.1	54.7

RESOURCE USE CATEGORY	1971-1980 Federal	Non-Fed	Private	Total	1981-2000 Federal	Non-Fed	Private	Total	2001-2020 Federal	Non-Fed	Private	Total	Total
COMMERCIAL FISHING	---	---	---	---	---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	76.0	0	0	76.0	363.0	0	0	363.0	0	0	0	0	439.0
RELATED LAND USES & PROBLEMS													
AGRIC. LAND-TREATMENT	0.4	0	0.9	1.3	0.7	0	1.8	2.5	0.4	0	1.1	1.5	5.3
-CROPLAND DRAINAGE	0	0	0	0	0	0	0	0	0	0	0	0	0
FOREST LAND-TREATMENT	9.6	0.6	1.8	12.0	20.0	1.2	3.8	25.0	20.0	1.2	3.8	25.0	62.0
SHORELAND EROSION	0.2	0	1.0	1.2	0.5	0	2.0	2.5	0.5	0	2.0	2.5	6.2
STREAMBANK EROSION	0.4	0	1.1	1.5	1.3	0	3.2	4.5	2.1	0	5.4	7.5	13.5
FLOOD PLAINS-URBAN	---	---	---	---	---	---	---	---	---	---	---	---	---
-URBAN	3.3	0	1.1	4.4	1.3	0	0.4	1.7	1.1	0	0.4	1.5	7.6
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
-RURAL			---	---	---	---	---	---	---	---	---		---
WILDLIFE MANAGEMENT	0.9	8.3	0	9.2	1.6	13.9	0	15.5	1.4	13.1	0	14.5	39.2
AESTHETIC & CULTURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	2.7	5.1	0	7.8	6.6	12.3	0	18.9	8.4	15.6	0	24	50.7
-EXTENSIVE	---	---	---	---	---	---	---	---	---	---	---	---	---
TOTAL	108.4	22.9	10.3	141.6	415.3	40.4	19.6	475.3	56.0	45.4	23.2	124.6	741.5

TABLE 1-279 RBG 3.1, Operation, Maintenance, and Replacement Costs, Proposed Framework (in $1,000,000)

	1971-1980				1981-2000				2001-2020				
RESOURCE USE CATEGORY	Federal	Non-Fed	Private	Total	Federal	Non-Fed	Private	Total	Federal	Non-Fed	Private	Total	Total
WATER WITHDRAWALS													
MUNICIPALLY SUPPLIED	0	0.3	0	0.3	0	2.7	0	2.7	0	6.6	0	6.6	9.6
SELF-SUPPLIED INDUSTRIAL	0	0	0	0	0	0	1.3	1.3	0	0	10.3	10.3	11.6
RURAL DOMESTIC & LIVESTOCK	0	0	0.9	0.9	0	0	2.9	2.9	0	0	5.5	5.5	5.5
IRRIGATION	0	0	0.0	0.0	0	0	0.1	0.1	0	0	0.2	0.2	0.3
MINING	0	0	0.6	0.6	0	0	4.7	4.7	0	0	10.4	10.4	15.7
THERMAL POWER COOLING	0	0	0	0	0	0	0	0	0	0	0	0	0
NON-WITHDRAWAL WATER USES													
MUNICIPAL WASTEWATER DISCHARGES	0	27.3	0	27.3	0	64.5	0	64.5	0	83.1	0	83.1	174.9
INDUSTRIAL WASTEWATER DISCHARGES	---	---	---	---	---	---	---	---	---	---	---	---	---
HYDROELECTRIC POWER	---	---	---	---	---	----	---	---	---	---	---	---	---
WATER ORIENTED OUTDOOR REC.	---	---	---	---	---	---	---	---	---	---	---	---	---
SPORT FISHING	0.6	0.9	0	1.5	1.3	3.4	0	4.7	2.4	4.4	0	6.8	13.0
RECREATIONAL BOATING	0	0	3.6	3.6	0	0	27.0	27.0	0	0	51.1	51.1	81.7
COMMERCIAL FISHING	---	---	---	---	---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	9.0	0	0	9.0	127.0	0	0	127.0	218.0	0	0	218.0	354.0
RELATED LAND USES & PROBLEMS													
AGRIC. LAND-TREATMENT	0	0	0.0	0.0	0	0	0.3	0.3	0	0	0.5	0.5	0.8
-CROPLAND DRAINAGE	0	0	0	0	0	0	0	0	0	0	0	0	0
FOREST LAND-TREATMENT	0.0	0.1	0.2	0.3	0.3	0.5	1.9	2.7	0.5	1.0	3.5	5.0	8.0
SHORELAND EROSION	0.0	0	0.1	0.1	0.2	0	0.80	1.0	0.4	0	1.6	2.0	3.1
STREAMBANK EROSION	0	0	0.2	0.2	0	0	1.5	1.5	0	0	4.0	4.0	5.7
FLOOD PLAINS-URBAN	---	---	---	---	---	---	---	---	---	---	---	---	---
-URBAN	0	0	0	0	0.0	0.2	0	0.2	0.0	0.3	0	0.3	0.5
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
WILDLIFE MANAGEMENT	0	0.5	0	0.5	0	0.8	0	0.8	0	0.7	0	0.7	2.0
AESTHETIC & CULTURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	0.3	1.1	0	1.4	2.4	9.7	0	12.1	6.1	24.4	0	30.5	44.0
-EXTENSIVE	---	---	---	---	---	---	---	---	---	---	---	---	---
TOTAL	9.9	30.2	5.6	45.7	131.2	81.8	40.5	253.5	227.4	120.5	87.1	435.0	734.2

TABLE 1–280 RBG 3.2, Needs, Outputs, and Percent Needs Met, Normal Framework

RESOURCE USE CATEGORY	UNIT	1970 SUPPLY	1980 N	1980 O	1980 %	2000 N	2000 O	2000 %	2020 N	2020 O	2020 %
WATER WITHDRAWALS											
MUNICIPALLY SUPPLIED	MILLION GALLONS PER DAY	125.6	32.1	32.1	100	115.4	115.4	100	232.4	232.4	100
SELF-SUPPLIED INDUSTRIAL	MILLION GALLONS PER DAY	515	107	107	100	349	349	100	825	825	100
RURAL DOMESTIC & LIVESTOCK	MILLION GALLONS PER DAY	32.5	5.8	5.8	100	15.3	15.3	100	22.5	22.5	100
IRRIGATION	MILLION GALLONS PER DAY	19.8	79.4	79.4	100	120.3	120.3	100	190.6	190.6	100
MINING	MILLION GALLONS PER DAY	3.9	1.6	1.6	100	6.2	6.2	100	15.1	15.1	100
THERMAL POWER COOLING	MILLION GALLONS PER DAY	750	1,130	1,130	100	7,320	7,320	100	18,800	18,800	100
NON-WITHDRAWAL WATER USES											
MUNICIPAL WASTEWATER DISCHARGES	MILLION GALLONS PER DAY	80	104	104	100	163	163	100	245	245	100
INDUSTRIAL WASTEWATER DISCHARGES	MILLION GALLONS PER DAY	453	408	408	100	252	252	100	346	346	100
HYDROELECTRIC POWER	MILLION GALLONS PER DAY	NA	0	0	---	0	0	---	0	0	---
WATER ORIENTED OUTDOOR REC.	1000 RECREATION DAYS	2,682	6,648	3,230	49	11,720	7,310	62	17,600	12,020	68
	1000 ACRES WATER SURFACE	NA	---	---	---	---	---	---	---	---	---
SPORT FISHING	1000 ANGLER DAYS	2,343	1,180	900	76	2,451	1,900	78	3,906	3,100	79
	1000 ACRES WATER SURFACE	NA	---	---	---	---	---	---	---	---	---
RECREATIONAL BOATING	1000 BOAT DAYS	2,361	552	109	20	1,014	192	19	1,605	376	23
	1000 ACRES WATER SURFACE	262	262	---	---	262	---	---	262	---	---
COMMERCIAL FISHING	MILLION TONS PER YEAR	NA	---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	MILLION TONS PER YEAR	---	5.2	5.2	100	7.2	7.2	100	9.4	9.4	100
RELATED LAND USES & PROBLEMS											
AGRIC. LAND-TREATMENT	1000 ACRES	1,616	1,616	161.5	10	1,616	484.5	30	1,616	678.3	42
-CROPLAND DRAINAGE	1000 ACRES	509	509	47.0	9	509	55.0	11	509	170	33
FOREST LAND-TREATMENT	1000 ACRES	781	781	58	7	781	173	22	781	288	37
SHORELAND EROSION	MILES	91.7	92	0	0	92	0.1	<1	92	0.2	<1
STREAMBANK EROSION	MILES	1,067	1,067	79.4	7	1,067	238.2	22	1,067	397.0	37
	$1000 AVE ANNUAL DAMAGES	79.5	79.5	15.9	20	79.5	47.7	60	79.5	79.5	100
FLOOD PLAINS-URBAN	1000 ACRES	7.4	8.2	2.1	26	9.1	4.3	47	10.1	8.6	85
-URBAN	$1000 AVE ANNUAL DAMAGES	591.9	816.4	299.3	37	1,306	708.6	54	2,386	1,944	81
-RURAL	1000 ACRES	254.2	253	56.5	22	253	98.6	39	252	178	71
-RURAL	$1000 AVE ANNUAL DAMAGES	892.6	1,044	206.5	20	1,211	326.4	27	1,387	934.2	67
WILDLIFE MANAGEMENT	1000 ACRES	---	217	24.0	11	619	62.0	10	1,082	76.0	7
	1000 USER DAYS	5,194	793.2	264.5	33	1,573	864.5	55	2,407	1,219	51
AESTHETIC & CULTURAL	1000 ACRES	NA	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	1000 ACRES	---	1.7	0.9	53	3.2	2.1	66	5.3	3.5	66
-EXTENSIVE	1000 ACRES	NA	9.6	5.1	53	18.3	10.2	56	30.3	16.8	55

TABLE 1–281 RBG 3.2, Capital Costs, Normal Framework (in $1,000,000)

RESOURCE USE CATEGORY	1971-1980 Federal	1971-1980 Non-Fed	1971-1980 Private	1971-1980 Total	1981-2000 Federal	1981-2000 Non-Fed	1981-2000 Private	1981-2000 Total	2001-2020 Federal	2001-2020 Non-Fed	2001-2020 Private	2001-2020 Total	Total
WATER WITHDRAWALS													
MUNICIPALLY SUPPLIED	4.2	9.8	0	14.0	11.3	26.5	0	37.8	15.7	36.5	0	52.2	104.0
SELF-SUPPLIED INDUSTRIAL	0	0	8.9	8.9	0	0	20.1	20.1	0	0	39.5	39.5	68.5
RURAL DOMESTIC & LIVESTOCK	0.0	0	0.2	0.2	0.0	0	0.3	0.3	0.0	0	0.2	0.2	0.7
IRRIGATION	0	0	2.1	2.1	0	0	1.1	1.1	0	0	1.9	1.9	5.1
MINING	0	0	0.1	0.1	0	0	0.3	0.3	0	0	0.5	0.5	0.9
THERMAL POWER COOLING	0	2.0	37.5	39.5	0	10.8	206.0	216.8	0	20.0	380.6	400.6	656.9
NON-WITHDRAWAL WATER USES													
MUNICIPAL WASTEWATER DISCHARGES	48.0	16.0	0	64.0	53.3	17.7	0	71.0	73.5	24.5	0	98.0	233.0
INDUSTRIAL WASTEWATER DISCHARGES	---	---	---	---	---	---	---	---	---	---	---	---	---
HYDROELECTRIC POWER	---	---	---	---	---	---	---	---	---	---	---	---	---
WATER ORIENTED OUTDOOR REC.	---	---	---	---	---	---	---	---	---	---	---	---	---
SPORT FISHING	0.1	0.1	0	0.2	0.6	1.2	0	1.8	1.9	3.2	0	5.1	7.1
RECREATIONAL BOATING	6.3	6.3	5.3	17.9	4.4	4.4	3.8	12.6	12.9	12.9	17.1	36.9	67.4

RESOURCE USE CATEGORY	Federal	Non-Fed	Private	Total	Federal	Non-Fed	Private	Total	Federal	Non-Fed	Private	Total	Total
COMMERCIAL FISHING	---	---	---	---	---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	0	0	0	0	0	0	0	0	0	0	0	0	0
RELATED LAND USES & PROBLEMS													
AGRIC. LAND-TREATMENT	2.0	0	5.1	7.1	3.9	0	10.1	14.0	2.4	0	6.1	8.5	29.6
-CROPLAND DRAINAGE	4.3	0	10.1	14.4	0.2	0	0.6	0.8	7.9	0	18.4	26.3	41.5
FOREST LAND-TREATMENT	2.4	0.2	0.4	8.0	4.8	0.3	0.9	6.0	4.8	0.3	0.9	6.0	15.0
SHORELAND EROSION	0	0	0	0	0.0	0	0.1	0.1	0.0	0	0.1	0.1	0.2
STREAMBANK EROSION	0.7	0	1.9	2.6	2.2	0	5.6	7.8	3.6	0	9.4	13.0	23.4
FLOOD PLAINS-URBAN	---	---	---	---	---	---	---	---	---	---	---	---	---
-URBAN	17.4	0	5.8	23.2	14.7	0	4.9	19.6	25.6	0	8.5	34.1	76.9
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
WILDLIFE MANAGEMENT	1.9	16.7	0	18.6	3.5	31.5	0	35.0	1.7	15.4	0	17.1	70.7
AESTHETIC & CULTURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	11.3	20.9	0	32.2	13.4	24.9	0	38.3	14.9	27.7	0	42.6	113.1
-EXTENSIVE	---	---	---	---	---	---	---	---	---	---	---	---	---
TOTAL	98.6	72.0	77.4	248.0	112.3	117.3	253.8	483.4	164.9	140.5	477.2	782.6	1514.0

TABLE 1-282 RBG 3.2, Operation, Maintenance, and Replacement Costs, Normal Framework (in $1,000,000)

	1971-1980				1981-2000				2001-2020				
RESOURCE USE CATEGORY	Federal	Non-Fed	Private	Total	Federal	Non-Fed	Private	Total	Federal	Non-Fed	Private	Total	Total
WATER WITHDRAWALS													
MUNICIPALLY SUPPLIED	0	5.5	0	5.5	0	63.4	0	63.4	0	131.7	0	131.7	200.6
SELF-SUPPLIED INDUSTRIAL	0	0	8.2	8.2	0	0	132.8	132.8	0	0	400.3	400.3	541.3
RURAL DOMESTIC & LIVESTOCK	0	0	1.6	1.6	0	0	11.4	11.4	0	0	20.5	20.5	33.5
IRRIGATION	0	0	0.3	0.3	0	0	1.4	1.4	0	0	2.1	2.1	3.8
MINING	0	0	0.2	0.2	0	0	1.7	1.7	0	0	4.1	4.1	6.0
THERMAL POWER COOLING	0	.5	9.7	10.2	0	7.6	144.5	152.1	0	23.5	446.7	470.2	632.5
NON-WITHDRAWAL WATER USES													
MUNICIPAL WASTEWATER DISCHARGES	0	36.0	0	36.0	0	146.0	0	146.0	0	204.0	0	204.0	386.0
INDUSTRIAL WASTEWATER DISCHARGES	---	---	---	---	---	---	---	---	---	---	---	---	---
HYDROELECTRIC POWER	---	---	---	---	---	---	---	---	---	---	---	---	---
WATER ORIENTED OUTDOOR REC.	---	---	---	---	---	---	---	---	---	---	---	---	---
SPORT FISHING	0.1	0.2	0	0.3	1.1	2.1	0	3.2	1.7	2.9	0	4.6	8.1
RECREATIONAL BOATING	0	0	4.1	4.1	0	0	22.5	22.5	0	0	38.9	38.9	65.5
COMMERCIAL FISHING	---	---	---	---	---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	0	0	0	0	0	0	0	0	0	0	0	0	0
RELATED LAND USES & PROBLEMS													
AGRIC. LAND-TREATMENT	0	0	0.2	0.2	0	0	1.4	1.4	0	0	2.5	2.5	4.1
-CROPLAND DRAINAGE	0	0	0.4	0.4	0	0	1.5	1.5	0	0	2.8	2.8	4.7
FOREST LAND-TREATMENT	0.0	0.0	0.1	0.1	0.1	0.1	0.4	0.6	0.1	0.2	0.9	1.2	1.9
SHORELAND EROSION	0	0	0	0	0	0	0	0	0.0	0	0.1	0.1	0.1
STREAMBANK EROSION	0	0	0.3	0.3	0	0	2.6	2.6	0	0	6.7	6.7	9.6
FLOOD PLAINS-URBAN	---	---	---	---	---	---	---	---	---	---	---	---	---
-URBAN	0.0	0.1	0	0.1	0.0	0.3	0	0.3	0.0	0.7	0	0.7	1.1
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
WILDLIFE MANAGEMENT	0	0.9	0	0.9	0	1.7	0	1.7	0	0.9	0	0.9	3.5
AESTHETIC & CULTURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	1.6	6.6	0	8.2	10.7	43.0	0	53.7	19.7	78.9	0	98.6	160.5
-EXTENSIVE	---	---	---	---	---	---	---	---	---	---	---	---	---
TOTAL	1.7	49.8	25.1	76.6	11.9	264.2	320.2	596.3	21.5	442.8	925.6	1389.9	2062.8

TABLE 1-283 RBG 3.2, Needs, Outputs, and Percent Needs Met, Proposed Framework

RESOURCE USE CATEGORY	UNIT	1970 SUPPLY	1980 N	1980 O	1980 %	2000 N	2000 O	2000 %	2020 N	2020 O	2020 %
WATER WITHDRAWALS											
MUNICIPALLY SUPPLIED	MILLION GALLONS PER DAY	125.6	32.1	32.1	100	115.4	115.4	100	232.4	232.4	100
SELF-SUPPLIED INDUSTRIAL	MILLION GALLONS PER DAY	515	107	107	100	349	349	100	825	825	100
RURAL DOMESTIC & LIVESTOCK	MILLION GALLONS PER DAY	32.5	5.8	5.8	100	15.3	15.3	100	22.5	22.5	100
IRRIGATION	MILLION GALLONS PER DAY	19.8	79.4	79.4	100	120.3	120.3	100	190.6	190.6	100
MINING	MILLION GALLONS PER DAY	3.9	1.6	1.6	100	6.2	6.2	100	15.1	15.1	100
THERMAL POWER COOLING	MILLION GALLONS PER DAY	750	1,130	1,130	100	7,320	7,320	100	18,800	18,800	100
NON-WITHDRAWAL WATER USES											
MUNICIPAL WASTEWATER DISCHARGES	MILLION GALLONS PER DAY	80	104	104	100	163	163	100	245	245	100
INDUSTRIAL WASTEWATER DISCHARGES	MILLION GALLONS PER DAY	453	408	408	100	252	252	100	346	346	100
HYDROELECTRIC POWER	MILLION GALLONS PER DAY	NA	0	0	---	0	0	---	0	0	---
WATER ORIENTED OUTDOOR REC.	1000 RECREATION DAYS	2,682	6,648	3,230	49	11,720	7,310	62	17,600	12,020	68
	1000 ACRES WATER SURFACE	NA	---	---	---	---	---	---	---	---	---
SPORT FISHING	1000 ANGLER DAYS	2,343	1,180	900	76	2,451	1,900	78	3,906	3,100	79
	1000 ACRES WATER SURFACE	NA	---	---	---	---	---	---	---	---	---
RECREATIONAL BOATING	1000 BOAT DAYS	2,361	552	109	20	1,014	192	19	1,605	376	23
	1000 ACRES WATER SURFACE	262	262	---	---	262	---	---	262	---	---
COMMERCIAL FISHING	MILLION TONS PER YEAR	NA	---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	MILLION TONS PER YEAR	---	5.2	5.2	100	7.2	7.2	100	9.4	9.4	100
RELATED LAND USES & PROBLEMS											
AGRIC. LAND-TREATMENT	1000 ACRES	1,616	1,616	*355.3*	*22*	1,616	*101.8*	*63*	1,616	*1,421*	*88*
-CROPLAND DRAINAGE	1000 ACRES	509	509	*76.3*	*15*	509	*190*	*37*	509	*305*	*60*
FOREST LAND-TREATMENT	1000 ACRES	781	781	*77*	*10*	781	*232*	*30*	781	*387*	*50*
SHORELAND EROSION	MILES	91.7	92	0	0	92	0.1	<1	92	0.2	<1
STREAMBANK EROSION	MILES	1,067	1,067	79.4	7	1,067	238.2	22	1,067	397.0	37
	$1000 AVE ANNUAL DAMAGES	79.5	79.5	15.9	20	79.5	47.7	60	79.5	79.5	100
FLOOD PLAINS-URBAN	1000 ACRES	7.4	8.2	2.1	26	9.1	4.3	47	10.1	8.6	85
-URBAN	$1000 AVE ANNUAL DAMAGES	591.9	816.4	299.3	37	1,306	708.6	54	2,386	1,944	81
-RURAL	1000 ACRES	254.2	253	56.5	22	253	98.6	39	252	178	71
-RURAL	$1000 AVE ANNUAL DAMAGES	892.6	1,044	206.5	20	1,211	326.4	27	1,387	934.2	67
WILDLIFE MANAGEMENT	1000 ACRES	---	217	24.0	11	619	62.0	10	1,082	76.0	7
	1000 USER DAYS	5,194	793.2	264.5	33	1,573	864.5	55	2,407	1,219	51
AESTHETIC & CULTURAL	1000 ACRES	NA	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	1000 ACRES	---	1.7	0.9	53	3.2	2.1	66	5.3	3.5	66
-EXTENSIVE	1000 ACRES	NA	9.6	5.1	53	18.3	10.2	56	30.3	16.8	55

TABLE 1-284 RBG 3.2, Capital Costs, Proposed Framework (in $1,000,000)

RESOURCE USE CATEGORY	1971-1980 Federal	1971-1980 Non-Fed	1971-1980 Private	1971-1980 Total	1981-2000 Federal	1981-2000 Non-Fed	1981-2000 Private	1981-2000 Total	2001-2020 Federal	2001-2020 Non-Fed	2001-2020 Private	2001-2020 Total	Total
WATER WITHDRAWALS													
MUNICIPALLY SUPPLIED	4.2	9.8	0	14.0	11.3	26.5	0	37.8	15.7	36.5	0	52.2	104.0
SELF-SUPPLIED INDUSTRIAL	0	0	8.9	8.9	0	0	20.1	20.1	0	0	39.5	39.5	68.5
RURAL DOMESTIC & LIVESTOCK	0.0	0	0.2	0.2	0.0	0	0.3	0.3	0.0	0	0.2	0.2	0.7
IRRIGATION	0	0	2.1	2.1	0	0	1.1	1.1	0	0	1.9	1.9	5.1
MINING	0	0	0.1	0.1	0	0	0.3	0.3	0	0	0.5	0.5	0.9
THERMAL POWER COOLING	0	2.0	37.5	39.5	0	10.8	206.0	216.8	0	20.0	380.6	400.6	656.9
NON-WITHDRAWAL WATER USES													
MUNICIPAL WASTEWATER DISCHARGES	*120.7*	*40.3*	*0*	*161.0*	*103.5*	*34.5*	*0*	*138.0*	*102.7*	*34.3*	*0*	*137.0*	*436.0*
INDUSTRIAL WASTEWATER DISCHARGES	---	---	---	---	---	---	---	---	---	---	---	---	---
HYDROELECTRIC POWER	---	---	---	---	---	---	---	---	---	---	---	---	---
WATER ORIENTED OUTDOOR REC.	---	---	---	---	---	---	---	---	---	---	---	---	---
SPORT FISHING	0.1	0.1	0	0.2	0.6	1.2	0	1.8	1.9	3.2	0	5.1	7.1
RECREATIONAL BOATING	6.3	6.3	5.3	17.9	4.4	4.4	3.8	12.6	12.9	12.9	17.1	36.9	67.4

COMMERCIAL FISHING	---	---	---	---	---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	0	0	0	0	0	0	0	0	0	0	0	0	0
RELATED LAND USES & PROBLEMS													
AGRIC. LAND-TREATMENT	4.4	0	11.2	15.6	8.1	0	20.7	28.8	5.0	0	12.7	17.7	62.1
-CROPLAND DRAINAGE	3.2	0	9.9	14.2	7.0	0	16.5	23.5	4.5	0	10.4	14.9	52.6
FOREST LAND-TREATMENT	3.2	0.2	0.6	4.0	7.2	0.4	1.4	9.0	7.2	0.4	1.4	9.0	22.0
SHORELAND EROSION	0	0	0	0	0.0	0	0.1	0.1	0.0	0	0.1	0.1	0.2
STREAMBANK EROSION	0.7	0	1.9	2.6	2.2	0	5.6	7.8	3.6	0	9.4	13.0	23.4
FLOOD PLAINS-URBAN	---	---	---	---	---	---	---	---	---	---	---	---	---
-URBAN	17.4	0	5.8	23.2	14.7	0	4.9	19.6	25.6	0	8.5	34.1	76.9
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
WILDLIFE MANAGEMENT	1.9	16.7	0	18.6	3.5	31.5	0	35.0	1.7	15.4	0	17.1	70.7
AESTHETIC & CULTURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	11.3	20.9	0	32.2	13.4	24.9	0	38.3	14.9	27.7	0	42.6	113.1
-EXTENSIVE	---	---	---	---	---	---	---	---	---	---	---	---	---
TOTAL	174.5	96.3	83.5	354.3	175.9	134.2	280.8	590.9	195.7	150.4	476.3	822.4	1,767.6

TABLE 1-285 RBG 3.2, Operation, Maintenance, and Replacement Costs, Proposed Framework (in $1,000,000)

	1971-1980				1981-2000				2001-2020				
RESOURCE USE CATEGORY	Federal	Non-Fed	Private	Total	Federal	Non-Fed	Private	Total	Federal	Non-Fed	Private	Total	Total
WATER WITHDRAWALS													
MUNICIPALLY SUPPLIED	0	5.5	0	5.5	0	63.4	0	63.4	0	131.7	0	131.7	200.6
SELF-SUPPLIED INDUSTRIAL	0	0	8.2	8.2	0	0	132.8	132.8	0	0	400.3	400.3	541.3
RURAL DOMESTIC & LIVESTOCK	0	0	1.6	1.6	0	0	11.4	11.4	0	0	20.5	20.5	33.5
IRRIGATION	0	0	0.3	0.3	0	0	1.4	1.4	0	0	2.1	2.1	3.8
MINING	0	0	0.2	0.2	0	0	1.7	1.7	0	0	4.1	4.1	6.0
THERMAL POWER COOLING	0	.5	9.7	10.2	0	7.6	144.5	152.1	0	23.5	446.7	470.2	632.5
NON-WITHDRAWAL WATER USES													
MUNICIPAL WASTEWATER DISCHARGES	0	205.0	0	205.0	0	506.2	0	506.2	0	768.8	0	768.8	1,480.0
INDUSTRIAL WASTEWATER DISCHARGES	---	---	---	---	---	---	---	---	---	---	---	---	---
HYDROELECTRIC POWER	---	---	---	---	---	---	---	---	---	---	---	---	---
WATER ORIENTED OUTDOOR REC.	---	---	---	---	---	---	---	---	---	---	---	---	---
SPORT FISHING	0.1	0.2	0	0.3	1.1	2.1	0	3.2	1.7	2.9	0	4.6	8.1
RECREATIONAL BOATING	0	0	4.1	4.1	0	0	22.5	22.5	0	0	38.9	38.9	65.5
COMMERCIAL FISHING	---	---	---	---	---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	0	0	0	0	0	0	0	0	0	0	0	0	0
RELATED LAND USES & PROBLEMS													
AGRIC. LAND-TREATMENT	0	0	0.4	0.4	0	0	3.4	3.4	0	0	5.3	5.3	9.1
-CROPLAND DRAINAGE	0	0	0.4	0.4	0	0	2.9	2.9	0	0	4.5	4.5	7.8
FOREST LAND-TREATMENT	0.0	0.0	0.1	0.1	0.1	0.2	0.6	0.9	0.1	0.4	1.3	1.8	2.8
SHORELAND EROSION	0	0	0	0	0	0	0	0	0.0	0	0.1	0.1	0.1
STREAMBANK EROSION	0	0	0.3	0.3	0	0	2.6	2.6	0	0	6.7	6.7	9.6
FLOOD PLAINS-URBAN	---	---	---	---	---	---	---	---	---	---	---	---	---
-URBAN	0.0	0.1	0	0.1	0.0	0.3	0	0.3	0.0	0.7	0	0.7	1.1
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
WILDLIFE MANAGEMENT	0	0.9	0	0.9	0	1.7	0	1.7	0	0.9	0	0.9	3.5
AESTHETIC & CULTURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	1.6	6.6	0	8.2	10.7	43.0	0	53.7	19.7	78.9	0	98.6	160.5
-EXTENSIVE	---	---	---	---	---	---	---	---	---	---	---	---	---
TOTAL	1.7	218.8	25.3	245.8	11.9	624.5	323.8	960.2	21.5	1,007.8	930.5	1,959.8	3,165.8

TABLE 1-286 RBG 4.1, Needs, Outputs, and Percent Needs Met, Normal Framework

RESOURCE USE CATEGORY	UNIT	1970 SUPPLY	1980 N	1980 O	1980 %	2000 N	2000 O	2000 %	2020 N	2020 O	2020 %
WATER WITHDRAWALS											
MUNICIPALLY SUPPLIED	MILLION GALLONS PER DAY	738.9	165.3	165.3	100	553.4	553.4	100	1,094	1,094	100
SELF-SUPPLIED INDUSTRIAL	MILLION GALLONS PER DAY	1,297	30.8	30.8	100	401	401	100	923	923	100
RURAL DOMESTIC & LIVESTOCK	MILLION GALLONS PER DAY	49.4	4.8	4.8	100	13.9	13.9	100	18.3	18.3	100
IRRIGATION	MILLION GALLONS PER DAY	50	192.1	192.1	100	291.9	291.9	100	389.1	389.1	100
MINING	MILLION GALLONS PER DAY	59.6	21.6	21.6	100	83.4	83.4	100	180.1	180.1	100
THERMAL POWER COOLING	MILLION GALLONS PER DAY	3,850	0	0	---	1,046	1,046	100	2,679	2,679	100
NON-WITHDRAWAL WATER USES											
MUNICIPAL WASTEWATER DISCHARGES	MILLION GALLONS PER DAY	897	992	992	100	1,194	1,194	100	1,556	1,556	100
INDUSTRIAL WASTEWATER DISCHARGES	MILLION GALLONS PER DAY	746	504	504	100	247	247	100	255	255	100
HYDROELECTRIC POWER	MILLION GALLONS PER DAY	NA	0	0	---	0	0	---	0	0	---
WATER ORIENTED OUTDOOR REC.	1000 RECREATION DAYS	9,033	16,610	7,680	46	29,800	16,210	54	47,530	16,210	34
	1000 ACRES WATER SURFACE	NA	---	---	---	---	---	---	---	---	---
SPORT FISHING	1000 ANGLER DAYS	4,000	723	723	100	1,628	1,628	100	2,860	2,628	92
	1000 ACRES WATER SURFACE	NA	---	---	---	---	---	---	---	---	---
RECREATIONAL BOATING	1000 BOAT DAYS	3,447	930	82	9	1,932	158	8	3,150	264	8
	1000 ACRES WATER SURFACE	318	318	---	---	318	---	---	318	---	---
COMMERCIAL FISHING	MILLION TONS PER YEAR	NA	---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	MILLION TONS PER YEAR	---	52.0	52.0	100	68.9	68.9	100	88.1	88.1	100
RELATED LAND USES & PROBLEMS											
AGRIC. LAND-TREATMENT	1000 ACRES	1,305	1,305	130.6	10	1,305	391.7	30	1,305	548.2	42
-CROPLAND DRAINAGE	1000 ACRES	434	434	71.3	16	434	163	38	434	181	42
FOREST LAND-TREATMENT	1000 ACRES	421	421	31	7	421	93	22	421	155	37
SHORELAND EROSION	MILES	0	0	0	---	0	0	---	0	0	---
STREAMBANK EROSION	MILES	887	887	64.8	7	887	194	22	887	324	37
	$1000 AVE ANNUAL DAMAGES	61.7	61.7	12.3	20	61.7	37.0	60	61.7	61.7	100
FLOOD PLAINS-URBAN	1000 ACRES	57.9	58.6	24.8	42	59.5	38.6	65	60.8	47.5	78
-URBAN	$1000 AVE ANNUAL DAMAGES	23,950	35,370	32,620	92	56,460	53,930	96	66,220	64,950	98
-RURAL	1000 ACRES	206	206	80.5	39	204.8	130.3	64	203.5	155.8	77
-RURAL	$1000 AVE ANNUAL DAMAGES	2,104	2,466	1,758	71	3,025	2,400	79	3,571	2,905	81
WILDLIFE MANAGEMENT	1000 ACRES	---	440	19.0	4	874	68.8	8	1,447	118.6	8
	1000 USER DAYS	5,804	3,193	757.0	24	4,948	2,930	59	7,078	5,619	79
AESTHETIC & CULTURAL	1000 ACRES	NA	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	1000 ACRES	---	5.6	2.1	38	9.5	4.7	49	15.7	4.7	30
-EXTENSIVE	1000 ACRES	NA	32	9.9	31	53.9	19.3	36	89.0	19.3	22

TABLE 1-287 RBG 4.1, Capital Costs, Normal Framework (in $1,000,000)

RESOURCE USE CATEGORY	1971-1980 Federal	1971-1980 Non-Fed	1971-1980 Private	1971-1980 Total	1981-2000 Federal	1981-2000 Non-Fed	1981-2000 Private	1981-2000 Total	2001-2020 Federal	2001-2020 Non-Fed	2001-2020 Private	2001-2020 Total	Total
WATER WITHDRAWALS													
MUNICIPALLY SUPPLIED	64.2	149.7	0	213.9	61.2	142.9	0	204.1	77.0	179.6	0	256.6	674.6
SELF-SUPPLIED INDUSTRIAL	0	0	2.6	2.6	0	0	30.7	30.7	0	0	43.3	43.3	76.6
RURAL DOMESTIC & LIVESTOCK	0.0	0	0.2	0.2	0.0	0	0.3	0.3	0.0	0	0.2	0.2	0.7
IRRIGATION	0	0	5.8	5.8	0	0	2.3	2.3	0	0	2.3	2.3	10.4
MINING	0	0	0.8	0.8	0	0	2.1	2.1	0	0	3.4	3.4	6.3
THERMAL POWER COOLING	0	0.0	0.0	0.0	0	1.8	34.8	36.6	0	2.9	54.2	57.1	93.7
NON-WITHDRAWAL WATER USES													
MUNICIPAL WASTEWATER DISCHARGES	525.0	175.0	0	700.0	225.0	75.0	0	300.0	281.3	93.7	0	375.0	1375.0
INDUSTRIAL WASTEWATER DISCHARGES	---	---	---	---	---	---	---	---	---	---	---	---	---
HYDROELECTRIC POWER	---	---	---	---	---	---	---	---	---	---	---	---	---
WATER ORIENTED OUTDOOR REC.	---	---	---	---	---	---	---	---	---	---	---	---	---
SPORT FISHING	0.7	2.0	0	2.7	0.4	0.8	0	1.2	0.8	1.6	0	2.4	6.3
RECREATIONAL BOATING	3.7	3.7	3.1	10.5	3.6	3.6	3.1	10.3	5.3	5.3	4.5	15.1	35.9

COMMERCIAL FISHING	---	---	---	---	---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	0	0	0	0	0	0	0	0	0	0	0	0	0
RELATED LAND USES & PROBLEMS													
AGRIC. LAND-TREATMENT	1.6	0	4.1	5.7	3.2	0	8.3	11.5	1.9	0	4.9	6.8	24.0
-CROPLAND DRAINAGE	7.5	0	17.4	24.9	10.0	0	23.3	33.3	2.0	0	4.6	6.6	64.8
FOREST LAND-TREATMENT	1.6	0.1	0.3	2.0	2.4	0.2	0.4	3.0	2.4	0.2	0.4	3.0	8.0
SHORELAND EROSION	0	0	0.0	0	0	0	0.0	0	0	0	0.0	0	0
STREAMBANK EROSION	0.6	0	1.5	2.1	1.8	0	4.6	6.4	3.0	0	7.7	10.7	19.2
FLOOD PLAINS-URBAN	---	---	---	---	---	---	---	---	---	---	---	---	---
-URBAN	180.1	0	60.0	240.1	15.5	0	5.1	20.6	29.9	0	9.9	39.8	300.5
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
WILDLIFE MANAGEMENT	1.9	16.9	0	18.8	1.5	13.7	0	15.2	1.6	13.9	0	15.5	49.5
AESTHETIC & CULTURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	50.6	93.9	0	144.5	55.1	102.3	0	157.4	46.8	86.9	0	133.7	435.6
-EXTENSIVE	---	---	---	---	---	---	---	---	---	---	---	---	---
TOTAL	837.5	441.3	95.8	1374.6	379.7	340.3	115.0	835.0	452.0	384.1	135.4	971.5	3181.1

TABLE 1–288 RBG 4.1, Operation, Maintenance, and Replacement Costs, Normal Framework (in $1,000,000)

RESOURCE USE CATEGORY	1971-1980				1981-2000				2001-2020				
	Federal	Non-Fed	Private	Total	Federal	Non-Fed	Private	Total	Federal	Non-Fed	Private	Total	Total
WATER WITHDRAWALS													
MUNICIPALLY SUPPLIED	0	80.6	0	80.6	0	274.2	0	274.2	0	554.9	0	554.9	909.7
SELF-SUPPLIED INDUSTRIAL	0	0	2.3	2.3	0	0	63.9	63.9	0	0	195.9	195.9	262.1
RURAL DOMESTIC & LIVESTOCK	0	0	0.8	0.8	0	0	5.7	5.7	0	0	9.9	9.9	16.4
IRRIGATION	0	0	0.8	0.8	0	0	3.9	3.9	0	0	5.2	5.2	9.9
MINING	0	0	2.0	2.0	0	0	19.1	19.1	0	0	47.9	47.9	69.0
THERMAL POWER COOLING	0	0.0	0	0.0	0	0.9	17.9	18.8	0	3.4	63.7	67.1	85.9
NON-WITHDRAWAL WATER USES													
MUNICIPAL WASTEWATER DISCHARGES	0	450.0	0	450.0	0	1100.0	0	1100.0	0	1500.0	0	1500.0	3050.0
INDUSTRIAL WASTEWATER DISCHARGES	---	---	---	---	---	---	---	---	---	---	---	---	---
HYDROELECTRIC POWER	---	---	---	---	---	---	---	---	---	---	---	---	---
WATER ORIENTED OUTDOOR REC.	---	---	---	---	---	---	---	---	---	---	---	---	---
SPORT FISHING	0.2	0.7	0	0.9	0.7	1.4	0	2.1	1.1	2.0	0	3.1	6.1
RECREATIONAL BOATING	0	0	2.4	2.4	0	0	14.3	14.3	0	0	26.2	26.2	42.9
COMMERCIAL FISHING	---	---	---	---	---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	0	0	0	0	0	0	0	0	0	0	0	0	0
RELATED LAND USES & PROBLEMS													
AGRIC. LAND-TREATMENT	0	0	0.1	0.1	0	0	1.1	1.1	0	0	2.1	2.1	3.3
-CROPLAND DRAINAGE	0	0	0.6	0.6	0	0	4.2	4.2	0	0	6.2	6.2	11.0
FOREST LAND-TREATMENT	0.0	0.0	0.1	0.1	0.0	0.1	0.3	0.4	0.1	0.1	0.5	0.7	1.2
SHORELAND EROSION	0	0	0	0	0	0	0	0	0	0	0	0	0
STREAMBANK EROSION	0	0	0.2	0.2	0	0	1.1	1.1	0	0	5.5	5.5	6.8
FLOOD PLAINS-URBAN	---	---	---	---	---	---	---	---	---	---	---	---	---
-URBAN	0.0	0.5	0	0.5	0.1	2.1	0	2.2	0.1	2.4	0	2.5	5.2
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
WILDLIFE MANAGEMENT	0	0.9	0	0.9	0	0.8	0	0.8	0	0.8	0	0.8	2.5
AESTHETIC & CULTURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	3.9	15.7	0	19.6	32.2	128.9	0	161.1	57.3	229.1	0	286.4	467.1
-EXTENSIVE	---	---	---	---	---	---	---	---	---	---	---	---	---
TOTAL	4.1	548.4	9.3	561.8	33.0	1508.4	131.5	1672.9	58.6	2292.7	363.0	2714.4	4949.1

TABLE 1-289 RBG 4.1, Needs, Outputs, and Percent Needs Met, Proposed Framework

RESOURCE USE CATEGORY	UNIT	1970 SUPPLY	1980 N	1980 O	1980 %	2000 N	2000 O	2000 %	2020 N	2020 O	2020 %
WATER WITHDRAWALS											
MUNICIPALLY SUPPLIED	MILLION GALLONS PER DAY	738.9	165.3	165.3	100	553.4	553.4	100	1,094	1,094	100
SELF-SUPPLIED INDUSTRIAL	MILLION GALLONS PER DAY	1,297	30.8	30.8	100	401	401	100	923	923	100
RURAL DOMESTIC & LIVESTOCK	MILLION GALLONS PER DAY	49.4	4.8	4.8	100	13.9	13.9	100	18.3	18.3	100
IRRIGATION	MILLION GALLONS PER DAY	50	192.1	192.1	100	291.9	291.9	100	389.1	389.1	100
MINING	MILLION GALLONS PER DAY	59.6	21.6	21.6	100	83.4	83.4	100	180.1	180.1	100
THERMAL POWER COOLING	MILLION GALLONS PER DAY	3,850	0	0	---	1,046	1,046	100	2,679	2,679	100
NON-WITHDRAWAL WATER USES											
MUNICIPAL WASTEWATER DISCHARGES	MILLION GALLONS PER DAY	897	992	992	100	1,194	1,194	100	1,556	1,556	100
INDUSTRIAL WASTEWATER DISCHARGES	MILLION GALLONS PER DAY	746	504	504	100	247	247	100	255	255	100
HYDROELECTRIC POWER	MILLION GALLONS PER DAY	NA	0	0	---	0	0	---	0	0	---
WATER ORIENTED OUTDOOR REC.	1000 RECREATION DAYS	9,033	16,610	7,680	46	29,800	16,210	54	47,530	16,210	34
	1000 ACRES WATER SURFACE	NA	---	---	---	---	---	---	---	---	---
SPORT FISHING	1000 ANGLER DAYS	4,000	723	723	100	1,628	1,628	100	2,860	2,628	92
	1000 ACRES WATER SURFACE	NA	---	---	---	---	---	---	---	---	---
RECREATIONAL BOATING	1000 BOAT DAYS	3,447	930	82	9	1,932	158	8	3,150	264	8
	1000 ACRES WATER SURFACE	318	318	---	---	318	---	---	318	---	---
COMMERCIAL FISHING	MILLION TONS PER YEAR	NA	---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	MILLION TONS PER YEAR	---	52.0	52.0	100	68.9	68.9	100	88.1	88.1	100
RELATED LAND USES & PROBLEMS											
AGRIC. LAND-TREATMENT	1000 ACRES	1,305	1,305	*287.1*	*22*	1,305	*822.3*	*63*	1,305	*1,149*	*88*
-CROPLAND DRAINAGE	1000 ACRES	434	434	*71.3*	*16*	434	*186.8*	*43*	434	*260.9*	*60*
FOREST LAND-TREATMENT	1000 ACRES	421	421	*85*	*20*	421	*253*	*60*	421	*421*	*100*
SHORELAND EROSION	MILES	0	0	0	---	0	0	---	0	0	---
STREAMBANK EROSION	MILES	887	887	64.8	7	887	194	22	887	324	37
	$1000 AVE ANNUAL DAMAGES	61.7	61.7	12.3	20	61.7	37.0	60	61.7	61.7	100
FLOOD PLAINS-URBAN	1000 ACRES	57.9	58.6	24.8	42	59.5	38.6	65	60.8	47.5	78
-URBAN	$1000 AVE ANNUAL DAMAGES	23,950	35,370	32,620	92	56,460	53,930	96	66,220	64,950	98
-RURAL	1000 ACRES	206	206	80.5	39	204.8	130.3	64	203.5	155.8	77
-RURAL	$1000 AVE ANNUAL DAMAGES	2,104	2,466	1,758	71	3,025	2,400	79	3,571	2,905	81
WILDLIFE MANAGEMENT	1000 ACRES	---	440	19.0	4	874	68.8	8	1,447	118.6	8
	1000 USER DAYS	5,804	3,193	757.0	24	4,948	2,930	59	7,078	5,619	79
AESTHETIC & CULTURAL	1000 ACRES	NA	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	1000 ACRES	---	5.6	2.1	38	9.5	4.7	49	15.7	4.7	30
-EXTENSIVE	1000 ACRES	NA	32	9.9	31	53.9	19.3	36	89.0	19.3	22

TABLE 1-290 RBG 4.1, Capital Costs, Proposed Framework (in $1,000,000)

RESOURCE USE CATEGORY	1971-1980 Federal	1971-1980 Non-Fed	1971-1980 Private	1971-1980 Total	1981-2000 Federal	1981-2000 Non-Fed	1981-2000 Private	1981-2000 Total	2001-2020 Federal	2001-2020 Non-Fed	2001-2020 Private	2001-2020 Total	Total
WATER WITHDRAWALS													
MUNICIPALLY SUPPLIED	64.2	149.7	0	213.9	61.2	142.9	0	204.1	77.0	179.6	0	256.6	674.6
SELF-SUPPLIED INDUSTRIAL	0	0	2.6	2.6	0	0	30.7	30.7	0	0	43.3	43.3	76.6
RURAL DOMESTIC & LIVESTOCK	0.0	0	0.2	0.2	0.0	0	0.3	0.3	0.0	0	0.2	0.2	0.7
IRRIGATION	0	0	5.8	5.8	0	0	2.3	2.3	0	0	2.3	2.3	10.4
MINING	0	0	0.8	0.8	0	0	2.1	2.1	0	0	3.4	3.4	6.3
THERMAL POWER COOLING	0	0.0	0.0	0.0	0	1.8	34.8	36.6	0	2.9	54.2	57.1	93.7
NON-WITHDRAWAL WATER USES													
MUNICIPAL WASTEWATER DISCHARGES	*372.8*	*124.2*	*0*	*497.0*	*417.0*	*139.0*	*0*	*556.0*	*482.2*	*160.8*	*0*	*643.0*	*1,696.0*
INDUSTRIAL WASTEWATER DISCHARGES	---	---	---	---	---	---	---	---	---	---	---	---	---
HYDROELECTRIC POWER	---	---	---	---	---	---	---	---	---	---	---	---	---
WATER ORIENTED OUTDOOR REC.	---	---	---	---	---	---	---	---	---	---	---	---	---
SPORT FISHING	0.7	2.0	0	2.7	0.4	0.8	0	1.2	0.8	1.6	0	2.4	6.3
RECREATIONAL BOATING	3.7	3.7	3.1	10.5	3.6	3.6	3.1	10.3	5.3	5.3	4.5	15.1	35.9

COMMERCIAL FISHING	---	---	---	---	---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	17.0	0	0	17.0	445.0	0	0	445.0	0	0	0	0	462.0
RELATED LAND USES & PROBLEMS													
AGRIC. LAND-TREATMENT	3.5	0	8.9	12.4	6.6	0	16.9	23.5	4.0	0	10.3	14.3	50.2
-CROPLAND DRAINAGE	6.1	0	14.2	20.3	11.0	0	25.5	36.5	5.5	0	12.8	18.3	75.1
FOREST LAND--TREATMENT	4.0	0.2	0.8	5.0	8.0	0.5	1.5	10.0	8.0	0.5	1.5	10.0	25.0
SHORELAND EROSION	0	0	0.0	0	0	0	0.0	0	0	0	0.0	0	0
STREAMBANK EROSION	0.6	0	1.5	2.1	1.8	0	4.6	6.4	3.0	0	7.7	10.7	19.2
FLOOD PLAINS--URBAN	---	---	---	---	---	---	---	---	---	---	---	---	---
--URBAN	180.1	0	60.0	240.1	15.5	0	5.1	20.6	29.9	0	9.9	39.8	300.5
--RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
--RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
WILDLIFE MANAGEMENT	1.9	16.9	0	18.8	1.5	13.7	0	15.2	1.6	13.9	0	15.5	49.5
AESTHETIC & CULTURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION--INTENSIVE	50.6	93.9	0	144.5	55.1	102.3	0	157.4	46.8	86.9	0	133.7	435.6
-EXTENSIVE	---	---	---	---	---	---	---	---	---	---	---	---	---
TOTAL	705.2	390.6	97.9	1,193.7	1,026.7	404.6	126.9	1,558.2	664.1	451.5	150.1	1,265.7	4,017.6

TABLE 1-291 RBG 4.1, Operation, Maintenance, and Replacement Costs, Proposed Framework (in $1,000,000)

	1971-1980				1981-2000				2001-2020				
RESOURCE USE CATEGORY	Federal	Non-Fed	Private	Total	Federal	Non-Fed	Private	Total	Federal	Non-Fed	Private	Total	Total
WATER WITHDRAWALS													
MUNICIPALLY SUPPLIED	0	80.6	0	80.6	0	274.2	0	274.2	0	554.9	0	554.9	909.7
SELF-SUPPLIED INDUSTRIAL	0	0	2.3	2.3	0	0	63.9	63.9	0	0	195.9	195.9	262.1
RURAL DOMESTIC & LIVESTOCK	0	0	0.8	0.8	0	0	5.7	5.7	0	0	9.9	9.9	16.4
IRRIGATION	0	0	0.8	0.8	0	0	3.9	3.9	0	0	5.2	5.2	9.9
MINING	0	0	2.0	2.0	0	0	19.1	19.1	0	0	47.9	47.9	69.0
THERMAL POWER COOLING	0	0.0	0	0.0	0	0.9	17.9	18.8	0	3.4	63.7	67.1	85.9
NON-WITHDRAWAL WATER USES													
MUNICIPAL WASTEWATER DISCHARGES	0	952.5	0	952.5	0	2,250.6	0	2,250.6	0	3,239.5	0	3,239.5	6,442.6
INDUSTRIAL WASTEWATER DISCHARGES	---	---	---	---	---	---	---	---	---	---	---	---	---
HYDROELECTRIC POWER	---	---	---	---	---	---	---	---	---	---	---	---	---
WATER ORIENTED OUTDOOR REC.	---	---	---	---	---	---	---	---	---	---	---	---	---
SPORT FISHING	0.2	0.7	0	0.9	0.7	1.4	0	2.1	1.1	2.0	0	3.1	6.1
RECREATIONAL BOATING	0	0	2.4	2.4	0	0	14.3	14.3	0	0	26.2	26.2	42.9
COMMERCIAL FISHING	---	---	---	---	---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	2.0	0	0	2.0	118.0	0	0	118.0	228.0	0	0	228.0	348.0
RELATED LAND USES & PROBLEMS													
AGRIC. LAND-TREATMENT	0	0	0.3	0.3	0	0	2.7	2.7	0	0	4.3	4.3	7.3
--CROPLAND DRAINAGE	0	0	0.5	0.5	0	0	4.4	4.4	0	0	6.6	6.6	11.5
FOREST LAND-TREATMENT	0.0	0.0	0.1	0.1	0.1	0.2	0.9	1.2	0.2	0.4	1.3	1.9	3.2
SHORELAND EROSION	0	0	0	0	0	0	0	0	0	0	0	0	0
STREAMBANK EROSION	0	0	0.2	0.2	0	0	1.1	1.1	0	0	5.5	5.5	6.8
FLOOD PLAINS-URBAN	---	---	---	---	---	---	---	---	---	---	---	---	---
--URBAN	0.0	0.5	0	0.5	0.1	2.1	0	2.2	0.1	2.4	0	2.5	5.2
--RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
--RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
WILDLIFE MANAGEMENT	0	0.9	0	0.9	0	0.8	0	0.8	0	0.8	0	0.8	2.5
AESTHETIC & CULTURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION--INTENSIVE	3.9	15.7	0	19.6	32.2	128.9	0	161.1	57.3	229.1	0	286.4	467.1
--EXTENSIVE	---	---	---	---	---	---	---	---	---	---	---	---	---
TOTAL	6.1	1,050.9	9.4	1,066.4	151.1	2,659.1	133.9	2,944.1	386.7	4,032.5	366.5	4,685.7	8,696.2

TABLE 1-292 RBG 4.2, Needs, Outputs, and Percent Needs Met, Normal Framework

RESOURCE USE CATEGORY	UNIT	1970 SUPPLY	1980 N	1980 O	1980 %	2000 N	2000 O	2000 %	2020 N	2020 O	2020 %
WATER WITHDRAWALS											
MUNICIPALLY SUPPLIED	MILLION GALLONS PER DAY	185.9	23.4	23.4	100	116.2	116.2	100	260.8	260.8	100
SELF-SUPPLIED INDUSTRIAL	MILLION GALLONS PER DAY	318	58	58	100	238	238	100	523		100
RURAL DOMESTIC & LIVESTOCK	MILLION GALLONS PER DAY	42.4	8.7	8.7	100	21.7	21.7	100	33.9		100
IRRIGATION	MILLION GALLONS PER DAY	69	0.8	0.8	100	49.4	49.4	100	113.7	113.7	100
MINING	MILLION GALLONS PER DAY	22.1	8.7	8.7	100	29.6	29.6	100	59.5	59.5	100
THERMAL POWER COOLING	MILLION GALLONS PER DAY	891.8	0	0	---	3,623	3,623	100	8,787	8,787	100
NON-WITHDRAWAL WATER USES											
MUNICIPAL WASTEWATER DISCHARGES	MILLION GALLONS PER DAY	194.0	238.1	238.1	100	317.5	317.5	100	411.1	411.1	100
INDUSTRIAL WASTEWATER DISCHARGES	MILLION GALLONS PER DAY	329.0	345	345	100	271	271	100	382	382	100
HYDROELECTRIC POWER	MILLION GALLONS PER DAY	NA	0	0	---	0	0	---	0	0	---
WATER ORIENTED OUTDOOR REC.	1000 RECREATION DAYS	5,070	8,780	5,455	62	15,940	10,570	66	25,580	17,030	67
	1000 ACRES WATER SURFACE	NA	---	---	---	---	---	---	---	---	---
SPORT FISHING	1000 ANGLER DAYS	9,900	2,269	2,269	100	5,275	5,275	100	9,661	9,661	100
	1000 ACRES WATER SURFACE	NA	---	---	---	---	---	---	---	---	---
RECREATIONAL BOATING	1000 BOAT DAYS	1,302	207	144	70	474	462	97	828	696	84
	1000 ACRES WATER SURFACE	265	265	---	---	265	---	---	265	---	---
COMMERCIAL FISHING	MILLION TONS PER YEAR	NA	---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	MILLION TONS PER YEAR	---	54.4	54.4	100	68.7	68.7	100	80.0	80.0	100
RELATED LAND USES & PROBLEMS											
AGRIC. LAND-TREATMENT	1000 ACRES	3,821	3,821	382.1	10	3,821	1,146	30	3,821	1,600	42
-CROPLAND DRAINAGE	1000 ACRES	2,520	2,520	61.0	2	2,520	251	10	2,520	518.6	21
FOREST LAND-TREATMENT	1000 ACRES	348	348	31	9	348	92	26	348	153	44
SHORELAND EROSION	MILES	28.0	28.0	0	0	28.0	0	0	28.0	0	0
STREAMBANK EROSION	MILES	888	888	21.2	2	888	63.6	7	888	106	12
	$1000 AVE ANNUAL DAMAGES	117.2	117.2	23.4	20	117.2	70.3	60	117.2	117.2	100
FLOOD PLAINS-URBAN	1000 ACRES	26.5	26.7	4.4	16	27.0	16.0	59	27.4	22.9	84
-URBAN	$1000 AVE ANNUAL DAMAGES	4,510	6,081	2,652	44	11,320	9,964	88	20,800	19,290	93
-RURAL	1000 ACRES	371.2	371	99.3	27	370.6	150.6	41	370.3	185.8	50
-RURAL	$1000 AVE ANNUAL DAMAGES	4,610	5,758	1,853	32	7,714	3,217	42	9,875	4,688	47
WILDLIFE MANAGEMENT	1000 ACRES	---	312	19.1	6	618	55.1	9	944	98.1	10
	1000 USER DAYS	3,688	1,162	95.0	8	1,844	270.0	15	2,547	518.2	20
AESTHETIC & CULTURAL	1000 ACRES	NA	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	1000 ACRES	---	2.6	1.7	65	4.9	3.3	67	8.2	5.1	62
-EXTENSIVE	1000 ACRES	NA	14.7	10.2	69	27.2	19.2	71	39.1	29.6	76

TABLE 1-293 RBG 4.2, Capital Costs, Normal Framework (in $1,000,000)

RESOURCE USE CATEGORY	1971-1980 Federal	1971-1980 Non-Fed	1971-1980 Private	1971-1980 Total	1981-2000 Federal	1981-2000 Non-Fed	1981-2000 Private	1981-2000 Total	2001-2020 Federal	2001-2020 Non-Fed	2001-2020 Private	2001-2020 Total	Total
WATER WITHDRAWALS													
MUNICIPALLY SUPPLIED	2.0	4.7	0	6.7	12.1	28.2	0	40.3	12.6	29.5	0	42.1	89.1
SELF-SUPPLIED INDUSTRIAL	0	0	4.8	4.8	0	0	15.0	15.0	0	0	23.6	23.6	43.4
RURAL DOMESTIC & LIVESTOCK	0.0	0	0.2	0.2	0.0	0	0.3	0.3	0.0	0	0.3	0.3	0.8
IRRIGATION	0	0	0.0	0.0	0	0	1.2	1.2	0	0	1.5	1.5	2.7
MINING	0	0	0.2	0.2	0	0	0.8	0.8	0	0	1.0	1.0	2.0
THERMAL POWER COOLING	0	0.0	0.0	0.0	0	6.3	120.5	126.8	0	9.0	171.7	180.7	307.5
NON-WITHDRAWAL WATER USES													
MUNICIPAL WASTEWATER DISCHARGES	41.1	13.7	0	54.8	81.1	27.0	0	108.1	102.2	34.1	0	136.3	299.2
INDUSTRIAL WASTEWATER DISCHARGES	---	---	---	---	---	---	---	---	---	---	---	---	---
HYDROELECTRIC POWER	---	---	---	---	---	---	---	---	---	---	---	---	---
WATER ORIENTED OUTDOOR REC.	---	---	---	---	---	---	---	---	---	---	---	---	---
SPORT FISHING	6.8	17.9	0	24.7	1.7	5.2	0	6.9	1.3	4.0	0	5.3	36.9
RECREATIONAL BOATING	8.9	8.9	7.5	25.3	23.0	22.9	19.7	65.6	14.1	14.1	12.1	40.3	131.2

COMMERCIAL FISHING	---	---	---	---	---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	0	0	0	0	0	0	0	0	0	0	0	0	0
RELATED LAND USES & PROBLEMS													
AGRIC. LAND-TREATMENT	4.7	0	12.0	16.7	9.4	0	24.0	33.4	5.6	0	14.4	20.0	70.1
-CROPLAND DRAINAGE	4.5	0	10.5	15.0	14.0	0	32.5	46.5	20.0	0	46.8	66.8	128.3
FOREST LAND-TREATMENT	1.6	0.1	0.3	2.0	3.2	0.2	0.6	4.0	3.2	0.2	0.6	4.0	10.0
SHORELAND EROSION	0	---	0.0	0.0	0	0	0.0	0.0	0	0	0.0	0.0	0.0
STREAMBANK EROSION	0.2	0	0.5	0.7	0.6	0	1.5	2.1	1.0	0	2.5	3.5	6.3
FLOOD PLAINS-URBAN	---	---	---	---	---	---	---	---	---	---	---	---	---
-URBAN	43.5	0	14.5	58.0	72.2	0	24.0	96.2	2.9	0	1.0	3.9	158.1
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
WILDLIFE MANAGEMENT	1.5	13.5	0	15.0	3.4	30.3	0	33.7	4.4	39.1	0	43.5	92.2
AESTHETIC & CULTURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	11.5	21.3	0	32.8	16.9	31.5	0	48.4	20.0	37.0	0	57.0	138.2
-EXTENSIVE	---	---	---	---	---	---	---	---	---	---	---	---	---
TOTAL	126.3	80.1	50.5	256.9	237.6	151.6	240.1	629.3	187.3	167.0	275.5	629.8	1516.0

TABLE 1-294 RBG 4.2, Operation, Maintenance, and Replacement Costs, Normal Framework (in $1,000,000)

	1971-1980				1981-2000				2001-2020				
RESOURCE USE CATEGORY	Federal	Non-Fed	Private	Total	Federal	Non-Fed	Private	Total	Federal	Non-Fed	Private	Total	Total
WATER WITHDRAWALS													
MUNICIPALLY SUPPLIED	0	3.4	0	3.4	0	41.9	0	41.9	0	111.9	0	111.9	157.2
SELF-SUPPLIED INDUSTRIAL	0	0	4.6	4.6	0	0	46.1	46.1	0	0	117.8	117.8	168.5
RURAL DOMESTIC & LIVESTOCK	0	0	0.8	0.8	0	0	5.3	5.3	0	0	9.7	9.7	15.8
IRRIGATION	0	0	0.0	0.0	0	0	0.4	0.4	0	0	1.1	1.1	1.5
MINING	0	0	0.4	0.4	0	0	4.0	4.0	0	0	9.2	9.2	13.6
THERMAL POWER COOLING	0	0.0	0.0	0.0	0	3.2	62.0	65.2	0	11.2	212.3	223.5	288.7
NON-WITHDRAWAL WATER USES													
MUNICIPAL WASTEWATER DISCHARGES	0	76.0	0	76.0	0	202.0	0	202.0	0	244.0	0	244.0	522.0
INDUSTRIAL WASTEWATER DISCHARGES	---	---	---	---	---	---	---	---	---	---	---	---	---
HYDROELECTRIC POWER	---	---	---	---	---	---	---	---	---	---	---	---	---
WATER ORIENTED OUTDOOR REC.	---	---	---	---	---	---	---	---	---	---	---	---	---
SPORT FISHING	1.2	1.4	0	2.6	0.8	2.3	0	3.1	1.7	3.9	0	5.6	11.3
RECREATIONAL BOATING	0	0	5.9	5.9	0	0	48.1	48.1	0	0	92.1	92.1	146.1
COMMERCIAL FISHING	---	---	---	---	---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	0	0	0	0	0	0	0	0	0	0	0	0	0
RELATED LAND USES & PROBLEMS													
AGRIC. LAND-TREATMENT	0	0	0.4	0.4	0	0	3.3	3.3	0	0	6.0	6.0	9.7
-CROPLAND DRAINAGE	0	0	0.4	0.4	0	0	3.8	3.8	0	0	9.5	9.5	13.7
FOREST LAND-TREATMENT	0.0	0.0	0.1	0.1	0.0	0.1	0.3	0.4	0.1	0.2	0.5	0.8	1.3
SHORELAND EROSION	0	0	0	0	0	0	0	0	0	0	0	0	0
STREAMBANK EROSION	0	0	0.1	0.1	0	0	0.7	0.7	0	0	1.8	1.8	2.6
FLOOD PLAINS-URBAN	---	---	---	---	---	---	---	---	---	---	---	---	---
-URBAN	0.0	0.1	0	0.1	0.1	1.7	0	1.8	0.1	2.2	0	2.3	4.2
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
WILDLIFE MANAGEMENT	0	0.7	0	0.7	0	1.7	0	1.7	0	2.2	0	2.2	4.6
AESTHETIC & CULTURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	2.3	9.2	0	11.5	14.7	58.9	0	73.6	26.5	105.9	0	132.4	217.5
-EXTENSIVE	---	---	---	---	---	---	---	---	---	---	---	---	---
TOTAL	3.5	90.8	12.7	107.0	15.6	311.8	174.0	501.4	78.4	481.5	460.0	969.9	1578.3

TABLE 1–295 RBG 4.2, Needs, Outputs, and Percent Needs Met, Proposed Framework

RESOURCE USE CATEGORY	UNIT	1970 SUPPLY	1980 N	1980 O	1980 %	2000 N	2000 O	2000 %	2020 N	2020 O	2020 %
WATER WITHDRAWALS											
MUNICIPALLY SUPPLIED	MILLION GALLONS PER DAY	185.9	23.4	23.4	100	116.2	116.2	100	260.8	260.8	100
SELF-SUPPLIED INDUSTRIAL	MILLION GALLONS PER DAY	318	58	58	100	238	238	100	523		100
RURAL DOMESTIC & LIVESTOCK	MILLION GALLONS PER DAY	42.4	8.7	8.7	100	21.7	21.7	100	33.9		100
IRRIGATION	MILLION GALLONS PER DAY	69	0.8	0.8	100	49.4	49.4	100	113.7	113.7	100
MINING	MILLION GALLONS PER DAY	22.1	8.7	8.7	100	29.6	29.6	100	59.5	59.5	100
THERMAL POWER COOLING	MILLION GALLONS PER DAY	891.8	0	0	---	3,623	3,623	100	8,787	8,787	100
NON-WITHDRAWAL WATER USES											
MUNICIPAL WASTEWATER DISCHARGES	MILLION GALLONS PER DAY	194.0	238.1	238.1	100	317.5	317.5	100	411.1	411.1	100
INDUSTRIAL WASTEWATER DISCHARGES	MILLION GALLONS PER DAY	329.0	345	345	100	271	271	100	382	382	100
HYDROELECTRIC POWER	MILLION GALLONS PER DAY	NA	0	0	---	0	0	---	0	0	---
WATER ORIENTED OUTDOOR REC.	1000 RECREATION DAYS	5,070	8,780	5,455	62	15,940	10,570	66	25,580	17,030	67
	1000 ACRES WATER SURFACE	NA	---	---	---	---	---	---	---	---	---
SPORT FISHING	1000 ANGLER DAYS	9,900	2,269	2,269	100	5,275	5,275	100	9,661	9,661	100
	1000 ACRES WATER SURFACE	NA	---	---	---	---	---	---	---	---	---
RECREATIONAL BOATING	1000 BOAT DAYS	1,302	207	144	70	474	462	97	828	696	84
	1000 ACRES WATER SURFACE	265	265	---	---	265	---	---	265	---	---
COMMERCIAL FISHING	MILLION TONS PER YEAR	NA	---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	MILLION TONS PER YEAR	---	54.4	54.4	100	68.7	68.7	100	80.0	80.0	100
RELATED LAND USES & PROBLEMS											
AGRIC. LAND-TREATMENT	1000 ACRES	3,821	3,821	*840.6*	*22*	3,821	*2,407*	*63*	3,821	*3,362*	*88*
-CROPLAND DRAINAGE	1000 ACRES	2,520	2,520	*208.3*	*8*	2,520	*565.4*	*22*	2,520	*833.1*	*33*
FOREST LAND-TREATMENT	1000 ACRES	348	348	*38*	*11*	348	*113*	*32*	348	*188*	*54*
SHORELAND EROSION	MILES	28.0	28.0	0	0	28.0	0	0	28.0	0	0
STREAMBANK EROSION	MILES	888	888	21.2	2	888	63.6	7	888	106	12
	$1000 AVE ANNUAL DAMAGES	117.2	117.2	23.4	20	117.2	70.3	60	117.2	117.2	100
FLOOD PLAINS-URBAN	1000 ACRES	26.5	26.7	4.4	16	27.0	16.0	59	27.4	22.9	84
-URBAN	$1000 AVE ANNUAL DAMAGES	4,510	6,081	2,652	44	11,320	9,964	88	20,800	19,290	93
-RURAL	1000 ACRES	371.2	371	99.3	27	370.6	150.6	41	370.3	185.8	50
-RURAL	$1000 AVE ANNUAL DAMAGES	4,610	5,758	1,853	32	7,714	3,217	42	9,875	4,688	47
WILDLIFE MANAGEMENT	1000 ACRES	---	312	19.1	6	618	55.1	9	944	98.1	10
	1000 USER DAYS	3,688	1,162	95.0	8	1,844	270.0	15	2,547	518.2	20
AESTHETIC & CULTURAL	1000 ACRES	NA	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	1000 ACRES	---	2.6	1.7	65	4.9	3.3	67	8.2	5.1	62
-EXTENSIVE	1000 ACRES	NA	14.7	10.2	69	27.2	19.2	71	39.1	29.6	76

TABLE 1–296 RBG 4.2, Capital Costs, Proposed Framework (in $1,000,000)

RESOURCE USE CATEGORY	1971-1980 Federal	1971-1980 Non-Fed	1971-1980 Private	1971-1980 Total	1981-2000 Federal	1981-2000 Non-Fed	1981-2000 Private	1981-2000 Total	2001-2020 Federal	2001-2020 Non-Fed	2001-2020 Private	2001-2020 Total	Total
WATER WITHDRAWALS													
MUNICIPALLY SUPPLIED	2.0	4.7	0	6.7	12.1	28.2	0	40.3	12.6	29.5	0	42.1	89.1
SELF-SUPPLIED INDUSTRIAL	0	0	4.8	4.8	0	0	15.0	15.0	0	0	23.6	23.6	43.4
RURAL DOMESTIC & LIVESTOCK	0.0	0	0.2	0.2	0.0	0	0.3	0.3	0.0	0	0.3	0.3	0.8
IRRIGATION	0	0	0.0	0.0	0	0	1.2	1.2	0	0	1.5	1.5	2.7
MINING	0	0	0.2	0.2	0	0	0.8	0.8	0	0	1.0	1.0	2.0
THERMAL POWER COOLING	0	0.0	0.0	0.0	0	6.3	120.5	126.8	0	9.0	171.7	180.7	307.5
NON-WITHDRAWAL WATER USES													
MUNICIPAL WASTEWATER DISCHARGES	*182.2*	*60.8*	*0*	*243.0*	*150.8*	*50.2*	*0*	*201.0*	*143.2*	*47.8*	*0*	*191.0*	*635.0*
INDUSTRIAL WASTEWATER DISCHARGES	---	---	---	---	---	---	---	---	---	---	---	---	---
HYDROELECTRIC POWER	---	---	---	---	---	---	---	---	---	---	---	---	---
WATER ORIENTED OUTDOOR REC.	---	---	---	---	---	---	---	---	---	---	---	---	---
SPORT FISHING	6.8	17.9	0	24.7	1.7	5.2	0	6.9	1.3	4.0	0	5.3	36.9
RECREATIONAL BOATING	8.9	8.9	7.5	25.3	23.0	22.9	19.7	65.6	14.1	14.1	12.1	40.3	131.2

COMMERCIAL FISHING	---	---	---	---	---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	9.0	0	0	9.0	58.2	0	0	58.2	0	0	0	0	67.2
RELATED LAND USES & PROBLEMS													
AGRIC. LAND-TREATMENT	10.3	0	26.4	36.7	19.4	0	49.9	69.3	11.7	0	30.1	41.8	147.8
-CROPLAND DRAINAGE	10.0	0	23.3	33.3	17.1	0	40.0	57.1	12.9	0	30.0	42.9	133.3
FOREST LAND-TREATMENT	2.4	0.1	0.5	3.0	4.0	0.2	0.8	5.0	4.0	0.2	0.8	5.0	13.0
SHORELAND EROSION	0	---	0.0	0.0	0	0	0.0	0.0	0	0	0.0	0.0	0.0
STREAMBANK EROSION	0.2	0	0.5	0.7	0.6	0	1.5	2.1	1.0	0	2.5	3.5	6.3
FLOOD PLAINS-URBAN	---	---	---	---	---	---	---	---	---	---	---	---	---
-URBAN	43.5	0	14.5	58.0	72.2	0	24.0	96.2	2.9	0	1.0	3.9	158.1
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
WILDLIFE MANAGEMENT	1.5	13.5	0	15.0	3.4	30.3	0	33.7	4.4	39.1	0	43.5	92.2
AESTHETIC & CULTURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	11.5	21.3	0	32.8	16.9	31.5	0	48.4	20.0	37.0	0	57.0	138.2
-EXTENSIVE	---	---	---	---	---	---	---	---	---	---	---	---	---
TOTAL	288.3	127.2	77.8	493.4	379.4	174.8	273.7	827.9	228.1	181.7	273.6	683.4	2,004.7

TABLE 1-297 RBG 4.2, Operation, Maintenance, and Replacement Costs, Proposed Framework (in $1,000,000)

RESOURCE USE CATEGORY	1971-1980				1981-2000				2001-2020				
	Federal	Non-Fed	Private	Total	Federal	Non-Fed	Private	Total	Federal	Non-Fed	Private	Total	Total
WATER WITHDRAWALS													
MUNICIPALLY SUPPLIED	0	3.4	0	3.4	0	41.9	0	41.9	0	111.9	0	111.9	157.2
SELF-SUPPLIED INDUSTRIAL	0	0	4.6	4.6	0	0	46.1	46.1	0	0	117.8	117.8	168.5
RURAL DOMESTIC & LIVESTOCK	0	0	0.8	0.8	0	0	5.3	5.3	0	0	9.7	9.7	15.8
IRRIGATION	0	0	0.0	0.0	0	0	0.4	0.4	0	0	1.1	1.1	1.5
MINING	0	0	0.4	0.4	0	0	4.0	4.0	0	0	9.2	9.2	13.6
THERMAL POWER COOLING	0	0.0	0.0	0.0	0	3.2	62.0	65.2	0	11.2	212.3	223.5	288.7
NON-WITHDRAWAL WATER USES													
MUNICIPAL WASTEWATER DISCHARGES	0	307.5	0	307.5	0	731.5	0	731.5	0	1,146.2	0	1,146.2	2,185.2
INDUSTRIAL WASTEWATER DISCHARGES	---	---	---	---	---	---	---	---	---	---	---	---	---
HYDROELECTRIC POWER	---	---	---	---	---	---	---	---	---	---	---	---	---
WATER ORIENTED OUTDOOR REC.	---	---	---	---	---	---	---	---	---	---	---	---	---
SPORT FISHING	1.2	1.4	0	2.6	0.8	2.3	0	3.1	1.7	3.9	0	5.6	11.3
RECREATIONAL BOATING	0	0	5.9	5.9	0	0	48.1	48.1	0	0	92.1	92.1	146.1
COMMERCIAL FISHING	---	---	---	---	---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	1.0	0	0	1.0	17.0	0	0	17.0	30.0	0	0	30.0	48.0
RELATED LAND USES & PROBLEMS													
AGRIC. LAND-TREATMENT	0	0	0.9	0.9	0	0	8.0	8.0	0	0	12.7	12.7	21.6
-CROPLAND DRAINAGE	0	0	0.8	0.8	0	0	7.1	7.1	0	0	11.1	11.1	19.0
FOREST LAND-TREATMENT	0.0	0.0	0.1	0.1	0.0	0.1	0.3	0.4	0.1	0.2	0.9	1.2	1.7
SHORELAND EROSION	0	0	0	0	0	0	0	0	0	0	0	0	0
STREAMBANK EROSION	0	0	0.1	0.1	0	0	0.7	0.7	0	0	1.8	1.8	2.6
FLOOD PLAINS-URBAN	---	---	---	---	---	---	---	---	---	---	---	---	---
-URBAN	0.0	0.1	0	0.1	0.1	1.7	0	1.8	0.1	2.2	0	2.3	4.2
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
WILDLIFE MANAGEMENT	0	0.7	0	0.7	0	1.7	0	1.7	0	2.2	0	2.2	4.6
AESTHETIC & CULTURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	2.3	9.2	0	11.5	14.7	58.9	0	73.6	26.5	105.9	0	132.4	217.5
-EXTENSIVE	---	---	---	---	---	---	---	---	---	---	---	---	---
TOTAL	4.5	322.3	13.6	340.4	32.6	841.3	182.0	1,055.9	58.4	1,383.7	468.7	1,910.8	3,307.1

TABLE 1–298 RBG 4.3, Needs, Outputs, and Percent Needs Met, Normal Framework

RESOURCE USE CATEGORY	UNIT	1970 SUPPLY	1980 N	1980 O	1980 %	2000 N	2000 O	2000 %	2020 N	2020 O	2020 %
WATER WITHDRAWALS											
MUNICIPALLY SUPPLIED	MILLION GALLONS PER DAY	516.9	79.5	79.5	100	247.7	247.7	100	494.8	494.8	100
SELF-SUPPLIED INDUSTRIAL	MILLION GALLONS PER DAY	1,306	153	153	100	836	836	100	1,730	1,730	100
RURAL DOMESTIC & LIVESTOCK	MILLION GALLONS PER DAY	24.7	1.6	1.6	100	6.3	6.3	100	8.7	8.7	100
IRRIGATION	MILLION GALLONS PER DAY	97	+	+	100	16.5	16.5	100	63.7	63.7	100
MINING	MILLION GALLONS PER DAY	24.3	14.4	14.4	100	53.1	53.1	100	128.1	128.1	100
THERMAL POWER COOLING	MILLION GALLONS PER DAY	2,548	0	0	---	2,553	2,553	100	8,206	8,206	100
NON-WITHDRAWAL WATER USES											
MUNICIPAL WASTEWATER DISCHARGES	MILLION GALLONS PER DAY	516.9	610.2	610.2	100	800.3	800.3	100	1,037	1,037	100
INDUSTRIAL WASTEWATER DISCHARGES	MILLION GALLONS PER DAY	1,349	1,190	1,190	100	938	938	100	1,284	1,284	100
HYDROELECTRIC POWER	MILLION GALLONS PER DAY	NA	0	0	---	0	0	---	0	0	---
WATER ORIENTED OUTDOOR REC.	1000 RECREATION DAYS	8,045	9,175	5,690	62	17,220	11,750	68	28,070	15,180	54
	1000 ACRES WATER SURFACE	NA	---	---	---	---	---	---	---	---	---
SPORT FISHING	1000 ANGLER DAYS	9,333	972	972	100	5,174	5,174	100	5,558	5,558	100
	1000 ACRES WATER SURFACE	NA	---	---	---	---	---	---	---	---	---
RECREATIONAL BOATING	1000 BOAT DAYS	699	135	109	81	327	307	94	468	490	over
	1000 ACRES WATER SURFACE	298	298	---	---	298	---	---	298	---	---
COMMERCIAL FISHING	MILLION TONS PER YEAR	NA	---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	MILLION TONS PER YEAR	---	70.4	70.4	100	94.9	94.9	100	120.4	120.4	100
RELATED LAND USES & PROBLEMS											
AGRIC. LAND-TREATMENT	1000 ACRES	700	700	52.1	7	700	156	22	700	219	31
-CROPLAND DRAINAGE	1000 ACRES	265	265	4.1	2	265	7.2	3	265	35.0	13
FOREST LAND-TREATMENT	1000 ACRES	430	430	32	7	430	97	23	430	162	38
SHORELAND EROSION	MILES	28.2	28.2	2.9	10	28.2	8.8	31	28.2	14.6	52
STREAMBANK EROSION	MILES	356	356	16.0	4	356	48.0	19	356	80	22
	$1000 AVE ANNUAL DAMAGES	341.7	342	68.4	20	342	205.2	60	342	342.0	100
FLOOD PLAINS-URBAN	1000 ACRES	14.4	15.1	6.3	42	15.9	9.4	59	16.6	14.3	86
-URBAN	$1000 AVE ANNUAL DAMAGES	1,221	1,799	1,118	62	3,598	2,573	72	7,475	6,373	85
-RURAL	1000 ACRES	64	63.3	11.1	18	62.4	28.9	46	61.7	39.6	64
-RURAL	$1000 AVE ANNUAL DAMAGES	623.5	830.8	377.4	45	1,179	668.0	57	1,821	1,160	64
WILDLIFE MANAGEMENT	1000 ACRES	---	100	2.8	3	410	11.4	3	800	26.0	3
	1000 USER DAYS	3,184	1,793	84.3	5	2,841	233.3	8	4,070	453.1	11
AESTHETIC & CULTURAL	1000 ACRES	NA	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	1000 ACRES	---	2.6	1.7	65	5.2	3.5	67	9.0	4.4	49
-EXTENSIVE	1000 ACRES	NA	15	10	67	29.7	20.4	69	51.1	25.8	50

TABLE 1–299 RBG 4.3, Capital Costs, Normal Framework (in $1,000,000)

RESOURCE USE CATEGORY	1971-1980 Federal	1971-1980 Non-Fed	1971-1980 Private	1971-1980 Total	1981-2000 Federal	1981-2000 Non-Fed	1981-2000 Private	1981-2000 Total	2001-2020 Federal	2001-2020 Non-Fed	2001-2020 Private	2001-2020 Total	Total
WATER WITHDRAWALS													
MUNICIPALLY SUPPLIED	7.0	16.2	0	23.2	14.7	34.3	0	49.0	21.7	50.5	0	72.2	144.4
SELF-SUPPLIED INDUSTRIAL	0	0	12.7	12.7	0	0	56.7	56.7	0	0	74.2	74.2	143.6
RURAL DOMESTIC & LIVESTOCK	0.0	0	0.0	0.0	0.0	0	0.1	0.1	0.0	0	0.1	0.1	0.2
IRRIGATION	0	0	0.0	0.0	0	0	0.6	0.6	0	0	1.8	1.8	2.4
MINING	0	0	0.8	0.8	0	0	2.3	2.3	0	0	4.4	4.4	7.5
THERMAL POWER COOLING	0	0.0	0.0	0.0	0	4.5	84.8	89.3	0	9.9	188.0	197.9	287.2
NON-WITHDRAWAL WATER USES													
MUNICIPAL WASTEWATER DISCHARGES	102.0	34.0	0	136.0	218.3	72.7	0	291.0	264.0	88.0	0	352.0	779.0
INDUSTRIAL WASTEWATER DISCHARGES	---	---	---	---	---	---	---	---	---	---	---	---	---
HYDROELECTRIC POWER	---	---	---	---	---	---	---	---	---	---	---	---	---
WATER ORIENTED OUTDOOR REC.	---	---	---	---	---	---	---	---	---	---	---	---	---
SPORT FISHING	0.1	0.2	0	0.3	0.3	0.9	0	1.2	0.4	1.4	0	1.8	3.3
RECREATIONAL BOATING	10.2	10.2	8.6	29.0	15.9	15.9	13.7	45.5	10.9	10.9	9.3	31.1	105.6

COMMERCIAL FISHING	---	---	---	---	---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	0	0	0	0	0	0	0	0	0	0	0	0	0
RELATED LAND USES & PROBLEMS													
AGRIC. LAND-TREATMENT	0.6	0	1.5	2.1	1.2	0	3.0	4.2	0.7	0	1.8	2.5	8.8
-CROPLAND DRAINAGE	0.3	0.0	0.7	1.0	0.2	0	0.6	0.8	2.0	0	4.8	6.8	8.6
FOREST LAND-TREATMENT	1.6	0.1	0.3	2.0	4.0	0.2	0.8	5.0	4.0	0.2	0.8	5.0	12.0
SHORELAND EROSION	0.3	0	1.2	1.5	0.6	0	2.3	2.9	0.6	0	2.3	2.9	7.3
STREAMBANK EROSION	0.1	0	0.4	0.5	0.4	0	1.2	1.6	0.7	0	1.9	2.6	4.7
FLOOD PLAINS-URBAN	---	---	---	---	---	---	---	---	---	---	---	---	---
-URBAN	14.2	0	4.7	18.9	5.4	0	1.8	7.2	0.8	0	0.3	1.1	27.2
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
WILDLIFE MANAGEMENT	0.3	3.1	0	3.4	1.2	11.0	0	12.2	2.3	20.8	0	23.1	38.7
AESTHETIC & CULTURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	36.9	68.6	0	105.5	38.0	70.7	0	108.7	20.8	38.5	0	59.3	273.5
-EXTENSIVE	---	---	---	---	---	---	---	---	---	---	---	---	---
TOTAL	173.6	132.4	30.9	336.9	300.2	210.2	167.9	678.3	328.9	220.2	289.7	838.8	1854.0

TABLE 1–300 RBG 4.3, Operation, Maintenance, and Replacement Costs, Normal Framework (in $1,000,000)

	1971-1980				1981-2000				2001-2020				
RESOURCE USE CATEGORY	Federal	Non-Fed	Private	Total	Federal	Non-Fed	Private	Total	Federal	Non-Fed	Private	Total	Total
WATER WITHDRAWALS													
MUNICIPALLY SUPPLIED	0	11.7	0	11.7	0	96.7	0	96.7	0	219.2	0	219.2	327.6
SELF-SUPPLIED INDUSTRIAL	0	0	11.5	11.5	0	0	149.5	149.5	0	0	387.8	387.8	548.8
RURAL DOMESTIC & LIVESTOCK	0	0	0.1	0.1	0	0	1.3	1.3	0	0	2.5	2.5	3.9
IRRIGATION	0	0	0.0	0.0	0	0	0.2	0.2	0	0	0.8	0.8	1.0
MINING	0	0	0.8	0.8	0	0	8.0	8.0	0	0	21.5	21.5	30.3
THERMAL POWER COOLING	0	0.0	0.0	0.0	0	2.3	43.6	45.9	0	9.7	184	193.7	239.6
NON-WITHDRAWAL WATER USES													
MUNICIPAL WASTEWATER DISCHARGES	0	259	0	259	0	738	0	738	0	912	0	912	1909
INDUSTRIAL WASTEWATER DISCHARGES	---	---	---	---	---	---	---	---	---	---	---	---	---
HYDROELECTRIC POWER	---	---	---	---	---	---	---	---	---	---	---	---	---
WATER ORIENTED OUTDOOR REC.	---	---	---	---	---	---	---	---	---	---	---	---	---
SPORT FISHING	0.2	0.3	0	0.5	0.4	1.2	0	1.6	0.4	1.6	0	2.0	4.1
RECREATIONAL BOATING	0	0	4.9	4.9	0	0	34.8	34.8	0	0	62.3	62.3	102.0
COMMERCIAL FISHING	---	---	---	---	---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	0	0	0	0	0	0	0	0	0	0	0	0	0
RELATED LAND USES & PROBLEMS													
AGRIC. LAND-TREATMENT	0	0	0.1	0.1	0	0	0.4	0.4	0	0	0.8	0.8	1.3
-CROPLAND DRAINAGE	0	0	0.0	0.0	0	0	0.2	0.2	0	0	0.5	0.5	0.7
FOREST LAND-TREATMENT	0.0	0.0	0.1	0.1	0.1	0.1	0.3	0.5	0.1	0.2	0.7	1.0	1.6
SHORELAND EROSION	0.0	0	0.1	0.1	0.2	0	1.0	1.2	0.5	0	1.9	2.4	3.7
STREAMBANK EROSION	0	0	0.0	0.0	0	0	0.5	0.5	0	0	1.3	1.3	1.8
FLOOD PLAINS-URBAN	---	---	---	---	---	---	---	---	---	---	---	---	---
-URBAN	0.0	0.1	0	0.1	0.0	0.5	0	0.5	0.0	0.6	0	0.6	1.2
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
WILDLIFE MANAGEMENT	0	0.2	0	0.2	0	0.6	0	0.6	0	1.6	0	1.6	2.4
AESTHETIC & CULTURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	3.4	13.5	0	16.9	20.7	82.7	0	103.4	31.7	126.7	0	158.4	278.7
-EXTENSIVE	---	---	---	---	---	---	---	---	---	---	---	---	---
TOTAL	3.6	284.8	17.6	306.0	21.4	922.1	239.8	1183.3	33.7	1271.6	664.1	1968.4	3457.7

TABLE 1–301 RBG 4.3, Needs, Outputs, and Percent Needs Met, Proposed Framework

RESOURCE USE CATEGORY	UNIT	1970 SUPPLY	1980 N	1980 O	1980 %	2000 N	2000 O	2000 %	2020 N	2020 O	2020 %
WATER WITHDRAWALS											
MUNICIPALLY SUPPLIED	MILLION GALLONS PER DAY	516.9	79.5	79.5	100	247.7	247.7	100	494.8	494.8	100
SELF-SUPPLIED INDUSTRIAL	MILLION GALLONS PER DAY	1,306	153	153	100	836	836	100	1,730	1,730	100
RURAL DOMESTIC & LIVESTOCK	MILLION GALLONS PER DAY	24.7	1.6	1.6	100	6.3	6.3	100	8.7	8.7	100
IRRIGATION	MILLION GALLONS PER DAY	97	+	---	---	16.5	5.2	32	63.7	49.1	77
MINING	MILLION GALLONS PER DAY	24.3	14.4	14.4	100	53.1	14.4	27	128.1	14.4	11
THERMAL POWER COOLING	MILLION GALLONS PER DAY	2,548	0	0	---	2,553	2,553	100	8,206	8,206	100
NON-WITHDRAWAL WATER USES											
MUNICIPAL WASTEWATER DISCHARGES	MILLION GALLONS PER DAY	516.9	610.2	610.2	100	800.3	800.3	100	1,037	1,037	100
INDUSTRIAL WASTEWATER DISCHARGES	MILLION GALLONS PER DAY	1,349	1,190	1,190	100	938	938	100	1,284	1,284	100
HYDROELECTRIC POWER	MILLION GALLONS PER DAY	NA	0	0	---	0	0	---	0	0	---
WATER ORIENTED OUTDOOR REC.	1000 RECREATION DAYS	8,045	9,175	5,690	62	17,220	11,750	68	28,070	15,180	54
	1000 ACRES WATER SURFACE	NA	---	---	---	---	---	---	---	---	---
SPORT FISHING	1000 ANGLER DAYS	9,333	972	972	100	5,174	5,174	100	5,558	5,558	100
	1000 ACRES WATER SURFACE	NA	---	---	---	---	---	---	---	---	---
RECREATIONAL BOATING	1000 BOAT DAYS	699	135	109	81	327	307	94	468	490	over
	1000 ACRES WATER SURFACE	298	298	---	---	298	---	---	298	---	---
COMMERCIAL FISHING	MILLION TONS PER YEAR	NA	---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	MILLION TONS PER YEAR	---	70.4	70.4	100	94.9	94.9	100	120.4	120.4	100
RELATED LAND USES & PROBLEMS											
AGRIC. LAND-TREATMENT	1000 ACRES	700	700.1	114.6	16	700.1	328.4	47	700.1	458.9	66
-CROPLAND DRAINAGE	1000 ACRES	265	235.3	21.9	8	235.3	59.8	23	265.3	87.6	33
FOREST LAND-TREATMENT	1000 ACRES	430	430	86	20	430	258	60	430	430	100
SHORELAND EROSION	MILES	28.2	28.2	2.9	10	28.2	8.8	31	28.2	14.6	52
STREAMBANK EROSION	MILES	356	356	16.0	4	356	48.0	19	356	80	22
	$1000 AVE ANNUAL DAMAGES	341.7	342	68.4	20	342	205.2	60	342	342.0	100
FLOOD PLAINS-URBAN	1000 ACRES	14.4	15.1	6.3	42	15.9	9.4	59	16.6	14.3	86
-URBAN	$1000 AVE ANNUAL DAMAGES	1,221	1,799	1,118	62	3,598	2,573	72	7,475	6,373	85
-RURAL	1000 ACRES	64	63.3	11.1	18	62.4	28.9	46	61.7	39.6	64
-RURAL	$1000 AVE ANNUAL DAMAGES	623.5	830.8	377.4	45	1,179	668.0	57	1,821	1,160	64
WILDLIFE MANAGEMENT	1000 ACRES	---	100	2.8	3	410	11.4	3	800	26.0	3
	1000 USER DAYS	3,184	1,793	84.3	5	2,841	233.3	8	4,070	453.1	11
AESTHETIC & CULTURAL	1000 ACRES	NA	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	1000 ACRES	---	2.6	1.7	65	5.2	3.5	67	9.0	4.4	49
-EXTENSIVE	1000 ACRES	NA	15	10	67	29.7	20.4	69	51.1	25.8	50

TABLE 1–302 RBG 4.3, Capital Costs, Proposed Framework (in $1,000,000)

RESOURCE USE CATEGORY	1971-1980 Federal	1971-1980 Non-Fed	1971-1980 Private	1971-1980 Total	1981-2000 Federal	1981-2000 Non-Fed	1981-2000 Private	1981-2000 Total	2001-2020 Federal	2001-2020 Non-Fed	2001-2020 Private	2001-2020 Total	Total
WATER WITHDRAWALS													
MUNICIPALLY SUPPLIED	7.0	16.2	0	23.2	14.7	34.3	0	49.0	21.7	50.5	0	72.2	144.4
SELF-SUPPLIED INDUSTRIAL	0	0	12.7	12.7	0	0	56.7	56.7	0	0	74.2	74.2	143.6
RURAL DOMESTIC & LIVESTOCK	0.0	0	0.0	0.0	0.0	0	0.1	0.1	0.0	0	0.1	0.1	0.2
IRRIGATION	0	0	0	0	0	0	0.2	0.2	0	0	1.9	1.9	2.1
MINING	0	0	0.5	0.5	0	0	0	0	0	0	0	0	0.5
THERMAL POWER COOLING	0	0.0	0.0	0.0	0	4.5	84.8	89.3	0	9.9	188.0	197.9	287.2
NON-WITHDRAWAL WATER USES													
MUNICIPAL WASTEWATER DISCHARGES	521.2	173.8	0	695.0	326.2	108.8	0	435.0	255.8	85.2	0	341.0	1,471.0
INDUSTRIAL WASTEWATER DISCHARGES	---	---	---	---	---	---	---	---	---	---	---	---	---
HYDROELECTRIC POWER	---	---	---	---	---	---	---	---	---	---	---	---	---
WATER ORIENTED OUTDOOR REC.	---	---	---	---	---	---	---	---	---	---	---	---	---
SPORT FISHING	0.1	0.2	0	0.3	0.3	0.9	0	1.2	0.4	1.4	0	1.8	3.3
RECREATIONAL BOATING	10.2	10.2	8.6	29.0	15.9	15.9	13.7	45.5	10.9	10.9	9.3	31.1	105.6

RESOURCE USE CATEGORY	Federal	Non-Fed	Private	Total	Federal	Non-Fed	Private	Total	Federal	Non-Fed	Private	Total	Total
COMMERCIAL FISHING	---	---	---	---	---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	9.0	0	0	9.0	12.5	0	0	12.5	0	0	0	0	21.5
RELATED LAND USES & PROBLEMS													
AGRIC. LAND-TREATMENT	1.3	0	3.3	4.6	2.4	0	6.2	8.6	1.5	0	3.8	5.3	18.5
--CROPLAND DRAINAGE	1.2	0.0	2.9	4.1	2.2	0	5.0	7.2	1.5	0	3.6	5.1	16.4
FOREST LAND-TREATMENT	4.8	0.3	0.9	6.0	10.4	0.7	1.9	13.0	10.4	0.7	1.9	13.0	32.0
SHORELAND EROSION	0.3	0	1.2	1.5	0.6	0	2.3	2.9	0.6	0	2.3	2.9	7.3
STREAMBANK EROSION	0.1	0	0.4	0.5	0.4	0	1.2	1.6	0.7	0	1.9	2.6	4.7
FLOOD PLAINS--URBAN	---	---	---	---	---	---	---	---	---	---	---	---	---
--URBAN	14.2	0	4.7	18.9	5.4	0	1.8	7.2	0.8	0	0.3	1.1	27.2
--RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
--RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
WILDLIFE MANAGEMENT	0.3	3.1	0	3.4	1.2	11.0	0	12.2	2.3	20.8	0	23.1	38.7
AESTHETIC & CULTURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION--INTENSIVE	36.9	68.6	0	105.5	38.0	70.7	0	108.7	20.8	38.5	0	59.3	273.5
--EXTENSIVE	---	---	---	---	---	---	---	---	---	---	---	---	---
TOTAL	606.6	272.4	35.2	914.2	430.2	246.8	173.9	850.9	327.4	217.9	287.3	832.6	2,597.7

TABLE 1-303 RBG 4.3, Operation, Maintenance, and Replacement Costs, Proposed Framework (in $1,000,000)

RESOURCE USE CATEGORY	1971-1980				1981-2000				2001-2020				
	Federal	Non-Fed	Private	Total	Federal	Non-Fed	Private	Total	Federal	Non-Fed	Private	Total	Total
WATER WITHDRAWALS													
MUNICIPALLY SUPPLIED	0	11.7	0	11.7	0	96.7	0	96.7	0	219.2	0	219.2	327.6
SELF-SUPPLIED INDUSTRIAL	0	0	11.5	11.5	0	0	149.5	149.5	0	0	387.8	387.8	548.8
RURAL DOMESTIC & LIVESTOCK	0	0	0.1	0.1	0	0	1.3	1.3	0	0	2.5	2.5	3.9
IRRIGATION	0	0	0	0	0	0	0.1	0.1	0	0	0.6	0.6	0.7
MINING	0	0	0.9	0.9	0	0	3.7	3.7	0	0	3.7	3.7	8.3
THERMAL POWER COOLING	0	0.0	0.0	0.0	0	2.3	43.6	45.9	0	9.7	184	193.7	239.6
NON-WITHDRAWAL WATER USES													
MUNICIPAL WASTEWATER DISCHARGES	0	538.7	0	538.7	0	1,336.5	0	1,336.5	0	2,358.7	0	2,358.7	4,233.9
INDUSTRIAL WASTEWATER DISCHARGES	---	---	---	---	---	---	---	---	---	---	---	---	---
HYDROELECTRIC POWER	---	---	---	---	---	---	---	---	---	---	---	---	---
WATER ORIENTED OUTDOOR REC.	---	---	---	---	---	---	---	---	---	---	---	---	---
SPORT FISHING	0.2	0.3	0	0.5	0.4	1.2	0	1.6	0.4	1.6	0	2.0	4.1
RECREATIONAL BOATING	0	0	4.9	4.9	0	0	34.8	34.8	0	0	62.3	62.3	102.0
COMMERCIAL FISHING	---	---	---	---	---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	1.0	0	0	1.0	7.0	0	0	7.0	10.0	0	0	10.0	18.0
RELATED LAND USES & PROBLEMS													
AGRIC. LAND-TREATMENT	0	0	0.1	0.1	0	0	1.0	1.0	0	0	1.7	1.7	2.8
--CROPLAND DRAINAGE	0	0	0.1	0.1	0	0	0.9	0.9	0	0	1.3	1.3	2.3
FOREST LAND-TREATMENT	0.0	0.0	0.2	0.2	0.1	0.3	1.0	1.4	0.2	0.5	1.8	2.5	4.1
SHORELAND EROSION	0.0	0	0.1	0.1	0.2	0	1.0	1.2	0.5	0	1.9	2.4	3.7
STREAMBANK EROSION	0	0	0.0	0.0	0	0	0.5	0.5	0	0	1.3	1.3	1.8
FLOOD PLAINS--URBAN	---	---	---	---	---	---	---	---	---	---	---	---	---
--URBAN	0.0	0.1	0	0.1	0.0	0.5	0	0.5	0.0	0.6	0	0.6	1.2
--RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
--RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
WILDLIFE MANAGEMENT	0	0.2	0	0.2	0	0.6	0	0.6	0	1.6	0	1.6	2.4
AESTHETIC & CULTURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION--INTENSIVE	3.4	13.5	0	16.9	20.7	82.7	0	103.4	31.7	126.7	0	158.4	278.7
--EXTENSIVE	---	---	---	---	---	---	---	---	---	---	---	---	---
TOTAL	4.6	564.5	17.9	587.0	28.4	1,520.8	237.4	1,786.6	42.8	2,718.6	648.9	3,410.3	5,783.9

TABLE 1–304 RBG 4.4, Needs, Outputs, and Percent Needs Met, Normal Framework

RESOURCE USE CATEGORY	UNIT	1970 SUPPLY	1980 N	1980 O	1980 %	2000 N	2000 O	2000 %	2020 N	2020 O	2020 %
WATER WITHDRAWALS											
MUNICIPALLY SUPPLIED	MILLION GALLONS PER DAY	327.2	39.1	39.1	100	137.7	137.7	100	260.1	260.1	100
SELF-SUPPLIED INDUSTRIAL	MILLION GALLONS PER DAY	946	114	114	100	454	454	100	849	849	100
RURAL DOMESTIC & LIVESTOCK	MILLION GALLONS PER DAY	16.6	0	0	---	6.9	6.9	100	15	15	100
IRRIGATION	MILLION GALLONS PER DAY	20.5	22.5	22.5	100	55.7	55/7	100	100.8	100.8	100
MINING	MILLION GALLONS PER DAY	9.1	3.6	3.6	100	13.8	13.8	100	30.5	30.5	100
THERMAL POWER COOLING	MILLION GALLONS PER DAY	1,470	0	0	---	1,800	1,800	100	6,503	6,503	100
NON-WITHDRAWAL WATER USES											
MUNICIPAL WASTEWATER DISCHARGES	MILLION GALLONS PER DAY	268	294	294	100	359	359	100	445	445	100
INDUSTRIAL WASTEWATER DISCHARGES	MILLION GALLONS PER DAY	1,067	942	942	100	627	627	100	767	767	100
HYDROELECTRIC POWER	MILLION GALLONS PER DAY	NA	0	0	---	0	0	---	0	0	---
WATER ORIENTED OUTDOOR REC.	1000 RECREATION DAYS	8,596	4,343	4,820	over	10,130	10,040	99	17,560	16,540	94
	1000 ACRES WATER SURFACE	NA	---	---	---	---	---	---	---	---	---
SPORT FISHING	1000 ANGLER DAYS	4,617	911	478	63	2,068	1,427	69	2,632	1,996	76
	1000 ACRES WATER SURFACE	NA	---	---	---	---	---	---	---	---	---
RECREATIONAL BOATING	1000 BOAT DAYS	657	249	78	31	267	206	77	387	344	89
	1000 ACRES WATER SURFACE	358	358	---	---	358	---	---	358	---	---
COMMERCIAL FISHING	MILLION TONS PER YEAR	NA	---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	MILLION TONS PER YEAR	---	15.2	15.2	100	21.0	21.0	100	29.0	29.0	100
RELATED LAND USES & PROBLEMS											
AGRIC. LAND-TREATMENT	1000 ACRES	551.9	551.9	49.9	9	551.9	149.6	27	551.9	209.9	38
-CROPLAND DRAINAGE	1000 ACRES	182	182	15.1	8	182	15.1	8	182	15.1	8
FOREST LAND-TREATMENT	1000 ACRES	1,027	1,030	78	8	1,030	234	23	1,030	390	38
SHORELAND EROSION	MILES	48.6	49	6.0	12	49	6.0	12	49	6.0	12
STREAMBANK EROSION	MILES	363	363	14.4	4	363	43.2	12	363	72.0	20
	$1000 AVE ANNUAL DAMAGES	58.8	58.0	11.6	20	58.0	34.8	60	58.0	58.0	100
FLOOD PLAINS-URBAN	1000 ACRES	21.8	23.2	13.9	60	25.6	21.9	86	27.9	24.4	87
-URBAN	$1000 AVE ANNUAL DAMAGES	928.1	1,344	576.4	43	2,760	2,000	72	5,688	4,253	75
-RURAL	1000 ACRES	93.6	92.2	16.9	18	89.8	54.8	61	87.5	85.5	98
-RURAL	$1000 AVE ANNUAL DAMAGES	405.4	592.1	88.4	15	1,180	949.3	80	2,345	2,046	87
WILDLIFE MANAGEMENT	1000 ACRES	---	36.0	54.5	over	175.0	139.5	80	266.0	214.5	81
	1000 USER DAYS	1,230	338.4	79.8	24	524.6	227.1	43	662.0	387.1	58
AESTHETIC & CULTURAL	1000 ACRES	NA	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	1000 ACRES	---	1.1	1.8	over	2.9	3.8	over	5.3	6.0	over
-EXTENSIVE	1000 ACRES	NA	6.2	9.1	over	16.3	19.7	over	29.8	32.3	over

TABLE 1–305 RBG 4.4, Capital Costs, Normal Framework (in $1,000,000)

RESOURCE USE CATEGORY	1971-1980 Federal	1971-1980 Non-Fed	1971-1980 Private	1971-1980 Total	1981-2000 Federal	1981-2000 Non-Fed	1981-2000 Private	1981-2000 Total	2001-2020 Federal	2001-2020 Non-Fed	2001-2020 Private	2001-2020 Total	Total
WATER WITHDRAWALS													
MUNICIPALLY SUPPLIED	3.5	8.2	0	11.7	8.9	20.9	0	29.8	10.9	25.5	0	36.4	77.9
SELF-SUPPLIED INDUSTRIAL	0	0	9.4	9.4	0	0	28.2	28.2	0	0	32.7	32.7	70.3
RURAL DOMESTIC & LIVESTOCK	0	0	0	0	0.0	0	0.4	0.4	0.0	0	0.4	0.4	0.8
IRRIGATION	0	0	0.6	0.6	0	0	0.3	0.3	0	0	1.2	1.2	2.1
MINING	0	0	0.2	0.2	0	0	0.5	0.5	0	0	1.0	1.0	1.7
THERMAL POWER COOLING	0	0.0	0.0	0.0	0	3.2	59.8	63.0	0	8.2	156.4	164.6	227.6
NON-WITHDRAWAL WATER USES													
MUNICIPAL WASTEWATER DISCHARGES	129.6	43.2	0	172.8	42.5	14.1	0	56.6	106.1	35.4	0	141.5	370.9
INDUSTRIAL WASTEWATER DISCHARGES	---	---	---	---	---	---	---	---	---	---	---	---	---
HYDROELECTRIC POWER	---	---	---	---	---	---	---	---	---	---	---	---	---
WATER ORIENTED OUTDOOR REC.	---	---	---	---	---	---	---	---	---	---	---	---	---
SPORT FISHING	2.5	2.3	0	4.8	3.0	1.5	0	4.5	5.9	2.9	0	8.8	18.1
RECREATIONAL BOATING	6.4	6.4	5.4	18.2	7.9	7.9	6.7	22.5	5.8	5.8	4.9	16.5	57.2

RESOURCE USE CATEGORY	1971-1980 Federal	Non-Fed	Private	Total	1981-2000 Federal	Non-Fed	Private	Total	2001-2020 Federal	Non-Fed	Private	Total	Total
COMMERCIAL FISHING	---	---	---	---	---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	0	0	0	0	0	0	0	0	0	0	0	0	0
RELATED LAND USES & PROBLEMS													
AGRIC. LAND-TREATMENT	0.6	0	1.4	2.0	1.1	0	3.0	4.1	0.7	0	1.7	2.4	8.5
-CROPLAND DRAINAGE	1.0	0	2.4	3.4	0	0	0	0	0	0	0	0	3.4
FOREST LAND-TREATMENT	4.8	0.3	0.9	0.9	9.6	0.6	1.8	12.0	9.6	0.6	1.8	12.0	30.0
SHORELAND EROSION	1.0	0	3.8	3.8	0.0	0	0.0	0.0	0.0	0	0.0	0.0	4.8
STREAMBANK EROSION	0.1	0	0.4	0.4	0.4	0	1.0	1.4	0.7	0	1.7	2.4	4.3
FLOOD PLAINS-URBAN	---	---	---	---	---	---	---	---	---	---	---	---	---
-URBAN	7.7	0	2.5	10.2	60.2	0	20.1	80.3	0	0	0	0	90.5
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
WILDLIFE MANAGEMENT	0.1	0.5	0	0.6	0.3	2.8	0	3.1	0.3	2.7	0	3.0	6.7
AESTHETIC & CULTURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	12.2	22.7	0	34.9	30.3	56.2	0	86.5	29.0	53.8	0	82.8	204.2
-EXTENSIVE	---	---	---	---	---	---	---	---	---	---	---	---	---
TOTAL	169.5	83.6	27.0	280.1	164.2	107.7	121.8	393.2	169.0	134.9	201.8	506.7	1179.0

TABLE 1–306 RBG 4.4, Operation, Maintenance, and Replacement Costs, Normal Framework (in $1,000,000)

	1971-1980				1981-2000				2001-2020				
RESOURCE USE CATEGORY	Federal	Non-Fed	Private	Total	Federal	Non-Fed	Private	Total	Federal	Non-Fed	Private	Total	Total
WATER WITHDRAWALS													
MUNICIPALLY SUPPLIED	0	5.8	0	5.8	0	53.3	0	53.3	0	119.3	0	119.3	178.4
SELF-SUPPLIED INDUSTRIAL	0	0	8.3	8.3	0	0	82.9	82.9	0	0	190.3	190.3	281.5
RURAL DOMESTIC & LIVESTOCK	0	0	0	0	0	0	0.8	0.8	0	0	2.3	2.3	3.1
IRRIGATION	0	0	0.1	0.1	0	0	0.4	0.4	0	0	0.8	0.8	1.3
MINING	0	0	0.1	0.1	0	0	1.3	1.3	0	0	3.4	3.4	4.8
THERMAL POWER COOLING	0	0.0	0.0	0.0	0	1.6	30.8	32.4	0	7.5	142.2	149.7	182.1
NON-WITHDRAWAL WATER USES													
MUNICIPAL WASTEWATER DISCHARGES	0	114.0	0	114.0	0	136.0	0	136.0	0	184.0	0	184.0	434.0
INDUSTRIAL WASTEWATER DISCHARGES	---	---	---	---	---	---	---	---	---	---	---	---	---
HYDROELECTRIC POWER	---	---	---	---	---	---	---	---	---	---	---	---	---
WATER ORIENTED OUTDOOR REC.	---	---	---	---	---	---	---	---	---	---	---	---	---
SPORT FISHING	1.9	1.9	0	3.8	2.1	1.0	0	3.1	2.7	1.3	0	4.0	10.9
RECREATIONAL BOATING	0	0	3.5	3.5	0	0	22.4	22.4	0	0	37.8	37.8	63.7
COMMERCIAL FISHING	---	---	---	---	---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	0	0	0	0	0	0	0	0	0	0	0	0	0
RELATED LAND USES & PROBLEMS													
AGRIC. LAND-TREATMENT	0	0	0.1	0.1	0	0	0.4	0.4	0	0	0.7	0.7	1.2
-CROPLAND DRAINAGE	0	0	0.1	0.1	0	0	0.3	0.3	0	0	0.3	0.3	0.7
FOREST LAND-TREATMENT	0.0	0.0	0.2	0.2	0.1	0.2	0.9	1.2	0.3	0.5	1.6	2.4	3.8
SHORELAND EROSION	0.1	0	0.4	0.5	0.4	0	1.5	1.9	0.4	0	1.5	1.9	4.3
STREAMBANK EROSION	0	0	0	0	0	0	0.5	0.5	0	0	1.2	1.2	1.7
FLOOD PLAINS-URBAN	---	---	---	---	---	---	---	---	---	---	---	---	---
-URBAN	0	0	0	0	0.0	0.6	0	0.6	0.0	0.9	0	0.9	1.5
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
WILDLIFE MANAGEMENT	0	0	0	0	0	0.1	0	0.1	0	0.1	0	0.1	0.2
AESTHETIC & CULTURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	1.8	7.3	0	9.1	15.6	62.6	0	78.2	31.4	125.4	0	156.8	244.1
-EXTENSIVE	---	---	---	---	---	---	---	---	---	---	---	---	---
TOTAL	3.8	129.0	12.8	145.6	18.2	255.4	142.2	415.8	34.8	439.0	382.1	855.9	1417.3

TABLE 1-307 RBG 4.4, Needs, Outputs, and Percent Needs Met, Proposed Framework

RESOURCE USE CATEGORY	UNIT	1970 SUPPLY	1980 N	1980 O	1980 %	2000 N	2000 O	2000 %	2020 N	2020 O	2020 %
WATER WITHDRAWALS											
MUNICIPALLY SUPPLIED	MILLION GALLONS PER DAY	327.2	39.1	39.1	100	137.7	137.7	100	260.1	260.1	100
SELF-SUPPLIED INDUSTRIAL	MILLION GALLONS PER DAY	946	114	114	100	454	454	100	849	849	100
RURAL DOMESTIC & LIVESTOCK	MILLION GALLONS PER DAY	16.6	0	0	---	6.9	6.9	100	15	15	100
IRRIGATION	MILLION GALLONS PER DAY	20.5	22.5	22.5	100	55.7	55/7	100	100.8	100.8	100
MINING	MILLION GALLONS PER DAY	9.1	3.6	3.6	100	13.8	13.8	100	30.5	30.5	100
THERMAL POWER COOLING	MILLION GALLONS PER DAY	1,470	0	0	---	1,800	1,800	100	6,503	6,503	100
NON-WITHDRAWAL WATER USES											
MUNICIPAL WASTEWATER DISCHARGES	MILLION GALLONS PER DAY	268	294	294	100	359	359	100	445	445	100
INDUSTRIAL WASTEWATER DISCHARGES	MILLION GALLONS PER DAY	1,067	942	942	100	627	627	100	767	767	100
HYDROELECTRIC POWER	MILLION GALLONS PER DAY	NA	0	0	---	0	0	---	0	0	---
WATER ORIENTED OUTDOOR REC.	1000 RECREATION DAYS	8,596	4,343	4,820	over	10,130	10,040	99	17,560	16,540	94
	1000 ACRES WATER SURFACE	NA	---	---	---	---	---	---	---	---	---
SPORT FISHING	1000 ANGLER DAYS	4,617	911	478	63	2,068	1,427	69	2,632	1,996	76
	1000 ACRES WATER SURFACE	NA	---	---	---	---	---	---	---	---	---
RECREATIONAL BOATING	1000 BOAT DAYS	657	249	78	31	267	206	77	387	344	89
	1000 ACRES WATER SURFACE	358	358	---	---	358	---	---	358	---	---
COMMERCIAL FISHING	MILLION TONS PER YEAR	NA	---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	MILLION TONS PER YEAR	---	15.2	15.2	100	21.0	21.0	100	29.0	29.0	100
RELATED LAND USES & PROBLEMS											
AGRIC. LAND-TREATMENT	1000 ACRES	551.9	551.9	*92.8*	*17*	551.9	*265.5*	*48*	551.9	*370.1*	*67*
-CROPLAND DRAINAGE	1000 ACRES	182	182	*0*	*0*	182	*0*	*0*	182	*0*	*0*
FOREST LAND-TREATMENT	1000 ACRES	1,027	1,030	*104*	*10*	1,030	*310*	*30*	1,030	*516*	*50*
SHORELAND EROSION	MILES	48.6	49	6.0	12	49	6.0	12	49	6.0	12
STREAMBANK EROSION	MILES	363	363	14.4	4	363	43.2	12	363	72.0	20
	$1000 AVE ANNUAL DAMAGES	58.8	58.0	11.6	20	58.0	34.8	60	58.0	58.0	100
FLOOD PLAINS--URBAN	1000 ACRES	21.8	23.2	13.9	60	25.6	21.9	86	27.9	24.4	87
-URBAN	$1000 AVE ANNUAL DAMAGES	928.1	1,344	576.4	43	2,760	2,000	72	5,688	4,253	75
-RURAL	1000 ACRES	93.6	92.2	16.9	18	89.8	54.8	61	87.5	85.5	98
-RURAL	$1000 AVE ANNUAL DAMAGES	405.4	592.1	88.4	15	1,180	949.3	80	2,345	2,046	87
WILDLIFE MANAGEMENT	1000 ACRES	---	36.0	54.5	over	175.0	139.5	80	266.0	214.5	81
	1000 USER DAYS	1,230	338.4	79.8	24	524.6	227.1	43	662.0	387.1	58
AESTHETIC & CULTURAL	1000 ACRES	NA	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	1000 ACRES	---	1.1	1.8	over	2.9	3.8	over	5.3	6.0	over
-EXTENSIVE	1000 ACRES	NA	6.2	9.1	over	16.3	19.7	over	29.8	32.3	over

TABLE 1-308 RBG 4.4, Capital Costs, Proposed Framework (in $1,000,000)

RESOURCE USE CATEGORY	1971-1980 Federal	1971-1980 Non-Fed	1971-1980 Private	1971-1980 Total	1981-2000 Federal	1981-2000 Non-Fed	1981-2000 Private	1981-2000 Total	2001-2020 Federal	2001-2020 Non-Fed	2001-2020 Private	2001-2020 Total	Total
WATER WITHDRAWALS													
MUNICIPALLY SUPPLIED	3.5	8.2	0	11.7	8.9	20.9	0	29.8	10.9	25.5	0	36.4	77.9
SELF-SUPPLIED INDUSTRIAL	0	0	9.4	9.4	0	0	28.2	28.2	0	0	32.7	32.7	70.3
RURAL DOMESTIC & LIVESTOCK	0	0	0	0	0.0	0	0.4	0.4	0.0	0	0.4	0.4	0.8
IRRIGATION	0	0	0.6	0.6	0	0	0.3	0.3	0	0	1.2	1.2	2.1
MINING	0	0	0.2	0.2	0	0	0.5	0.5	0	0	1.0	1.0	1.7
THERMAL POWER COOLING	0	0.0	0.0	0.0	0	3.2	59.8	63.0	0	8.2	156.4	164.6	227.6
NON-WITHDRAWAL WATER USES													
MUNICIPAL WASTEWATER DISCHARGES	*755.2*	*251.8*	*0*	*1,007.0*	*301.5*	*100.5*	*0*	*402.0*	*129.0*	*43.0*	*0*	*172.0*	*1,581.0*
INDUSTRIAL WASTEWATER DISCHARGES	---	---	---	---	---	---	---	---	---	---	---	---	---
HYDROELECTRIC POWER	---	---	---	---	---	---	---	---	---	---	---	---	---
WATER ORIENTED OUTDOOR REC.	---	---	---	---	---	---	---	---	---	---	---	---	---
SPORT FISHING	2.5	2.3	0	4.8	3.0	1.5	0	4.5	5.9	2.9	0	8.8	18.1
RECREATIONAL BOATING	6.4	6.4	5.4	18.2	7.9	7.9	6.7	22.5	5.8	5.8	4.9	16.5	57.2

COMMERCIAL FISHING	---	---	---	---	---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	19.0	0	0	19.0	28.8	0	0	28.8	0	0	0	0	47.8
RELATED LAND USES & PROBLEMS													
AGRIC. LAND-TREATMENT	0.4	0	0.9	1.3	0.7	0	1.8	2.5	0.4	0	1.1	1.5	5.3
-CROPLAND DRAINAGE	0	0	0	0	0	0	0	0	0	0	0	0	0
FOREST LAND-TREATMENT	6.4	0.4	1.2	8.0	2.0	0.8	2.2	15.0	12.0	0.8	2.2	15.0	38.0
SHORELAND EROSION	1.0	0	3.8	4.8	0.0	0	0.0	0.0	0.0	0	0.0	0.0	4.8
STREAMBANK EROSION	0.1	0	0.4	0.5	0.4	0	1.0	1.4	0.7	0	1.7	2.4	4.3
FLOOD PLAINS-URBAN	---	---	---	---	---	---	---	---	---	---	---	---	---
-URBAN	7.7	0	2.5	10.2	60.2	0	20.1	80.3	0	0	0	0	90.5
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
WILDLIFE MANAGEMENT	0.1	0.5	0	0.6	0.3	2.8	0	3.1	0.3	2.7	0	3.0	6.7
AESTHETIC & CULTURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	12.2	22.7	0	34.9	30.3	56.2	0	86.5	29.0	53.8	0	82.8	204.2
-EXTENSIVE	---	---	---	---	---	---	---	---	---	---	---	---	---
TOTAL	314.5	292.3	24.4	1,131.2	454.0	193.8	121.0	768.8	194.0	142.7	201.6	538.3	2,438.3

TABLE 1-309 RBG 4.4, Operation, Maintenance, and Replacement Costs, Proposed Framework (in $1,000,000)

RESOURCE USE CATEGORY	1971-1980				1981-2000				2001-2020				
	Federal	Non-Fed	Private	Total	Federal	Non-Fed	Private	Total	Federal	Non-Fed	Private	Total	Total
WATER WITHDRAWALS													
MUNICIPALLY SUPPLIED	0	5.8	0	5.8	0	53.3	0	53.3	0	119.3	0	119.3	178.4
SELF-SUPPLIED INDUSTRIAL	0	0	8.3	8.3	0	0	82.9	82.9	0	0	190.3	190.3	281.5
RURAL DOMESTIC & LIVESTOCK	0	0	0	0	0	0	0.8	0.8	0	0	2.3	2.3	3.1
IRRIGATION	0	0	0.1	0.1	0	0	0.4	0.4	0	0	0.8	0.8	1.3
MINING	0	0	0.1	0.1	0	0	1.3	1.3	0	0	3.4	3.4	4.8
THERMAL POWER COOLING	0	0.0	0.0	0.0	0	1.6	30.8	32.4	0	7.5	142.2	149.7	182.1
NON-WITHDRAWAL WATER USES													
MUNICIPAL WASTEWATER DISCHARGES	0	335.0	0	335.0	0	923.6	0	923.6	0	2,150.0	0	2,150.0	3,408.6
INDUSTRIAL WASTEWATER DISCHARGES	---	---	---	---	---	---	---	---	---	---	---	---	---
HYDROELECTRIC POWER	---	---	---	---	---	---	---	---	---	---	---	---	---
WATER ORIENTED OUTDOOR REC.	---	---	---	---	---	---	---	---	---	---	---	---	---
SPORT FISHING	1.9	1.9	0	3.8	2.1	1.0	0	3.1	2.7	1.3	0	4.0	10.9
RECREATIONAL BOATING	0	0	3.5	3.5	0	0	22.4	22.4	0	0	37.8	37.8	63.7
COMMERCIAL FISHING	---	---	---	---	---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	2.0	0	0	2.0	12.0	0	0	12.0	16.0	0	0	16.0	30.0
RELATED LAND USES & PROBLEMS													
AGRIC. LAND-TREATMENT	0	0	0.0	0.0	0	0	0.3	0.3	0	0	0.5	0.5	0.8
-CROPLAND DRAINAGE	0	0	0	0	0	0	0	0	0	0	0	0	0
FOREST LAND-TREATMENT	0.0	0.0	0.2	0.2	0.3	0.6	1.9	2.8	0.2	0.4	1.4	2.0	5.0
SHORELAND EROSION	0.1	0	0.4	0.5	0.4	0	1.5	1.9	0.4	0	1.5	1.9	4.3
STREAMBANK EROSION	0	0	0	0	0	0	0.5	0.5	0	0	1.2	1.2	1.7
FLOOD PLAINS-URBAN	---	---	---	---	---	---	---	---	---	---	---	---	---
-URBAN	0	0	0	0	0.0	0.6	0	0.6	0.0	0.9	0	0.9	1.5
-RURAL	--	---	---	---	---	---	---	---	---	---	---	---	---
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
WILDLIFE MANAGEMENT	0	0	0	0	0	0.1	0	0.1	0	0.1	0	0.1	0.2
AESTHETIC & CULTURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	1.8	7.3	0	9.1	15.6	62.6	0	78.2	31.4	125.4	0	156.8	244.1
-EXTENSIVE	---	---	---	---	---	---	---	---	---	---	---	---	---
TOTAL	5.8	350.0	12.6	368.4	30.4	1,043.4	142.8	1,216.6	50.7	2,404.9	381.4	2,837.9	4,422.0

TABLE 1-310 RBG 5.1, Needs, Outputs, and Percent Needs Met, Normal Framework

RESOURCE USE CATEGORY	UNIT	1970 SUPPLY	1980 N	1980 O	1980 %	2000 N	2000 O	2000 %	2020 N	2020 O	2020 %
WATER WITHDRAWALS											
MUNICIPALLY SUPPLIED	MILLION GALLONS PER DAY	131.0	14.3	14.3	100	82.6	82.6	100	144.4	144.4	100
SELF-SUPPLIED INDUSTRIAL	MILLION GALLONS PER DAY	50	4	4	100	21	21	100	84	84	100
RURAL DOMESTIC & LIVESTOCK	MILLION GALLONS PER DAY	10.8	4.1	4.1	100	3.6	3.6	100	6.8	6.8	100
IRRIGATION	MILLION GALLONS PER DAY	12.6	16.8	16.8	100	42.9	42.9	100	77.7	77.7	100
MINING	MILLION GALLONS PER DAY	2.7	6.7	6.7	100	13.5	13.5	100	25.5	25.5	100
THERMAL POWER COOLING	MILLION GALLONS PER DAY	737	838	838	100	1,665	1,665	100	3,654	3,654	100
NON-WITHDRAWAL WATER USES											
MUNICIPAL WASTEWATER DISCHARGES	MILLION GALLONS PER DAY	225	256	256	100	351	351	100	464	464	100
INDUSTRIAL WASTEWATER DISCHARGES	MILLION GALLONS PER DAY	298	298	298	100	377	377	100	775	775	100
HYDROELECTRIC POWER	MILLION GALLONS PER DAY	NA	+	+	---	4,000	4,000	100	24,000	24,000	100
WATER ORIENTED OUTDOOR REC.	1000 RECREATION DAYS	3,292	3,740	2,810	75	7,039	6,438	91	11,310	11,020	97
	1000 ACRES WATER SURFACE	NA	---	---	---	---	---	---	---	---	---
SPORT FISHING	1000 ANGLER DAYS	2,625	1,456	1,000	69	2,273	1,700	75	3,886	3,200	82
	1000 ACRES WATER SURFACE	NA	---	---	---	---	---	---	---	---	---
RECREATIONAL BOATING	1000 BOAT DAYS	648	201	103	51	312	200	64	474	319	67
	1000 ACRES WATER SURFACE	165	165	---	---	165	---	---	165	---	---
COMMERCIAL FISHING	MILLION TONS PER YEAR	NA	---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	MILLION TONS PER YEAR	---	0.6	0.6	100	0.7	0.7	100	0.8	0.8	100
RELATED LAND USES & PROBLEMS											
AGRIC. LAND-TREATMENT	1000 ACRES	654.2	654.2	58.0	9	654.2	174.2	27	654.2	243.7	37
-CROPLAND DRAINAGE	1000 ACRES	147	147	18.5	13	147	18.5	13	147	18.5	13
FOREST LAND-TREATMENT	1000 ACRES	443	443	38	9	443	113	26	443	188	42
SHORELAND EROSION	MILES	59	59	2.5	4	59	7.4	13	59	12	20
STREAMBANK EROSION	MILES	311	311	9.0	3	311	27.0	9	311	45.0	14
	$1000 AVE ANNUAL DAMAGES	234.6	234.6	469	20	234.6	140.8	60	234.6	234.6	100
FLOOD PLAINS-URBAN	1000 ACRES	7.5	7.7	2.0	26	7.9	3.5	44	8.2	5.8	71
-URBAN	$1000 AVE ANNUAL DAMAGES	213.5	301.0	154.0	51	613.8	375.8	61	1,254	929.1	74
-RURAL	1000 ACRES	72.2	72.0	24.2	34	71.8	38.8	54	71.5	46.9	66
-RURAL	$1000 AVE ANNUAL DAMAGES	496.6	720.2	346.7	48	1,054	591.5	56	1,622	1,047	65
WILDLIFE MANAGEMENT	1000 ACRES	---	24	4.0	17	161	75.0	47	296.0	104.4	35
	1000 USER DAYS	599.4	168	10.0	6	322.4	125.0	39	481.4	203.0	42
AESTHETIC & CULTURAL	1000 ACRES	NA	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	1000 ACRES	---	0.8	0.8	100	1.6	1.9	over	3.0	3.1	over
-EXTENSIVE	1000 ACRES	NA	2.8	5.8	over	8.0	12.3	over	14.9	21.0	over

TABLE 1-311 RBG 5.1, Capital Costs, Normal Framework (in $1,000,000)

RESOURCE USE CATEGORY	1971-1980 Federal	1971-1980 Non-Fed	1971-1980 Private	1971-1980 Total	1981-2000 Federal	1981-2000 Non-Fed	1981-2000 Private	1981-2000 Total	2001-2020 Federal	2001-2020 Non-Fed	2001-2020 Private	2001-2020 Total	Total
WATER WITHDRAWALS													
MUNICIPALLY SUPPLIED	1.3	3.0	0	4.3	6.1	14.3	0	20.4	5.6	12.9	0	18.5	43.2
SELF-SUPPLIED INDUSTRIAL	0	0	0.3	0.3	0	0	1.4	1.4	0	0	5.3	5.3	7.0
RURAL DOMESTIC & LIVESTOCK	0.0	0	0.2	0.2	0.0	0	0.0	0.0	0.0	0	0.2	0.2	0.4
IRRIGATION	0	0	0.4	0.4	0	0	0.6	0.6	0	0	0.8	0.8	1.8
MINING	0	0	0.4	0.4	0	0	0.5	0.5	0	0	2.3	2.3	3.2
THERMAL POWER COOLING	0	1.5	27.8	29.3	0	1.4	27.5	28.9	0	3.5	66.2	69.7	127.9
NON-WITHDRAWAL WATER USES													
MUNICIPAL WASTEWATER DISCHARGES	58.5	19.5	0	78.0	40.5	13.5	0	54.0	67.5	22.5	0	90.0	222.0
INDUSTRIAL WASTEWATER DISCHARGES	---	---	---	---	---	---	---	---	---	---	---	---	---
HYDROELECTRIC POWER	---	---	---	---	---	---	---	---	---	---	---	---	---
WATER ORIENTED OUTDOOR REC.	---	---		---	---	---	---	---	---	---	---	---	---
SPORT FISHING	2.5	2.5	0	5.0	2.7	1.4	0	4.1	4.2	2.0	0	6.2	15.3
RECREATIONAL BOATING	6.3	6.3	5.5	18.1	3.7	3.7	3.2	10.6	3.7	3.7	3.1	10.5	39.2

RESOURCE USE CATEGORY	1971-1980 Federal	Non-Fed	Private	Total	1981-2000 Federal	Non-Fed	Private	Total	2001-2020 Federal	Non-Fed	Private	Total	Total
COMMERCIAL FISHING	---	---	---	---	---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	0	0	0	0	0	0	0	0	0	0	0	0	0
RELATED LAND USES & PROBLEMS													
AGRIC. LAND-TREATMENT	0.7	0	1.7	2.4	1.3	0	3.4	4.7	0.8	0	2.0	2.8	9.9
-CROPLAND DRAINAGE	1.6	0	3.7	5.3	0.0	0	0.0	0.0	0.0	0	0.0	0.0	5.3
FOREST LAND-TREATMENT	1.6	0.1	0.3	2.0	3.2	0.2	0.6	4.0	3.2	0.2	0.6	4.0	10.0
SHORELAND EROSION	0.5	0	1.9	2.4	1.0	0	3.9	4.9	1.0	0	3.9	4.9	12.2
STREAMBANK EROSION	0.1	0	0.2	0.3	0.3	0	0.6	0.9	0.4	0	1.1	1.5	2.7
FLOOD PLAINS-URBAN	---	---	---	---	---	---	---	---	---	---	---	---	---
-URBAN	14.9	0	5.0	19.9	102.8	0	34.2	137.0	0	0	0	0	156.9
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
WILDLIFE MANAGEMENT	0.1	0.4	0	0.5	0.4	3.8	0	4.2	0.4	3.9	0	4.3	9.0
AESTHETIC & CULTURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	11.1	20.7	0	31.8	14.6	27.1	0	41.7	8.3	15.4	0	23.7	97.2
-EXTENSIVE	---	---	---	---	---	---	---	---	---	---	---	---	---
TOTAL	99.2	54.0	47.4	200.6	176.6	65.4	75.9	317.9	95.1	64.1	86.5	244.7	763.2

TABLE 1-312 RBG 5.1, Operation, Maintenance, and Replacement Costs, Normal Framework (in $1,000,000)

RESOURCE USE CATEGORY	1971-1980				1981-2000				2001-2020				
	Federal	Non-Fed	Private	Total	Federal	Non-Fed	Private	Total	Federal	Non-Fed	Private	Total	Total
WATER WITHDRAWALS													
MUNICIPALLY SUPPLIED	0	2.1	0	2.1	0	31.7	0	31.7	0	59.7	0	59.7	93.5
SELF-SUPPLIED INDUSTRIAL	0	0	0.3	0.3	0	0	3.7	3.7	0	0	15.6	15.6	19.6
RURAL DOMESTIC & LIVESTOCK	0	0	0.3	0.3	0	0	1.2	1.2	0	0	1.7	1.7	3.2
IRRIGATION	0	0	0.1	0.1	0	0	0.4	0.4	0	0	0.7	0.7	1.2
MINING	0	0	0.3	0.3	0	0	1.8	1.8	0	0	3.5	3.5	5.6
THERMAL POWER COOLING	0	.4	7.1	7.5	0	2.3	42.8	45.1	0	4.8	90.9	95.7	148.3
NON-WITHDRAWAL WATER USES													
MUNICIPAL WASTEWATER DISCHARGES	0	31.0	0	31.0	0	84.0	0	84.0	0	88.0	0	88.0	203.0
INDUSTRIAL WASTEWATER DISCHARGES	---	---	---	---	---	---	---	---	---	---	---	---	---
HYDROELECTRIC POWER	---	---	---	---	---	---	---	---	---	---	---	---	---
WATER ORIENTED OUTDOOR REC.	---	---	---	---	---	---	---	---	---	---	---	---	---
SPORT FISHING	0.5	0.6	0	1.1	1.8	0.9	0	2.7	2.5	1.2	0	3.7	7.5
RECREATIONAL BOATING	0	0	3.5	3.5	0	0	18.8	18.8	0	0	28.3	28.3	50.6
COMMERCIAL FISHING	---	---	---	---	---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	0	0	0	0	0	0	0	0	0	0	0	0	0
RELATED LAND USES & PROBLEMS													
AGRIC. LAND-TREATMENT	0	0	0.1	0.1	0	0	0.5	0.5	0	0	0.9	0.9	1.5
-CROPLAND DRAINAGE	0	0	0.1	0.1	0	0	0.5	0.5	0	0	0.5	0.5	1.1
FOREST LAND-TREATMENT	0.0	0.0	0.1	0.1	0.0	0.1	0.3	0.4	0.1	0.2	0.5	0.8	1.3
SHORELAND EROSION	0.0	0	0.2	0.2	0.4	0	1.6	2.0	.8	0	3.1	3.9	6.1
STREAMBANK EROSION	0	0	0.0	0.0	0	0	0.3	0.3	0	0	0.8	0.8	1.1
FLOOD PLAINS-URBAN	---	---	---	---	---	---	---	---	---	---	---	---	---
-URBAN	0.0	0.1	0	0.1	0.0	0.9	0	0.9	0.1	1.4	0	1.5	2.5
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
WILDLIFE MANAGEMENT	0	0.0	0	0.0	0	0.2	0	0.2	0	0.2	0	0.2	0.4
AESTHETIC & CULTURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	2.5	10.1	0	12.6	15.3	61.0	0	76.3	23.8	95.0	0	118.8	207.7
-EXTENSIVE	---	---	---	---	---	---	---	---	---	---	---	---	---
TOTAL	3.0	44.3	12.1	59.4	17.5	181.1	71.9	270.5	27.3	250.5	146.5	424.3	754.2

TABLE 1–313 RBG 5.1, Needs, Outputs, and Percent Needs Met, Proposed Framework

RESOURCE USE CATEGORY	UNIT	1970 SUPPLY	1980 N	1980 O	1980 %	2000 N	2000 O	2000 %	2020 N	2020 O	2020 %
WATER WITHDRAWALS											
MUNICIPALLY SUPPLIED	MILLION GALLONS PER DAY	131.0	14.3	14.3	100	82.6	82.6	100	144.4	144.4	100
SELF-SUPPLIED INDUSTRIAL	MILLION GALLONS PER DAY	50	4	4	100	21	21	100	84	84	100
RURAL DOMESTIC & LIVESTOCK	MILLION GALLONS PER DAY	10.8	4.1	4.1	100	3.6	3.6	100	6.8	6.8	100
IRRIGATION	MILLION GALLONS PER DAY	12.6	16.8	16.8	100	42.9	42.9	100	77.7	77.7	100
MINING	MILLION GALLONS PER DAY	2.7	6.7	6.7	100	13.5	13.5	100	25.5	25.5	100
THERMAL POWER COOLING	MILLION GALLONS PER DAY	737	838	838	100	1,665	1,665	100	3,654	3,654	100
NON-WITHDRAWAL WATER USES											
MUNICIPAL WASTEWATER DISCHARGES	MILLION GALLONS PER DAY	225	256	256	100	351	351	100	464	464	100
INDUSTRIAL WASTEWATER DISCHARGES	MILLION GALLONS PER DAY	298	298	298	100	377	377	100	775	775	100
HYDROELECTRIC POWER	MILLION GALLONS PER DAY	NA	+	+	---	4.000	4,000	100	24,000	24,000	100
WATER ORIENTED OUTDOOR REC.	1000 RECREATION DAYS	3,292	3,740	2,810	75	7,039	6,438	91	11,310	11,020	97
	1000 ACRES WATER SURFACE	NA	---	---	---	---	---	---	---	---	---
SPORT FISHING	1000 ANGLER DAYS	2,625	1,456	1,000	69	2,273	1,700	75	3,886	3,200	82
	1000 ACRES WATER SURFACE	NA	---	---	---	---	---	---	---	---	---
RECREATIONAL BOATING	1000 BOAT DAYS	648	201	103	51	312	200	64	474	319	67
	1000 ACRES WATER SURFACE	165	165	---	---	165	---	---	165	---	---
COMMERCIAL FISHING	MILLION TONS PER YEAR	NA	---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	MILLION TONS PER YEAR	---	0.6	0.6	100	0.7	0.7	100	0.8	0.8	100
RELATED LAND USES & PROBLEMS											
AGRIC. LAND-TREATMENT	1000 ACRES	654.2	654.2	*127.1*	*19*	654.2	*363.8*	*56*	654.2	*506.9*	*77*
-CROPLAND DRAINAGE	1000 ACRES	147	147	*0*	*0*	147	*0*	*0*	147	*0*	*0*
FOREST LAND-TREATMENT	1000 ACRES	443	443	*47*	*11*	443	*141*	*32*	443	*235*	*53*
SHORELAND EROSION	MILES	59	59	2.5	4	59	7.4	13	59	12	20
STREAMBANK EROSION	MILES	311	311	9.0	3	311	27.0	9	311	45.0	14
	$1000 AVE ANNUAL DAMAGES	234.6	234.6	469	20	234.6	140.8	60	234.6	234.6	100
FLOOD PLAINS-URBAN	1000 ACRES	7.5	7.7	2.0	26	7.9	3.5	44	8.2	5.8	71
-URBAN	$1000 AVE ANNUAL DAMAGES	213.5	301.0	154.0	51	613.8	375.8	61	1,254	929.1	74
-RURAL	1000 ACRES	72.2	72.0	24.2	34	71.8	38.8	54	71.5	46.9	66
-RURAL	$1000 AVE ANNUAL DAMAGES	496.6	720.2	346.7	48	1,054	591.5	56	1,622	1,047	65
WILDLIFE MANAGEMENT	1000 ACRES	---	24	4.0	17	161	75.0	47	296.0	104.4	35
	1000 USER DAYS	599.4	168	10.0	6	322.4	125.0	39	481.4	203.0	42
AESTHETIC & CULTURAL	1000 ACRES	NA	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	1000 ACRES	---	0.8	0.8	100	1.6	1.9	over	3.0	3.1	over
-EXTENSIVE	1000 ACRES	NA	2.8	5.8	over	8.0	12.3	over	14.9	21.0	over

TABLE 1–314 RBG 5.1, Capital Costs, Proposed Framework (in $1,000,000)

RESOURCE USE CATEGORY	1971-1980 Federal	1971-1980 Non-Fed	1971-1980 Private	1971-1980 Total	1981-2000 Federal	1981-2000 Non-Fed	1981-2000 Private	1981-2000 Total	2001-2020 Federal	2001-2020 Non-Fed	2001-2020 Private	2001-2020 Total	Total
WATER WITHDRAWALS													
MUNICIPALLY SUPPLIED	1.3	3.0	0	4.3	6.1	14.3	0	20.4	5.6	12.9	0	18.5	43.2
SELF-SUPPLIED INDUSTRIAL	0	0	0.3	0.3	0	0	1.4	1.4	0	0	5.3	5.3	7.0
RURAL DOMESTIC & LIVESTOCK	0.0	0	0.2	0.2	0.0	0	0.0	0.0	0.0	0	0.2	0.2	0.4
IRRIGATION	0	0	0.4	0.4	0	0	0.6	0.6	0	0	0.8	0.8	1.8
MINING	0	0	0.4	0.4	0	0	0.5	0.5	0	0	2.3	2.3	3.2
THERMAL POWER COOLING	0	1.5	27.8	29.3	0	1.4	27.5	28.9	0	3.5	66.2	69.7	127.9
NON-WITHDRAWAL WATER USES													
MUNICIPAL WASTEWATER DISCHARGES	*849.0*	*283.0*	*0*	*1,132.0*	*100.5*	*33.5*	*0*	*1,340.0*	*71.2*	*23.8*	*0*	*95.0*	*1,361.0*
INDUSTRIAL WASTEWATER DISCHARGES	---	---	---	---	---	---	---	---	---	---	---	---	---
HYDROELECTRIC POWER	---	---	---	---	---	---	---	---	---	---	---	---	---
WATER ORIENTED OUTDOOR REC.	---	---		---	---	---	---	---	---	---	---	---	---
SPORT FISHING	2.5	2.5	0	5.0	2.7	1.4	0	4.1	4.2	2.0	0	6.2	15.3
RECREATIONAL BOATING	6.3	6.3	5.5	18.1	3.7	3.7	3.2	10.6	3.7	3.7	3.1	10.5	39.2

COMMERCIAL FISHING	---	---	---	---	---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	0	0	0	0	0	0	0	0	0	0	0	0	0
RELATED LAND USES & PROBLEMS													
AGRIC. LAND-TREATMENT	0.5	0	1.3	1.8	1.0	0	2.5	3.5	0.6	0	1.5	2.1	7.4
-CROPLAND DRAINAGE	0	0	0	0	0.0	0	0.0	0.0	0.0	0	0.0	0.0	5.3
FOREST LAND-TREATMENT	2.4	0.1	0.5	3.0	4.8	0.3	0.9	6.0	4.8	0.3	0.9	6.0	15.0
SHORELAND EROSION	0.5	0	1.9	2.4	1.0	0	3.9	4.9	1.0	0	3.9	4.9	12.2
STREAMBANK EROSION	0.1	0	0.2	0.3	0.3	0	0.6	0.9	0.4	0	1.1	1.5	2.7
FLOOD PLAINS-URBAN	---	---	---	---	---	---	---	---	---	---	---	---	---
-URBAN	14.9	0	5.0	19.9	102.8	0	34.2	137.0	0	0	0	0	156.9
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
WILDLIFE MANAGEMENT	0.1	0.4	0	0.5	0.4	3.8	0	4.2	0.4	3.9	0	4.3	9.0
AESTHETIC & CULTURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	11.1	20.7	0	31.8	14.6	27.1	0	41.7	8.3	15.4	0	23.7	97.2
-EXTENSIVE	---	---	---	---	---	---	---	---	---	---	---	---	---
TOTAL	888.7	317.5	43.5	1,249.7	85.5	237.9	75.3	398.7	100.2	65.5	85.3	251.0	1,899.4

TABLE 1–315 RBG 5.1, Operation, Maintenance, and Replacement Costs, Proposed Framework (in $1,000,000)

	1971-1980				1981-2000				2001-2020				
RESOURCE USE CATEGORY	Federal	Non-Fed	Private	Total	Federal	Non-Fed	Private	Total	Federal	Non-Fed	Private	Total	Total
WATER WITHDRAWALS													
MUNICIPALLY SUPPLIED	0	2.1	0	2.1	0	31.7	0	31.7	0	59.7	0	59.7	93.5
SELF-SUPPLIED INDUSTRIAL	0	0	0.3	0.3	0	0	3.7	3.7	0	0	15.6	15.6	19.6
RURAL DOMESTIC & LIVESTOCK	0	0	0.3	0.3	0	0	1.2	1.2	0	0	1.7	1.7	3.2
IRRIGATION	0	0	0.1	0.1	0	0	0.4	0.4	0	0	0.7	0.7	1.2
MINING	0	0	0.3	0.3	0	0	1.8	1.8	0	0	3.5	3.5	5.6
THERMAL POWER COOLING	0	.4	7.1	7.5	0	2.3	42.8	45.1	0	4.8	90.9	95.7	148.3
NON-WITHDRAWAL WATER USES													
MUNICIPAL WASTEWATER DISCHARGES	0	149.2	0	149.2	0	371.7	0	371.7	0	720.5	0	720.5	1,241.4
INDUSTRIAL WASTEWATER DISCHARGES	---	---	---	---	---	---	---	---	---	---	---	---	---
HYDROELECTRIC POWER	---	---	---	---	---	---	---	---	---	---	---	---	---
WATER ORIENTED OUTDOOR REC.	---	---	---	---	---	---	---	---	---	---	---	---	---
SPORT FISHING	0.5	0.6	0	1.1	1.8	0.9	0	2.7	2.5	1.2	0	3.7	7.5
RECREATIONAL BOATING	0	0	3.5	3.5	0	0	18.8	18.8	0	0	28.3	28.3	50.6
COMMERCIAL FISHING	---	---	---	---	---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	0	0	0	0	0	0	0	0	0	0	0	0	0
RELATED LAND USES & PROBLEMS													
AGRIC. LAND-TREATMENT	0	0	0.0	0.0	0	0	0.4	0.4	0	0	0.7	0.7	1.1
-CROPLAND DRAINAGE	0	0	0	0	0	0	0	0	0	0	0	0	0
FOREST LAND-TREATMENT	0.0	0.0	0.1	0.1	0.1	0.1	0.5	0.7	0.1	0.2	0.9	1.2	2.0
SHORELAND EROSION	0.0	0	0.2	0.2	0.4	0	1.6	2.0	.8	0	3.1	3.9	6.1
STREAMBANK EROSION	0	0	0.0	0.0	0	0	0.3	0.3	0	0	0.8	0.8	1.1
FLOOD PLAINS-URBAN	---	---	---	---	---	---	---	---	---	---	---	---	---
-URBAN	0.0	0.1	0	0.1	0.0	0.9	0	0.9	0.1	1.4	0	1.5	2.5
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
WILDLIFE MANAGEMENT	0	0.0	0	0.0	0	0.2	0	0.2	0	0.2	0	0.2	0.4
AESTHETIC & CULTURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	2.5	10.1	0	12.6	15.3	61.0	0	76.3	23.8	95.0	0	118.8	207.7
-EXTENSIVE	---	---	---	---	---	---	---	---	---	---	---	---	---
TOTAL	3.0	162.5	11.9	177.4	17.6	468.8	71.5	557.9	27.3	883.0	146.2	1,056.5	1,791.8

TABLE 1–316 RBG 5.2, Needs, Outputs, and Percent Needs Met, Normal Framework

RESOURCE USE CATEGORY	UNIT	1970 SUPPLY	1980 N	1980 O	1980 %	2000 N	2000 O	2000 %	2020 N	2020 O	2020 %
WATER WITHDRAWALS											
MUNICIPALLY SUPPLIED	MILLION GALLONS PER DAY	186.7	29.2	29.2	100	123.3	123.3	100	251.0	251.0	100
SELF-SUPPLIED INDUSTRIAL	MILLION GALLONS PER DAY	262	55	55	100	159	159	100	435	435	100
RURAL DOMESTIC & LIVESTOCK	MILLION GALLONS PER DAY	32.1	4.4	4.4	100	11.3	11.3	100	15.0	15.0	100
IRRIGATION	MILLION GALLONS PER DAY	32.8	27.9	27.9	100	71.2	71.2	100	118.8	118.8	100
MINING	MILLION GALLONS PER DAY	12.8	5.6	5.6	100	20.6	20.6	100	45.9	45.9	100
THERMAL POWER COOLING	MILLION GALLONS PER DAY	1,046	3,080	3,080	100	2,446	2,446	100	2,505	2,505	100
NON-WITHDRAWAL WATER USES											
MUNICIPAL WASTEWATER DISCHARGES	MILLION GALLONS PER DAY	128	155	155	100	216	216	100	289	289	100
INDUSTRIAL WASTEWATER DISCHARGES	MILLION GALLONS PER DAY	188	205	205	100	98	98	100	209	209	100
HYDROELECTRIC POWER	MILLION GALLONS PER DAY	NA	+	+	over	+	+	over	33,900	33,900	100
WATER ORIENTED OUTDOOR REC.	1000 RECREATION DAYS	7,386	6,064	3,554	59	12,800	10,900	85	21,270	15,520	73
	1000 ACRES WATER SURFACE	NA	---	---	---	---	---	---	---	---	---
SPORT FISHING	1000 ANGLER DAYS	6,216	3,180	2,500	79	6,036	5,300	88	9,171	8,435	92
	1000 ACRES WATER SURFACE	NA	---	---	---	---	---	---	---	---	---
RECREATIONAL BOATING	1000 BOAT DAYS	2,460	420	285	68	885	818	92	1,455	1,467	over
	1000 ACRES WATER SURFACE	364	364	---	---	364	---	---	364	---	---
COMMERCIAL FISHING	MILLION TONS PER YEAR	NA	---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	MILLION TONS PER YEAR	---	0.5	0.5	100	0.6	0.6	100	0.7	0.7	100
RELATED LAND USES & PROBLEMS											
AGRIC. LAND-TREATMENT	1000 ACRES	1,412	1,412	125.2	9	1,412	375.8	27	1,412	527.8	37
-CROPLAND DRAINAGE	1000 ACRES	250.9	251	41.0	16	251	86.7	35	251	86.7	35
FOREST LAND-TREATMENT	1000 ACRES	1,671	1,670	132	8	1,670	398	24	1,670	664	40
SHORELAND EROSION	MILES	89	89	0.9	1	89	2.7	3	89	4.5	5
STREAMBANK EROSION	MILES	783	783	21.8	3	783	65.4	8	783	109	14
	$1000 AVE ANNUAL DAMAGES	69.0	69.0	13.8	20	69.0	41.4	60	69.0	69.0	100
FLOOD PLAINS–URBAN	1000 ACRES	8.1	8.3	0.6	7	8.6	2.3	27	8.8	3.6	41
-URBAN	$1000 AVE ANNUAL DAMAGES	116.1	160	25.0	16	312.2	111.9	36	619.3	307.3	50
-RURAL	1000 ACRES	130.8	131	11.7	9	131	22.8	17	131	37.1	28
-RURAL	$1000 AVE ANNUAL DAMAGES	822.8	1,187	347.6	29	1,869	627.9	34	3,140	1,591	51
WILDLIFE MANAGEMENT	1000 ACRES	---	26.0	76.5	over	307.0	144.5	47	609.0	219.5	36
	1000 USER DAYS	1228.0	276.6	150.0	54	587.6	405.0	69	922.2	475.0	52
AESTHETIC & CULTURAL	1000 ACRES	NA	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	1000 ACRES	---	0.3	4.1	over	2.0	9.2	over	4.1	11.6	over
-EXTENSIVE	1000 ACRES	NA	1.5	23.0	over	11.3	52.2	over	23.5	65.4	over

TABLE 1–317 RBG 5.2, Capital Costs, Normal Framework (in $1,000,000)

RESOURCE USE CATEGORY	1971-1980 Federal	1971-1980 Non-Fed	1971-1980 Private	1971-1980 Total	1981-2000 Federal	1981-2000 Non-Fed	1981-2000 Private	1981-2000 Total	2001-2020 Federal	2001-2020 Non-Fed	2001-2020 Private	2001-2020 Total	Total
WATER WITHDRAWALS													
MUNICIPALLY SUPPLIED	2.6	6.1	0	8.7	8.3	19.5	0	27.8	11.0	25.5	0	36.5	73.0
SELF-SUPPLIED INDUSTRIAL	0	0	4.6	4.6	0	0	8.6	8.6	0	0	22.9	22.9	36.1
RURAL DOMESTIC & LIVESTOCK	0.0	0	0.1	0.1	0.0	0	0.2	0.2	0.0	0	0.1	0.1	0.4
IRRIGATION	0	0	0.5	0.5	0	0	0.7	0.7	0	0	1.0	1.0	2.2
MINING	0	0	0.2	0.2	0	0	0.5	0.5	0	0	0.8	0.8	1.5
THERMAL POWER COOLING	0	5.4	102.4	107.8	0	0	0.0	0.0	0	0.1	2.0	2.1	109.9
NON-WITHDRAWAL WATER USES													
MUNICIPAL WASTEWATER DISCHARGES	26.3	8.7	0	35.0	16.5	5.5	0	22.0	37.5	12.5	0	50.0	107.0
INDUSTRIAL WASTEWATER DISCHARGES	---	---	---	---	---	---	---	---	---	---	---	---	---
HYDROELECTRIC POWER	---	---	---	---	---	---	---	---	---	---	---	---	---
WATER ORIENTED OUTDOOR REC.	---	---	---	---	---	---	---	---	---	---	---	---	---
SPORT FISHING	2.2	2.3	0	4.5	3.0	1.5	0	4.5	2.8	1.4	0	4.2	13.2
RECREATIONAL BOATING	5.4	5.4	4.6	15.4	8.4	8.4	7.2	24.0	7.6	7.6	6.4	21.6	61.0

	Federal	Non-Fed	Private	Total	Federal	Non-Fed	Private	Total	Federal	Non-Fed	Private	Total	Total
COMMERCIAL FISHING	---	---	---	---	---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	0	0	0	0	0	0	0	0	0	0	0	0	0
RELATED LAND USES & PROBLEMS													
AGRIC. LAND-TREATMENT	1.4	0	3.6	5.0	2.9	0	7.3	10.2	1.7	0	4.4	6.1	21.3
-CROPLAND DRAINAGE	2.7	0	6.2	8.9	3.1	0	7.1	10.2	0	0	0	0	19.1
FOREST LAND-TREATMENT	5.6	0.3	1.1	7.0	12.0	0.7	2.3	15.0	12.0	0.7	2.3	15.0	37.0
SHORELAND EROSION	0.2	0	0.6	0.8	0.3	0	1.1	1.4	0.3	0	1.1	1.4	3.6
STREAMBANK EROSION	0.2	0	0.5	0.7	0.6	0	1.5	2.1	1.0	0	2.5	3.5	6.3
FLOOD PLAINS-URBAN	---	---	---	---	---	---	---	---	---	---	---	---	---
-URBAN	3.8	0	1.3	5.1	0.4	0	0.1	0.5	0	0	0	0	5.6
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
WILDLIFE MANAGEMENT	0.4	3.1	0	3.5	1.5	13.5	0	15.0	1.0	9.0	0	10.0	28.5
AESTHETIC & CULTURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	13.1	24.4	0	37.5	13.4	24.9	0	38.3	12.8	23.9	0	36.7	112.5
-EXTENSIVE	---	---	---	---	---	---	---	---	---	---	---	---	---
TOTAL	63.9	55.7	125.7	245.3	70.4	74.0	36.6	181.0	87.7	80.7	43.5	211.9	638.2

TABLE 1–318 RBG 5.2, Operation, Maintenance, and Replacement Costs, Normal Framework (in $1,000,000)

RESOURCE USE CATEGORY	1971-1980				1981-2000				2001-2020				
	Federal	Non-Fed	Private	Total	Federal	Non-Fed	Private	Total	Federal	Non-Fed	Private	Total	Total
WATER WITHDRAWALS													
MUNICIPALLY SUPPLIED	0	4.3	0	4.3	0	43.2	0	43.2	0	117.8	0	117.8	165.3
SELF-SUPPLIED INDUSTRIAL	0	0	4.1	4.1	0	0	31.7	31.7	0	0	87.9	87.9	123.7
RURAL DOMESTIC & LIVESTOCK	0	0	0.4	0.4	0	0	2.9	2.9	0	0	4.8	4.8	8.1
IRRIGATION	0	0	0.1	0.1	0	0	0.5	0.5	0	0	0.9	0.9	1.5
MINING	0	0	0.3	0.3	0	0	2.9	2.9	0	0	7.4	7.4	10.6
THERMAL POWER COOLING	0	1.4	26.3	27.7	0	5.0	94.5	99.5	0	4.5	84.6	89.1	216.3
NON-WITHDRAWAL WATER USES													
MUNICIPAL WASTEWATER DISCHARGES	0	26.0	0	26.0	0	68.0	0	68.0	0	72.0	0	72.0	166.0
INDUSTRIAL WASTEWATER DISCHARGES	---	---	---	---	---	---	---	---	---	---	---	---	---
HYDROELECTRIC POWER	---	---	---	---	---	---	---	---	---	---	---	---	---
WATER ORIENTED OUTDOOR REC.	---	---	---	---	---	---	---	---	---	---	---	---	---
SPORT FISHING	0.8	0.9	0	1.7	2.8	1.4	0	4.2	2.8	1.4	0	4.2	10.1
RECREATIONAL BOATING	0	0	5.4	5.4	0	0	38.2	38.2	0	0	70.4	70.4	114.0
COMMERCIAL FISHING	---	---	---	---	---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	0	0	0	0	0	0	0	0	0	0	0	0	0
RELATED LAND USES & PROBLEMS													
AGRIC. LAND-TREATMENT	0	0	0.1	0.1	0	0	1.0	1.0	0	0	1.8	1.8	2.9
-CROPLAND DRAINAGE	0	0	0.2	0.2	0	0	1.4	1.4	0	0	1.9	1.9	3.5
FOREST LAND-TREATMENT	0.0	0.0	0.2	0.2	0.1	0.3	1.1	1.5	0.3	0.6	2.1	3.0	4.7
SHORELAND EROSION	0	0	0.1	0.1	0.1	0	0.5	0.6	0.2	0	0.9	1.1	1.8
STREAMBANK EROSION	0	0	0	0	0	0	0.6	0.6	0	0	1.6	1.6	2.2
FLOOD PLAINS-URBAN	---	---	---	---	---	---	---	---	---	---	---	---	---
-URBAN	0.0	0.0	0	0.0	0.0	0.2	0	0.2	0.0	0.2	0	0.2	0.4
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
WILDLIFE MANAGEMENT	0	0.2	0	0.2	0	0.7	0	0.7	0	0.5	0	0.5	1.4
AESTHETIC & CULTURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	2.5	10.2	0	12.7	15.4	61.4	0	76.8	25.3	101.1	0	126.4	215.9
-EXTENSIVE	---	---	---	---	---	---	---	---	---	---	---	---	---
TOTAL	3.3	43.0	37.2	83.5	18.4	180.2	175.3	373.9	28.6	298.1	264.3	591.0	1078.4

TABLE 1–319 RBG 5.2, Needs, Outputs, and Percent Needs Met, Proposed Framework

RESOURCE USE CATEGORY	UNIT	1970 SUPPLY	1980 N	1980 O	1980 %	2000 N	2000 O	2000 %	2020 N	2020 O	2020 %
WATER WITHDRAWALS											
MUNICIPALLY SUPPLIED	MILLION GALLONS PER DAY	186.7	29.2	29.2	100	123.3	123.3	100	251.0	251.0	100
SELF-SUPPLIED INDUSTRIAL	MILLION GALLONS PER DAY	262	55	55	100	159	159	100	435	435	100
RURAL DOMESTIC & LIVESTOCK	MILLION GALLONS PER DAY	32.1	4.4	4.4	100	11.3	11.3	100	15.0	15.0	100
IRRIGATION	MILLION GALLONS PER DAY	32.8	27.9	27.9	100	71.2	71.2	100	118.8	118.8	100
MINING	MILLION GALLONS PER DAY	12.8	5.6	5.6	100	20.6	20.6	100	45.9	45.9	100
THERMAL POWER COOLING	MILLION GALLONS PER DAY	1,046	3,080	3,080	100	2,446	2,446	100	2,505	2,505	100
NON-WITHDRAWAL WATER USES											
MUNICIPAL WASTEWATER DISCHARGES	MILLION GALLONS PER DAY	128	155	155	100	216	216	100	289	289	100
INDUSTRIAL WASTEWATER DISCHARGES	MILLION GALLONS PER DAY	188	205	205	100	98	98	100	209	209	100
HYDROELECTRIC POWER	MILLION GALLONS PER DAY	NA	+	+	over	+	+	over	33,900	33,900	100
WATER ORIENTED OUTDOOR REC.	1000 RECREATION DAYS	7,386	6,064	3,554	59	12,800	10,900	85	21,270	15,520	73
	1000 ACRES WATER SURFACE	NA	---	---	---	---	---	---	---	---	---
SPORT FISHING	1000 ANGLER DAYS	6,216	3,180	2,500	79	6,036	5,300	88	9,171	8,435	92
	1000 ACRES WATER SURFACE	NA	---	---	---	---	---	---	---	---	---
RECREATIONAL BOATING	1000 BOAT DAYS	2,460	420	285	68	885	818	92	1,455	1,467	over
	1000 ACRES WATER SURFACE	364	364	---	---	364	---	---	364	---	---
COMMERCIAL FISHING	MILLION TONS PER YEAR	NA	---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	MILLION TONS PER YEAR	---	0.5	0.5	100	0.6	0.6	100	0.7	0.7	100
RELATED LAND USES & PROBLEMS											
AGRIC. LAND-TREATMENT	1000 ACRES	1,412	1,412	*275.6*	*20*	1,412	*789.2*	*56*	1,412	*1,104*	*78*
-CROPLAND DRAINAGE	1000 ACRES	250.9	250.9	*41.5*	*17*	250.9	*118.9*	*47*	250.9	*166.1*	*66*
FOREST LAND-TREATMENT	1000 ACRES	1,671	1,670	*172*	*10*	1,670	*515*	*31*	1,670	*859*	*51*
SHORELAND EROSION	MILES	89	89	0.9	1	89	2.7	3	89	4.5	5
STREAMBANK EROSION	MILES	783	783	21.8	3	783	65.4	8	783	109	14
	$1000 AVE ANNUAL DAMAGES	69.0	69.0	13.8	20	69.0	41.4	60	69.0	69.0	100
FLOOD PLAINS-URBAN	1000 ACRES	8.1	8.3	0.6	7	8.6	2.3	27	8.8	3.6	41
-URBAN	$1000 AVE ANNUAL DAMAGES	116.1	160	25.0	16	312.2	111.9	36	619.3	307.3	50
-RURAL	1000 ACRES	130.8	131	11.7	9	131	22.8	17	131	37.1	28
-RURAL	$1000 AVE ANNUAL DAMAGES	822.8	1,187	347.6	29	1,869	627.9	34	3,140	1,591	51
WILDLIFE MANAGEMENT	1000 ACRES	---	26.0	76.5	over	307.0	144.5	47	609.0	219.5	36
	1000 USER DAYS	1228.0	276.6	150.0	54	587.6	405.0	69	922.2	475.0	52
AESTHETIC & CULTURAL	1000 ACRES	NA	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	1000 ACRES	---	0.3	4.1	over	2.0	9.2	over	4.1	11.6	over
-EXTENSIVE	1000 ACRES	NA	1.5	23.0	over	11.3	52.2	over	23.5	65.4	over

TABLE 1–320 RBG 5.2, Capital Costs, Proposed Framework (in $1,000,000)

RESOURCE USE CATEGORY	1971-1980 Federal	1971-1980 Non-Fed	1971-1980 Private	1971-1980 Total	1981-20 Federal	1981-20 Non-Fed	1981-20 yate	1981-20 Total	2001-2020 Federal	2001-2020 Non-Fed	2001-2020 Private	2001-2020 Total	Total
WATER WITHDRAWALS													
MUNICIPALLY SUPPLIED	2.6	6.1	0	8.7	8.3	19.5	0	27.8	11.0	25.5	0	36.5	73.0
SELF-SUPPLIED INDUSTRIAL	0	0	4.6	4.6	0	0	8.6	8.6	0	0	22.9	22.9	36.1
RURAL DOMESTIC & LIVESTOCK	0.0	0	0.1	0.1	0.0	0	0.2	0.2	0.0	0	0.1	0.1	0.4
IRRIGATION	0	0	0.5	0.5	0	0	0.7	0.7	0	0	1.0	1.0	2.2
MINING	0	0	0.2	0.2	0	0	0.5	0.5	0	0	0.8	0.8	1.5
THERMAL POWER COOLING	0	5.4	102.4	107.8	0	0	0.0	0.0	0	0.1	2.0	2.1	109.9
NON-WITHDRAWAL WATER USES													
MUNICIPAL WASTEWATER DISCHARGES	*114.8*	*38.2*	*0*	*153.0*	*117.8*	*39.2*	*0*	*157.0*	*65.2*	*21.8*	*0*	*87.0*	*397.0*
INDUSTRIAL WASTEWATER DISCHARGES	---	---	---	---	---	---	---	---	---	---	---	---	---
HYDROELECTRIC POWER	---	---	---	---	---	---	---	---	---	---	---	---	---
WATER ORIENTED OUTDOOR REC.	---	---	---	---	---	---	---	---	---	---	---	---	---
SPORT FISHING	2.2	2.3	0	4.5	3.0	1.5	0	4.5	2.8	1.4	0	4.2	13.2
RECREATIONAL BOATING	5.4	5.4	4.6	15.4	8.4	8.4	7.2	24.0	7.6	7.6	6.4	21.6	61.0

COMMERCIAL FISHING	---	---	---	---	---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	33.0	0	0	33.0	0	0	0	0	0	0	0	0	33.0
RELATED LAND USES & PROBLEMS													
AGRIC. LAND-TREATMENT	3.1	0	7.9	11.0	5.8	0	15.0	20.8	3.6	0	9.1	12.7	44.5
-CROPLAND DRAINAGE	2.0	0	4.5	6.5	3.7	0	8.5	12.2	2.2	0	5.2	7.4	26.1
FOREST LAND-TREATMENT	8.0	0.5	1.5	10.0	15.2	1.0	2.8	19.0	15.2	1.0	2.8	19.0	48.0
SHORELAND EROSION	0.2	0	0.6	0.8	0.3	0	1.1	1.4	0.3	0	1.1	1.4	3.6
STREAMBANK EROSION	0.2	0	0.5	0.7	0.6	0	1.5	2.1	1.0	0	2.5	3.5	6.3
FLOOD PLAINS-URBAN	---	---	---	---	---	---	---	---	---	---	---	---	---
-URBAN	3.8	0	1.3	5.1	0.4	0	0.1	0.5	0	0	0	0	5.6
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
WILDLIFE MANAGEMENT	0.4	3.1	0	3.5	1.5	13.5	0	15.0	1.0	9.0	0	10.0	28.5
AESTHETIC & CULTURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	13.1	24.4	0	37.5	13.4	24.9	0	38.3	12.8	23.9	0	36.7	112.5
-EXTENSIVE	---	---	---	---	---	---	---	---	---	---	---	---	---
TOTAL	188.8	85.4	128.7	402.9	178.4	108.0	46.2	332.6	122.7	90.3	53.9	266.9	1,002.4

TABLE 1-321 RBG 5.2, Operation, Maintenance, and Replacement Costs, Proposed Framework (in $1,000,000)

	1971-1980				1981-2000				2001-2020				
RESOURCE USE CATEGORY	Federal	Non-Fed	Private	Total	Federal	Non-Fed	Private	Total	Federal	Non-Fed	Private	Total	Total
WATER WITHDRAWALS													
MUNICIPALLY SUPPLIED	0	4.3	0	4.3	0	43.2	0	43.2	0	117.8	0	117.8	165.3
SELF-SUPPLIED INDUSTRIAL	0	0	4.1	4.1	0	0	31.7	31.7	0	0	87.9	87.9	123.7
RURAL DOMESTIC & LIVESTOCK	0	0	0.4	0.4	0	0	2.9	2.9	0	0	4.8	4.8	8.1
IRRIGATION	0	0	0.1	0.1	0	0	0.5	0.5	0	0	0.9	0.9	1.5
MINING	0	0	0.3	0.3	0	0	2.9	2.9	0	0	7.4	7.4	10.6
THERMAL POWER COOLING	0	1.4	26.3	27.7	0	5.0	94.5	99.5	0	4.5	84.6	89.1	216.3
NON-WITHDRAWAL WATER USES													
MUNICIPAL WASTEWATER DISCHARGES	0	251.7	0	251.7	0	585.3	0	585.3	0	888.3	0	888.3	1,725.3
INDUSTRIAL WASTEWATER DISCHARGES	---	---	---	---	---	---	---	---	---	---	---	---	---
HYDROELECTRIC POWER	---	---	---	---	---	---	---	---	---	---	---	---	---
WATER ORIENTED OUTDOOR REC.	---	---	---	---	---	---	---	---	---	---	---	---	---
SPORT FISHING	0.8	0.9	0	1.7	2.8	1.4	0	4.2	2.8	1.4	0	4.2	10.1
RECREATIONAL BOATING	0	0	5.4	5.4	0	0	38.2	38.2	0	0	70.4	70.4	114.0
COMMERCIAL FISHING	---	---	---	---	---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	4.0	0	0	4.0	16.0	0	0	16.0	16.0	0	0	16.0	36.0
RELATED LAND USES & PROBLEMS													
AGRIC. LAND-TREATMENT	0	0	0.3	0.3	0	0	2.3	2.3	0	0	3.9	3.9	6.5
-CROPLAND DRAINAGE	0	0	0.2	0.2	0	0	1.4	1.4	0	0	2.2	2.2	3.8
FOREST LAND-TREATMENT	0.0	0.1	0.2	0.3	0.3	0.4	1.5	2.2	0.4	0.8	2.6	3.8	6.3
SHORELAND EROSION	0	0	0.1	0.1	0.1	0	0.5	0.6	0.2	0	0.9	1.1	1.8
STREAMBANK EROSION	0	0	0	0	0	0	0.6	0.6	0	0	1.6	1.6	2.2
FLOOD PLAINS-URBAN	---	---	---	---	---	---	---	---	---	---	---	---	---
-URBAN	0.0	0.0	0	0.0	0.0	0.2	0	0.2	0.0	0.2	0	0.2	0.4
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
WILDLIFE MANAGEMENT	0	0.2	0	0.2	0	0.7	0	0.7	0	0.5	0	0.5	1.4
AESTHETIC & CULTURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	2.5	10.2	0	12.7	15.4	61.4	0	76.8	25.3	101.1	0	126.4	215.9
-EXTENSIVE	---	---	---	---	---	---	---	---	---	---	---	---	---
TOTAL	7.3	268.8	37.4	313.5	34.6	697.6	177.0	909.2	44.7	1,114.6	267.2	1,426.5	2,649.2

TABLE 1–322 RBG 5.3, Needs, Outputs, and Percent Needs Met, Normal Framework

RESOURCE USE CATEGORY	UNIT	1970 SUPPLY	1980 N	1980 O	1980 %	2000 N	2000 O	2000 %	2020 N	2020 O	2020 %
WATER WITHDRAWALS											
MUNICIPALLY SUPPLIED	MILLION GALLONS PER DAY	44.4	3.8	3.8	100	14.1	14.1	100	28.7	28.7	100
SELF-SUPPLIED INDUSTRIAL	MILLION GALLONS PER DAY	76	+	+	100	+	+	100	+	+	100
RURAL DOMESTIC & LIVESTOCK	MILLION GALLONS PER DAY	93	0.9	0.9	100	2.8	2.8	100	4.1	4.1	100
IRRIGATION	MILLION GALLONS PER DAY	2.7	5.8	5.8	100	11.6	11.6	100	17.8	17.8	100
MINING	MILLION GALLONS PER DAY	2.2	0.9	0.9	100	1.9	1.9	100	4.0	4.0	100
THERMAL POWER COOLING	MILLION GALLONS PER DAY	0	0	0	---	0	0	---	0	0	---
NON-WITHDRAWAL WATER USES											
MUNICIPAL WASTEWATER DISCHARGES	MILLION GALLONS PER DAY	15	16	16	100	18	18	100	20	20	100
INDUSTRIAL WASTEWATER DISCHARGES	MILLION GALLONS PER DAY	145	69	69	100	15	15	100	19	19	100
HYDROELECTRIC POWER	MILLION GALLONS PER DAY	NA	0	0	---	0	0	---	0	0	---
WATER ORIENTED OUTDOOR REC.	1000 RECREATION DAYS	2,051	311	2,220	over	1,346	5,634	over	2,993	5,634	over
	1000 ACRES WATER SURFACE	NA	---	---	---	---	---	---	---	---	---
SPORT FISHING	1000 ANGLER DAYS	3,006	712	712	100	1,388	1,388	100	2,183	2,183	100
	1000 ACRES WATER SURFACE	NA	---	---	---	---	---	---	---	---	---
RECREATIONAL BOATING	1000 BOAT DAYS	918	15	13	87	15	19	over	9	27	over
	1000 ACRES WATER SURFACE	221	221	---	---	221	---	---	221	---	---
COMMERCIAL FISHING	MILLION TONS PER YEAR	NA	---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	MILLION TONS PER YEAR	---	0.4	0.4	100	0.5	0.5	100	0.6	0.6	100
RELATED LAND USES & PROBLEMS											
AGRIC. LAND-TREATMENT	1000 ACRES	530	530	32.2	6	530	96.6	18	530	135	25
-CROPLAND DRAINAGE	1000 ACRES	206	206	18.6	9	206	38.8	19	206	38.8	19
FOREST LAND-TREATMENT	1000 ACRES	1,730	1,730	130	8	1,730	392	23	1,730	654	38
SHORELAND EROSION	MILES	38.2	38.2	0	0	38.2	0	0	38.2	0	0
STREAMBANK EROSION	MILES	417	417	15.4	4	417	46.2	11	417	77.0	18
	$1000 AVE ANNUAL DAMAGES	21.9	21.9	4.4	20	21.9	13.1	60	21.9	21.9	100
FLOOD PLAINS-URBAN	1000 ACRES	0.8	0.8	0	0	0.8	0.1	13	0.8	0.3	38
-URBAN	$1000 AVE ANNUAL DAMAGES	9.5	12.0	0.2	2	21.6	4.1	19	39.9	17.8	45
-RURAL	1000 ACRES	46.2	46.2	2.4	5	46.2	8.2	18	46.2	17.2	37
-RURAL	$1000 AVE ANNUAL DAMAGES	205.1	266	7.8	3	520.1	107.5	21	1,079	524.3	49
WILDLIFE MANAGEMENT	1000 ACRES	---	28.0	42.5	over	76.0	45.5	60	144	90.5	63
	1000 USER DAYS	284.4	46.4	20.0	43	72.6	50.0	69	107.2	95.0	89
AESTHETIC & CULTURAL	1000 ACRES	NA	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	1000 ACRES	---	0.3	0.8	over	0.6	1.9	over	1.1	1.9	over
-EXTENSIVE	1000 ACRES	NA	0	5.0	over	0	13.8	over	2.3	13.8	over

TABLE 1–323 RBG 5.3, Capital Costs, Normal Framework (in $1,000,000)

RESOURCE USE CATEGORY	1971-1980 Federal	1971-1980 Non-Fed	1971-1980 Private	1971-1980 Total	1981-2000 Federal	1981-2000 Non-Fed	1981-2000 Private	1981-2000 Total	2001-2020 Federal	2001-2020 Non-Fed	2001-2020 Private	2001-2020 Total	Total
WATER WITHDRAWALS													
MUNICIPALLY SUPPLIED	0.3	0.8	0	1.1	0.9	2.1	0	3.0	1.3	2.9	0	4.2	8.3
SELF-SUPPLIED INDUSTRIAL	0	0	0	0	0	0	0	0	0	0	0	0	0
RURAL DOMESTIC & LIVESTOCK	0.0	0	0.0	0.0	0.0	0	0.1	0.1	0.0	0	0.0	0.0	0.1
IRRIGATION	0	0	0.2	0.2	0	0	0.2	0.2	0	0	0.2	0.2	0.6
MINING	0	0	0.1	0.1	0	0	0.1	0.1	0	0	0.1	0.1	0.3
THERMAL POWER COOLING	0	0	0	0	0	0	0	0	0	0	0	0	0
NON-WITHDRAWAL WATER USES													
MUNICIPAL WASTEWATER DISCHARGES	5.3	1.7	0	7.0	3.8	1.2	0	5.0	5.3	1.7	0	7.0	19.0
INDUSTRIAL WASTEWATER DISCHARGES	---	---	---	---	---	---	---	---	---	---	---	---	---
HYDROELECTRIC POWER	---	---	---	---	---	---	---	---	---	---	---	---	---
WATER ORIENTED OUTDOOR REC.	---	---	---	---	---	---	---	---	---	---	---	---	---
SPORT FISHING	2.5	2.5	0	5.0	3.4	1.6	0	5.0	3.1	1.6	0	4.7	14.7
RECREATIONAL BOATING	0.2	0.2	0.0	0.4	0.1	0.1	0.1	0.3	0.1	0.1	0.1	0.3	1.0

COMMERCIAL FISHING	---	---	---	---	---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	0	0	0	0	0	0	0	0	0	0	0	0	0
RELATED LAND USES & PROBLEMS													
AGRIC. LAND-TREATMENT	0.4	0	0.9	1.3	0.8	0	1.9	2.7	0.4	0	1.2	1.6	5.6
-CROPLAND DRAINAGE	0.9	0	2.2	3.1	1.1	0	2.5	3.6	0	0	0	0	6.7
FOREST LAND-TREATMENT	6.4	0.4	1.2	8.0	12.0	0.8	2.2	15.0	12.0	0.8	2.2	15.0	38.0
SHORELAND EROSION	0	0	0	0	0	0	0	0	0	0	0	0	0
STREAMBANK EROSION	0.1	0	0.4	0.5	0.4	0	1.1	1.5	0.7	0	1.8	2.5	4.5
FLOOD PLAINS-URBAN	---	---	---	---	---	---	---	---	---	---	---	---	---
-URBAN	0.9	0	0.3	1.2	0	0	0	0	0.3	0	0.1	0.4	1.6
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
WILDLIFE MANAGEMENT	1.0	9.0	0	10.0	1.7	15.3	0	17.0	0.9	8.1	0	9.0	36.0
AESTHETIC & CULTURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	6.8	12.6	0	19.4	3.6	6.8	0	10.4	7.1	13.1	0	20.2	50.0
-EXTENSIVE	---	---	---	---	---	---	---	---	---	---	---	---	---
TOTAL	24.8	27.2	5.3	57.3	27.8	27.9	8.2	63.9	31.2	28.3	5.7	65.2	186.4

TABLE 1-324 RBG 5.3, Operation, Maintenance, and Replacement Costs, Normal Framework (in $1,000,000)

	1971-1980				1981-2000				2001-2020				
RESOURCE USE CATEGORY	Federal	Non-Fed	Private	Total	Federal	Non-Fed	Private	Total	Federal	Non-Fed	Private	Total	Total
WATER WITHDRAWALS													
MUNICIPALLY SUPPLIED	0	0.5	0	0.5	0	4.7	0	4.7	0	13.5	0	13.5	18.7
SELF-SUPPLIED INDUSTRIAL	0	0	0	0	0	0	0	0	0	0	0	0	0
RURAL DOMESTIC & LIVESTOCK	0	0	0.1	0.1	0	0	0.5	0.5	0	0	0.9	0.9	1.5
IRRIGATION	0	0	0.0	0.0	0	0	0.2	0.2	0	0	0.2	0.2	0.4
MINING	0	0	0.0	0.0	0	0	0.2	0.2	0	0	0.5	0.5	0.7
THERMAL POWER COOLING	0	0	0	0	0	0	0	0	0	0	0	0	0
NON-WITHDRAWAL WATER USES													
MUNICIPAL WASTEWATER DISCHARGES	0	6.0	0	6.0	0	16.0	0	16.0	0	16.0	0	16.0	38.0
INDUSTRIAL WASTEWATER DISCHARGES	---	---	---	---	---	---	---	---	---	---	---	---	---
HYDROELECTRIC POWER	---	---	---	---	---	---	---	---	---	---	---	---	---
WATER ORIENTED OUTDOOR REC.	---	---	---	---	---	---	---	---	---	---	---	---	---
SPORT FISHING	0.8	0.9	0	1.7	2.8	1.4	0	4.2	2.8	1.4	0	4.2	10.1
RECREATIONAL BOATING	0	0	0.2	0.2	0	0	0.9	0.9	0	0	1.4	1.4	2.5
COMMERCIAL FISHING	---	---	---	---	---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	0	0	0	0	0	0	0	0	0	0	0	0	0
RELATED LAND USES & PROBLEMS													
AGRIC. LAND-TREATMENT	0	0	0.0	0.0	0	0	0.3	0.3	0	0	0.5	0.5	0.8
-CROPLAND DRAINAGE	0	0	0.1	0.1	0	0	0.5	0.5	0	0	0.7	0.7	1.3
FOREST LAND-TREATMENT	0.0	0.0	0.2	0.2	0.2	0.3	1.1	1.6	0.3	0.6	2.2	3.1	4.9
SHORELAND EROSION	0	0	0	0	0	0	0	0	0	0	0	0	0
STREAMBANK EROSION	0	0	0.0	0.0	0	0	0.5	0.5	0	0	1.3	1.3	1.8
FLOOD PLAINS-URBAN	---	---	---	---	---	---	---	---	---	---	---	---	---
-URBAN	0.0	0.0	0	0.0	0.0	0.1	0	0.1	0.0	0.1	0	0.1	0.2
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
WILDLIFE MANAGEMENT	0	0.5	0	0.5	0	0.9	0	0.9	0	0.5	0	0.5	1.9
AESTHETIC & CULTURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	1.1	4.6	0	5.7	6.0	23.9	0	29.9	9.9	39.6	0	49.5	85.1
-EXTENSIVE	---	---	---	---	---	---	---	---	---	---	---	---	---
TOTAL	1.9	12.5	0.6	15.0	9.0	47.3	4.2	60.5	13.0	71.7	7.7	92.5	167.9

TABLE 1-325 RBG 5.3, Needs, Outputs, and Percent Needs Met, Proposed Framework

RESOURCE USE CATEGORY	UNIT	1970 SUPPLY	1980 N	1980 O	1980 %	2000 N	2000 O	2000 %	2020 N	2020 O	2020 %
WATER WITHDRAWALS											
MUNICIPALLY SUPPLIED	MILLION GALLONS PER DAY	44.4	3.8	3.8	100	14.1	14.1	100	28.7	28.7	100
SELF-SUPPLIED INDUSTRIAL	MILLION GALLONS PER DAY	76	+	+	100	+	+	100	+	+	100
RURAL DOMESTIC & LIVESTOCK	MILLION GALLONS PER DAY	93	0.9	0.9	100	2.8	2.8	100	4.1	4.1	100
IRRIGATION	MILLION GALLONS PER DAY	2.7	5.8	5.8	100	11.6	11.6	100	17.8	17.8	100
MINING	MILLION GALLONS PER DAY	2.2	0.9	0.9	100	1.9	1.9	100	4.0	4.0	100
THERMAL POWER COOLING	MILLION GALLONS PER DAY	0	0	0	---	0	0	---	0	0	---
NON-WITHDRAWAL WATER USES											
MUNICIPAL WASTEWATER DISCHARGES	MILLION GALLONS PER DAY	15	16	16	100	18	18	100	20	20	100
INDUSTRIAL WASTEWATER DISCHARGES	MILLION GALLONS PER DAY	145	69	69	100	15	15	100	19	19	100
HYDROELECTRIC POWER	MILLION GALLONS PER DAY	NA	0	0	---	0	0	---	0	0	---
WATER ORIENTED OUTDOOR REC.	1000 RECREATION DAYS	2,051	311	2,220	over	1,346	5,634	over	2,993	5,634	over
	1000 ACRES WATER SURFACE	NA	---	---	---	---	---	---	---	---	---
SPORT FISHING	1000 ANGLER DAYS	3,006	712	712	100	1,388	1,388	100	2,183	2,183	100
	1000 ACRES WATER SURFACE	NA	---	---	---	---	--	---	---	---	---
RECREATIONAL BOATING	1000 BOAT DAYS	918	15	13	87	15	19	over	9	27	over
	1000 ACRES WATER SURFACE	221	221	---	---	221	---	---	221	---	---
COMMERCIAL FISHING	MILLION TONS PER YEAR	NA	---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	MILLION TONS PER YEAR	---	0.4	0.4	100	0.5	0.5	100	0.6	0.6	100
RELATED LAND USES & PROBLEMS											
AGRIC. LAND--TREATMENT	1000 ACRES	530	530	*82.0*	*15*	530	*232.9*	*44*	530	*324.3*	*61*
--CROPLAND DRAINAGE	1000 ACRES	206	206	*0*	*0*	206	*0*	*0*	206	*0*	*0*
FOREST LAND--TREATMENT	1000 ACRES	1,730	1,730	*173*	*10*	1,730	*521*	*30*	1,730	*869*	*50*
SHORELAND EROSION	MILES	38.2	38.2	0	0	38.2	0	0	38.2	0	0
STREAMBANK EROSION	MILES	417	417	15.4	4	417	46.2	11	417	77.0	18
	$1000 AVE ANNUAL DAMAGES	21.9	21.9	4.4	20	21.9	13.1	60	21.9	21.9	100
FLOOD PLAINS--URBAN	1000 ACRES	0.8	0.8	0	0	0.8	0.1	13	0.8	0.3	38
--URBAN	$1000 AVE ANNUAL DAMAGES	9.5	12.0	0.2	2	21.6	4.1	19	39.9	17.8	45
--RURAL	1000 ACRES	46.2	46.2	2.4	5	46.2	8.2	18	46.2	17.2	37
--RURAL	$1000 AVE ANNUAL DAMAGES	205.1	266	7.8	3	520.1	107.5	21	1,079	524.3	49
WILDLIFE MANAGEMENT	1000 ACRES	---	28.0	42.5	over	76.0	45.5	60	144	90.5	63
	1000 USER DAYS	284.4	46.4	20.0	43	72.6	50.0	69	107.2	95.0	89
AESTHETIC & CULTURAL	1000 ACRES	NA	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION--INTENSIVE	1000 ACRES	---	0.3	0.8	over	0.6	1.9	over	1.1	1.9	over
--EXTENSIVE	1000 ACRES	NA	0	5.0	over	0	13.8	over	2.3	13.8	over

TABLE 1-326 RBG 5.3, Capital Costs, Proposed Framework (in $1,000,000)

RESOURCE USE CATEGORY	1971-1980 Federal	1971-1980 Non-Fed	1971-1980 Private	1971-1980 Total	1981-2000 Federal	1981-2000 Non-Fed	1981-2000 Private	1981-2000 Total	2001-2020 Federal	2001-2020 Non-Fed	2001-2020 Private	2001-2020 Total	Total
WATER WITHDRAWALS													
MUNICIPALLY SUPPLIED	0.3	0.8	0	1.1	0.9	2.1	0	3.0	1.3	2.9	0	4.2	8.3
SELF-SUPPLIED INDUSTRIAL	0	0	0	0	0	0	0	0	0	0	0	0	0
RURAL DOMESTIC & LIVESTOCK	0.0	0	0.0	0.0	0.0	0	0.1	0.1	0.0	0	0.0	0.0	0.1
IRRIGATION	0	0	0.2	0.2	0	0	0.2	0.2	0	0	0.2	0.2	0.6
MINING	0	0	0.1	0.1	0	0	0.1	0.1	0	0	0.1	0.1	0.3
THERMAL POWER COOLING	0	0	0	0	0	0	0	0	0	0	0	0	0
NON-WITHDRAWAL WATER USES													
MUNICIPAL WASTEWATER DISCHARGES	*10.5*	*3.5*	*0*	*14.0*	*4.5*	*1.5*	*0*	*6.0*	*9.0*	*3.0*	*0*	*12.0*	*32.0*
INDUSTRIAL WASTEWATER DISCHARGES	---	---	---	---	---	---	---	---	---	---	---	---	---
HYDROELECTRIC POWER	---	---	---	---	---	---	---	---	---	---	---	---	---
WATER ORIENTED OUTDOOR REC.	---	---	---	---	---	---	---	---	---	---	---	---	---
SPORT FISHING	2.5	2.5	0	5.0	3.4	1.6	0	5.0	3.1	1.6	0	4.7	14.7
RECREATIONAL BOATING	0.2	0.2	0.0	0.4	0.1	0.1	0.1	0.3	0.1	0.1	0.1	0.3	1.0

COMMERCIAL FISHING	---	---	---	---	---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	40.0	0	0	40.0	305.2	0	0	305.2	0	0	0	0	345.2
RELATED LAND USES & PROBLEMS													
AGRIC. LAND-TREATMENT	0.3	0	0.9	1.2	0.6	0	1.5	2.1	0.4	0	0.9	1.3	4.6
-CROPLAND DRAINAGE	0	0	0	0	0	0	0	0	0	0	0	0	0
FOREST LAND-TREATMENT	0.8	0.6	1.6	11.0	16.0	1.0	3.0	20.0	16.0	1.0	3.0	20.0	51.0
SHORELAND EROSION	0	0	0	0	0	0	0	0	0	0	0	0	0
STREAMBANK EROSION	0.1	0	0.4	0.5	0.4	0	1.1	1.5	0.7	0	1.8	2.5	4.5
FLOOD PLAINS-URBAN	---	---	---	---	---	---	---	---	---	---	---	---	---
-URBAN	0.9	0	0.3	1.2	0	0	0	0	0.3	0	0.1	0.4	1.6
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
WILDLIFE MANAGEMENT	1.0	9.0	0	10.0	1.7	15.3	0	17.0	0.9	8.1	0	9.0	36.0
AESTHETIC & CULTURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	6.8	12.6	0	19.4	3.6	6.8	0	10.4	7.1	13.1	0	20.2	50.0
-EXTENSIVE	---	---	---	---	---	---	---	---	---	---	---	---	---
TOTAL	71.4	29.2	3.5	104.1	336.4	28.4	6.1	370.9	38.9	29.8	6.2	74.9	549.9

TABLE 1–327 RBG 5.3, Operation, Maintenance, and Replacement Costs, Proposed Framework (in $1,000,000)

	1971-1980				1981-2000				2001-2020				
RESOURCE USE CATEGORY	Federal	Non-Fed	Private	Total	Federal	Non-Fed	Private	Total	Federal	Non-Fed	Private	Total	Total
WATER WITHDRAWALS													
MUNICIPALLY SUPPLIED	0	0.5	0	0.5	0	4.7	0	4.7	0	13.5	0	13.5	18.7
SELF-SUPPLIED INDUSTRIAL	0	0	0	0	0	0	0	0	0	0	0	0	0
RURAL DOMESTIC & LIVESTOCK	0	0	0.1	0.1	0	0	0.5	0.5	0	0	0.9	0.9	1.5
IRRIGATION	0	0	0.0	0.0	0	0	0.2	0.2	0	0	0.2	0.2	0.4
MINING	0	0	0.0	0.0	0	0	0.2	0.2	0	0	0.5	0.5	0.7
THERMAL POWER COOLING	0	0	0	0	0	0	0	0	0	0	0	0	0
NON-WITHDRAWAL WATER USES													
MUNICIPAL WASTEWATER DISCHARGES	0	38.5	0	38.5	0	83.3	0	83.3	0	105.2	0	105.2	227.0
INDUSTRIAL WASTEWATER DISCHARGES	---	---	---	---	---	---	---	---	---	---	---	---	---
HYDROELECTRIC POWER	---	---	---	---	---	---	---	---	---	---	---	---	---
WATER ORIENTED OUTDOOR REC.	---	---	---	---	---	---	---	---	---	---	---	---	---
SPORT FISHING	0.8	0.9	0	1.7	2.8	1.4	0	4.2	2.8	1.4	0	4.2	10.1
RECREATIONAL BOATING	0	0	0.2	0.2	0	0	0.9	0.9	0	0	1.4	1.4	2.5
COMMERCIAL FISHING	---	---	---	---	---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	5.0	0	0	5.0	58.0	0	0	58.0	96.0	0	0	96.0	159.0
RELATED LAND USES & PROBLEMS													
AGRIC. LAND-TREATMENT	0	0	0.0	0.0	0	0	0.3	0.3	0	0	0.4	0.4	0.7
-CROPLAND DRAINAGE	0	0	0	0	0	0	0	0	0	0	0	0	0
FOREST LAND-TREATMENT	0.0	0.1	0.2	0.3	0.2	0.5	1.6	2.3	0.4	0.8	2.9	4.1	6.7
SHORELAND EROSION	0	0	0	0	0	0	0	0	0	0	0	0	0
STREAMBANK EROSION	0	0	0.0	0.0	0	0	0.5	0.5	0	0	1.3	1.3	1.8
FLOOD PLAINS-URBAN	---	---	---	---	---	---	---	---	---	---	---	---	---
-URBAN	0.0	0.0	0	0.0	0.0	0.1	0	0.1	0.0	0.1	0	0.1	0.2
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
WILDLIFE MANAGEMENT	0	0.5	0	0.5	0	0.9	0	0.9	0	0.5	0	0.5	1.9
AESTHETIC & CULTURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	1.1	4.6	0	5.7	6.0	23.9	0	29.9	9.9	39.6	0	49.5	85.1
-EXTENSIVE	---	---	---	---	---	---	---	---	---	---	---	---	---
TOTAL	6.9	45.1	0.5	52.5	67.0	114.8	4.2	186.0	109.1	161.1	7.6	277.8	516.3

TABLE 1–328 RBG 1.1, Comparison of PRO and NOR Land Treatment Programs (thousands of acres)

RESOURCE USE CATEGORY	Opportunity	NOR				PRO				Difference PRO Minus NOR			
		By 1980	1981-2000	2001-2020	TOTAL	By 1980	1981-2000	2001-2020	TOTAL	By 1980	1981-2000	2001-2020	TOTAL
AGRICULTURAL LAND TREATMENT	317.6	27.6	55.4	33.4	116.4	58.5	108.7	65.8	233.0	30.9	53.3	32.4	116.6
CROPLAND DRAINAGE	84.6	11.1	4.8	0	15.9	0.0	0.0	0.0	0.0	-11.1	-4.8	0	-15.9
FORESTED LAND	5,640.0	616.0	1,232.0	1,332.0	3,180.0	1,129.0	2,256.0	2,255.0	5,640.0	513.0	1,024.0	923.0	2,460.0

TABLE 1–329 RBG 1.2, Comparison of PRO and NOR Land Treatment Programs (thousands of acres)

RESOURCE USE CATEGORY	Opportunity	NOR				PRO				Difference PRO Minus NOR			
		By 1980	1981-2000	2001-2020	TOTAL	By 1980	1981-2000	2001-2020	TOTAL	By 1980	1981-2000	2001-2020	TOTAL
AGRICULTURAL LAND TREATMENT	155.3	11.4	22.9	12.7	47.0	30.7	57.3	34.8	122.8	19.3	34.4	22.1	75.8
CROPLAND DRAINAGE	32.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FORESTED LAND	4,390.0	475.0	947.0	947.0	2,369.0	878.0	1,756.0	1,756.0	4,390.0	403.0	809.0	809.0	2,021.0

TABLE 1–330 RBG 2.1, Comparison of PRO and NOR Land Treatment Programs (thousands of acres)

RESOURCE USE CATEGORY	Opportunity	NOR				PRO				Difference PRO Minus NOR			
		By 1980	1981-2000	2001-2020	TOTAL	By 1980	1981-2000	2001-2020	TOTAL	By 1980	1981-2000	2001-2020	TOTAL
AGRICULTURAL LAND TREATMENT	2,225.0	222.5	445.1	267.1	934.7	489.5	912.5	556.0	1,958.0	267.0	467.4	288.9	1,023.3
CROPLAND DRAINAGE	451.0	111.0	24.0	19.0	154.0	111.0	104.0	85.0	300.0	0	80.0	66.0	146.0
FORESTED LAND	3,046.0	405.0	809.0	809.0	2,023.0	609.0	1,219.0	1,218.0	3,046.0	204.0	410.0	409.0	1,023.0

TABLE 1–331 RBG 2.2, Comparison of PRO and NOR Land Treatment Programs (thousands of acres)

RESOURCE USE CATEGORY	Opportunity	NOR				PRO				Difference PRO Minus NOR			
		By 1980	1981-2000	2001-2020	TOTAL	By 1980	1981-2000	2001-2020	TOTAL	By 1980	1981-2000	2001-2020	TOTAL
AGRICULTURAL LAND TREATMENT	2,170.0	52.1	103.8	52.1	208.0	114.5	213.5	130.1	458.1	62.4	109.7	78.0	250.1
CROPLAND DRAINAGE	442.0	4.5	3.4	13.7	21.6	19.9	37.1	22.6	79.6	15.4	33.7	8.9	58.0
FORESTED LAND	212.0	19.7	31.7	0.0	51.4	19.7	31.7	0.0	51.4	0	0	0	0

TABLE 1–332 RBG 2.3, Comparison of PRO and NOR Land Treatment Programs (thousands of acres)

		NOR				PRO				Difference PRO Minus NOR			
RESOURCE USE CATEGORY	Opportunity	By 1980	1981-2000	2001-2020	TOTAL	By 1980	1981-2000	2001-2020	TOTAL	By 1980	1981-2000	2001-2020	TOTAL
AGRICULTURAL LAND TREATMENT	3,540.0	354.0	708.0	425.0	1,487.0	778.8	1,456.2	556.0	2,791.0	424.8	748.2	131.0	1,304.0
CROPLAND DRAINAGE	578.0	15.6	16.4	143.0	175.0	144.5	269.3	164.1	577.9	128.9	252.9	21.1	402.9
FORESTED LAND	1,230.0	96.0	193.0	193.0	482.0	125.0	252.0	252.0	629.0	29.0	59.0	59.0	147.0

TABLE 1–333 RBG 2.4, Comparison of PRO and NOR Land Treatment Programs (thousands of acres)

		NOR				PRO				Difference PRO Minus NOR			
RESOURCE USE CATEGORY	Opportunity	By 1980	1981-2000	2001-2020	TOTAL	By 1980	1981-2000	2001-2020	TOTAL	By 1980	1981-2000	2001-2020	TOTAL
AGRICULTURAL LAND TREATMENT	1,018.0	101.8	203.6	122.2	427.6	243.3	417.4	274.1	934.8	141.5	213.8	151.9	507.2
CROPLAND DRAINAGE	47.6	10.8	11.0	2.7	24.5	0	0	0	0	-10.8	-11.0	-2.7	-24.5
FORESTED LAND	4,560.0	460.0	921.0	921.0	2,302.0	561.0	1,121.0	1,121.0	2,803.0	101.0	200.0	200.0	501.0

TABLE 1–334 RBG 3.1, Comparison of PRO and NOR Land Treatment Programs (thousands of acres)

		NOR				PRO				Difference PRO Minus NOR			
RESOURCE USE CATEGORY	Opportunity	By 1980	1981-2000	2001-2020	TOTAL	By 1980	1981-2000	2001-2020	TOTAL	By 1980	1981-2000	2001-2020	TOTAL
AGRICULTURAL LAND TREATMENT	435.6	43.6	87.1	52.3	183.0	93.4	133.7	105.2	332.3	49.8	46.6	52.9	149.3
CROPLAND DRAINAGE	63.3	4.7	5.5	5.5	15.7	0	0	0	0	-4.7	-5.5	-5.5	-15.7
FORESTED LAND	2,030.0	228.0	457.0	457.0	1,142.0	266.0	533.0	533.0	1,332.0	38.0	76.0	76.0	190.0

TABLE 1–335 RBG 3.2, Comparison of PRO and NOR Land Treatment Programs (thousands of acres)

		NOR				PRO				Difference PRO Minus NOR			
RESOURCE USE CATEGORY	Opportunity	By 1980	1981-2000	2001-2020	TOTAL	By 1980	1981-2000	2001-2020	TOTAL	By 1980	1981-2000	2001-2020	TOTAL
AGRICULTURAL LAND TREATMENT	1,616.0	161.5	323.0	193.8	678.3	355.3	662.7	403.0	1,421.0	193.8	339.7	209.2	742.7
CROPLAND DRAINAGE	509.0	47.0	8.0	115.0	170.0	76.3	113.7	115.0	305.0	29.3	105.7	0	135.0
FORESTED LAND	781.0	58.0	115.0	115.0	288.0	77.0	155.0	155.0	387.0	19.0	40.0	40.0	99.0

TABLE 1–336 RBG 4.1, Comparison of PRO and NOR Land Treatment Programs (thousands of acres)

		NOR				PRO				Difference PRO Minus NOR			
RESOURCE USE CATEGORY	Opportunity	By 1980	1981-2000	2001-2020	TOTAL	By 1980	1981-2000	2001-2020	TOTAL	By 1980	1981-2000	2001-2020	TOTAL
AGRICULTURAL LAND TREATMENT	1,305.0	130.6	261.1	156.5	548.2	287.1	535.2	326.7	1,149.0	156.5	274.1	170.2	600.8
CROPLAND DRAINAGE	434.0	71.3	91.7	18.0	181.0	71.3	115.5	74.1	260.9	0	23.8	56.1	79.9
FORESTED LAND	421.0	31.0	62.0	62.0	155.0	85.0	168.0	168.0	421.0	54.0	106.0	106.0	266.0

TABLE 1–337 RBG 4.2, Comparison of PRO and NOR Land Treatment Programs (thousands of acres)

		NOR				PRO				Difference PRO Minus NOR			
RESOURCE USE CATEGORY	Opportunity	By 1980	1981-2000	2001-2020	TOTAL	By 1980	1981-2000	2001-2020	TOTAL	By 1980	1981-2000	2001-2020	TOTAL
AGRICULTURAL LAND TREATMENT	3,821.0	382.1	763.9	454.0	1,600.0	840.6	1,566.4	955.0	3,362.0	458.5	802.5	501.0	1,762.0
CROPLAND DRAINAGE	2,520.0	61.0	190.0	267.6	518.6	208.3	357.1	267.7	833.1	147.3	167.1	0.1	314.5
FORESTED LAND	348.0	31.0	61.0	61.0	153.0	38.0	75.0	75.0	188.0	7.0	14.0	14.0	35.0

TABLE 1–338 RBG 4.3, Comparison of PRO and NOR Land Treatment Programs (thousands of acres)

		NOR				PRO				Difference PRO Minus NOR			
RESOURCE USE CATEGORY	Opportunity	By 1980	1981-2000	2001-2020	TOTAL	By 1980	1981-2000	2001-2020	TOTAL	By 1980	1981-2000	2001-2020	TOTAL
AGRICULTURAL LAND TREATMENT	700.0	52.1	103.9	63.0	219.0	114.6	213.8	130.5	458.9	62.5	109.9	67.5	239.9
CROPLAND DRAINAGE	265.0	4.1	3.1	27.8	35.0	21.9	37.9	27.8	87.6	17.8	34.8	0	52.6
FORESTED LAND	430.0	32.0	65.0	65.0	162.0	86.0	172.0	172.0	430.0	54.0	107.0	107.0	268.0

TABLE 1–339 RBG 4.4, Comparison of PRO and NOR Land Treatment Programs (thousands of acres)

		NOR				PRO				Difference PRO Minus NOR			
RESOURCE USE CATEGORY	Opportunity	By 1980	1981-2000	2001-2020	TOTAL	By 1980	1981-2000	2001-2020	TOTAL	By 1980	1981-2000	2001-2020	TOTAL
AGRICULTURAL LAND TREATMENT	551.9	49.9	99.7	60.3	209.9	92.8	172.7	104.6	370.1	42.9	73.0	44.3	160.2
CROPLAND DRAINAGE	182.0	15.1	0.0	0.0	15.1	0	0	0	0	-15.1	-0.0	-0.0	-15.1
FORESTED LAND	1,030.0	78.0	156.0	156.0	390.0	104.0	206.0	206.0	516.0	26.0	50.0	50.0	126.0

TABLE 1–340 RBG 5.1, Comparison of PRO and NOR Land Treatment Programs (thousands of acres)

		NOR				PRO				Difference PRO Minus NOR			
RESOURCE USE CATEGORY	Opportunity	By 1980	1981-2000	2001-2020	TOTAL	By 1980	1981-2000	2001-2020	TOTAL	By 1980	1981-2000	2001-2020	TOTAL
AGRICULTURAL LAND TREATMENT	654.2	58.0	116.2	69.5	243.7	127.1	236.7	143.1	506.9	69.1	120.5	73.6	263.2
CROPLAND DRAINAGE	147.0	18.5	0.0	0.0	18.5	0	0	0	0	-18.5	-0.0	-0.0	-18.5
FORESTED LAND	443.0	38.0	75.0	75.0	188.0	47.0	94.0	94.0	235.0	9.0	19.0	19.0	47.0

TABLE 1–341 RBG 5.2, Comparison of PRO and NOR Land Treatment Programs (thousands of acres)

		NOR				PRO				Difference PRO Minus NOR			
RESOURCE USE CATEGORY	Opportunity	By 1980	1981-2000	2001-2020	TOTAL	By 1980	1981-2000	2001-2020	TOTAL	By 1980	1981-2000	2001-2020	TOTAL
AGRICULTURAL LAND TREATMENT	1,412.0	125.2	250.6	152.0	527.8	275.6	513.6	314.8	1,104.0	150.4	263.0	162.8	576.2
CROPLAND DRAINAGE	251.0	41.0	45.7	0.0	86.7	41.5	77.4	47.2	166.1	0.5	31.7	47.2	79.4
FORESTED LAND	1,670.0	132.0	266.0	266.0	664.0	172.0	343.0	344.0	859.0	40.0	77.0	78.0	195.0

TABLE 1–342 RBG 5.3, Comparison of PRO and NOR Land Treatment Programs (thousands of acres)

		NOR				PRO				Difference PRO Minus NOR			
RESOURCE USE CATEGORY	Opportunity	By 1980	1981-2000	2001-2020	TOTAL	By 1980	1981-2000	2001-2020	TOTAL	By 1980	1981-2000	2001-2020	TOTAL
AGRICULTURAL LAND TREATMENT	530.0	32.2	64.4	38.4	135.0	82.0	150.9	91.4	324.3	49.8	86.5	53.0	189.3
CROPLAND DRAINAGE	206.0	18.6	20.2	0.0	38.8	0	0	0	0	-18.6	-20.2	-0.0	-38.8
FORESTED LAND	1,730.0	130.0	262.0	262.0	654.0	173.0	348.0	348.0	869.0	43.0	86.0	86.0	215.0

TABLE 1–343 RBG 1.1, Comparison of Total Costs NOR and PRO Frameworks (in $1,000,000)

RESOURCE USE CATEGORY	1971-1980						1971-2020					
	NORMAL			PROPOSED			NORMAL			PROPOSED		
	Capital	OM&R	TOTAL	Capital	OM&R	TOTAL	Capital	OM&R	TOTAL	Capital	OM&R	TOTAL
WATER WITHDRAWALS												
MUNICIPALLY SUPPLIED	0.9	0.5	1.4	0.9	0.5	1.4	6.9	18.5	25.4	6.9	18.5	25.4
SELF-SUPPLIED INDUSTRIAL	0	0	0	0	0	0	1.7	3.3	5.0	1.7	3.3	5.0
RURAL DOMESTIC & LIVESTOCK	0.0	0.1	0.1	0.0	0.1	0.1	0.1	2.4	2.5	0.1	2.4	2.5
IRRIGATION	0.2	0.0	0.2	0.2	0.0	0.2	0.6	0.5	1.1	0.6	0.5	1.1
MINING	2.0	2.0	4.0	2.0	2.0	4.0	7.1	37.2	44.3	7.1	37.2	44.3
THERMAL POWER COOLING	0	0	0	0	0	0	71.3	67.3	138.6	71.3	67.3	138.6
NON-WITHDRAWAL WATER USES												
MUNICIPAL WASTEWATER DISCHARGES	12.8	16.2	29.0	36.0	88.6	124.6	29.2	207.2	236.4	77.0	502.7	579.7
INDUSTRIAL WASTEWATER DISCHARGES	---	---	---	---	---	---	---	---	---	---	---	---
HYDROELECTRIC POWER	---	---	---	---	---	---	---	---	---	---	---	---
WATER ORIENTED OUTDOOR REC.	---	---	---	---	---	---	---	---	---	---	---	---
SPORT FISHING	4.2	2.0	6.2	4.2	2.0	6.2	6.8	8.6	15.4	6.8	8.6	15.4
RECREATIONAL BOATING	24.8	6.7	31.5	24.8	6.7	31.5	60.6	118.6	179.2	60.6	118.6	179.2
COMMERCIAL FISHING	---	---	---	---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	0	0	0	48.0	6.0	54.0	17.8	12.0	29.8	65.8	66.0	131.8
RELATED LAND USES & PROBLEMS												
AGRIC. LAND-TREATMENT	1.1	0.0	1.1	0.7	0.0	0.7	4.7	0.6	5.3	3.4	0.5	3.9
-CROPLAND DRAINAGE	2.4	0.1	2.5	0	0	0	3.4	0.7	4.1	0	0	0
FOREST LAND-TREATMENT	21.0	0.5	21.5	39.0	1.0	40.0	107.0	13.2	110.2	199.0	21.8	220.8
SHORELAND EROSION	1.8	0.2	2.0	1.8	0.2	2.0	8.9	4.5	13.4	8.9	4.5	13.4
STREAMBANK EROSION	1.0	0.1	1.1	1.0	0.1	1.1	9.0	3.5	12.5	9.0	3.5	12.5
FLOOD PLAINS-URBAN	---	---	---	---	---	---	---	---	---	---	---	---
-URBAN	3.4	0.0	3.4	3.4	0.0	3.4	7.7	0.9	8.6	7.7	0.9	8.6
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---
WILDLIFE MANAGEMENT	5.4	0.3	5.7	5.4	0.3	5.7	39.0	2.0	41.0	39.0	2.0	41.0
AESTHETIC & CULTURAL	---	---	---	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	42.6	5.9	48.5	42.6	5.9	48.5	69.2	119.1	188.3	69.2	119.1	188.3
-EXTENSIVE	---	---	---	---	---	---	---	---	---	---	---	---
TOTAL	123.6	34.6	158.2	210.0	113.4	323.4	451.0	620.1	1,071.1	634.1	977.4	1,611.5

TABLE 1–344 RBG 1.2, Comparison of Total Costs NOR and PRO Frameworks (in $1,000,000)

RESOURCE USE CATEGORY	1971-1980						1971-2020					
	NORMAL			PROPOSED			NORMAL			PROPOSED		
	Capital	OM&R	TOTAL	Capital	OM&R	TOTAL	Capital	OM&R	TOTAL	Capital	OM&R	TOTAL
WATER WITHDRAWALS												
MUNICIPALLY SUPPLIED	0	0	0	0	0	0	0	0	0	0	0	0
SELF-SUPPLIED INDUSTRIAL	0.2	0.2	0.4	0.2	0.2	0.4	4.4	14.2	18.6	4.4	14.2	18.6
RURAL DOMESTIC & LIVESTOCK	0	0	0	0	0	0	0.2	2.8	3.0	0.2	2.8	3.0
IRRIGATION	0.1	0.0	0.1	0.1	0.0	0.1	0.3	0.2	0.5	0.3	0.2	0.5
MINING	0.6	0.3	0.9	0.6	0.3	0.9	5.6	9.9	15.5	5.6	9.9	15.5
THERMAL POWER COOLING	0	0	0	0	0	0	30.4	24.5	54.9	30.4	24.5	54.9
NON-WITHDRAWAL WATER USES												
MUNICIPAL WASTEWATER DISCHARGES	7.0	8.8	15.8	3.0	20.0	23.0	19.8	53.8	73.6	10.0	98.8	108.8
INDUSTRIAL WASTEWATER DISCHARGES	---	---	---	---	---	---	---	---	---	---	---	---
HYDROELECTRIC POWER	---	---	---	---	---	---	---	---	---	---	---	---
WATER ORIENTED OUTDOOR REC.	---	---	---	---	---	---	---	---	---	---	---	---
SPORT FISHING	1.5	0.4	1.9	1.5	0.4	1.9	5.0	6.5	11.5	5.0	6.5	11.5
RECREATIONAL BOATING	3.2	0.6	3.8	3.2	0.6	3.8	8.1	10.6	18.7	8.1	10.6	18.7

COMMERCIAL FISHING	---	---	---	---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	0	0	0	0	0	0	0	0	0	0.2	0	0.2
RELATED LAND USES & PROBLEMS												
AGRIC. LAND-TREATMENT	0.5	0.0	0.5	0.5	0.0	0.5	1.8	0.3	2.1	1.9	0.3	2.2
-CROPLAND DRAINAGE	0	0	0	0	0	0	0	0	0	0	0	0
FOREST LAND-TREATMENT	16.0	0.4	16.4	32.0	0.8	32.8	82.0	10.2	92.2	158.0	20.6	178.6
SHORELAND EROSION	2.0	0.2	2.2	2.0	0.2	2.2	10.0	5.0	15.0	10.0	5.0	15.0
STREAMBANK EROSION	2.1	0.2	2.3	2.1	0.2	2.3	18.9	7.7	26.6	18.9	7.7	26.6
FLOOD PLAINS-URBAN	---	---	---	---	---	---	---	---	---	---	---	---
-URBAN	1.4	0.0	1.4	1.4	0.0	1.4	1.4	0.4	1.8	1.4	0.4	1.8
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---
WILDLIFE MANAGEMENT	2.9	0.1	3.0	2.9	0.1	3.0	10.4	0.5	10.9	10.4	0.5	10.9
AESTHETIC & CULTURAL	---	---	---	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	10.5	1.8	12.3	10.5	1.8	12.3	24.9	44.4	69.3	24.9	44.4	69.3
-EXTENSIVE	---	---	---	---	---	---	---	---	---	---	---	---
TOTAL	48.0	13.0	61.0	60.0	24.6	84.6	223.2	191.0	414.2	289.7	246.6	536.3

TABLE 1-345 RBG 2.1, Comparison of Total Costs NOR and PRO Frameworks (in $1,000,000)

RESOURCE USE CATEGORY	1971-1980						1971-2020					
	NORMAL			PROPOSED			NORMAL			PROPOSED		
	Capital	OM&R	TOTAL	Capital	OM&R	TOTAL	Capital	OM&R	TOTAL	Capital	OM&R	TOTAL
WATER WITHDRAWALS												
MUNICIPALLY SUPPLIED	9.8	5.2	15.0	9.8	5.2	15.0	53.1	144.9	198.0	53.1	144.9	198.0
SELF-SUPPLIED INDUSTRIAL	8.7	8.8	17.5	8.7	8.8	17.5	28.7	150.4	179.1	28.7	150.4	179.1
RURAL DOMESTIC & LIVESTOCK	0.5	1.5	2.0	0.5	1.5	2.0	1.7	28.4	30.1	1.7	28.4	30.1
IRRIGATION	2.5	0.3	2.8	2.5	0.3	2.8	7.5	6.1	13.6	7.5	6.1	13.6
MINING	0	0	0	0	0	0	0.3	2.8	3.1	0.3	2.8	3.1
THERMAL POWER COOLING	27.3	7.0	34.3	27.3	7.0	34.3	158.4	178.7	337.1	158.4	178.7	337.1
NON-WITHDRAWAL WATER USES												
MUNICIPAL WASTEWATER DISCHARGES	72.9	74.0	146.9	102.0	159.3	261.3	304.5	568.0	872.5	313.0	1,106.7	1,419.7
INDUSTRIAL WASTEWATER DISCHARGES	---	---	---	---	---	---	---	---	---	---	---	---
HYDROELECTRIC POWER	---	---	---	---	---	---	---	---	---	---	---	---
WATER ORIENTED OUTDOOR REC.	---	---	---	---	---	---	---	---	---	---	---	---
SPORT FISHING	0.8	0.6	1.4	0.8	0.6	1.4	3.1	5.4	8.5	3.1	5.4	8.5
RECREATIONAL BOATING	40.8	7.2	48.0	40.8	7.2	48.0	107.8	125.0	232.8	107.8	125.0	232.8
COMMERCIAL FISHING	---	---	---	---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	0	0	0	7.0	1.0	8.0	0	0	0	7.0	9.0	16.0
RELATED LAND USES & PROBLEMS												
AGRIC. LAND-TREATMENT	9.0	0.2	9.2	19.7	0.5	20.2	37.6	5.2	42.8	78.8	11.5	90.3
-CROPLAND DRAINAGE	24.3	0.6	24.9	14.6	0.4	15.0	35.0	6.6	41.6	40.2	6.4	46.6
FOREST LAND-TREATMENT	16.0	0.4	16.4	25.0	0.6	25.6	80.0	8.9	88.9	123.0	16.0	139.0
SHORELAND EROSION	0	0	0	0	0	0	0	0	0	0	0	0
STREAMBANK EROSION	1.1	0.1	1.2	1.1	0.1	1.2	9.6	3.6	13.2	9.6	3.6	13.2
FLOOD PLAINS-URBAN	---	---	---	---	---	---	---	---	---	---	---	---
-URBAN	7.2	0	7.2	7.2	0	7.2	30.8	0.6	31.4	30.8	0.6	31.4
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---
WILDLIFE MANAGEMENT	15.4	0.8	16.2	15.4	0.8	16.2	64.7	3.3	68.0	64.7	3.3	68.0
AESTHETIC & CULTURAL	---	---	---	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	21.0	5.3	26.3	21.0	5.3	26.3	112.2	134.1	246.3	112.2	134.1	246.3
-EXTENSIVE	---	---	---	---	---	---	---	---	---	---	---	---
TOTAL	257.3	112.0	369.3	303.4	198.6	502.0	1,035.0	1,372.0	2,407.0	1,139.9	1,932.9	3,072.8

TABLE 1–346 RBG 2.2, Comparison of Total Costs NOR and PRO Frameworks (in $1,000,000)

RESOURCE USE CATEGORY	1971-1980						1971-2020					
	NORMAL			PROPOSED			NORMAL			PROPOSED		
	Capital	OM&R	TOTAL	Capital	OM&R	TOTAL	Capital	OM&R	TOTAL	Capital	OM&R	TOTAL
WATER WITHDRAWALS												
MUNICIPALLY SUPPLIED	96.9	55.0	151.9	96.9	55.0	151.9	475.4	1,331.0	1,806.4	475.4	1,331.0	1,806.4
SELF-SUPPLIED INDUSTRIAL	2.0	1.8	3.8	2.0	1.8	3.8	164.8	512.6	677.4	164.8	512.6	677.4
RURAL DOMESTIC & LIVESTOCK	0.1	0.3	0.4	0.1	0.3	0.4	0.3	7.5	7.8	0.3	7.5	7.8
IRRIGATION	1.2	0.2	1.4	1.2	0.2	1.4	3.1	2.6	5.7	3.1	2.6	5.7
MINING	0.1	0.1	0.2	0.1	0.1	0.2	0.5	4.3	4.8	0.5	4.3	4.8
THERMAL POWER COOLING	45.9	11.8	57.7	45.9	11.8	57.7	883.4	810.7	1,694.1	883.4	810.7	1,694.1
NON-WITHDRAWAL WATER USES												
MUNICIPAL WASTEWATER DISCHARGES	253.4	104.0	357.4	404.0	491.4	895.4	599.1	776.0	1,375.1	1,216.0	3,685.8	4,901.8
INDUSTRIAL WASTEWATER DISCHARGES	---	---	---	---	---	---	---	---	---	---	---	---
HYDROELECTRIC POWER	---	---	---	---	---	---	---	---	---	---	---	---
WATER ORIENTED OUTDOOR REC.	---	---	---	---	---	---	---	---	---	---	---	---
SPORT FISHING	9.3	0.9	10.2	9.3	0.9	10.2	17.5	9.6	27.1	17.5	9.6	27.1
RECREATIONAL BOATING	25.9	5.9	31.8	25.9	5.9	31.8	76.2	100.5	176.7	76.2	100.5	176.7
COMMERCIAL FISHING	---	---	---	---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	0	0	0	22.0	3.0	25.0	36.9	27.0	63.9	154.3	102.0	256.3
RELATED LAND USES & PROBLEMS												
AGRIC. LAND-TREATMENT	2.1	0.1	2.2	4.6	0.1	4.7	8.4	1.2	9.6	18.4	2.7	21.1
-CROPLAND DRAINAGE	1.5	0.0	1.5	3.0	0.1	3.1	9.8	1.0	10.8	12.0	1.8	13.8
FOREST LAND-TREATMENT	1.0	0.0	1.0	1.0	0	1.0	3.0	0.4	3.4	3.0	0.6	3.6
SHORELAND EROSION	6.9	0.7	7.6	6.9	0.7	7.6	34.5	17.2	51.7	34.5	17.2	51.7
STREAMBANK EROSION	0	0.0	0.0	0	0.0	0.0	0.1	0.5	0.6	0.1	0.5	0.6
FLOOD PLAINS-URBAN	---	---	---	---	---	---	---	---	---	---	---	---
-URBAN	101.7	0.2	101.9	101.7	0.2	101.9	109.9	2.3	112.2	109.9	2.3	112.2
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---
WILDLIFE MANAGEMENT	4.2	0.2	4.4	4.2	0.2	4.4	22.3	1.1	23.4	22.3	1.1	23.4
AESTHETIC & CULTURAL	---	---	---	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	90.6	16.8	107.4	90.6	16.8	107.4	224.1	323.5	547.6	224.1	323.5	547.6
-EXTENSIVE	---	---	---	---	---	---	---	---	---	---	---	---
TOTAL	642.8	198.0	840.8	819.4	588.5	1,407.9	2,669.3	3,929.0	6,598.3	3,415.8	6,916.3	10,332.1

TABLE 1–347 RBG 2.3, Comparison of Total Costs NOR and PRO Frameworks (in $1,000,000)

RESOURCE USE CATEGORY	1971-1980						1971-2020					
	NORMAL			PROPOSED			NORMAL			PROPOSED		
	Capital	OM&R	TOTAL	Capital	OM&R	TOTAL	Capital	OM&R	TOTAL	Capital	OM&R	TOTAL
WATER WITHDRAWALS												
MUNICIPALLY SUPPLIED	24.6	15.7	40.3	24.6	15.7	40.3	244.5	532.6	777.1	244.5	532.6	777.1
SELF-SUPPLIED INDUSTRIAL	3.3	3.4	6.7	3.3	3.4	6.7	27.2	118.9	146.1	27.2	118.9	146.1
RURAL DOMESTIC & LIVESTOCK	0.8	1.0	1.8	0.8	1.0	1.8	3.5	24.0	27.5	3.5	24.0	27.5
IRRIGATION	5.3	0.8	6.1	5.3	0.8	6.1	15.3	12.4	27.7	15.3	12.4	27.7
MINING	0.6	0.5	1.1	0.6	0.5	1.1	5.7	18.3	24.0	5.7	18.3	24.0
THERMAL POWER COOLING	37.4	9.6	47.0	37.4	9.6	47.0	404.6	454.1	858.7	404.6	454.1	858.7
NON-WITHDRAWAL WATER USES												
MUNICIPAL WASTEWATER DISCHARGES	121.1	136.0	257.1	303.0	456.8	759.8	613.8	1,186.0	1,799.8	941.0	3,235.3	4,176.3
INDUSTRIAL WASTEWATER DISCHARGES	---	---	---	---	---	---	---	---	---	---	---	---
HYDROELECTRIC POWER	---	---	---	---	---	---	---	---	---	---	---	---
WATER ORIENTED OUTDOOR REC.	---	---	---	---	---	---	---	---	---	---	---	---
SPORT FISHING	3.5	1.6	5.1	3.5	1.6	5.1	11.0	16.9	27.9	11.0	16.9	27.9
RECREATIONAL BOATING	8.6	1.7	10.3	8.6	1.7	10.3	139.2	90.4	229.6	139.2	90.4	229.6

COMMERCIAL FISHING	---	---	---	---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	0	0	0	8.0	1.0	9.0	0	0	0	8.0	9.0	17.0
RELATED LAND USES & PROBLEMS												
AGRIC. LAND-TREATMENT	14.2	0.4	14.6	31.3	0.8	32.1	59.8	8.3	68.1	125.1	18.3	143.4
-CROPLAND DRAINAGE	5.4	0.1	5.5	24.6	0.6	25.2	39.3	3.4	42.7	97.6	14.4	112.0
FOREST LAND-TREATMENT	6.0	0.1	6.1	7.0	0.2	7.2	30.0	3.3	33.3	37.0	4.7	41.7
SHORELAND EROSION	3.0	0.3	3.3	3.0	0.3	3.3	15.2	7.6	22.8	15.2	7.6	22.8
STREAMBANK EROSION	2.0	0.2	2.2	2.0	0.2	2.2	18.0	7.4	25.4	18.0	7.4	25.4
FLOOD PLAINS-URBAN	---	---	---	---	---	---	---	---	---	---	---	---
-URBAN	51.0	0.1	51.1	51.0	0.1	51.1	75.3	1.6	76.9	75.3	1.6	76.9
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---
-RURAL												
WILDLIFE MANAGEMENT	9.0	0.5	9.5	9.0	0.5	9.5	33.4	1.8	35.2	33.4	1.8	35.2
AESTHETIC & CULTURAL	---	---	---	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	70.6	14.9	85.5	70.6	14.9	85.5	269.3	303.8	573.1	269.3	303.8	573.1
-EXTENSIVE	---	---	---	---	---	---	---	---	---	---	---	---
TOTAL	366.4	186.9	553.3	593.6	509.7	1,103.3	2,005.1	2,790.8	4,795.9	2,470.9	4,871.5	7,342.4

TABLE 1–348 RBG 2.4, Comparison of Total Costs NOR and PRO Frameworks (in $1,000,000)

RESOURCE USE CATEGORY	1971-1980						1971-2020					
	NORMAL			PROPOSED			NORMAL			PROPOSED		
	Capital	OM&R	TOTAL	Capital	OM&R	TOTAL	Capital	OM&R	TOTAL	Capital	OM&R	TOTAL
WATER WITHDRAWALS												
MUNICIPALLY SUPPLIED	2.4	1.4	3.8	2.4	1.4	3.8	17.2	42.6	59.8	17.2	42.6	59.8
SELF-SUPPLIED INDUSTRIAL	0	0	0	0	0	0	6.4	17.0	23.4	6.4	17.0	23.4
RURAL DOMESTIC & LIVESTOCK	0.2	0.4	0.6	0.2	0.4	0.6	0.6	9.2	9.9	0.6	9.2	9.8
IRRIGATION	1.0	0.2	1.2	1.0	0.2	1.2	3.9	3.4	7.3	3.9	3.4	7.3
MINING	0.0	0.1	0.1	0.0	0.1	0.1	0.3	1.6	1.9	0.3	1.6	1.9
THERMAL POWER COOLING	0	0	0	0	0	0	37.1	19.1	56.2	37.1	19.1	56.2
NON-WITHDRAWAL WATER USES												
MUNICIPAL WASTEWATER DISCHARGES	66.0	38.0	104.0	21.0	87.2	108.2	154.0	234.0	388.0	114.0	539.4	653.4
INDUSTRIAL WASTEWATER DISCHARGES	---	---	---	---	---	---	---	---	---	---	---	---
HYDROELECTRIC POWER	---	---	---	---	---	---	---	---	---	---	---	---
WATER ORIENTED OUTDOOR REC.	---	---	---	---	---	---	---	---	---	---	---	---
SPORT FISHING	3.7	2.4	6.1	3.7	2.4	6.1	9.7	19.4	29.1	9.7	19.4	29.1
RECREATIONAL BOATING	21.6	7.3	28.9	21.6	7.3	28.9	83.3	153.3	236.6	83.3	153.3	236.6
COMMERCIAL FISHING	---	---	---	---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	0	0	0	7.6	1.0	8.6	0.6	18.6	19.2	31.2	27.6	58.8
RELATED LAND USES & PROBLEMS												
AGRIC. LAND-TREATMENT	4.0	0.1	4.1	3.5	0.0	3.5	17.2	2.4	19.6	14.1	2.0	16.1
-CROPLAND DRAINAGE	3.1	0.1	3.2	0	0	0	7.1	1.2	8.3	0	0	0
FOREST LAND-TREATMENT	18.0	0.4	18.4	22.0	0.5	22.5	92.0	9.9	101.9	114.0	14.7	128.7
SHORELAND EROSION	3.4	0.3	3.7	3.4	0.3	3.7	16.8	8.4	25.2	16.8	8.4	25.2
STREAMBANK EROSION	3.6	0.4	4.0	3.6	0.4	4.0	32.7	13.4	46.1	32.7	13.4	46.1
FLOOD PLAINS-URBAN	---	---	---	---	---	---	---	---	---	---	---	---
-URBAN	1.7	0.0	1.7	1.7	0.0	1.7	6.7	0.2	6.9	6.7	0.2	6.9
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---
WILDLIFE MANAGEMENT	4.6	0.2	4.8	4.6	0.2	4.8	17.3	0.8	18.1	17.3	0.8	18.1
AESTHETIC & CULTURAL	---	---	---	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	40.7	4.8	45.5	40.7	4.8	45.5	121.6	105.1	226.7	121.6	105.1	226.7
-EXTENSIVE	---	---	---	---	---	---	---	---	---	---	---	---
TOTAL	174.0	56.1	230.1	137.0	106.2	243.2	624.5	659.6	1,284.1	626.9	977.2	1,604.1

TABLE 1–349 RBG 3.1, Comparison of Total Costs NOR and PRO Frameworks (in $1,000,000)

RESOURCE USE CATEGORY	1971-1980 NORMAL Capital	OM&R	TOTAL	1971-1980 PROPOSED Capital	OM&R	TOTAL	1971-2020 NORMAL Capital	OM&R	TOTAL	1971-2020 PROPOSED Capital	OM&R	TOTAL
WATER WITHDRAWALS												
MUNICIPALLY SUPPLIED	0.4	0.3	0.7	0.4	0.3	0.7	2.9	9.6	12.5	2.9	9.6	12.5
SELF-SUPPLIED INDUSTRIAL	0	0	0	0	0	0	3.0	11.6	14.6	3.0	11.6	14.6
RURAL DOMESTIC & LIVESTOCK	0.1	0.9	1.0	0.1	0.9	1.0	0.5	9.3	9.8	0.5	9.3	9.8
IRRIGATION	0.2	0.0	0.2	0.2	0.0	0.2	0.8	0.3	1.1	0.8	0.3	1.1
MINING	0.4	0.6	1.0	0.4	0.6	1.0	2.6	15.7	18.3	2.6	15.7	18.3
THERMAL POWER COOLING	0	0	0	0	0	0	0	0	0	0	0	0
NON-WITHDRAWAL WATER USES												
MUNICIPAL WASTEWATER DISCHARGES	6.1	6.0	12.1	13.0	27.3	40.3	24.3	50.0	74.3	46.0	174.9	220.9
INDUSTRIAL WASTEWATER DISCHARGES	---	---	---	---	---	---	---	---	---	---	---	---
HYDROELECTRIC POWER	---	---	---	---	---	---	---	---	---	---	---	---
WATER ORIENTED OUTDOOR REC.	---	---	---	---	---	---	---	---	---	---	---	---
SPORT FISHING	1.8	1.5	3.3	1.8	1.5	3.3	7.5	13.0	20.5	7.5	13.0	20.5
RECREATIONAL BOATING	12.3	3.6	15.9	12.3	3.6	15.9	54.7	81.7	136.4	54.7	81.7	136.4
COMMERCIAL FISHING	---	---	---	---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	0	0	0	76.0	9.0	85.0	340.0	240.0	580.0	439.0	354.0	793.0
RELATED LAND USES & PROBLEMS												
AGRIC. LAND-TREATMENT	1.8	0.0	1.8	1.3	0.0	1.3	7.4	1.1	8.5	5.3	0.8	6.1
-CROPLAND DRAINAGE	1.1	0	1.1	0	0	0	5.6	0.7	6.3	0	0	0
FOREST LAND-TREATMENT	11.0	0.3	11.3	12.0	0.3	12.3	53.0	4.7	57.7	62.0	8.0	70.0
SHORELAND EROSION	1.2	0.1	1.3	1.2	0.1	1.3	6.2	3.1	9.3	6.2	3.1	9.3
STREAMBANK EROSION	1.5	0.2	1.7	1.5	0.2	1.7	13.5	5.7	19.2	13.5	5.7	19.2
FLOOD PLAINS-URBAN	---	---	---	---	---	---	---	---	---	---	---	---
-URBAN	4.4	0	4.4	4.4	0	4.4	7.6	0.5	8.1	7.6	0.5	8.1
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---
WILDLIFE MANAGEMENT	9.2	0.5	9.7	9.2	0.5	9.7	39.2	2.0	41.2	39.2	2.0	41.2
AESTHETIC & CULTURAL	---	---	---	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	7.8	1.4	9.2	7.8	1.4	9.2	50.7	44.0	94.7	50.7	44.0	94.7
-EXTENSIVE	---	---	---	---	---	---	---	---	---	---	---	---
TOTAL	59.3	15.4	74.7	41.6	45.7	187.3	619.5	493.0	1,112.5	741.5	734.2	1,475.7

TABLE 1–350 RBG 3.2, Comparison of Total Costs NOR and PRO Frameworks (in $1,000,000)

RESOURCE USE CATEGORY	1971-1980 NORMAL Capital	OM&R	TOTAL	1971-1980 PROPOSED Capital	OM&R	TOTAL	1971-2020 NORMAL Capital	OM&R	TOTAL	1971-2020 PROPOSED Capital	OM&R	TOTAL
WATER WITHDRAWALS												
MUNICIPALLY SUPPLIED	14.0	5.5	19.5	14.0	5.5	19.5	104.0	200.6	304.6	104.0	200.6	304.6
SELF-SUPPLIED INDUSTRIAL	8.9	8.2	17.1	8.9	8.2	17.1	68.5	541.3	609.8	68.5	541.3	609.8
RURAL DOMESTIC & LIVESTOCK	0.2	1.6	1.8	0.2	1.6	1.8	0.7	33.5	34.2	0.7	33.5	34.2
IRRIGATION	2.1	0.3	2.4	2.1	0.3	2.4	5.1	3.8	8.9	5.1	3.8	8.9
MINING	0.1	0.2	0.3	0.1	0.2	0.3	0.9	6.0	6.9	0.9	6.0	6.9
THERMAL POWER COOLING	39.5	10.2	49.7	39.5	10.2	49.7	656.9	632.5	1,289.4	656.9	632.5	1,289.4
NON-WITHDRAWAL WATER USES												
MUNICIPAL WASTEWATER DISCHARGES	64.0	36.0	100.0	161.0	205.0	366.0	233.0	386.0	619.0	436.0	1,480.0	1,916.0
INDUSTRIAL WASTEWATER DISCHARGES	---	---	---	---	---	---	---	---	---	---	---	---
HYDROELECTRIC POWER	---	---	---	---	---	---	---	---	---	---	---	---
WATER ORIENTED OUTDOOR REC.	---	---	---	---	---	---	---	---	---	---	---	---
SPORT FISHING	0.2	0.3	0.5	0.2	0.3	0.5	7.1	8.1	15.2	7.1	8.1	15.2
RECREATIONAL BOATING	17.9	4.1	22.0	17.9	4.1	22.0	67.4	65.5	132.9	67.4	65.5	132.9

COMMERCIAL FISHING	---	---	---	---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	0	0	0	0	0	0	0	0	0	0	0	0
RELATED LAND USES & PROBLEMS												
AGRIC. LAND-TREATMENT	7.1	0.2	7.3	15.6	0.4	16.0	29.6	4.1	33.7	62.1	9.1	71.2
-CROPLAND DRAINAGE	14.4	0.4	14.8	14.2	0.4	14.6	41.5	4.7	46.2	52.6	7.8	60.4
FOREST LAND-TREATMENT	3.0	0.1	3.1	4.0	0.1	4.1	15.0	1.9	16.9	22.0	2.8	24.8
SHORELAND EROSION	0	0	0	0	0	0	0.2	0.1	0.3	0.2	0.1	0.3
STREAMBANK EROSION	2.6	0.3	2.9	2.6	0.3	2.9	23.4	9.6	33.0	23.4	9.6	33.0
FLOOD PLAINS-URBAN	---	---	---	---	---	---	---	---	---	---	---	---
-URBAN	23.2	0.1	23.3	23.2	0.1	23.3	76.9	1.1	78.0	76.9	1.1	78.0
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---
WILDLIFE MANAGEMENT	18.6	0.9	19.5	18.6	0.9	19.5	70.7	3.5	74.2	70.7	3.5	74.2
AESTHETIC & CULTURAL	---	---	---	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	32.2	8.2	40.4	32.2	8.2	40.4	113.1	160.5	273.6	113.1	160.5	273.6
-EXTENSIVE	---	---	---	---	---	---	---	---	---	---	---	---
TOTAL	248.0	76.6	324.6	354.3	245.8	600.1	1,514.0	2,062.8	3,576.8	1,767.6	3,165.8	4,933.4

TABLE 1–351 RBG 4.1, Comparison of Total Costs NOR and PRO Frameworks (in $1,000,000)

RESOURCE USE CATEGORY	1971-1980						1971-2020					
	NORMAL			PROPOSED			NORMAL			PROPOSED		
	Capital	OM&R	TOTAL	Capital	OM&R	TOTAL	Capital	OM&R	TOTAL	Capital	OM&R	TOTAL
WATER WITHDRAWALS												
MUNICIPALLY SUPPLIED	213.9	80.6	294.5	213.9	80.6	294.5	674.6	909.7	1,584.3	674.6	909.7	1,584.3
SELF-SUPPLIED INDUSTRIAL	2.6	2.3	4.9	2.6	2.3	4.9	76.6	262.1	338.7	76.6	262.1	338.7
RURAL DOMESTIC & LIVESTOCK	0.2	0.8	1.0	0.2	0.8	1.0	0.7	16.4	17.1	0.7	16.4	17.1
IRRIGATION	5.8	0.8	6.6	5.8	0.8	6.6	10.4	9.9	20.3	10.4	9.9	20.3
MINING	0.8	2.0	2.8	0.8	2.0	2.8	6.3	69.0	75.3	6.3	69.0	75.3
THERMAL POWER COOLING	0.0	0.0	0.0	0.0	0.0	0.0	93.7	85.9	179.6	93.7	85.9	179.6
NON-WITHDRAWAL WATER USES												
MUNICIPAL WASTEWATER DISCHARGES	700.0	450.0	1,150.0	497.0	952.5	1,449.5	1,375.0	3,050.0	4,425.0	1,696.0	6,442.6	8,138.6
INDUSTRIAL WASTEWATER DISCHARGES	---	---	---	---	---	---	---	---	---	---	---	---
HYDROELECTRIC POWER	---	---	---	---	---	---	---	---	---	---	---	---
WATER ORIENTED OUTDOOR REC.	---	---	---	---	---	---	---	---	---	---	---	---
SPORT FISHING	2.7	0.9	3.6	2.7	0.9	3.6	6.3	6.1	12.4	6.3	6.1	12.4
RECREATIONAL BOATING	10.5	2.4	12.9	10.5	2.4	12.9	35.9	42.9	78.8	35.9	42.9	78.8
COMMERCIAL FISHING	---	---	---	---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	0	0	0	17.0	2.0	19.0	0	0	0	462.0	348.0	810.0
RELATED LAND USES & PROBLEMS												
AGRIC. LAND-TREATMENT	5.7	0.1	5.8	12.4	0.3	12.7	24.0	3.3	27.3	50.2	7.3	57.5
-CROPLAND DRAINAGE	24.9	0.6	25.5	20.3	0.5	20.8	64.8	11.0	75.8	75.1	11.5	86.6
FOREST LAND-TREATMENT	2.0	0.1	2.1	5.0	0.1	5.1	8.0	1.2	9.2	25.0	3.2	28.2
SHORELAND EROSION	0	0	0	0	0	0	0.0	0	0.0	0.0	0	0.0
STREAMBANK EROSION	2.1	0.2	2.3	2.1	0.2	2.3	19.2	6.8	26.0	19.2	6.8	26.0
FLOOD PLAINS-URBAN	---	---	---	---	---	---	---	---	---	---	---	---
-URBAN	240.1	0.5	240.6	240.1	0.5	240.6	300.5	5.2	305.7	300.5	5.2	305.7
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---
WILDLIFE MANAGEMENT	18.8	0.9	19.7	18.8	0.9	19.7	49.5	2.5	52.0	49.5	2.5	52.0
AESTHETIC & CULTURAL	---	---	---	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	144.5	19.6	164.1	144.5	19.6	164.1	435.6	467.1	902.7	435.6	467.1	902.7
-EXTENSIVE	---	---	---	---	---	---	---	---	---	---	---	---
TOTAL	1,374.6	561.8	1,936.4	1,193.7	1,066.4	2,260.1	3,181.1	4,949.1	8,130.2	4,017.6	8,696.2	12,713.8

TABLE 1–352 RBG 4.2, Comparison of Total Costs NOR and PRO Frameworks (in $1,000,000)

RESOURCE USE CATEGORY	1971-1980						1971-2020					
	NORMAL			PROPOSED			NORMAL			PROPOSED		
	Capital	OM&R	TOTAL	Capital	OM&R	TOTAL	Capital	OM&R	TOTAL	Capital	OM&R	TOTAL
WATER WITHDRAWALS												
MUNICIPALLY SUPPLIED	6.7	3.4	10.1	6.7	3.4	10.1	89.1	157.2	246.3	89.1	157.2	246.3
SELF-SUPPLIED INDUSTRIAL	4.8	4.6	9.4	4.8	4.6	9.4	43.4	168.5	211.9	43.4	168.5	211.9
RURAL DOMESTIC & LIVESTOCK	0.2	0.8	1.0	0.2	0.8	1.0	0.8	15.8	16.6	0.8	15.8	16.6
IRRIGATION	0.0	0.0	0.0	0.0	0.0	0.0	2.7	1.5	4.2	2.7	1.5	4.2
MINING	0.2	0.4	0.6	0.2	0.4	0.6	2.0	13.6	15.6	2.0	13.6	15.6
THERMAL POWER COOLING	0.0	0.0	0.0	0.0	0.0	0.0	307.5	288.7	596.2	307.5	288.7	596.2
NON-WITHDRAWAL WATER USES												
MUNICIPAL WASTEWATER DISCHARGES	54.8	76.0	130.8	243.0	307.5	550.5	299.2	522.0	821.2	635.0	2,185.2	2,820.2
INDUSTRIAL WASTEWATER DISCHARGES	---	---	---	---	---	---	---	---	---	---	---	---
HYDROELECTRIC POWER	---	---	---	---	---	---	---	---	---	---	---	---
WATER ORIENTED OUTDOOR REC.	---	---	---	---	---	---	---	---	---	---	---	---
SPORT FISHING	24.7	2.6	27.3	24.7	2.6	27.3	36.9	11.3	48.2	36.9	11.3	48.2
RECREATIONAL BOATING	25.3	5.9	31.2	25.3	5.9	31.2	131.2	146.1	277.3	131.2	146.1	277.3
COMMERCIAL FISHING	---	---	---	---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	0	0	0	9.0	1.0	10.0	0	0	0	67.2	48.0	115.2
RELATED LAND USES & PROBLEMS												
AGRIC. LAND-TREATMENT	16.7	0.4	17.1	36.7	0.9	37.6	70.1	9.7	79.8	147.8	21.6	169.4
-CROPLAND DRAINAGE	15.0	0.4	15.4	33.3	0.8	34.1	128.3	13.7	142.0	133.3	19.0	152.3
FOREST LAND-TREATMENT	2.0	0.1	2.1	3.0	0.1	3.1	10.0	1.3	11.3	13.0	1.7	14.7
SHORELAND EROSION	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0
STREAMBANK EROSION	0.7	0.1	0.8	0.7	0.1	0.8	6.3	2.6	8.9	6.3	2.6	8.9
FLOOD PLAINS-URBAN	---	---	---	---	---	---	---	---	---	---	---	---
-URBAN	58.0	0.1	58.1	58.0	0.1	58.1	158.1	4.2	162.3	158.1	4.2	162.3
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---
WILDLIFE MANAGEMENT	15.0	0.7	15.7	15.0	0.7	15.7	92.2	4.6	96.8	92.2	4.6	96.8
AESTHETIC & CULTURAL	---	---	---	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	32.8	11.5	44.3	32.8	11.5	44.3	138.2	217.5	355.7	138.2	217.5	355.7
-EXTENSIVE	---	---	---	---	---	---	---	---	---	---	---	---
TOTAL	256.9	107.0	363.9	493.4	340.4	833.8	1,516.0	1,578.3	3,094.3	2,004.7	3,307.1	5,311.8

TABLE 1–353 RBG 4.3, Comparison of Total Costs NOR and PRO Frameworks (in $1,000,000)

RESOURCE USE CATEGORY	1971-1980						1971-2020					
	NORMAL			PROPOSED			NORMAL			PROPOSED		
	Capital	OM&R	TOTAL	Capital	OM&R	TOTAL	Capital	OM&R	TOTAL	Capital	OM&R	TOTAL
WATER WITHDRAWALS												
MUNICIPALLY SUPPLIED	23.2	11.7	34.9	23.2	11.7	34.9	144.4	327.6	472.0	144.4	327.6	472.0
SELF-SUPPLIED INDUSTRIAL	12.7	11.5	24.2	12.7	11.5	24.2	143.6	548.8	692.4	143.6	548.8	692.4
RURAL DOMESTIC & LIVESTOCK	0.0	0.1	0.1	0.0	0.1	0.1	0.2	3.9	4.1	0.2	3.9	4.1
IRRIGATION	0.0	0.0	0.0	0	0	0	2.4	1.0	3.4	2.1	0.7	2.8
MINING	0.8	0.8	1.6	0.5	0.9	1.4	7.5	30.3	37.8	0.5	8.3	8.8
THERMAL POWER COOLING	0.0	0.0	0.0	0.0	0.0	0.0	287.2	239.6	526.8	287.2	239.6	526.8
NON-WITHDRAWAL WATER USES												
MUNICIPAL WASTEWATER DISCHARGES	136.0	259.0	395.0	695.0	538.7	1,233.7	779.0	1,909.0	2,688.0	1,471.0	4,233.9	5,704.9
INDUSTRIAL WASTEWATER DISCHARGES	---	---	---	---	---	---	---	---	---	---	---	---
HYDROELECTRIC POWER	---	---	---	---	---	---	---	---	---	---	---	---
WATER ORIENTED OUTDOOR REC.	---	---	---	---	---	---	---	---	---	---	---	---
SPORT FISHING	0.3	0.5	0.8	0.3	0.5	0.8	3.3	4.1	7.4	3.3	4.1	7.4
RECREATIONAL BOATING	29.0	4.9	33.9	29.0	4.9	33.9	105.6	102.0	207.6	105.6	102.0	207.6

COMMERCIAL FISHING	---	---	---	---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	0	0	0	9.0	1.0	10.0	0	0	0	21.5	18.0	39.5
RELATED LAND USES & PROBLEMS												
AGRIC. LAND-TREATMENT	2.1	0.1	2.2	4.6	0.1	4.7	8.8	1.3	10.1	18.5	2.8	21.3
-CROPLAND DRAINAGE	1.0	0.0	1.0	4.1	0.1	4.2	8.6	0.7	9.3	16.4	2.3	18.7
FOREST LAND-TREATMENT	2.0	0.1	2.1	6.0	0.2	6.2	12.0	1.6	13.6	32.0	4.1	36.1
SHORELAND EROSION	1.5	0.1	1.6	1.5	0.1	1.6	7.3	3.7	11.0	7.3	3.7	11.0
STREAMBANK EROSION	0.5	0.0	0.5	0.5	0.0	0.5	4.7	1.8	6.5	4.7	1.8	6.5
FLOOD PLAINS-URBAN	---	---	---	---	---	---	---	---	---	---	---	---
-URBAN	18.9	0.1	19.0	18.9	0.1	19.0	27.2	1.2	28.4	27.2	1.2	28.4
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---
WILDLIFE MANAGEMENT	3.4	0.2	3.6	3.4	0.2	3.6	38.7	2.4	41.1	38.7	2.4	41.1
AESTHETIC & CULTURAL	---	---	---	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	105.5	16.9	122.4	105.5	16.9	122.4	273.5	278.7	552.2	273.5	278.7	552.2
-EXTENSIVE	---	---	---	---	---	---	---	---	---	---	---	---
TOTAL	336.9	306.0	642.9	914.2	587.0	1,501.2	1,854.0	3,457.7	5,311.7	2,597.7	5,783.9	8,381.6

TABLE 1–354 RBG 4.4, Comparison of Total Costs NOR and PRO Frameworks (in $1,000,000)

RESOURCE USE CATEGORY	1971-1980						1971-2020					
	NORMAL			PROPOSED			NORMAL			PROPOSED		
	Capital	OM&R	TOTAL	Capital	OM&R	TOTAL	Capital	OM&R	TOTAL	Capital	OM&R	TOTAL
WATER WITHDRAWALS												
MUNICIPALLY SUPPLIED	11.7	5.8	17.5	11.7	5.8	17.5	77.9	178.4	256.3	77.9	178.4	256.3
SELF-SUPPLIED INDUSTRIAL	9.4	8.3	17.7	9.4	8.3	17.7	70.3	281.5	351.8	70.3	281.5	351.8
RURAL DOMESTIC & LIVESTOCK	0	0	0	0	0	0	0.8	3.1	3.9	0.8	3.1	3.9
IRRIGATION	0.6	0.1	0.7	0.6	0.1	0.7	2.1	1.3	3.4	2.1	1.3	3.4
MINING	0.2	0.1	0.3	0.2	0.1	0.3	1.7	4.8	6.5	1.7	4.8	6.5
THERMAL POWER COOLING	0.0	0.0	0.0	0.0	0.0	0.0	227.6	182.1	409.7	227.6	182.1	409.7
NON-WITHDRAWAL WATER USES												
MUNICIPAL WASTEWATER DISCHARGES	172.8	114.0	286.8	1,007.0	335.0	1,342.0	370.9	434.0	804.9	1,581.0	3,408.6	4,989.6
INDUSTRIAL WASTEWATER DISCHARGES	---	---	---	---	---	---	---	---	---	---	---	---
HYDROELECTRIC POWER	---	---	---	---	---	---	---	---	---	---	---	---
WATER ORIENTED OUTDOOR REC.	---	---	---	---	---	---	---	---	---	---	---	---
SPORT FISHING	4.8	3.8	8.6	4.8	3.8	8.6	18.1	10.9	29.0	18.1	10.9	29.0
RECREATIONAL BOATING	18.2	3.5	21.7	18.2	3.5	21.7	57.2	63.7	120.9	57.2	63.7	120.9
COMMERCIAL FISHING	---	---	---	---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	0	0	0	19.0	2.0	21.0	0	0	0	47.8	30.0	77.8
RELATED LAND USES & PROBLEMS												
AGRIC. LAND-TREATMENT	2.0	0.1	2.1	1.3	0.0	1.3	8.5	1.2	9.7	5.3	0.8	6.1
-CROPLAND DRAINAGE	3.4	0.1	3.5	0	0	0	3.4	0.7	4.1	0	0	0
FOREST LAND-TREATMENT	6.0	0.2	6.2	8.0	0.2	8.2	30.0	3.8	33.8	38.0	5.0	43.0
SHORELAND EROSION	4.8	0.5	5.3	4.8	0.5	5.3	4.8	4.3	9.1	4.8	4.3	9.1
STREAMBANK EROSION	0.5	0	0.5	0.5	0	0.5	4.3	1.7	6.0	4.3	1.7	6.0
FLOOD PLAINS-URBAN	---	---	---	---	---	---	---	---	---	---	---	---
-URBAN	10.2	0	10.2	10.2	0	10.2	90.5	1.5	92.0	90.5	1.5	92.0
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---
WILDLIFE MANAGEMENT	0.6	0	0.6	0.6	0	0.6	6.7	0.2	6.9	6.7	0.2	6.9
AESTHETIC & CULTURAL	---	---	---	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	34.9	9.1	44.0	34.9	9.1	44.0	204.2	244.1	448.3	204.2	244.1	448.3
-EXTENSIVE	---	---	---	---	---	---	---	---	---	---	---	---
TOTAL	280.1	145.6	425.7	1,131.2	368.4	1,499.6	1,179.0	1,417.3	2,596.3	2,438.3	4,422.0	8,860.3

TABLE 1–355 RBG 5.1, Comparison of Total Costs NOR and PRO Frameworks (in $1,000,000)

RESOURCE USE CATEGORY	1971-1980						1971-2020					
	NORMAL			PROPOSED			NORMAL			PROPOSED		
	Capital	OM&R	TOTAL	Capital	OM&R	TOTAL	Capital	OM&R	TOTAL	Capital	OM&R	TOTAL
WATER WITHDRAWALS												
MUNICIPALLY SUPPLIED	4.3	2.1	6.4	4.3	2.1	6.4	43.2	93.5	136.7	43.2	93.5	136.7
SELF-SUPPLIED INDUSTRIAL	0.3	0.3	0.6	0.3	0.3	0.6	7.0	19.6	26.6	7.0	19.6	26.6
RURAL DOMESTIC & LIVESTOCK	0.2	0.3	0.5	0.2	0.3	0.5	0.4	3.2	3.6	0.4	3.2	3.6
IRRIGATION	0.4	0.1	0.5	0.4	0.1	0.5	1.8	1.2	3.0	1.8	1.2	3.0
MINING	0.4	0.3	0.7	0.4	0.3	0.7	3.2	5.6	8.8	3.2	5.6	8.8
THERMAL POWER COOLING	29.3	7.5	36.8	29.3	7.5	36.8	127.9	148.3	276.2	127.9	148.3	276.2
NON-WITHDRAWAL WATER USES												
MUNICIPAL WASTEWATER DISCHARGES	78.0	31.0	109.0	1,132.0	149.2	1,281.2	222.0	203.0	425.0	1,361.0	1,241.4	2,602.4
INDUSTRIAL WASTEWATER DISCHARGES	---	---	---	---	---	---	---	---	---	---	---	---
HYDROELECTRIC POWER	---	---	---	---	---	---	---	---	---	---	---	---
WATER ORIENTED OUTDOOR REC.	---	---	---	---	---	---	---	---	---	---	---	---
SPORT FISHING	5.0	1.1	6.1	5.0	1.1	6.1	15.3	7.5	22.8	15.3	7.5	22.8
RECREATIONAL BOATING	18.1	3.5	21.6	18.1	3.5	21.6	39.2	50.6	89.8	39.2	50.6	89.8
COMMERCIAL FISHING	---	---	---	---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	0	0	0	0	0	0	0	0	0	0	0	0
RELATED LAND USES & PROBLEMS												
AGRIC. LAND--TREATMENT	2.4	0.1	2.5	1.8	0.0	1.8	9.9	1.5	11.4	7.4	1.1	8.5
--CROPLAND DRAINAGE	5.3	0.1	5.4	0	0	0	5.3	1.1	6.4	0	0	0
FOREST LAND--TREATMENT	2.0	0.1	2.1	3.0	0.1	3.1	10.0	1.3	11.3	15.0	2.0	17.0
SHORELAND EROSION	2.4	0.2	2.6	2.4	0.2	2.6	12.2	6.1	18.3	12.2	6.1	18.3
STREAMBANK EROSION	0.3	0.0	0.3	0.3	0.0	0.3	2.7	1.1	3.8	2.7	1.1	3.8
FLOOD PLAINS--URBAN	---	---	---	---	---	---	---	---	---	---	---	---
--URBAN	19.9	0.1	20.0	19.9	0.1	20.0	156.9	2.5	159.4	156.9	2.5	159.4
--RURAL	---	---	---	---	---	---	---	---	---	---	---	---
--RURAL	---	---	---	---	---	---	---	---	---	---	---	---
WILDLIFE MANAGEMENT	0.5	0.0	0.5	0.5	0.0	0.5	9.0	0.4	9.4	9.0	0.4	9.4
AESTHETIC & CULTURAL	---	---	---	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION--INTENSIVE	31.8	12.6	44.4	31.8	12.6	44.4	97.2	207.7	304.9	97.2	207.7	304.9
--EXTENSIVE	---	---	---	---	---	---	---	---	---	---	---	---
TOTAL	200.6	59.4	260.0	1,249.7	177.4	1,427.1	763.2	754.2	1,517.4	1,899.4	1,791.8	3,691.2

TABLE 1–356 RBG 5.2, Comparison of Total Costs NOR and PRO Frameworks (in $1,000,000)

RESOURCE USE CATEGORY	1971-1980						1971-2020					
	NORMAL			PROPOSED			NORMAL			PROPOSED		
	Capital	OM&R	TOTAL	Capital	OM&R	TOTAL	Capital	OM&R	TOTAL	Capital	OM&R	TOTAL
WATER WITHDRAWALS												
MUNICIPALLY SUPPLIED	8.7	4.3	13.0	8.7	4.3	13.0	73.0	165.3	238.3	73.0	165.3	238.3
SELF-SUPPLIED INDUSTRIAL	4.6	4.1	8.7	4.6	4.1	8.7	36.1	123.7	159.8	36.1	123.7	159.8
RURAL DOMESTIC & LIVESTOCK	0.1	0.4	0.5	0.1	0.4	0.5	0.4	8.1	8.5	0.4	8.1	8.5
IRRIGATION	0.5	0.1	0.6	0.5	0.1	0.6	2.2	1.5	3.7	2.2	1.5	3.7
MINING	0.2	0.3	0.5	0.2	0.3	0.5	1.5	10.6	12.1	1.5	10.6	12.1
THERMAL POWER COOLING	107.8	27.7	135.5	107.8	27.7	135.5	109.9	216.3	326.2	109.9	216.3	326.2
NON-WITHDRAWAL WATER USES												
MUNICIPAL WASTEWATER DISCHARGES	35.0	26.0	61.0	153.0	251.7	404.7	107.0	166.0	273.0	397.0	1,725.3	2,122.3
INDUSTRIAL WASTEWATER DISCHARGES	---	---	---	---	---	---	---	---	---	---	---	---
HYDROELECTRIC POWER	---	---	---	---	---	---	---	---	---	---	---	---
WATER ORIENTED OUTDOOR REC.	---	---	---	---	---	---	---	---	---	---	---	---
SPORT FISHING	4.5	1.7	6.2	4.5	1.7	6.2	13.2	10.1	23.3	13.2	10.1	23.3
RECREATIONAL BOATING	15.4	5.4	20.8	15.4	5.4	20.8	61.0	114.0	175.0	61.0	114.0	175.0

COMMERCIAL FISHING	---	---	---	---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	0	0	0	33.0	4.0	37.0	0	0	0	33.0	36.0	69.0
RELATED LAND USES & PROBLEMS												
AGRIC. LAND-TREATMENT	5.0	0.1	5.1	11.0	0.3	11.3	21.3	2.9	24.2	44.5	6.5	51.0
-CROPLAND DRAINAGE	8.9	0.2	9.1	6.5	0.2	6.7	19.1	3.5	22.6	26.1	3.8	29.9
FOREST LAND-TREATMENT	7.0	0.2	7.2	10.0	0.3	10.3	37.0	4.7	41.7	48.0	6.3	54.3
SHORELAND EROSION	0.8	0.1	0.9	0.8	0.1	0.9	3.6	1.8	5.4	3.6	1.8	5.4
STREAMBANK EROSION	0.7	0	0.7	0.7	0	0.7	6.3	2.2	8.5	6.3	2.2	8.5
FLOOD PLAINS-URBAN	---	---	---	---	---	---	---	---	---	---	---	---
-URBAN	5.1	0.0	5.1	5.1	0.0	5.1	5.6	0.4	6.0	5.6	0.4	6.0
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---
WILDLIFE MANAGEMENT	3.5	0.2	3.7	3.5	0.2	3.7	28.5	1.4	29.9	28.5	1.4	29.9
AESTHETIC & CULTURAL	---	---	---	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	37.5	12.7	50.2	37.5	12.7	50.2	112.5	215.9	328.4	112.5	215.9	328.4
-EXTENSIVE	---	---	---	---	---	---	---	---	---	---	---	---
TOTAL	245.3	83.5	328.8	402.9	313.5	716.4	638.2	1,048.4	1,686.6	1,002.4	2,649.2	3,651.6

TABLE 1-357 RBG 5.3, Comparison of Total Costs NOR and PRO Frameworks (in $1,000,000)

RESOURCE USE CATEGORY	1971-1980						1971-2020					
	NORMAL			PROPOSED			NORMAL			PROPOSED		
	Capital	OM&R	TOTAL	Capital	OM&R	TOTAL	Capital	OM&R	TOTAL	Capital	OM&R	TOTAL
WATER WITHDRAWALS												
MUNICIPALLY SUPPLIED	1.1	0.5	1.6	1.1	0.5	1.6	8.3	18.7	27.0	8.3	18.7	27.0
SELF-SUPPLIED INDUSTRIAL	0	0	0	0	0	0	0	0	0	0	0	0
RURAL DOMESTIC & LIVESTOCK	0.0	0.1	0.1	0.0	0.1	0.1	0.1	1.5	1.6	0.1	1.5	1.6
IRRIGATION	0.2	0.0	0.2	0.2	0.0	0.2	0.6	0.4	1.0	0.6	0.4	1.0
MINING	0.1	0.0	0.1	0.1	0.0	0.1	0.3	0.7	1.0	0.3	0.7	1.0
THERMAL POWER COOLING	0	0	0	0	0	0	0	0	0	0	0	0
NON-WITHDRAWAL WATER USES												
MUNICIPAL WASTEWATER DISCHARGES	7.0	6.0	13.0	14.0	38.5	52.5	19.0	38.0	57.0	32.0	227.0	259.0
INDUSTRIAL WASTEWATER DISCHARGES	---	---	---	---	---	---	---	---	---	---	---	---
HYDROELECTRIC POWER	---	---	---	---	---	---	---	---	---	---	---	---
WATER ORIENTED OUTDOOR REC.	---	---	---	---	---	---	---	---	---	---	---	---
SPORT FISHING	5.0	1.7	6.7	5.0	1.7	6.7	14.7	10.1	24.8	14.7	10.1	24.8
RECREATIONAL BOATING	0.4	0.2	0.6	0.4	0.2	0.6	1.0	2.5	3.5	1.0	2.5	3.5
COMMERCIAL FISHING	---	---	---	---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	0	0	0	40.0	5.0	45.0	0	0	0	345.2	159.0	504.2
RELATED LAND USES & PROBLEMS												
AGRIC. LAND-TREATMENT	1.3	0.0	1.3	1.2	0.0	1.2	5.6	0.8	6.4	4.6	0.7	5.3
-CROPLAND DRAINAGE	3.1	0.1	3.2	0	0	0	6.7	1.3	8.0	0	0	0
FOREST LAND-TREATMENT	8.0	0.2	8.2	11.0	0.3	11.3	38.0	4.9	42.9	51.0	6.7	57.7
SHORELAND EROSION	0	0	0	0	0	0	0	0	0	0	0	0
STREAMBANK EROSION	0.5	0.0	0.5	0.5	0.0	0.5	4.5	1.8	6.3	4.5	1.8	6.3
FLOOD PLAINS-URBAN	---	---	---	---	---	---	---	---	---	---	---	---
-URBAN	1.2	0.0	1.2	1.2	0.0	1.2	1.6	0.2	1.8	1.6	0.2	1.8
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---
WILDLIFE MANAGEMENT	10.0	0.5	10.5	10.0	0.5	10.5	36.0	1.9	37.9	36.0	1.9	37.9
AESTHETIC & CULTURAL	---	---	---	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	19.4	5.7	25.1	19.4	5.7	25.1	50.0	85.1	135.1	50.0	85.1	135.1
-EXTENSIVE	---	---	---	---	---	---	---	---	---	---	---	---
TOTAL	57.3	15.0	72.3	104.1	52.5	156.6	186.4	167.9	354.3	549.9	516.3	1,066.2

TABLE 1–358 Illinois, Needs, Outputs, and Percent Needs Met, Normal Framework

RESOURCE USE CATEGORY	UNIT	1970 SUPPLY	1980 N	1980 O	1980 %	2000 N	2000 O	2000 %	2020 N	2020 O	2020 %
WATER WITHDRAWALS											
MUNICIPALLY SUPPLIED	MILLION GALLONS PER DAY		210	490	over	588	1,110	over	1,020	1,810	over
SELF-SUPPLIED INDUSTRIAL	MILLION GALLONS PER DAY		182	---	---	1,130	---	---	2,650	---	---
RURAL DOMESTIC & LIVESTOCK	MILLION GALLONS PER DAY		3.0	0	0	9.8	0	0	12.4	0	0
IRRIGATION	MILLION GALLONS PER DAY		129	25.9	19	226	45.1	20	336	67.3	20
MINING	MILLION GALLONS PER DAY		0.8	0.1	13	2.0	0.2	10	4.2	0.3	7
THERMAL POWER COOLING	MILLION GALLONS PER DAY		831	831	100	6,350	6,350	100	17,000	17,000	100
NON-WITHDRAWAL WATER USES											
MUNICIPAL WASTEWATER DISCHARGES	MILLION GALLONS PER DAY		0	0	---	0	0	---	0	0	---
INDUSTRIAL WASTEWATER DISCHARGES	MILLION GALLONS PER DAY		0	0	---	0	0	---	0	0	---
HYDROELECTRIC POWER	MILLION GALLONS PER DAY		0	---	---	0	---	---	0	---	---
WATER ORIENTED OUTDOOR REC.	1000 RECREATION DAYS		---	1,200	---	---	3,600	---	---	3,600	---
	1000 ACRES WATER SURFACE		---	---	---	---	---	---	---	---	---
SPORT FISHING	1000 ANGLER DAYS		795	795	100	1,500	1,500	100	1,700	1,700	100
	1000 ACRES WATER SURFACE		---	---	---	---	---	---	---	---	---
RECREATIONAL BOATING	1000 BOAT DAYS		284	121	43	468	233	50	673	368	55
	1000 ACRES WATER SURFACE		---	---	---	---	---	---	---	---	---
COMMERCIAL FISHING	MILLION TONS PER YEAR		---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	MILLION TONS PER YEAR		---	---	---	---	---	---	---	---	---
RELATED LAND USES & PROBLEMS											
AGRIC. LAND-TREATMENT	1000 ACRES		65.1	0	0	65.1	0	0	65.1	0	0
-CROPLAND DRAINAGE	1000 ACRES		13.3	0	0	13.3	0	0	13.3	0	0
FOREST LAND-TREATMENT	1000 ACRES		6.4	0	0	6.4	0	0	6.4	0	0
SHORELAND EROSION	MILES		10.5	2.1	20	10.5	6.3	60	10.5	10.5	100
STREAMBANK EROSION	MILES		46	0	0	46	0	0	46	0	0
	$1000 AVE ANNUAL DAMAGES		29	1.7	6	29	5.0	17	29	8.3	29
FLOOD PLAINS-URBAN	1000 ACRES		0	0	---	0	0	---	0	0	---
-URBAN	$1000 AVE ANNUAL DAMAGES		0	0	---	0	0	---	0	0	---
-RURAL	1000 ACRES		0	0	---	0	0	---	0	0	---
-RURAL	$1000 AVE ANNUAL DAMAGES		0	0	---	0	0	---	0	0	---
WILDLIFE MANAGEMENT	1000 ACRES		692	0	0	1,370	0	0	2,200	0	0
	1000 USER DAYS		2,510	0	0	3,750	0	0	4,950	0	0
AESTHETIC & CULTURAL	1000 ACRES		---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	1000 ACRES		---	0.2	---	---	0.7	---	---	0.7	---
-EXTENSIVE	1000 ACRES		---	1.4	---	---	4.2	---	---	4.2	---

TABLE 1–359 Illinois, Capital Costs, Normal Framework (in $1,000,000)

RESOURCE USE CATEGORY	1971-1980 Federal	1971-1980 Non-Fed	1971-1980 Private	1971-1980 Total	1981-2000 Federal	1981-2000 Non-Fed	1981-2000 Private	1981-2000 Total	2001-2020 Federal	2001-2020 Non-Fed	2001-2020 Private	2001-2020 Total	Total
WATER WITHDRAWALS													
MUNICIPALLY SUPPLIED	27.9	65.1	0	93.0	48.3	112.8	0	161.1	57.8	134.8	0	192.6	446.7
SELF-SUPPLIED INDUSTRIAL	0	0	0.7	0.7	0	0	8.6	8.6	0	0	39.1	39.1	48.4
RURAL DOMESTIC & LIVESTOCK	0	0	0	0	0	0	0	0	0	0	0	0	0
IRRIGATION	0	0	0.9	0.9	0	0	0.7	0.7	0	0	0.7	0.7	2.3
MINING	0	0	0.0	0.0	0	0	0.0	0.0	0	0	0.0	0.0	0.0
THERMAL POWER COOLING	0	1.5	27.6	29.1	0	9.7	183.4	193.1	0	18.6	353.6	372.2	594.4
NON-WITHDRAWAL WATER USES													
MUNICIPAL WASTEWATER DISCHARGES	0	0	0	0	0	0	0	0	0	0	0	0	0
INDUSTRIAL WASTEWATER DISCHARGES	---	---	---	---	---	---	---	---	---	---	---	---	---
HYDROELECTRIC POWER	---	---	---	---	---	---	---	---	---	---	---	---	---
WATER ORIENTED OUTDOOR REC.	---	---	---	---	---	---	---	---	---	---	---	---	---
SPORT FISHING	2.5	3.8	0	6.3	1.1	1.6	0	2.7	1.0	1.5	0	2.5	11.5
RECREATIONAL BOATING	6.7	6.7	5.8	19.2	6.5	6.5	5.5	18.5	6.5	6.5	5.7	18.7	56.4

COMMERCIAL FISHING	---	---	---	---	---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	0	0	0	0	0.6	0	0	0.6	0	0	0	0	0.6
RELATED LAND USES & PROBLEMS													
AGRIC. LAND-TREATMENT	0	0	0	0	0	0	0	0	0	0	0	0	0
-CROPLAND DRAINAGE	0	0	0	0	0	0	0	0	0	0	0	0	0
FOREST LAND-TREATMENT	0	0	0	0	0	0	0	0	0	0	0	0	0
SHORELAND EROSION	0.3	0	1.4	1.7	0.7	0	2.6	3.3	0.7	0	2.7	3.4	8.4
STREAMBANK EROSION	0	0	0	0	0	0	0	0	0	0	0	0	0
FLOOD PLAINS-URBAN	---	---	---	---	---	---	---	---	---	---	---	---	---
-URBAN	0	0	0	0	0	0	0	0	0	0	0	0	0
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
WILDLIFE MANAGEMENT	0	0	0	0	0	0	0	0	0	0	0	0	0
AESTHETIC & CULTURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	4.8	8.9	0	13.7	24.0	44.6	0	68.6	0	0	0	0	82.3
-EXTENSIVE	---	---	---	---	---	---	---	---	---	---	---	---	---
TOTAL	42.2	86.0	36.4	164.6	81.2	175.2	200.8	457.2	66.0	161.4	401.8	629.2	1,251.0

TABLE 1–360 Illinois, Operation, Maintenance, and Replacement Costs, Normal Framework (in $1,000,000)

	1971-1980				1981-2000				2001-2020				
RESOURCE USE CATEGORY	Federal	Non-Fed	Private	Total	Federal	Non-Fed	Private	Total	Federal	Non-Fed	Private	Total	Total
WATER WITHDRAWALS													
MUNICIPALLY SUPPLIED	0	52.8	0	52.8	0	395.5	0	395.5	0	802.5	0	802.5	1,250.8
SELF-SUPPLIED INDUSTRIAL	0	0	0.4	0.4	0	0	18.1	18.1	0	0	132.6	132.6	151.1
RURAL DOMESTIC & LIVESTOCK	0	0	0	0	0	0	0	0	0	0	0	0	0
IRRIGATION	0	0	0.1	0.1	0	0	0.7	0.7	0	0	1.1	1.1	1.9
MINING	0	0	0	0	0	0	0.1	0.1	0	0	0.1	0.1	0.2
THERMAL POWER COOLING	0	0.4	7.1	7.5	0	6.6	125.4	132.0	0	20.3	385.6	405.9	545.4
NON-WITHDRAWAL WATER USES													
MUNICIPAL WASTEWATER DISCHARGES	0	0	0	0	0	0	0	0	0	0	0	0	0
INDUSTRIAL WASTEWATER DISCHARGES	---	---	---	---	---	---	---	---	---	---	---	---	---
HYDROELECTRIC POWER	---	---	---	---	---	---	---	---	---	---	---	---	---
WATER ORIENTED OUTDOOR REC.	---	---	---	---	---	---	---	---	---	---	---	---	---
SPORT FISHING	0.1	0.2	0	0.3	0.5	0.7	0	1.2	0.5	0.7	0	1.2	2.7
RECREATIONAL BOATING	0	0	4.4	4.4	0	0	26.3	26.3	0	0	43.7	43.7	74.4
COMMERCIAL FISHING	---	---	---	---	---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	0	0	0	0	0.2	0	0	0.2	0.4	0	0	0.4	0.6
RELATED LAND USES & PROBLEMS													
AGRIC. LAND-TREATMENT	0	0	0	0	0	0	0	0	0	0	0	0	0
-CROPLAND DRAINAGE	0	0	0	0	0	0	0	0	0	0	0	0	0
FOREST LAND-TREATMENT	0	0	0	0	0	0	0	0	0	0	0	0	0
SHORELAND EROSION	0.0	0	0.2	0.2	0.3	0	1.0	1.3	0.5	0	2.2	2.7	4.2
STREAMBANK EROSION	0	0	0	0	0	0	0	0	0	0	0	0	0
FLOOD PLAINS-URBAN	---	---	---	---	---	---	---	---	---	---	---	---	---
-URBAN	0	0	0	0	0	0	0	0	0	0	0	0	0
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
WILDLIFE MANAGEMENT	0	0	0	0	0	0	0	0	0	0	0	0	0
AESTHETIC & CULTURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	0.5	1.9	0	2.4	4.3	17.1	0	21.4	6.7	26.7	0	33.4	57.2
-EXTENSIVE	---	---	---	---	---	---	---	---	---	---	---	---	---
TOTAL	0.6	55.3	12.2	68.1	5.3	419.9	171.6	596.8	8.1	850.2	565.3	1,423.6	2,088.5

TABLE 1–361 Illinois, Needs, Outputs, and Percent Needs Met, Proposed Framework

RESOURCE USE CATEGORY	UNIT	1970 SUPPLY	1980 N	1980 O	1980 %	2000 N	2000 O	2000 %	2020 N	2020 O	2020 %
WATER WITHDRAWALS											
MUNICIPALLY SUPPLIED	MILLION GALLONS PER DAY	1337	210	490	over	588	1,110	over	1,020	1,810	over
SELF-SUPPLIED INDUSTRIAL	MILLION GALLONS PER DAY	1348	182	---	---	1,130	---	---	2,650	---	---
RURAL DOMESTIC & LIVESTOCK	MILLION GALLONS PER DAY	39.8	3.0	0	0	9.8	0	0	12.4	0	0
IRRIGATION	MILLION GALLONS PER DAY	40.8	129	25.9	19	226	45.1	20	336	67.3	20
MINING	MILLION GALLONS PER DAY	2.2	0.8	0.1	13	2.0	0.2	10	4.2	0.3	7
THERMAL POWER COOLING	MILLION GALLONS PER DAY	580	831	831	100	6,350	6,350	100	17,000	17,000	100
NON-WITHDRAWAL WATER USES											
MUNICIPAL WASTEWATER DISCHARGES	MILLION GALLONS PER DAY	7	0	0	---	0	0	---	0	0	---
INDUSTRIAL WASTEWATER DISCHARGES	MILLION GALLONS PER DAY	20	0	0	---	0	0	---	0	0	---
HYDROELECTRIC POWER	MILLION GALLONS PER DAY	0	0	---	---	0	---	---	0	---	---
WATER ORIENTED OUTDOOR REC.	1000 RECREATION DAYS	NA	---	1,200	---	---	3,600	---	---	3,600	---
	1000 ACRES WATER SURFACE	NA	---	---	---	---	---	---	---	---	---
SPORT FISHING	1000 ANGLER DAYS	1617	795	795	100	1,500	1,500	100	1,700	1,700	100
	1000 ACRES WATER SURFACE	NA	---	---	---	---	---	---	---	---	---
RECREATIONAL BOATING	1000 BOAT DAYS	599	284	121	43	468	233	50	673	368	55
	1000 ACRES WATER SURFACE	NA	---	---	---	---	---	---	---	---	---
COMMERCIAL FISHING	MILLION TONS PER YEAR	NA	---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	MILLION TONS PER YEAR		---	---	---	---	---	---	---	---	---
RELATED LAND USES & PROBLEMS											
AGRIC. LAND-TREATMENT	1000 ACRES	65.1	65.1	0	0	65.1	0	0	65.1	0	0
-CROPLAND DRAINAGE	1000 ACRES	13.3	13.3	---	---	13.3	---	---	13.3	---	---
FOREST LAND-TREATMENT	1000 ACRES	6.4	6.4	0	0	6.4	0	0	6.4	0	0
SHORELAND EROSION	MILES	10.5	10.5	2.1	20	10.5	6.3	60	10.5	10.5	100
STREAMBANK EROSION	MILES	46	46	0	0	46	0	0	46	0	0
	$1000 AVE ANNUAL DAMAGES	29	29	1.7	6	29	5.0	17	29	8.3	29
FLOOD PLAINS-URBAN	1000 ACRES	0	0	0	---	0	0	---	0	0	---
-URBAN	$1000 AVE ANNUAL DAMAGES	0	0	0	---	0	0	---	0	0	---
-RURAL	1000 ACRES	0	0	0	---	0	0	---	0	0	---
-RURAL	$1000 AVE ANNUAL DAMAGES	0	0	0	---	0	0	---	0	0	---
WILDLIFE MANAGEMENT	1000 ACRES		692	0	0	1,370	0	0	2,200	0	0
	1000 USER DAYS		2,510	0	0	3,750	0	0	4,950	0	0
AESTHETIC & CULTURAL	1000 ACRES	NA	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	1000 ACRES		---	0.2	---	---	0.7	---	---	0.7	---
-EXTENSIVE	1000 ACRES	NA	---	1.4	---	---	4.2	---	---	4.2	---

TABLE 1–362 Illinois, Capital Costs, Proposed Framework (in $1,000,000)

RESOURCE USE CATEGORY	1971-1980 Federal	1971-1980 Non-Fed	1971-1980 Private	1971-1980 Total	1981-2000 Federal	1981-2000 Non-Fed	1981-2000 Private	1981-2000 Total	2001-2020 Federal	2001-2020 Non-Fed	2001-2020 Private	2001-2020 Total	Total
WATER WITHDRAWALS													
MUNICIPALLY SUPPLIED	27.9	65.1	0	93.0	48.3	112.8	0	161.1	57.8	134.8	0	192.6	446.7
SELF-SUPPLIED INDUSTRIAL	0	0	0.7	0.7	0	0	8.6	8.6	0	0	39.1	39.1	48.4
RURAL DOMESTIC & LIVESTOCK	0	0	0	0	0	0	0	0	0	0	0	0	0
IRRIGATION	0	0	0.9	0.9	0	0	0.7	0.7	0	0	0.7	0.7	2.3
MINING	0	0	0.0	0.0	0	0	0.0	0.0	0	0	0.0	0.0	0.0
THERMAL POWER COOLING	0	1.5	27.6	29.1	0	9.7	183.4	193.1	0	18.6	353.6	372.2	594.4
NON-WITHDRAWAL WATER USES													
MUNICIPAL WASTEWATER DISCHARGES	0	0	0	0	0	0	0	0	0	0	0	0	0
INDUSTRIAL WASTEWATER DISCHARGES	---	---	---	---	---	---	---	---	---	---	---	---	---
HYDROELECTRIC POWER	---	---	---	---	---	---	---	---	---	---	---	---	---
WATER ORIENTED OUTDOOR REC.	---	---	---	---	---	---	---	---	---	---	---	---	---
SPORT FISHING	2.5	3.8	0	6.3	1.1	1.6	0	2.7	1.0	1.5	0	2.5	11.5
RECREATIONAL BOATING	6.7	6.7	5.8	19.2	6.5	6.5	5.5	18.5	6.5	6.5	5.7	18.7	56.4

COMMERCIAL FISHING	---	---	---	---	---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	9.9	0	0	9.9	56.4	0	0	56.4	0	0	0	0	66.3
RELATED LAND USES & PROBLEMS													
AGRIC. LAND-TREATMENT	0	0	0	0	0	0	0	0	0	0	0	0	0
-CROPLAND DRAINAGE	0	0	0	0	0	0	0	0	0	0	0	0	0
FOREST LAND-TREATMENT	0	0	0	0	0	0	0	0	0	0	0	0	0
SHORELAND EROSION	0.3	0	1.4	1.7	0.7	0	2.6	3.3	0.7	0	2.7	3.4	8.4
STREAMBANK EROSION	0	0	0	0	0	0	0	0	0	0	0	0	0
FLOOD PLAINS-URBAN	---	---	---	---	---	---	---	---	---	---	---	---	---
-URBAN	0	0	0	0	0	0	0	0	0	0	0	0	0
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
WILDLIFE MANAGEMENT	0	0	0	0	0	0	0	0	0	0	0	0	0
AESTHETIC & CULTURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	4.8	8.9	0	13.7	24.0	44.6	0	68.6	0	0	0	0	82.3
-EXTENSIVE	---	---	---	---	---	---	---	---	---	---	---	---	---
TOTAL	52.1	86.0	36.4	174.5	137.0	175.2	200.8	513.0	66.0	161.4	401.8	629.2	1,316.7

TABLE 1–363 Illinois, Operation, Maintenance, and Replacement Costs, Proposed Framwork (in $1,000,000)

RESOURCE USE CATEGORY	1971-1980				1981-2000				2001-2020				
	Federal	Non-Fed	Private	Total	Federal	Non-Fed	Private	Total	Federal	Non-Fed	Private	Total	Total
WATER WITHDRAWALS													
MUNICIPALLY SUPPLIED	0	52.8	0	52.8	0	395.5	0	395.5	0	802.5	0	802.5	1,250.8
SELF-SUPPLIED INDUSTRIAL	0	0	0.4	0.4	0	0	18.1	18.1	0	0	132.6	132.6	151.1
RURAL DOMESTIC & LIVESTOCK	0	0	0	0	0	0	0	0	0	0	0	0	0
IRRIGATION	0	0	0.1	0.1	0	0	0.7	0.7	0	0	1.1	1.1	1.9
MINING	0	0	0	0	0	0	0.1	0.1	0	0	0.1	0.1	0.2
THERMAL POWER COOLING	0	0.4	7.1	7.5	0	6.6	125.4	132.0	0	20.3	385.6	405.9	545.4
NON-WITHDRAWAL WATER USES													
MUNICIPAL WASTEWATER DISCHARGES	0	0	0	0	0	0	0	0	0	0	0	0	0
INDUSTRIAL WASTEWATER DISCHARGES	---	---	---	---	---	---	---	---	---	---	---	---	---
HYDROELECTRIC POWER	---	---	---	---	---	---	---	---	---	---	---	---	---
WATER ORIENTED OUTDOOR REC.	---	---	---	---	---	---	---	---	---	---	---	---	---
SPORT FISHING	0.1	0.2	0	0.3	0.5	0.7	0	1.2	0.5	0.7	0	1.2	2.7
RECREATIONAL BOATING	0	0	4.4	4.4	0	0	26.3	26.3	0	0	43.7	43.7	74.4
COMMERCIAL FISHING	---	---	---	---	---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	1.0	0	0	1.0	19.0	0	0	19.0	34.0	0	0	34.0	54.0
RELATED LAND USES & PROBLEMS													
AGRIC. LAND-TREATMENT	0	0	0	0	0	0	0	0	0	0	0	0	0
-CROPLAND DRAINAGE	0	0	0	0	0	0	0	0	0	0	0	0	0
FOREST LAND-TREATMENT	0	0	0	0	0	0	0	0	0	0	0	0	0
SHORELAND EROSION	0.0	0	0.2	0.2	0.3	0	1.0	1.3	0.5	0	2.2	2.7	4.2
STREAMBANK EROSION	0	0	0	0	0	0	0	0	0	0	0	0	0
FLOOD PLAINS-URBAN	---	---	---	---	---	---	---	---	---	---	---	---	---
-URBAN	0	0	0	0	0	0	0	0	0	0	0	0	0
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
WILDLIFE MANAGEMENT	0	0	0	0	0	0	0	0	0	0	0	0	0
AESTHETIC & CULTURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	0.5	1.9	0	2.4	4.3	17.1	0	21.4	6.7	26.7	0	33.4	57.2
-EXTENSIVE	---	---	---	---	---	---	---	---	---	---	---	---	---
TOTAL	1.6	55.3	12.2	69.1	24.1	419.9	171.6	615.6	41.7	850.2	565.3	1,457.2	2,141.9

TABLE 1–364 Indiana, Needs, Outputs, and Percent Needs Met, Normal Framework

RESOURCE USE CATEGORY	UNIT	1970 SUPPLY	1980 N	1980 O	1980 %	2000 N	2000 O	2000 %	2020 N	2020 O	2020 %
WATER WITHDRAWALS											
MUNICIPALLY SUPPLIED	MILLION GALLONS PER DAY		36.9	24.5	66	145	93.4	64	314	213	68
SELF-SUPPLIED INDUSTRIAL	MILLION GALLONS PER DAY		239	---	---	663	---	---	1,780	---	---
RURAL DOMESTIC & LIVESTOCK	MILLION GALLONS PER DAY		4.7	4.1	87	14.2	12.2	86	20.0	17.6	88
IRRIGATION	MILLION GALLONS PER DAY		39.0	27.8	71	82.1	62.6	76	131	102	78
MINING	MILLION GALLONS PER DAY		11.3	3.2	28	30.9	10.6	34	65.8	23.3	35
THERMAL POWER COOLING	MILLION GALLONS PER DAY		110	110	---	780	780	100	3,200	3,200	100
NON-WITHDRAWAL WATER USES											
MUNICIPAL WASTEWATER DISCHARGES	MILLION GALLONS PER DAY		274	274	100	363	363	100	531	531	100
INDUSTRIAL WASTEWATER DISCHARGES	MILLION GALLONS PER DAY		2,600	2,600	100	2,470	2,470	100	4,050	4,050	100
HYDROELECTRIC POWER	MILLION GALLONS PER DAY		0	---	---	0	---	---	0	---	---
WATER ORIENTED OUTDOOR REC.	1000 RECREATION DAYS		---	4,220	---	---	9,670	---	---	22,400	---
	1000 ACRES WATER SURFACE		---	---	---	---	---	---	---	---	---
SPORT FISHING	1000 ANGLER DAYS		1,690	1,690	100	2,690	2,690	100	3,640	3,640	100
	1000 ACRES WATER SURFACE		---	---	---	---	---	---	---	---	---
RECREATIONAL BOATING	1000 BOAT DAYS		362	74	20	640	231	36	989	385	39
	1000 ACRES WATER SURFACE		---	---	---	---	---	---	---	---	---
COMMERCIAL FISHING	MILLION TONS PER YEAR		---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	MILLION TONS PER YEAR		---	---	---	---	---	---	---	---	---
RELATED LAND USES & PROBLEMS											
AGRIC. LAND-TREATMENT	1000 ACRES		1,670	116	7	1,670	346	21	1,670	481	29
-CROPLAND DRAINAGE	1000 ACRES		549	18.8	3	549	55.4	10	549	121	22
FOREST LAND-TREATMENT	1000 ACRES		275	24.0	9	275	69.1	25	275	102	37
SHORELAND EROSION	MILES		22.6	2.6	12	22.6	7.8	35	22.6	13.0	58
STREAMBANK EROSION	MILES		346	8.9	3	346	26.6	8	346	44.3	13
	$1000 AVE ANNUAL DAMAGES		75.2	1.4	2	75.2	4.1	5	75.2	6.9	9
FLOOD PLAINS-URBAN	1000 ACRES		17.4	2.7	16	18.2	14.9	82	19.2	19.1	99
-URBAN	$1000 AVE ANNUAL DAMAGES		15,600	12,200	78	31,500	30,100	96	63,600	61,800	97
-RURAL	1000 ACRES		52.7	3.5	7	51.9	7.2	14	50.9	17.6	35
-RURAL	$1000 AVE ANNUAL DAMAGES		260	48.0	18	406	128	32	638	348	55
WILDLIFE MANAGEMENT	1000 ACRES		338	14.3	4	726	22.6	3	1,190	30.9	3
	1000 USER DAYS		1,220	101	8	1,840	243	13	2,430	435	18
AESTHETIC & CULTURAL	1000 ACRES		---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	1000 ACRES		---	1.1	---	---	2.6	---	---	3.4	---
-EXTENSIVE	1000 ACRES		---	6.1	---	---	14.4	---	---	20.3	---

TABLE 1–365 Indiana, Capital Costs, Normal Framework (in $1,000,000)

RESOURCE USE CATEGORY	1971-1980 Federal	1971-1980 Non-Fed	1971-1980 Private	1971-1980 Total	1981-2000 Federal	1981-2000 Non-Fed	1981-2000 Private	1981-2000 Total	2001-2020 Federal	2001-2020 Non-Fed	2001-2020 Private	2001-2020 Total	Total
WATER WITHDRAWALS													
MUNICIPALLY SUPPLIED	1.7	3.9	0	5.6	6.8	16.0	0	22.8	12.3	28.8	0	41.1	69.5
SELF-SUPPLIED INDUSTRIAL	0	0	3.5	3.5	0	0	47.5	47.5	0	0	74.5	74.5	125.5
RURAL DOMESTIC & LIVESTOCK	0.0	0	0.2	0.2	0.0	0	0.4	0.4	0.0	0	0.3	0.3	0.9
IRRIGATION	0	0	0.8	0.8	0	0	0.8	0.8	0	0	1.2	1.2	2.8
MINING	0	0	0.1	0.1	0	0	0.4	0.4	0	0	0.6	0.6	1.1
THERMAL POWER COOLING	0	0.2	3.7	3.9	0	1.2	22.3	23.5	0	4.2	80.5	84.7	112.1
NON-WITHDRAWAL WATER USES													
MUNICIPAL WASTEWATER DISCHARGES	14.2	4.7	0	18.9	48.4	16.1	0	64.5	77.6	25.8	0	103.4	186.8
INDUSTRIAL WASTEWATER DISCHARGES	---	---	---	---	---	---	---	---	---	---	---	---	---
HYDROELECTRIC POWER	---	---	---	---	---	---	---	---	---	---	---	---	---
WATER ORIENTED OUTDOOR REC.	---	---	---	---	---	---	---	---	---	---	---	---	---
SPORT FISHING	1.3	2.7	0	4.0	0.2	0.8	0	1.0	0.4	1.3	0	1.7	6.7
RECREATIONAL BOATING	3.0	3.0	2.7	8.7	9.9	9.9	8.3	28.1	7.6	7.6	6.7	21.9	58.7

COMMERCIAL FISHING													
COMMERCIAL NAVIGATION	0	0	0	0	11.2	0	0	11.2	0	0	0	0	11.2
RELATED LAND USES & PROBLEMS													
AGRIC. LAND-TREATMENT	1.3	0	3.5	4.8	2.7	0	7.0	9.7	1.6	0	4.0	5.6	20.1
-CROPLAND DRAINAGE	1.6	0	3.8	5.4	3.0	0	7.0	10.0	4.6	0	10.8	15.4	30.8
FOREST LAND-TREATMENT	1.2	0.1	0.2	1.5	2.2	0.1	0.4	2.7	1.7	0.1	0.3	2.1	6.3
SHORELAND EROSION	0.4	0	1.7	2.1	0.8	0	3.4	4.2	0.8	0	3.3	4.1	10.4
STREAMBANK EROSION	0.1	0	0.2	0.3	0.3	0	0.6	0.9	0.4	0	1.1	1.5	2.7
FLOOD PLAINS-URBAN	---	---	---	---	---	---	---	---	---	---	---	---	---
-URBAN	76.3	0	25.5	101.8	41.6	0	13.9	55.5	0.7	0	0.2	0.9	158.2
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
WILDLIFE MANAGEMENT	0.2	1.3	0	1.5	0.2	1.8	0	2.0	0.2	2.1	0	2.3	5.8
AESTHETIC & CULTURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	22.6	41.9	0	64.5	16.5	30.7	0	47.2	12.1	22.5	0	34.6	146.3
-EXTENSIVE	---	---	---	---	---	---	---	---	---	---	---	---	---
TOTAL	123.9	57.8	45.9	227.6	143.8	76.6	112.0	332.4	120.0	92.4	183.5	395.9	955.9

TABLE 1-366 Indiana, Operation, Maintenance, and Replacement Costs, Normal Framework (in $1,000,000)

	1971-1980				1981-2000				2001-2020				
RESOURCE USE CATEGORY	Federal	Non-Fed	Private	Total	Federal	Non-Fed	Private	Total	Federal	Non-Fed	Private	Total	Total
WATER WITHDRAWALS													
MUNICIPALLY SUPPLIED	0	3.3	0	3.3	0	37.9	0	37.9	0	115.1	0	115.1	156.3
SELF-SUPPLIED INDUSTRIAL	0	0	2.0	2.0	0	0	99.9	99.9	0	0	252.7	252.7	354.6
RURAL DOMESTIC & LIVESTOCK	0	0	0.5	0.5	0	0	3.8	3.8	0	0	7.1	7.1	11.4
IRRIGATION	0	0	0.1	0.1	0	0	0.7	0.7	0	0	1.3	1.3	2.1
MINING	0	0	0.0	0.0	0	0	1.6	1.6	0	0	3.9	3.9	5.5
THERMAL POWER COOLING	0	0.1	0.9	1.0	0	0.8	15.2	16.0	0	4.1	78.5	82.6	99.6
NON-WITHDRAWAL WATER USES													
MUNICIPAL WASTEWATER DISCHARGES	0	49.0	0	49.0	0	152.0	0	152.0	0	198.0	0	198.0	399.0
INDUSTRIAL WASTEWATER DISCHARGES	---	---	---	---	---	---	---	---	---	---	---	---	---
HYDROELECTRIC POWER	---	---	---	---	---	---	---	---	---	---	---	---	---
WATER ORIENTED OUTDOOR REC.	---	---	---	---	---	---	---	---	---	---	---	---	---
SPORT FISHING	0.9	1.0	0	1.9	0.2	1.7	0	1.9	1.1	3.7	0	4.8	8.6
RECREATIONAL BOATING	0	0	2.0	2.0	0	0	17.4	17.4	0	0	35.0	35.0	54.4
COMMERCIAL FISHING	---	---	---	---	---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	0	0	0	0	2.8	0	0	2.8	5.6	0	0	5.6	8.4
RELATED LAND USES & PROBLEMS													
AGRIC. LAND-TREATMENT	0	0	0.0	0.0	0	0	1.1	1.1	0	0	1.8	1.8	2.9
-CROPLAND DRAINAGE	0	0	0.1	0.1	0	0	1.0	1.0	0	0	2.0	2.0	3.1
FOREST LAND-TREATMENT	0.0	0.0	0	0.0	0.0	0.1	0.2	0.3	0.1	0.1	0.3	0.5	0.8
SHORELAND EROSION	0.0	0	0.2	0.2	0.3	0	1.4	1.7	0.7	0	2.6	3.3	5.2
STREAMBANK EROSION	0	0	0.0	0.0	0	0	0.1	0.1	0	0	0.0	0.0	0.1
FLOOD PLAINS-URBAN	---	---	---	---	---	---	---	---	---	---	---	---	---
-URBAN	0.0	0.2	0	0.2	0.1	1.4	0	1.5	0.1	1.4	0	1.5	3.2
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
WILDLIFE MANAGEMENT	0	0.1	0	0.1	0	0.1	0	0.1	0	0.1	0	0.1	0.3
AESTHETIC & CULTURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	2.5	9.9	0	12.4	15.2	60.9	0	76.1	23.8	95.4	0	119.2	207.7
-EXTENSIVE	---	---	---	---	---	---	---	---	---	---	---	---	---
TOTAL	3.4	63.6	5.8	72.8	18.6	254.9	142.4	415.9	31.4	417.9	385.2	834.5	1,323.2

TABLE 1-367 Indiana, Needs, Outputs, and Percent Needs Met, Proposed Framework

RESOURCE USE CATEGORY	UNIT	1970 SUPPLY	1980 N	1980 O	1980 %	2000 N	2000 O	2000 %	2020 N	2020 O	2020 %
WATER WITHDRAWALS											
MUNICIPALLY SUPPLIED	MILLION GALLONS PER DAY	171	36.9	24.5	66	145	93.4	64	314	213	68
SELF-SUPPLIED INDUSTRIAL	MILLION GALLONS PER DAY	3,251	239	---	---	663	---	---	1,180	---	---
RURAL DOMESTIC & LIVESTOCK	MILLION GALLONS PER DAY	40.2	4.7	4.1	87	14.2	12.2	86	20.0	17.6	88
IRRIGATION	MILLION GALLONS PER DAY	53.1	39.0	27.8	71	82.1	62.6	76	131	102	78
MINING	MILLION GALLONS PER DAY	14.3	11.3	3.2	28	30.9	10.6	34	65.8	23.3	35
THERMAL POWER COOLING	MILLION GALLONS PER DAY	1,562	110	110	---	780	780	100	3,200	3,200	100
NON-WITHDRAWAL WATER USES											
MUNICIPAL WASTEWATER DISCHARGES	MILLION GALLONS PER DAY	223	274	274	100	363	363	100	531	531	100
INDUSTRIAL WASTEWATER DISCHARGES	MILLION GALLONS PER DAY	2,983	2,600	2,600	100	2,470	2,470	100	4,050	4,050	100
HYDROELECTRIC POWER	MILLION GALLONS PER DAY	NA	0	---	---	0	---	---	0	---	---
WATER ORIENTED OUTDOOR REC.	1000 RECREATION DAYS	NA	---	4,220	---	---	9,670	---	---	22,400	---
	1000 ACRES WATER SURFACE	NA	---	---	---	---	---	---	---	---	---
SPORT FISHING	1000 ANGLER DAYS	1,271	1,690	1,690	100	2,690	2,690	100	3,640	3,640	100
	1000 ACRES WATER SURFACE	NA	---	---	---	---	---	---	---	---	---
RECREATIONAL BOATING	1000 BOAT DAYS	1,170	362	74	20	640	231	36	989	385	39
	1000 ACRES WATER SURFACE	NA	---	---	---	---	---	---	---	---	---
COMMERCIAL FISHING	MILLION TONS PER YEAR	NA	---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	MILLION TONS PER YEAR		---	---	---	---	---	---	---	---	---
RELATED LAND USES & PROBLEMS											
AGRIC. LAND-TREATMENT	1000 ACRES	1,670	1,670	254	15	1,670	728	44	1,670	974	58
-CROPLAND DRAINAGE	1000 ACRES	549	549	53.5	10	549	149	27	549	263	48
FOREST LAND-TREATMENT	1000 ACRES	275	275	28.5	10	275	83.5	30	275	126	46
SHORELAND EROSION	MILES	22.6	22.6	2.6	12	22.6	7.8	35	22.6	13.0	58
STREAMBANK EROSION	MILES	346	346	8.9	3	346	26.6	8	346	44.3	13
	$1000 AVE ANNUAL DAMAGES	75.2	75.2	1.4	2	75.2	4.1	5	75.2	6.9	9
FLOOD PLAINS-URBAN	1000 ACRES	17	17.4	2.7	16	18.2	14.9	82	19.2	19.1	99
-URBAN	$1000 AVE ANNUAL DAMAGES	10,595	15,600	12,200	78	31,500	30,100	96	63,600	61,800	97
-RURAL	1000 ACRES	26	52.7	3.5	7	51.9	7.2	14	50.9	17.6	35
-RURAL	$1000 AVE ANNUAL DAMAGES	123	260	48.0	18	406	128	32	638	348	55
WILDLIFE MANAGEMENT	1000 ACRES		333	14.3	4	726	22.6	3	1,190	30.9	3
	1000 USER DAYS		1,220	101	8	1,840	243	13	2,430	435	18
AESTHETIC & CULTURAL	1000 ACRES	NA	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	1000 ACRES		---	1.1	---	---	2.6	---	---	3.4	---
-EXTENSIVE	1000 ACRES	NA	---	6.1	---	---	14.4	---	---	20.3	---

TABLE 1-368 Indiana, Capital Costs, Proposed Framework (in $1,000,000)

RESOURCE USE CATEGORY	1971-1980 Federal	1971-1980 Non-Fed	1971-1980 Private	1971-1980 Total	1981-2000 Federal	1981-2000 Non-Fed	1981-2000 Private	1981-2000 Total	2001-2020 Federal	2001-2020 Non-Fed	2001-2020 Private	2001-2020 Total	Total
WATER WITHDRAWALS													
MUNICIPALLY SUPPLIED	1.7	3.9	0	5.6	6.8	16.0	0	22.8	12.3	28.8	0	41.1	69.5
SELF-SUPPLIED INDUSTRIAL	0	0	3.5	3.5	0	0	47.5	47.5	0	0	74.5	74.5	125.5
RURAL DOMESTIC & LIVESTOCK	0.0	0	0.2	0.2	0.0	0	0.4	0.4	0.0	0	0.3	0.3	0.9
IRRIGATION	0	0	0.8	0.8	0	0	0.8	0.8	0.	0	1.2	1.2	2.8
MINING	0	0	0.1	0.1	0	0	0.4	0.4	0	0	0.6	0.6	1.1
THERMAL POWER COOLING	0	0.2	3.7	3.9	0	1.2	22.3	23.5	0	4.2	80.5	84.7	112.1
NON-WITHDRAWAL WATER USES													
MUNICIPAL WASTEWATER DISCHARGES	204.8	68.2	0	273.0	168.8	56.2	0	225.0	168.0	56.0	0	224.0	722.0
INDUSTRIAL WASTEWATER DISCHARGES	---	---	---	---	---	---	---	---	---	---	---	---	---
HYDROELECTRIC POWER	---	---	---	---	---	---	---	---	---	---	---	---	---
WATER ORIENTED OUTDOOR REC.	---	---	---	---	---	---	---	---	---	---	---	---	---
SPORT FISHING	1.3	2.7	0	4.0	0.2	0.8	0	1.0	0.4	1.3	0	1.7	6.7
RECREATIONAL BOATING	3.0	3.0	2.7	8.7	9.9	9.9	8.3	28.1	7.6	7.6	6.7	21.9	58.7

COMMERCIAL FISHING													
COMMERCIAL NAVIGATION	7.0	0	0	7.7	17.2	0	0	17.2	0	0	0	0	24.9
RELATED LAND USES & PROBLEMS													
AGRIC. LAND-TREATMENT	2.9	0	7.6	10.5	5.6	0	14.3	19.9	3.4	0	8.7	12.1	42.5
-CROPLAND DRAINAGE	2.6	0	6.0	8.6	4.7	0	11.0	15.7	3.1	0	7.2	10.3	34.6
FOREST LAND-TREATMENT	1.4	0.1	0.2	1.7	2.6	0.2	0.5	3.3	2.1	0.1	0.4	2.6	7.6
SHORELAND EROSION	0.4	0	1.7	2.1	0.8	0	3.4	4.2	0.8	0	3.3	4.1	10.4
STREAMBANK EROSION	0.1	0	0.2	0.3	0.3	0	0.6	0.9	0.4	0	1.1	1.5	2.7
FLOOD PLAINS-URBAN	---	---	---	---	---	---	---	---	---	---	---	---	---
--URBAN	76.3	0	25.5	101.8	41.6	0	13.9	55.5	0.7	0	0.2	0.9	158.2
--RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
--RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
WILDLIFE MANAGEMENT	0.2	1.3	0	1.5	0.2	1.8	0	2.0	0.2	2.1	0	2.3	5.8
AESTHETIC & CULTURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION--INTENSIVE	22.6	41.9	0	64.5	16.5	30.7	0	47.2	12.1	22.5	0	34.6	146.3
--EXTENSIVE	---	---	---	---	---	---	---	---	---	---	---	---	---
TOTAL	325.0	121.3	52.2	498.5	275.2	116.8	123.4	515.4	211.1	122.6	184.7	518.4	1,532.3

TABLE 1–369 Indiana, Operation, Maintenance, and Replacement Costs, Proposed Framework (in $1,000,000)

RESOURCE USE CATEGORY	1971-1980				1981-2000				2001-2020				
	Federal	Non-Fed	Private	Total	Federal	Non-Fed	Private	Total	Federal	Non-Fed	Private	Total	Total
WATER WITHDRAWALS													
MUNICIPALLY SUPPLIED	0	3.3	0	3.3	0	37.9	0	37.9	0	115.1	0	115.1	156.3
SELF-SUPPLIED INDUSTRIAL	0	0	2.0	2.0	0	0	99.9	99.9	0	0	252.7	252.7	354.6
RURAL DOMESTIC & LIVESTOCK	0	0	0.5	0.5	0	0	3.8	3.8	0	0	7.1	7.1	11.4
IRRIGATION	0	0	0.1	0.1	0	0	0.7	0.7	0	0	1.3	1.3	2.1
MINING	0	0	0.0	0.0	0	0	1.6	1.6	0	0	3.9	3.9	5.5
THERMAL POWER COOLING	0	0.1	0.9	1.0	0	0.8	15.2	16.0	0	4.1	78.5	82.6	99.6
NON-WITHDRAWAL WATER USES													
MUNICIPAL WASTEWATER DISCHARGES	0	294.0	0	294.0	0	719.2	0	719.2	0	1,186.1	0	1,186.1	2,199.3
INDUSTRIAL WASTEWATER DISCHARGES	---	---	---	---	---	---	---	---	---	---	---	---	---
HYDROELECTRIC POWER	---	---	---	---	---	---	---	---	---	---	---	---	---
WATER ORIENTED OUTDOOR REC.	---	---	---	---	---	---	---	---	---	---	---	---	---
SPORT FISHING	0.9	1.0	0	1.9	0.2	1.7	0	1.9	1.1	3.7	0	4.8	8.6
RECREATIONAL BOATING	0	0	2.0	2.0	0	0	17.4	17.4	0	0	35.0	35.0	54.4
COMMERCIAL FISHING	---	---	---	---	---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	1.0	0	0	1.0	8.0	0	0	8.0	12.0	0	0	12.0	21.0
RELATED LAND USES & PROBLEMS													
AGRIC. LAND-TREATMENT	0	0	0.2	0.2	0	0	2.2	2.2	0	0	3.0	3.6	6.0
-CROPLAND DRAINAGE	0	0	0.2	0.2	0	0	1.4	1.4	0	0	2.3	2.3	3.9
FOREST LAND-TREATMENT	0	0	0	0	0.0	0.1	0.3	0.4	0.1	0.1	0.3	0.5	0.9
SHORELAND EROSION	0.0	0	0.2	0.2	0.3	0	1.4	1.7	0.7	0	2.6	3.3	5.2
STREAMBANK EROSION	0	0	0.0	0.0	0	0	0.1	0.1	0	0	0.0	0.0	0.1
FLOOD PLAINS-URBAN	---	---	---	---	---	---	---	---	---	---	---	---	---
-URBAN	0.0	0.2	0	0.2	0.1	1.4	0	1.5	0.1	1.4	0	1.5	3.2
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
WILDLIFE MANAGEMENT	0	0.1	0	0.1	0	0.1	0	0.1	0	0.1	0	0.1	0.3
AESTHETIC & CULTURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	2.5	9.9	0	12.4	15.2	60.9	0	76.1	23.8	95.4	0	119.2	207.7
-EXTENSIVE	---	---	---	---	---	---	---	---	---	---	---	---	---
TOTAL	4.4	308.6	6.1	319.1	23.8	822.1	144.0	989.9	37.8	1,406	387.3	1,831.1	3,140.1

TABLE 1-370 Michigan, Needs, Outputs, and Percent Needs Met, Normal Framework

RESOURCE USE CATEGORY	UNIT	1970 SUPPLY	1980 N	1980 O	1980 %	2000 N	2000 O	2000 %	2020 N	2020 O	2020 %
WATER WITHDRAWALS											
MUNICIPALLY SUPPLIED	MILLION GALLONS PER DAY		282	282	100	960	960	100	1,910	1,910	100
SELF-SUPPLIED INDUSTRIAL	MILLION GALLONS PER DAY		95.9	95.9	100	726	726	100	1,820	1,820	100
RURAL DOMESTIC & LIVESTOCK	MILLION GALLONS PER DAY		27.3	27.3	100	77.7	77.7	100	116	116	100
IRRIGATION	MILLION GALLONS PER DAY		490	490	100	848	848	100	1,240	1,240	100
MINING	MILLION GALLONS PER DAY		50.0	50.0	100	181	181	100	407	407	100
THERMAL POWER COOLING	MILLION GALLONS PER DAY		2,200	2,200	100	14,700	14,700	100	34,900	34,900	100
NON-WITHDRAWAL WATER USES											
MUNICIPAL WASTEWATER DISCHARGES	MILLION GALLONS PER DAY		1,400	1,400	100	1,850	1,850	100	2,550	2,550	100
INDUSTRIAL WASTEWATER DISCHARGES	MILLION GALLONS PER DAY		1,160	1,160	100	698	698	100	930	930	100
HYDROELECTRIC POWER	MILLION GALLONS PER DAY		47,300	47,300	100	47,300	47,300	100	47,300	47,300	100
WATER ORIENTED OUTDOOR REC.	1000 RECREATION DAYS		---	20,400	---	---	46,400	---	---	67,200	---
	1000 ACRES WATER SURFACE		---	---	---	---	---	---	---	---	---
SPORT FISHING	1000 ANGLER DAYS		8,460	6,050	72	16,900	14,100	83	27,400	24,000	88
	1000 ACRES WATER SURFACE		---	---	---	---	---	---	---	---	---
RECREATIONAL BOATING	1000 BOAT DAYS		3,970	1,060	27	7,170	2,820	39	11,100	5,030	45
	1000 ACRES WATER SURFACE		---	---	---	---	---	---	---	---	---
COMMERCIAL FISHING	MILLION TONS PER YEAR		---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	MILLION TONS PER YEAR		---	---	---	---	---	---	---	---	---
RELATED LAND USES & PROBLEMS											
AGRIC. LAND-TREATMENT	1000 ACRES		8,080	804	10	8,080	2,410	30	8,080	3,370	42
-CROPLAND DRAINAGE	1000 ACRES		1,680	145	9	1,680	273	16	1,680	534	32
FOREST LAND-TREATMENT	1000 ACRES		13,900	1,420	10	13,900	4,260	31	13,900	7,100	51
SHORELAND EROSION	MILES		583	20.7	4	583	62.3	11	583	104	18
STREAMBANK EROSION	MILES		6,210	461	7	6,210	1,380	22	6,210	2,300	37
	$1000 AVE ANNUAL DAMAGES		564	60.8	11	564	182	32	564	304	54
FLOOD PLAINS-URBAN	1000 ACRES		126	46.2	37	129	74.2	58	134	108	81
-URBAN	$1000 AVE ANNUAL DAMAGES		40,600	35,100	86	66,000	60,100	91	85,400	80,400	94
-RURAL	1000 ACRES		991	213	21	987	359	36	983	507	52
-RURAL	$1000 AVE ANNUAL DAMAGES		6,750	3,050	45	8,170	4,200	51	9,520	5,690	60
WILDLIFE MANAGEMENT	1000 ACRES		959	140	15	2,850	369	13	5,190	551	11
	1000 USER DAYS		5,380	1,620	30	8,740	5,510	63	12,700	9,610	76
AESTHETIC & CULTURAL	1000 ACRES		---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	1000 ACRES		---	6.8	---	---	16.0	---	---	24.7	---
-EXTENSIVE	1000 ACRES		---	70.2	---	---	125	---	---	177	---

TABLE 1-371 Michigan, Capital Costs, Normal Framework (in $1,000,000)

RESOURCE USE CATEGORY	1971-1980 Federal	1971-1980 Non-Fed	1971-1980 Private	1971-1980 Total	1981-2000 Federal	1981-2000 Non-Fed	1981-2000 Private	1981-2000 Total	2001-2020 Federal	2001-2020 Non-Fed	2001-2020 Private	2001-2020 Total	Total
WATER WITHDRAWALS													
MUNICIPALLY SUPPLIED	76.0	177.2	0	253.2	93.5	218.3	0	311.8	136.1	317.7	0	453.8	1,018.8
SELF-SUPPLIED INDUSTRIAL	0	0	7.7	7.7	0	0	51.4	51.4	0	0	87.4	87.4	146.5
RURAL DOMESTIC & LIVESTOCK	0.2	0	1.3	1.5	0.3	0	2.2	2.5	0.2	0	1.7	1.9	5.9
IRRIGATION	0	0	14.3	14.3	0	0	10.2	10.2	0	0	10.9	10.9	35.4
MINING	0	0	2.4	2.4	0	0	6.6	6.6	0	0	11.8	11.8	20.8
THERMAL POWER COOLING	0	3.8	73.1	76.9	0	21.9	415.6	437.5	0	35.4	671.6	707.0	1,221.4
NON-WITHDRAWAL WATER USES													
MUNICIPAL WASTEWATER DISCHARGES	723.9	241.3	0	965.2	468.6	156.2	0	624.8	602.6	200.9	0	803.5	2,393.5
INDUSTRIAL WASTEWATER DISCHARGES	---	---	---	---	---	---	---	---	---	---	---	---	---
HYDROELECTRIC POWER	---	---	---	---	---	---	---	---	---	---	---	---	---
WATER ORIENTED OUTDOOR REC.	---	---	---	---	---	---	---	---	---	---	---	---	---
SPORT FISHING	5.1	8.3	0	13.4	2.8	6.0	0	8.8	8.8	16.0	0	24.8	47.0
RECREATIONAL BOATING	28.7	28.7	24.5	81.9	51.3	51.3	43.9	146.5	55.6	55.6	47.4	158.6	387.0

COMMERCIAL FISHING	---	---	---	---	---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	0	0	0	0	340.6	0	0	340.6	0	0	0	0	340.6
RELATED LAND USES & PROBLEMS													
AGRIC. LAND-TREATMENT	9.4	0	24.0	33.4	18.7	0	48.1	66.8	11.1	0	28.6	39.7	139.9
-CROPLAND DRAINAGE	14.1	0	33.0	47.1	13.1	0	30.6	43.7	18.1	0	42.2	60.3	151.1
FOREST LAND-TREATMENT	46.9	2.9	8.8	58.6	93.8	5.8	17.6	117.2	93.7	5.9	17.5	117.1	292.9
SHORELAND EROSION	1.9	0	7.7	9.6	3.9	0	15.5	19.4	3.9	0	15.5	19.4	48.4
STREAMBANK EROSION	3.8	0	9.9	13.7	11.5	0	29.7	41.2	19.2	0	49.5	68.7	123.6
FLOOD PLAINS-URBAN	---	---	---	---	---	---	---	---	---	---	---	---	---
-URBAN	240.0	0	80.0	320.0	45.7	0	15.3	61.0	59.1	0	19.7	78.8	459.8
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
WILDLIFE MANAGEMENT	6.6	59.0	0	65.6	9.6	86.1	0	95.7	6.8	61.8	0	68.4	229.7
AESTHETIC & CULTURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	101.8	189.0	0	290.8	117.8	218.9	0	336.7	119.5	221.8	0	341.3	968.8
-EXTENSIVE	---	---	---	---	---	---	---	---	---	---	---	---	---
TOTAL	1,258.4	710.2	286.7	2,255.3	1,271.2	764.5	686.7	2,722.4	1,134.7	914.9	1,003.8	3,053.4	8,031.1

TABLE 1-372 Michigan, Operation, Maintenance, and Replacement Costs, Normal Framework (in $1,000,000)

	1971-1980				1981-2000				2001-2020				
RESOURCE USE CATEGORY	Federal	Non-Fed	Private	Total	Federal	Non-Fed	Private	Total	Federal	Non-Fed	Private	Total	Total
WATER WITHDRAWALS													
MUNICIPALLY SUPPLIED	0	102.1	0	102.1	0	474.6	0	474.6	0	1,065.6	0	1,065.6	1,642.3
SELF-SUPPLIED INDUSTRIAL	0	0	13.9	13.9	0	0	230.4	230.4	0	0	706.6	706.6	950.9
RURAL DOMESTIC & LIVESTOCK	0	0	4.8	4.8	0	0	32.2	32.2	0	0	59.3	59.3	96.3
IRRIGATION	0	0	2.1	2.1	0	0	11.0	11.0	0	0	16.7	16.7	29.8
MINING	0	0	3.7	3.7	0	0	32.8	32.8	0	0	82.3	82.3	118.8
THERMAL POWER COOLING	0	1.0	18.8	19.8	0	15.2	289.5	304.7	0	44.5	845.4	989.9	1,214.4
NON-WITHDRAWAL WATER USES													
MUNICIPAL WASTEWATER DISCHARGES	0	663.8	0	663.8	0	1,780.0	0	1,780.0	0	2,431.0	0	2,431.0	4,874.8
INDUSTRIAL WASTEWATER DISCHARGES	---	---	---	---	---	---	---	---	---	---	---	---	---
HYDROELECTRIC POWER	---	---	---	---	---	---	---	---	---	---	---	---	---
WATER ORIENTED OUTDOOR REC.	---	---	---	---	---	---	---	---	---	---	---	---	---
SPORT FISHING	2.8	4.4	0	7.2	8.3	18.7	0	27.0	12.7	23.4	0	36.1	70.3
RECREATIONAL BOATING	0	0	19.8	19.8	0	0	143.5	143.5	0	0	271.4	271.4	434.7
COMMERCIAL FISHING	---	---	---	---	---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	0	0	0	0	86.2	0	0	86.2	172.4	0	0	172.4	258.6
RELATED LAND USES & PROBLEMS													
AGRIC. LAND-TREATMENT	0	0	0.8	0.8	0	0	6.6	6.6	0	0	12.1	12.1	19.5
-CROPLAND DRAINAGE	0	0	1.2	1.2	0	0	7.0	7.0	0	0	12.2	12.2	20.4
FOREST LAND-TREATMENT	0.2	0.3	1.0	1.5	1.1	2.2	7.7	11.0	2.8	4.0	14.2	20.2	32.7
SHORELAND EROSION	0.2	0	0.7	0.9	1.5	0	6.2	7.7	3.1	0	12.5	15.6	24.2
STREAMBANK EROSION	0	0	1.5	1.5	0	0	12.9	12.9	0	0	36.5	36.5	50.9
FLOOD PLAINS-URBAN	---	---	---	---	---	---	---	---	---	---	---	---	---
-URBAN	0.0	0.7	0	0.7	0.2	3.4	0	3.6	0.2	4.3	0	4.5	8.8
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
WILDLIFE MANAGEMENT	0	3.2	0	3.2	0	4.8	0	4.8	0	3.5	0	3.5	11.5
AESTHETIC & CULTURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	9.4	37.8	0	47.2	70.8	283.0	0	353.8	133.1	532.5	0	665.6	1,066.6
-EXTENSIVE	---	---	---	---	---	---	---	---	---	---	---	---	---
TOTAL	12.6	813.3	68.3	894.2	168.1	2,581.9	779.8	3,529.8	323.5	4,108.8	2,069.2	6,501.5	10,925.5

TABLE 1–373 Michigan, Needs, Outputs, and Percent Needs Met, Proposed Framework

RESOURCE USE CATEGORY	UNIT	1970 SUPPLY	1980 N	1980 O	1980 %	2000 N	2000 O	2000 %	2020 N	2020 O	2020 %
WATER WITHDRAWALS											
MUNICIPALLY SUPPLIED	MILLION GALLONS PER DAY	1,153	282	282	100	960	960	100	1,910	1,910	100
SELF-SUPPLIED INDUSTRIAL	MILLION GALLONS PER DAY	2,374	95.9	95.9	100	726	726	100	1,820	1,820	100
RURAL DOMESTIC & LIVESTOCK	MILLION GALLONS PER DAY	187	27.3	27.3	100	77.7	77.7	100	116	116	100
IRRIGATION	MILLION GALLONS PER DAY	250.6	490	490	100	848	848	100	1,240	1,240	100
MINING	MILLION GALLONS PER DAY	137.8	50.0	50.0	100	181	181	100	407	407	100
THERMAL POWER COOLING	MILLION GALLONS PER DAY	6,149	2,200	2,200	100	14,700	14,700	100	34,900	34,900	100
NON-WITHDRAWAL WATER USES											
MUNICIPAL WASTEWATER DISCHARGES	MILLION GALLONS PER DAY	1,196	1,400	1,400	100	1,850	1,850	100	2,550	2,550	100
INDUSTRIAL WASTEWATER DISCHARGES	MILLION GALLONS PER DAY	1,546	1,160	1,160	100	698	698	100	930	930	100
HYDROELECTRIC POWER	MILLION GALLONS PER DAY	NA	47,300	47,300	100	47,300	47,300	100	47,300	47,300	100
WATER ORIENTED OUTDOOR REC.	1000 RECREATION DAYS	NA	---	20,400	---	---	46,400	---	---	67,200	---
	1000 ACRES WATER SURFACE	NA	---	---	---	---	---	---	---	---	---
SPORT FISHING	1000 ANGLER DAYS	26,200	8,460	6,050	72	16,900	14,100	83	27,400	24,000	88
	1000 ACRES WATER SURFACE	NA	---	---	---	---	---	---	---	---	---
RECREATIONAL BOATING	1000 BOAT DAYS	14,400	3,970	1,060	27	7,170	2,820	39	11,100	5,030	45
	1000 ACRES WATER SURFACE	NA	---	---	---	---	---	---	---	---	---
COMMERCIAL FISHING	MILLION TONS PER YEAR	NA	---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	MILLION TONS PER YEAR		---	---	---	---	---	---	---	---	---
RELATED LAND USES & PROBLEMS											
AGRIC. LAND-TREATMENT	1000 ACRES	8,080	8,080	1,790	22	8,080	5,050	63	8,080	6,800	84
-CROPLAND DRAINAGE	1000 ACRES	1,680	1,680	297	18	1,680	782	47	1,680	1,130	67
FOREST LAND-TREATMENT	1000 ACRES	13,900	13,900	2,100	15	13,900	6,310	45	13,900	10,500	76
SHORELAND EROSION	MILES	583	583	20.7	4	583	62.3	11	583	104	18
STREAMBANK EROSION	MILES	6,210	6,210	461	7	6,210	1,380	22	6,210	2,300	37
	$1000 AVE ANNUAL DAMAGES	564	564	60.8	11	564	182	32	564	304	54
FLOOD PLAINS-URBAN	1000 ACRES	105.5	126	46.2	37	129	74.2	58	134	108	81
-URBAN	$1000 AVE ANNUAL DAMAGES	27,557.8	40,600	35,100	86	66,000	60,100	91	85,400	80,400	94
-RURAL	1000 ACRES	818.2	991	213	21	987	359	36	983	507	52
-RURAL	$1000 AVE ANNUAL DAMAGES	3,682.0	6,750	3,050	45	8,170	4,200	51	9,520	5,690	60
WILDLIFE MANAGEMENT	1000 ACRES	NA	959	140	15	2,850	369	13	5,190	551	11
	1000 USER DAYS	NA	5,380	1,620	30	8,740	5,510	63	12,700	9,610	76
AESTHETIC & CULTURAL	1000 ACRES	NA	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	1000 ACRES		---	6.8	---	---	16.0	---	---	24.7	---
-EXTENSIVE	1000 ACRES	NA	---	70.2	---	---	125	---	---	177	---

TABLE 1–374 Michigan, Capital Costs, Proposed Framework (in $1,000,000)

RESOURCE USE CATEGORY	1971-1980 Federal	1971-1980 Non-Fed	1971-1980 Private	1971-1980 Total	1981-2000 Federal	1981-2000 Non-Fed	1981-2000 Private	1981-2000 Total	2001-2020 Federal	2001-2020 Non-Fed	2001-2020 Private	2001-2020 Total	Total
WATER WITHDRAWALS													
MUNICIPALLY SUPPLIED	76.0	177.2	0	253.2	93.5	218.3	0	311.8	136.1	317.7	0	453.8	1,018.8
SELF-SUPPLIED INDUSTRIAL	0	0	7.7	7.7	0	0	51.4	51.4	0	0	87.4	87.4	146.5
RURAL DOMESTIC & LIVESTOCK	0.2	0	1.3	1.5	0.3	0	2.2	2.5	0.2	0	1.7	1.9	5.9
IRRIGATION	0	0	14.3	14.3	0	0	10.2	10.2	0	0	10.9	10.9	35.4
MINING	0	0	2.4	2.4	0	0	6.6	6.6	0	0	11.8	11.8	20.8
THERMAL POWER COOLING	0	3.8	73.1	76.9	0	21.9	415.6	437.5	0	35.4	671.6	707.0	1,221.4
NON-WITHDRAWAL WATER USES													
MUNICIPAL WASTEWATER DISCHARGES	740.2	246.8	0	987.0	773.2	257.8	0	1,031.0	858.8	286.2	0	1,145.0	3,163.0
INDUSTRIAL WASTEWATER DISCHARGES	---	---	---	---	---	---	---	---	---	---	---	---	---
HYDROELECTRIC POWER	---	---	---	---	---	---	---	---	---	---	---	---	---
WATER ORIENTED OUTDOOR REC.	---	---	---	---	---	---	---	---	---	---	---	---	---
SPORT FISHING	5.1	8.3	0	13.4	2.8	6.0	0	8.8	8.8	16.0	0	24.8	47.0
RECREATIONAL BOATING	28.7	28.7	24.5	81.9	51.3	51.3	43.9	146.5	55.6	55.6	47.4	158.6	387.0

COMMERCIAL FISHING	---	---	---	---	---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	108.6	0	0	108.6	831.8	0	0	831.8	0	0	0	0	940.4
RELATED LAND USES & PROBLEMS													
AGRIC. LAND-TREATMENT	18.1	0	46.4	64.7	33.8	0	86.9	120.7	20.6	0	52.9	73.5	253.9
-CROPLAND DRAINAGE	17.1	0	41.3	59.0	31.0	0	72.2	103.2	17.7	0	41.2	58.9	221.1
FOREST LAND-TREATMENT	69.1	4.3	13.0	86.4	141.0	8.8	26.4	176.2	141.1	8.8	26.5	176.4	439.0
SHORELAND EROSION	1.9	0	7.7	9.6	3.9	0	15.5	19.4	3.9	0	15.5	19.4	48.4
STREAMBANK EROSION	3.8	0	9.9	13.7	11.5	0	29.7	41.2	19.2	0	49.5	68.7	123.6
FLOOD PLAINS-URBAN	---	---	---	---	---	---	---	---	---	---	---	---	---
-URBAN	240.0	0	80.0	320.0	45.7	0	15.3	61.0	59.1	0	19.7	78.8	459.8
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
WILDLIFE MANAGEMENT	6.6	59.0	0	65.6	9.6	86.1	0	95.7	6.8	61.8	0	68.4	229.7
AESTHETIC & CULTURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	101.8	189.0	0	290.8	117.8	218.9	0	336.7	119.5	221.8	0	341.3	968.8
-EXTENSIVE	---	---	---	---	---	---	---	---	---	---	---	---	---
TOTAL	1,417.8	717.1	321.8	2,456.7	3,147.2	869.1	775.9	3,792.2	1,447.4	1,003.1	1,036.1	3,486.6	9,735.5

TABLE 1–375 Michigan, Operation, Maintenance, and Replacement Costs, Proposed Framework (in $1,000,000)

RESOURCE USE CATEGORY	1971-1980				1981-2000				2001-2020				
	Federal	Non-Fed	Private	Total	Federal	Non-Fed	Private	Total	Federal	Non-Fed	Private	Total	Total
WATER WITHDRAWALS													
MUNICIPALLY SUPPLIED	0	102.1	0	102.1	0	474.6	0	474.6	0	1,065.6	0	1,065.6	1,642.3
SELF-SUPPLIED INDUSTRIAL	0	0	13.9	13.9	0	0	230.4	230.4	0	0	706.6	706.6	950.9
RURAL DOMESTIC & LIVESTOCK	0	0	4.8	4.8	0	0	32.2	32.2	0	0	59.3	59.3	96.3
IRRIGATION	0	0	2.1	2.1	0	0	11.0	11.0	0	0	16.7	16.7	29.8
MINING	0	0	3.7	3.7	0	0	32.8	32.8	0	0	82.3	82.3	118.8
THERMAL POWER COOLING	0	1.0	18.8	19.8	0	15.2	289.5	304.7	0	44.5	845.4	889.9	1,214.4
NON-WITHDRAWAL WATER USES													
MUNICIPAL WASTEWATER DISCHARGES	0	1,671.9	0	1,671.9	0	3,976.7	0	3,976.7	0	5,857.9	0	5,857.9	11,506.5
INDUSTRIAL WASTEWATER DISCHARGES	---	---	---	---	---	---	---	---	---	---	---	---	---
HYDROELECTRIC POWER	---	---	---	---	---	---	---	---	---	---	---	---	---
WATER ORIENTED OUTDOOR REC.	---	---	---	---	---	---	---	---	---	---	---	---	---
SPORT FISHING	2.8	4.4	0	7.2	8.3	18.7	0	27.0	12.7	23.4	0	36.1	70.3
RECREATIONAL BOATING	0	0	19.8	19.8	0	0	143.5	143.5	0	0	271.4	271.4	434.7
COMMERCIAL FISHING	---	---	---	---	---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	14.0	0	0	14.0	263.2	0	0	263.2	470.4	0	0	470.4	747.6
RELATED LAND USES & PROBLEMS													
AGRIC. LAND-TREATMENT	0	0	0.8	0.8	0	0	6.6	6.6	0	0	12.1	12.1	19.5
-CROPLAND DRAINAGE	0	0	1.5	1.5	0	0	12.7	12.7	0	0	22.3	22.3	37.7
FOREST LAND-TREATMENT	0.2	0.4	1.5	2.1	2.0	4.0	13.5	19.5	3.5	7.0	24.6	35.1	56.7
SHORELAND EROSION	0.2	0	0.7	0.9	1.5	0	6.2	7.7	3.1	0	12.5	15.6	24.2
STREAMBANK EROSION	0	0	1.5	1.5	0	0	12.9	12.9	0	0	36.5	36.5	50.9
FLOOD PLAINS-URBAN	---	---	---	---	---	---	---	---	---	---	---	---	---
-URBAN	0.0	0.7	0	0.7	0.2	3.4	0	3.6	0.2	4.3	0	4.5	8.8
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
WILDLIFE MANAGEMENT	0	3.2	0	3.2	0	4.8	0	4.8	0	3.5	0	3.5	11.5
AESTHETIC & CULTURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	9.4	37.8	0	47.2	70.8	283.0	0	353.8	133.1	532.5	0	665.6	1,066.6
-EXTENSIVE	---	---	---	---	---	---	---	---	---	---	---	---	---
TOTAL	26.6	1,821.5	69.7	1,917.8	346.0	4,780.4	798.7	5,925.1	623.0	7,538.7	2,097.0	10,258.7	18,101.6

TABLE 1–376 Minnesota, Needs, Outputs, and Percent Needs Met, Normal Framework

RESOURCE USE CATEGORY	UNIT	1970 SUPPLY	1980 N	1980 O	1980 %	2000 N	2000 O	2000 %	2020 N	2020 O	2020 %
WATER WITHDRAWALS											
MUNICIPALLY SUPPLIED	MILLION GALLONS PER DAY		3.0	3.0	100	12.1	12.1	100	23.0	23.0	100
SELF-SUPPLIED INDUSTRIAL	MILLION GALLONS PER DAY		+	---	---	+	---	---	15.0	15.0	100
RURAL DOMESTIC & LIVESTOCK	MILLION GALLONS PER DAY		0.2	0.2	100	1.3	1.3	100	1.8	1.8	100
IRRIGATION	MILLION GALLONS PER DAY		3.8	3.8	100	9.6	9.6	100	15.2	15.2	100
MINING	MILLION GALLONS PER DAY		20.4	20.4	100	42.2	42.2	100	72.8	72.8	100
THERMAL POWER COOLING	MILLION GALLONS PER DAY		0	0	---	850	850	100	1,830	1,830	100
NON-WITHDRAWAL WATER USES											
MUNICIPAL WASTEWATER DISCHARGES	MILLION GALLONS PER DAY		28.1	28.1	100	34.2	34.2	100	42.2	42.2	100
INDUSTRIAL WASTEWATER DISCHARGES	MILLION GALLONS PER DAY		23.6	23.6	100	23.6	23.6	100	34.9	34.9	100
HYDROELECTRIC POWER	MILLION GALLONS PER DAY		0	---	---	0	---	---	0	---	---
WATER ORIENTED OUTDOOR REC.	1000 RECREATION DAYS		+	1,710	over	+	4,315	over	+	6,930	over
	1000 ACRES WATER SURFACE		---	---	---	---	---	---	---	---	---
SPORT FISHING	1000 ANGLER DAYS		710	400	56	1,370	900	66	2,080	1,500	72
	1000 ACRES WATER SURFACE		---	---	---	---	---	---	---	---	---
RECREATIONAL BOATING	1000 BOAT DAYS		193	177	92	306	316	over	424	480	over
	1000 ACRES WATER SURFACE		---	---	---	---	---	---	---	---	---
COMMERCIAL FISHING	MILLION TONS PER YEAR		---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	MILLION TONS PER YEAR		---	---	---	---	---	---	---	---	---
RELATED LAND USES & PROBLEMS											
AGRIC. LAND-TREATMENT	1000 ACRES		216	18.8	9	216	56.4	26	216	79.2	37
-CROPLAND DRAINAGE	1000 ACRES		57.5	5.5	10	57.5	7.9	14	57.5	7.9	14
FOREST LAND-TREATMENT	1000 ACRES		3,840	419	11	3,840	1,260	33	3,840	2,160	56
SHORELAND EROSION	MILES		11.4	0.1	1	11.4	0.3	3	11.4	0.5	4
STREAMBANK EROSION	MILES		179	7.6	4	179	22.8	13	179	38.0	21
	$1000 AVE ANNUAL DAMAGES		3.7	0.7	20	3.7	2.2	60	3.7	3.7	100
FLOOD PLAINS-URBAN	1000 ACRES		0.1	0.1	100	0.1	0.1	100	0.1	0.1	100
-URBAN	$1000 AVE ANNUAL DAMAGES		102	87.5	86	171	152	89	284	264	93
-RURAL	1000 ACRES		112	51.3	46	112	55.6	50	112	60.9	54
-RURAL	$1000 AVE ANNUAL DAMAGES		63.2	36.2	57	108	44.3	41	189	54.0	29
WILDLIFE MANAGEMENT	1000 ACRES		0	114	over	40	384	over	100	736	over
	1000 USER DAYS		34.8	17.0	49	36.2	35.0	97	42.9	56.1	over
AESTHETIC & CULTURAL	1000 ACRES		---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	1000 ACRES		---	1.1	---	---	2.8	---	---	4.5	---
-EXTENSIVE	1000 ACRES		---	0.8	---	---	0.8	---	---	0.8	---

TABLE 1–377 Minnesota, Capital Costs, Normal Framework (in $1,000,000)

RESOURCE USE CATEGORY	1971-1980 Federal	1971-1980 Non-Fed	1971-1980 Private	1971-1980 Total	1981-2000 Federal	1981-2000 Non-Fed	1981-2000 Private	1981-2000 Total	2001-2020 Federal	2001-2020 Non-Fed	2001-2020 Private	2001-2020 Total	Total
WATER WITHDRAWALS													
MUNICIPALLY SUPPLIED	0.2	0.6	0	0.8	0.8	1.7	0	2.5	0.9	2.1	0	3.0	6.3
SELF-SUPPLIED INDUSTRIAL	0	0	0	0	0	0	0	0	0	0	1.1	1.1	1.1
RURAL DOMESTIC & LIVESTOCK	0	0	0	0	0.0	0	0.1	0.1	0	0	0	0	0.1
IRRIGATION	0	0	0.2	0.2	0	0	0.1	0.1	0	0	0.2	0.2	0.5
MINING	0	0	1.4	1.4	0	0	1.4	1.4	0	0	2.0	2.0	4.8
THERMAL POWER COOLING	0	0	0	0	0	1.5	28.3	29.8	0	1.7	32.7	34.4	64.2
NON-WITHDRAWAL WATER USES													
MUNICIPAL WASTEWATER DISCHARGES	6.0	2.0	0	8.0	2.9	0.9	0	3.8	3.6	1.2	0	4.8	16.6
INDUSTRIAL WASTEWATER DISCHARGES	---	---	---	---	---	---	---	---	---	---	---	---	---
HYDROELECTRIC POWER	---	---	---	---	---	---	---	---	---	---	---	---	---
WATER ORIENTED OUTDOOR REC.	---	---	---	---	---	---	---	---	---	---	---	---	---
SPORT FISHING	0.6	1.4	0	2.0	0.4	0.4	0	0.8	0.3	0.5	0	0.8	3.6
RECREATIONAL BOATING	6.7	6.7	5.7	19.1	5.1	5.1	4.3	14.5	4.5	4.5	4.1	13.1	46.7

COMMERCIAL FISHING	---	---	---	---	---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	0	0	0	0	17.8	0	0	17.8	0	0	0	0	17.8
RELATED LAND USES & PROBLEMS													
AGRIC. LAND-TREATMENT	0.2	0	0.6	0.8	0.4	0	1.0	1.4	0.3	0	0.7	1.0	3.2
-CROPLAND DRAINAGE	0.4	0	0.8	1.2	0.1	0	0.4	0.5	0	0	0	0	1.7
FOREST LAND-TREATMENT	11.4	0.7	2.2	14.3	23.4	1.4	4.4	29.2	23.5	1.4	4.4	29.3	72.8
SHORELAND EROSION	0.0	0	0.1	0.1	0.1	0	0.2	0.3	0.1	0	0.2	0.3	0.7
STREAMBANK EROSION	0.1	0	0.1	0.2	0.2	0	0.4	0.6	0.3	0	0.7	1.0	1.8
FLOOD PLAINS-URBAN	---	---	---	---	---	---	---	---	---	---	---	---	---
-URBAN	2.4	0	0.8	3.2	0.4	0	0.1	0.5	1.0	0	0.4	1.4	5.1
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
WILDLIFE MANAGEMENT	0.2	1.8	0	2.0	0.7	6.3	0	7.0	1.2	10.8	0	12.0	21.0
AESTHETIC & CULTURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	10.9	20.2	0	31.1	2.8	5.3	0	8.1	2.8	5.2	0	8.0	47.2
-EXTENSIVE	---	---	---	---	---	---	---	---	---	---	---	---	---
TOTAL	39.1	33.4	11.9	84.4	55.1	22.6	40.7	118.4	38.5	27.4	46.5	112.4	315.2

TABLE 1–378 Minnesota, Operation, Maintenance, and Replacement Costs, Normal Framework (in $1,000,000)

RESOURCE USE CATEGORY	1971-1980				1981-2000				2001-2020				
	Federal	Non-Fed	Private	Total	Federal	Non-Fed	Private	Total	Federal	Non-Fed	Private	Total	Total
WATER WITHDRAWALS													
MUNICIPALLY SUPPLIED	0	0.5	0	0.5	0	4.9	0	4.9	0	11.4	0	11.4	16.8
SELF-SUPPLIED INDUSTRIAL	0	0	0	0	0	0	0	0	0	0	2.5	2.5	2.5
RURAL DOMESTIC & LIVESTOCK	0	0	0.1	0.1	0	0	0.5	0.5	0	0	1.1	1.1	1.7
IRRIGATION	0	0	0	0	0	0	0.2	0.2	0	0	0.2	0.2	0.4
MINING	0	0	1.4	1.4	0	0	8.4	8.4	0	0	15.5	15.5	25.3
THERMAL POWER COOLING	0	0	0	0	0	0.8	14.5	15.3	0	2.4	45.8	48.2	63.5
NON-WITHDRAWAL WATER USES													
MUNICIPAL WASTEWATER DISCHARGES	0	10.0	0	10.0	0	78.0	0	78.0	0	92.0	0	92.0	180.0
INDUSTRIAL WASTEWATER DISCHARGES	---	---	---	---	---	---	---	---	---	---	---	---	---
HYDROELECTRIC POWER	---	---	---	---	---	---	---	---	---	---	---	---	---
WATER ORIENTED OUTDOOR REC.	---	---	---	---	---	---	---	---	---	---	---	---	---
SPORT FISHING	0.3	0.7	0	1.0	0.1	0.2	0	0.3	0.3	0.6	0	0.9	2.2
RECREATIONAL BOATING	0	0	5.2	5.2	0	0	32.1	32.1	0	0	54.0	54.0	91.3
COMMERCIAL FISHING	---	---	---	---	---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	0	0	0	0	4.0	0	0	4.0	8.0	0	0	8.0	12.0
RELATED LAND USES & PROBLEMS													
AGRIC. LAND-TREATMENT	0	0	0.0	0.0	0	0	0.1	0.1	0	0	0.3	0.3	0.4
-CROPLAND DRAINAGE	0	0	0.0	0.0	0	0	0.2	0.2	0	0	0.1	0.1	0.3
FOREST LAND-TREATMENT	0.0	0.1	6.9	0.3	0.3	0.6	2.0	2.9	0.6	1.2	4.0	5.8	9.0
SHORELAND EROSION	0.0	0	0.0	0.0	0.0	0	0.1	0.1	0.1	0	0.2	0.3	0.4
STREAMBANK EROSION	0	0	0	0	0	0	0.2	0.2	0	0	0.6	0.6	0.8
FLOOD PLAINS-URBAN	---	---	---	---	---	---	---	---	---	---	---	---	---
-URBAN	0	0	0	0	0.0	0.3	0	0.3	0.0	0.2	0	0.2	0.5
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
WILDLIFE MANAGEMENT	0	0.1	0	0.1	0	0.3	0	0.3	0	0.6	0	0.6	1.0
AESTHETIC & CULTURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	0.6	2.5	0	3.1	4.4	17.6	0	22.0	8.3	33.1	0	41.4	66.5
-EXTENSIVE	---	---	---	---	---	---	---	---	---	---	---	---	---
TOTAL	0.9	13.9	6.9	21.7	8.8	102.7	58.3	169.8	17.3	141.5	124.3	283.1	474.6

TABLE 1–379 Minnesota, Needs, Outputs, and Percent Needs Met, Proposed Framework

RESOURCE USE CATEGORY	UNIT	1970 SUPPLY	1980 N	1980 O	1980 %	2000 N	2000 O	2000 %	2020 N	2020 O	2020 %
WATER WITHDRAWALS											
MUNICIPALLY SUPPLIED	MILLION GALLONS PER DAY	26	3.0	3.0	100	12.1	12.1	100	23.0	23.0	100
SELF-SUPPLIED INDUSTRIAL	MILLION GALLONS PER DAY	68	+	---	---	+	---	---	15.0	15.0	100
RURAL DOMESTIC & LIVESTOCK	MILLION GALLONS PER DAY	5.2	0.2	0.2	100	1.3	1.3	100	1.8	1.8	100
IRRIGATION	MILLION GALLONS PER DAY	5.9	3.8	3.8	100	9.6	9.6	100	15.2	15.2	100
MINING	MILLION GALLONS PER DAY	542	20.4	20.4	100	42.2	42.2	100	72.8	72.8	100
THERMAL POWER COOLING	MILLION GALLONS PER DAY	250	0	0	---	850	850	100	1,830	1,830	100
NON-WITHDRAWAL WATER USES											
MUNICIPAL WASTEWATER DISCHARGES	MILLION GALLONS PER DAY	23	28.1	28.1	100	34.2	34.2	100	42.2	42.2	100
INDUSTRIAL WASTEWATER DISCHARGES	MILLION GALLONS PER DAY	32	23.6	23.6	100	23.6	23.6	100	34.9	34.9	100
HYDROELECTRIC POWER	MILLION GALLONS PER DAY	NA	0	---	---	0	---	---	0	---	---
WATER ORIENTED OUTDOOR REC.	1000 RECREATION DAYS	NA	+	1,710	over	+	4,315	over	+	6,930	over
	1000 ACRES WATER SURFACE	NA	---	---	---	---	---	---	---	---	---
SPORT FISHING	1000 ANGLER DAYS	3,170	710	400	56	1,370	900	66	2,080	1,500	72
	1000 ACRES WATER SURFACE	NA	---	---	---	---	---	---	---	---	---
RECREATIONAL BOATING	1000 BOAT DAYS	1,301.6	193	177	92	306	316	over	424	480	over
	1000 ACRES WATER SURFACE	NA	---	---	---	---	---	---	---	---	---
COMMERCIAL FISHING	MILLION TONS PER YEAR	NA	---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	MILLION TONS PER YEAR		---	---	---	---	---	---	---	---	---
RELATED LAND USES & PROBLEMS											
AGRIC. LAND-TREATMENT	1000 ACRES	216	216	39.8	18	216	114	53	216	158	73
-CROPLAND DRAINAGE	1000 ACRES	57.5	57.5	0	0	57.5	0	0	57.5	0	0
FOREST LAND-TREATMENT	1000 ACRES	3,840	3,840	768	20	3,840	2,300	60	3,840	3,840	100
SHORELAND EROSION	MILES	11.4	11.4	0.1	1	11.4	0.3	3	11.4	0.5	4
STREAMBANK EROSION	MILES	164	179	7.6	4	179	22.8	13	179	38.0	21
	$1000 AVE ANNUAL DAMAGES	3.7	3.7	0.7	20	3.7	2.2	60	3.7	3.7	100
FLOOD PLAINS-URBAN	1000 ACRES	0.1	0.1	0.1	100	0.1	0.1	100	0.1	0.1	100
-URBAN	$1000 AVE ANNUAL DAMAGES	79	102	87.5	86	171	152	89	284	264	93
-RURAL	1000 ACRES	3.4	112	51.3	46	112	55.6	50	112	60.9	54
-RURAL	$1000 AVE ANNUAL DAMAGES	0	63.2	36.2	57	108	44.3	41	189	54.0	29
WILDLIFE MANAGEMENT	1000 ACRES	NA	0	114	over	40	384	over	100	736	over
	1000 USER DAYS	NA	34.8	17.0	49	36.2	35.0	97	42.9	56.1	over
AESTHETIC & CULTURAL	1000 ACRES	NA	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	1000 ACRES		---	1.1	---	---	2.8	---	---	4.5	---
-EXTENSIVE	1000 ACRES	NA	---	0.8	---	---	0.8	---	---	0.8	---

TABLE 1–380 Minnesota, Capital Costs, Proposed Framework (in $1,000,000)

RESOURCE USE CATEGORY	1971-1980 Federal	1971-1980 Non-Fed	1971-1980 Private	1971-1980 Total	1981-2000 Federal	1981-2000 Non-Fed	1981-2000 Private	1981-2000 Total	2001-2020 Federal	2001-2020 Non-Fed	2001-2020 Private	2001-2020 Total	Total
WATER WITHDRAWALS													
MUNICIPALLY SUPPLIED	0.2	0.6	0	0.8	0.8	1.7	0	2.5	0.9	2.1	0	3.0	6.3
SELF-SUPPLIED INDUSTRIAL	0	0	0	0	0	0	0	0	0	0	1.1	1.1	1.1
RURAL DOMESTIC & LIVESTOCK	0	0	0	0	0.0	0	0.1	0.1	0	0	0	0	0.1
IRRIGATION	0	0	0.2	0.2	0	0	0.1	0.1	0	0	0.2	0.2	0.5
MINING	0	0	1.4	1.4	0	0	1.4	1.4	0	0	2.0	2.0	4.8
THERMAL POWER COOLING	0	0	0	0	0	1.5	28.3	29.8	0	1.7	32.7	34.4	64.2
NON-WITHDRAWAL WATER USES													
MUNICIPAL WASTEWATER DISCHARGES	24.0	8.0	0	32.0	15.8	5.2	0	21.0	12.0	4.0	0	16.0	69.0
INDUSTRIAL WASTEWATER DISCHARGES	---	---	---	---	---	---	---	---	---	---	---	---	---
HYDROELECTRIC POWER	---	---	---	---	---	---	---	---	---	---	---	---	---
WATER ORIENTED OUTDOOR REC.	---	---	---	---	---	---	---	---	---	---	---	---	---
SPORT FISHING	0.6	1.4	0	2.0	0.4	0.4	0	0.8	0.3	0.5	0	0.8	3.6
RECREATIONAL BOATING	6.7	6.7	5.7	19.1	5.1	5.1	4.3	14.5	4.5	4.5	4.1	13.1	46.7

COMMERCIAL FISHING	---	---	---	---	---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	33.6	0	0	33.6	17.8	0	0	17.8	0	0	0	0	51.4
RELATED LAND USES & PROBLEMS													
AGRIC. LAND-TREATMENT	0.1	0	0.4	0.5	0.3	0	0.9	1.2	0.2	0	0.4	0.6	2.3
-CROPLAND DRAINAGE	0	0	0	0	0	0	0	0	0	0	0	0	0
FOREST LAND-TREATMENT	21.2	1.3	4.0	26.5	43.5	2.7	8.2	54.4	43.5	2.7	8.2	54.4	135.3
SHORELAND EROSION	0.0	0	0.1	0.1	0.1	0	0.2	0.3	0.1	0	0.2	0.3	0.7
STREAMBANK EROSION	0.1	0	0.1	0.2	0.2	0	0.4	0.6	0.3	0	0.7	1.0	1.8
FLOOD PLAINS-URBAN	---	---	---	---	---	---	---	---	---	---	---	---	---
-URBAN	2.4	0	0.8	3.2	0.4	0	0.1	0.5	1.0	0	0.4	1.4	5.1
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
WILDLIFE MANAGEMENT	0.2	1.8	0	2.0	0.7	6.3	0	7.0	1.2	10.8	0	12.0	21.0
AESTHETIC & CULTURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	10.9	20.2	0	31.1	2.8	5.3	0	8.1	2.8	5.2	0	8.0	47.2
-EXTENSIVE	---	---	---	---	---	---	---	---	---	---	---	---	---
TOTAL	100.0	40.0	12.7	152.7	87.9	28.2	44.0	160.1	66.8	31.5	50.0	148.3	461.1

TABLE 1-381 Minnesota, Operation, Maintenance, and Replacement Costs, Proposed Framework (in $1,000,000)

	1971-1980				1981-2000				2001-2020				
RESOURCE USE CATEGORY	Federal	Non-Fed	Private	Total	Federal	Non-Fed	Private	Total	Federal	Non-Fed	Private	Total	Total
WATER WITHDRAWALS													
MUNICIPALLY SUPPLIED	0	0.5	0	0.5	0	4.9	0	4.9	0	11.4	0	11.4	16.8
SELF-SUPPLIED INDUSTRIAL	0	0	0	0	0	0	0	0	0	0	2.5	2.5	2.5
RURAL DOMESTIC & LIVESTOCK	0	0	0.1	0.1	0	0	0.5	0.5	0	0	1.1	1.1	1.7
IRRIGATION	0	0	0	0	0	0	0.2	0.2	0	0	0.2	0.2	0.4
MINING	0	0	1.4	1.4	0	0	8.4	8.4	0	0	15.5	15.5	25.3
THERMAL POWER COOLING	0	0	0	0	0	0.8	14.5	15.3	0	2.4	45.8	48.2	63.5
NON-WITHDRAWAL WATER USES													
MUNICIPAL WASTEWATER DISCHARGES	0	62.7	0	62.7	0	138.1	0	138.1	0	186.9	0	186.9	387.7
INDUSTRIAL WASTEWATER DISCHARGES	---	---	---	---	---	---	---	---	---	---	---	---	---
HYDROELECTRIC POWER	---	---	---	---	---	---	---	---	---	---	---	---	---
WATER ORIENTED OUTDOOR REC.	---	---	---	---	---	---	---	---	---	---	---	---	---
SPORT FISHING	0.3	0.7	0	1.0	0.1	0.2	0	0.3	0.3	0.6	0	0.9	2.2
RECREATIONAL BOATING	0	0	5.2	5.2	0	0	32.1	32.1	0	0	54.0	54.0	91.3
COMMERCIAL FISHING	---	---	---	---	---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	6.0	0	0	6.0	28.0	0	0	28.0	32.0	0	0	32.0	66.0
RELATED LAND USES & PROBLEMS													
AGRIC. LAND-TREATMENT	0	0	0.0	0.0	0	0	0.1	0.1	0	0	0.2	0.2	0.3
-CROPLAND DRAINAGE	0	0	0	0	0	0	0	0	0	0	0	0	0
FOREST LAND-TREATMENT	0.1	0.1	0.5	0.7	0.6	1.2	4.4	6.2	0.8	1.7	5.9	8.4	15.3
SHORELAND EROSION	0.0	0	0.0	0.0	0.0	0	0.1	0.1	0.1	0	0.2	0.3	0.4
STREAMBANK EROSION	0	0	0	0	0	0	0.2	0.2	0	0	0.6	0.6	0.8
FLOOD PLAINS-URBAN	---	---	---	---	---	---	---	---	---	---	---	---	---
-URBAN	0	0	0	0	0.0	0.3	0	0.3	0.0	0.2	0	0.2	0.5
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
WILDLIFE MANAGEMENT	0	0.1	0	0.1	0	0.3	0	0.3	0	0.6	0	0.6	1.0
AESTHETIC & CULTURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	0.6	2.5	0	3.1	4.4	17.6	0	22.0	8.3	33.1	0	41.4	66.5
-EXTENSIVE	---	---	---	---	---	---	---	---	---	---	---	---	---
TOTAL	7.0	66.6	7.2	80.8	33.1	163.4	60.5	257.0	41.5	236.9	126.0	404.4	742.2

TABLE 1–382 New York, Needs, Outputs, and Percent Needs Met, Normal Framework

RESOURCE USE CATEGORY	UNIT	1970 SUPPLY	1980 N	1980 O	1980 %	2000 N	2000 O	2000 %	2020 N	2020 O	2020 %
WATER WITHDRAWALS											
MUNICIPALLY SUPPLIED	MILLION GALLONS PER DAY		78.1	78.1	100	333	333	100	644	644	100
SELF-SUPPLIED INDUSTRIAL	MILLION GALLONS PER DAY		156	156	100	566	566	100	1,240	1,240	100
RURAL DOMESTIC & LIVESTOCK	MILLION GALLONS PER DAY		9.4	9.4	100	23.4	23.4	100	38.4	38.4	100
IRRIGATION	MILLION GALLONS PER DAY		69.9	69.9	100	174	174	100	301	301	100
MINING	MILLION GALLONS PER DAY		16.3	16.3	100	48.0	48.0	100	102	102	100
THERMAL POWER COOLING	MILLION GALLONS PER DAY		3,920	3,920	100	5,900	5,900	100	12,700	12,700	100
NON-WITHDRAWAL WATER USES											
MUNICIPAL WASTEWATER DISCHARGES	MILLION GALLONS PER DAY		630	630	100	841	841	100	1,050	1,050	100
INDUSTRIAL WASTEWATER DISCHARGES	MILLION GALLONS PER DAY		1,380	1,380	100	1,020	1,020	100	1,650	1,650	100
HYDROELECTRIC POWER	MILLION GALLONS PER DAY		0	0	---	4,000	4,000	100	57,900	57,900	100
WATER ORIENTED OUTDOOR REC.	1000 RECREATION DAYS		---	13,100	---	---	32,500	---	---	47,700	---
	1000 ACRES WATER SURFACE		---	---	---	---	---	---	---	---	---
SPORT FISHING	1000 ANGLER DAYS		5,980	4,510	75	11,300	9,390	83	17,100	15,000	88
	1000 ACRES WATER SURFACE		---	---	---	---	---	---	---	---	---
RECREATIONAL BOATING	1000 BOAT DAYS		850	468	55	1,440	1,210	84	2,270	2,110	93
	1000 ACRES WATER SURFACE		---	---	---	---	---	---	---	---	---
COMMERCIAL FISHING	MILLION TONS PER YEAR		---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	MILLION TONS PER YEAR		---	---	---	---	---	---	---	---	---
RELATED LAND USES & PROBLEMS											
AGRIC. LAND-TREATMENT	1000 ACRES		3,080	259	8	3,080	777	25	3,080	1,090	35
-CROPLAND DRAINAGE	1000 ACRES		762	91.1	12	752	157	21	762	157	21
FOREST LAND-TREATMENT	1000 ACRES		4,730	368	8	4,730	1,110	23	4,730	1,850	39
SHORELAND EROSION	MILES		196	3.4	2	196	10.1	5	196	16.8	9
STREAMBANK EROSION	MILES		1,675	41.3	2	1,675	124	7	1,675	207	12
	$1000 AVE ANNUAL DAMAGES		381	72.4	19	381	217	57	381	362	95
FLOOD PLAINS-URBAN	1000 ACRES		36.2	16.5	46	39.1	27.7	71	41.9	33.8	81
-URBAN	$1000 AVE ANNUAL DAMAGES		1,470	755	51	2,990	2,490	83	6,140	5,480	89
-RURAL	1000 ACRES		339	55.2	16	336	125	37	333	187	56
-RURAL	$1000 AVE ANNUAL DAMAGES		2,750	791	29	4,610	2,280	49	8,170	5,210	64
WILDLIFE MANAGEMENT	1000 ACRES		110	173	over	702	395	56	1,290	619	48
	1000 USER DAYS		795	255	32	1,450	795	55	2,110	1,150	55
AESTHETIC & CULTURAL	1000 ACRES		---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	1000 ACRES		---	7.4	---	---	16.6	---	---	22.2	---
-EXTENSIVE	1000 ACRES		---	42.3	---	---	97.0	---	---	131	---

TABLE 1–383 New York, Capital Costs, Normal Framework (in $1,000,000)

RESOURCE USE CATEGORY	1971-1980 Federal	1971-1980 Non-Fed	1971-1980 Private	1971-1980 Total	1981-2000 Federal	1981-2000 Non-Fed	1981-2000 Private	1981-2000 Total	2001-2020 Federal	2001-2020 Non-Fed	2001-2020 Private	2001-2020 Total	Total
WATER WITHDRAWALS													
MUNICIPALLY SUPPLIED	6.8	15.8	0	22.6	22.6	52.6	0	75.2	26.9	62.8	0	89.7	187.5
SELF-SUPPLIED INDUSTRIAL	0	0	12.7	12.7	0	0	33.7	33.7	0	0	55.4	55.4	101.8
RURAL DOMESTIC & LIVESTOCK	0.0	0	0.3	0.3	0.1	0	0.5	0.6	0.1	0	0.6	0.7	1.6
IRRIGATION	0	0	1.6	1.6	0	0	1.7	1.7	0	0	3.1	3.1	6.4
MINING	0	0	0.9	0.9	0	0	1.5	1.5	0	0	4.0	4.0	6.4
THERMAL POWER COOLING	0	6.9	130.2	137.1	0	4.6	87.3	91.9	0	11.9	226.1	238.0	467.0
NON-WITHDRAWAL WATER USES													
MUNICIPAL WASTEWATER DISCHARGES	201.0	67.0	0	268.0	92.3	30.7	0	123.0	172.5	57.5	0	230.0	621.0
INDUSTRIAL WASTEWATER DISCHARGES	---	---	---	---	---	---	---	---	---	---	---	---	---
HYDROELECTRIC POWER	---	---	---	---	---	---	---	---	---	---	---	---	---
WATER ORIENTED OUTDOOR REC.	---	---	---	---	---	---	---	---	---	---	---	---	---
SPORT FISHING	8.9	8.9	0	17.8	11.9	5.9	0	17.8	15.9	7.9	0	23.8	59.4
RECREATIONAL BOATING	17.4	17.4	14.8	49.6	18.9	18.9	16.4	54.2	16.3	16.3	14.0	46.6	150.4

COMMERCIAL FISHING	---	---	---	---	---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	0	0	0	0	0	0	0	0	0	0	0	0	0
RELATED LAND USES & PROBLEMS													
AGRIC. LAND-TREATMENT	2.9	0	7.5	10.4	5.9	0	15.3	21.2	3.5	0	9.1	12.6	44.2
-CROPLAND DRAINAGE	6.1	0	14.1	20.2	4.1	0	9.7	13.8	0	0	0	0	34.0
FOREST LAND-TREATMENT	17.8	1.1	3.3	22.2	35.6	2.2	6.7	44.5	35.5	2.2	6.7	44.4	111.1
SHORELAND EROSION	0.6	0	2.6	3.2	1.3	0	5.0	6.3	1.3	0	5.0	6.3	15.8
STREAMBANK EROSION	0.6	0	1.4	2.0	1.7	0	4.2	5.9	2.7	0	7.1	9.8	17.7
FLOOD PLAINS-URBAN	---	---	---	---	---	---	---	---	---	---	---	---	---
-URBAN	27.3	0	9.1	36.4	163.3	0	54.5	217.8	0.3	0	0.1	0.4	254.6
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
WILDLIFE MANAGEMENT	1.4	12.8	0	14.2	3.9	34.8	0	38.7	2.6	23.7	0	26.3	79.2
AESTHETIC & CULTURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	42.4	78.8	0	121.2	60.7	112.6	0	173.3	54.8	101.9	0	156.7	451.2
-EXTENSIVE	---	---	---	---	---	---	---	---	---	---	---	---	---
TOTAL	333.2	208.7	198.5	740.4	422.3	262.3	236.5	921.1	332.4	284.2	331.2	947.8	2,609.3

TABLE 1–384 New York, Operation, Maintenance, and Replacement Costs, Normal Framework (in $1,000,000)

	1971-1980				1981-2000				2001-2020				
RESOURCE USE CATEGORY	Federal	Non-Fed	Private	Total	Federal	Non-Fed	Private	Total	Federal	Non-Fed	Private	Total	Total
WATER WITHDRAWALS													
MUNICIPALLY SUPPLIED	0	11.1	0	11.1	0	121.7	0	121.7	0	289.0	0	289.0	421.8
SELF-SUPPLIED INDUSTRIAL	0	0	11.5	11.5	0	0	105.9	105.9	0	0	265.3	265.3	382.7
RURAL DOMESTIC & LIVESTOCK	0	0	0.8	0.8	0	0	5.3	5.3	0	0	9.3	9.3	15.4
IRRIGATION	0	0	0.3	0.3	0	0	1.4	1.4	0	0	2.5	2.5	4.2
MINING	0	0	0.6	0.6	0	0	5.1	5.1	0	0	11.9	11.9	17.6
THERMAL POWER COOLING	0	1.8	33.4	35.2	0	8.9	168.1	177.0	0	16.8	317.7	334.5	546.7
NON-WITHDRAWAL WATER USES													
MUNICIPAL WASTEWATER DISCHARGES	0	168.0	0	168.0	0	280.0	0	280.0	0	320.0	0	320.0	768.0
INDUSTRIAL WASTEWATER DISCHARGES	---	---	---	---	---	---	---	---	---	---	---	---	---
HYDROELECTRIC POWER	---	---	---	---	---	---	---	---	---	---	---	---	---
WATER ORIENTED OUTDOOR REC.	---	---	---	---	---	---	---	---	---	---	---	---	---
SPORT FISHING	3.8	3.9	0	7.7	9.3	4.6	0	13.9	10.6	5.3	0	15.9	37.5
RECREATIONAL BOATING	0	0	12.1	12.1	0	0	77.2	77.2	0	0	132.6	132.6	221.9
COMMERCIAL FISHING	---	---	---	---	---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	0	0	0	0	0	0	0	0	0	0	0	0	0
RELATED LAND USES & PROBLEMS													
AGRIC. LAND-TREATMENT	0	0	0.3	0.3	0	0	2.1	2.1	0	0	3.8	3.8	6.2
-CROPLAND DRAINAGE	0	0	0.5	0.5	0	0	2.6	2.6	0	0	3.4	3.4	6.5
FOREST LAND-TREATMENT	0.1	0.1	0.5	0.7	0.4	0.9	3.2	4.5	0.9	1.8	6.3	9.0	14.2
SHORELAND EROSION	0.1	0	0.2	0.3	0.5	0	2.1	2.6	1.0	0	4.0	5.0	7.9
STREAMBANK EROSION	0	0	0	0	0	0	1.9	1.9	0	0	4.9	4.9	6.8
FLOOD PLAINS-URBAN	---	---	---	---	---	---	---	---	---	---	---	---	---
-URBAN	0.0	0.1	0	0.1	0.1	1.7	0	1.8	0.1	2.6	0	2.7	4.6
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
WILDLIFE MANAGEMENT	0	0.7	0	0.7	0	1.9	0	1.9	0	1.3	0	1.3	3.9
AESTHETIC & CULTURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	7.9	31.7	0	39.6	51.5	206.0	0	257.5	88.6	354.3	0	442.9	740.0
-EXTENSIVE	---	---	---	---	---	---	---	---	---	---	---	---	---
TOTAL	11.9	217.4	60.2	289.5	61.8	625.7	374.9	1,062.4	101.2	991.1	761.7	1,854.0	3,205.9

TABLE 1-385 New York, Needs, Outputs, and Percent Needs Met, Proposed Framework

RESOURCE USE CATEGORY	UNIT	1970 SUPPLY	1980 N	1980 O	1980 %	2000 N	2000 O	2000 %	2020 N	2020 O	2020 %
WATER WITHDRAWALS											
MUNICIPALLY SUPPLIED	MILLION GALLONS PER DAY	635	78.1	78.1	100	333	333	100	644	644	100
SELF-SUPPLIED INDUSTRIAL	MILLION GALLONS PER DAY	1,187	156	156	100	566	566	100	1,240	1,240	100
RURAL DOMESTIC & LIVESTOCK	MILLION GALLONS PER DAY	66	9.4	9.4	100	23.4	23.4	100	38.4	38.4	100
IRRIGATION	MILLION GALLONS PER DAY	65.3	69.9	69.9	100	174	174	100	301	301	100
MINING	MILLION GALLONS PER DAY	25	16.3	16.3	100	48.0	48.0	100	102	102	100
THERMAL POWER COOLING	MILLION GALLONS PER DAY	3,109	3,920	3,920	100	5,900	5,900	100	12,700	12,700	100
NON-WITHDRAWAL WATER USES											
MUNICIPAL WASTEWATER DISCHARGES	MILLION GALLONS PER DAY	590	630	630	100	841	841	100	1,050	1,050	100
INDUSTRIAL WASTEWATER DISCHARGES	MILLION GALLONS PER DAY	1,551	1,380	1,380	100	1,020	1,020	100	1,650	1,650	100
HYDROELECTRIC POWER	MILLION GALLONS PER DAY	NA	0	0	---	4,000	4,000	100	57,900	57,900	100
WATER ORIENTED OUTDOOR REC.	1000 RECREATION DAYS	NA	---	13,100	---	---	32,500	---	---	47,700	---
	1000 ACRES WATER SURFACE	NA	---	---	---	---	---	---	---	---	---
SPORT FISHING	1000 ANGLER DAYS	15,410	5,980	4,510	75	11,300	9,390	83	17,100	15,000	88
	1000 ACRES WATER SURFACE	NA	---	---	---	---	---	---	---	---	---
RECREATIONAL BOATING	1000 BOAT DAYS	4,639	850	468	55	1,440	1,210	84	2,270	2,110	93
	1000 ACRES WATER SURFACE	NA	---	---	---	---	---	---	---	---	---
COMMERCIAL FISHING	MILLION TONS PER YEAR	NA	---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	MILLION TONS PER YEAR		---	---	---	---	---	---	---	---	---
RELATED LAND USES & PROBLEMS											
AGRIC. LAND-TREATMENT	1000 ACRES	3,080	3,080	565	18	3,080	1,620	53	3,080	2,260	73
-CROPLAND DRAINAGE	1000 ACRES	762	762	41.5	5	762	119	16	762	166	22
FOREST LAND-TREATMENT	1000 ACRES	4,730	4,730	482	10	4,730	1,450	31	4,730	410	51
SHORELAND EROSION	MILES	196	196	3.4	2	196	10.1	5	196	16.8	9
STREAMBANK EROSION	MILES	1,675	1,675	41.3	2	1,675	124	7	1,675	207	12
	$1000 AVE ANNUAL DAMAGES	381	381	72.4	19	381	217	57	381	362	95
FLOOD PLAINS-URBAN	1000 ACRES	32	36.2	16.5	46	39.1	27.7	71	41.9	33.8	81
-URBAN	$1000 AVE ANNUAL DAMAGES	942.3	1,470	755	51	2,990	2,490	83	6,140	5,480	89
-RURAL	1000 ACRES	309.1	339	55.2	16	336	125	37	333	187	56
-RURAL	$1000 AVE ANNUAL DAMAGES	1,620.7	2,750	791	29	4,610	2,280	49	8,170	5,210	64
WILDLIFE MANAGEMENT	1000 ACRES	NA	110	173	over	702	395	56	1,290	619	48
	1000 USER DAYS	NA	795	255	32	1,450	795	55	2,110	1,150	55
AESTHETIC & CULTURAL	1000 ACRES	NA	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	1000 ACRES		---	7.4	---	---	16.6	---	---	22.2	---
-EXTENSIVE	1000 ACRES	NA	---	42.3	---	---	97.0	---	---	131	---

TABLE 1-386 New York, Capital Costs, Proposed Framework (in $1,000,000)

RESOURCE USE CATEGORY	1971-1980 Federal	1971-1980 Non-Fed	1971-1980 Private	1971-1980 Total	1981-2000 Federal	1981-2000 Non-Fed	1981-2000 Private	1981-2000 Total	2001-2020 Federal	2001-2020 Non-Fed	2001-2020 Private	2001-2020 Total	Total
WATER WITHDRAWALS													
MUNICIPALLY SUPPLIED	6.8	15.8	0	22.6	22.6	52.6	0	75.2	26.9	62.8	0	89.7	187.5
SELF-SUPPLIED INDUSTRIAL	0	0	12.7	12.7	0	0	33.7	33.7	0	0	55.4	55.4	101.8
RURAL DOMESTIC & LIVESTOCK	0.0	0	0.3	0.3	0.1	0	0.5	0.6	0.1	0	0.6	0.7	1.6
IRRIGATION	0	0	1.6	1.6	0	0	1.7	1.7	0	0	3.1	3.1	6.4
MINING	0	0	0.9	0.9	0	0	1.5	1.5	0	0	4.0	4.0	6.4
THERMAL POWER COOLING	0	6.9	130.2	137.1	0	4.6	87.3	91.9	0	11.9	226.1	238.0	467.0
NON-WITHDRAWAL WATER USES													
MUNICIPAL WASTEWATER DISCHARGES	1,338.8	446.2	0	1,785.0	399.8	133.2	0	533	254.2	84.8	0	339.0	2,657.0
INDUSTRIAL WASTEWATER DISCHARGES	---	---	---	---	---	---	---	---	---	---	---	---	---
HYDROELECTRIC POWER	---	---	---	---	---	---	---	---	---	---	---	---	---
WATER ORIENTED OUTDOOR REC.	---	---	---	---	---	---	---	---	---	---	---	---	---
SPORT FISHING	8.9	8.9	0	17.8	11.9	5.9	0	17.8	15.9	7.9	0	23.8	59.4
RECREATIONAL BOATING	17.4	17.4	14.8	49.6	18.9	18.9	16.4	54.2	16.3	16.3	14.0	46.6	150.4

COMMERCIAL FISHING	---	---	---	---	---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	*92.0*	*0*	*0*	*92.0*	*320.0*	*0*	*0*	*320.0*	*0*	*0*	*0*	*0*	*412.0*
RELATED LAND USES & PROBLEMS													
AGRIC. LAND-TREATMENT	*4.2*	*0*	*10.9*	*15.1*	*8.0*	*0*	*20.6*	*28.6*	*4.9*	*0*	*12.5*	*17.4*	*61.1*
-CROPLAND DRAINAGE	*1.9*	*0*	*4.6*	*6.5*	*3.7*	*0*	*8.5*	*12.2*	*2.2*	*0*	*5.2*	*7.4*	*26.1*
FOREST LAND-TREATMENT	*24.8*	*1.5*	*4.7*	*31.0*	*46.4*	*2.9*	*8.7*	*58.0*	*46.4*	*2.9*	*8.7*	*58.0*	*147.0*
SHORELAND EROSION	0.6	0	2.6	3.2	1.3	0	5.0	6.3	1.3	0	5.0	6.3	15.8
STREAMBANK EROSION	0.6	0	1.4	2.0	1.7	0	4.2	5.9	2.7	0	7.1	9.8	17.7
FLOOD PLAINS-URBAN	---	---	---	---	---	---	---	---	---	---	---	---	---
-URBAN	27.3	0	9.1	36.4	163.3	0	54.5	217.8	0.3	0	0.1	0.4	254.6
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
WILDLIFE MANAGEMENT	1.4	12.8	0	14.2	3.9	34.8	0	38.7	2.6	23.7	0	26.3	79.2
AESTHETIC & CULTURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	42.4	78.8	0	121.2	60.7	112.6	0	173.3	54.8	101.9	0	156.7	451.2
-EXTENSIVE	---	---	---	---	---	---	---	---	---	---	---	---	---
TOTAL	*1,567.1*	*588.3*	*193.8*	*2,349.2*	*1,062.3*	*365.5*	*242.6*	*1,670.4*	*428.6*	*312.2*	*341.8*	*1,082.6*	*5,102.2*

TABLE 1–387 New York, Operation, Maintenance, and Replacement Costs, Proposed Framework (in $1,000,000)

	1971-1980				1981-2000				2001-2020				
RESOURCE USE CATEGORY	Federal	Non-Fed	Private	Total	Federal	Non-Fed	Private	Total	Federal	Non-Fed	Private	Total	Total
WATER WITHDRAWALS													
MUNICIPALLY SUPPLIED	0	11.1	0	11.1	0	121.7	0	121.7	0	289.0	0	289.0	421.8
SELF-SUPPLIED INDUSTRIAL	0	0	11.5	11.5	0	0	105.9	105.9	0	0	265.3	265.3	382.7
RURAL DOMESTIC & LIVESTOCK	0	0	0.8	0.8	0	0	5.3	5.3	0	0	9.3	9.3	15.4
IRRIGATION	0	0	0.3	0.3	0	0	1.4	1.4	0	0	2.5	2.5	4.2
MINING	0	0	0.6	0.6	0	0	5.1	5.1	0	0	11.9	11.9	17.6
THERMAL POWER COOLING	0	1.8	33.4	35.2	0	8.9	168.1	177.0	0	16.8	317.7	334.5	546.7
NON-WITHDRAWAL WATER USES													
MUNICIPAL WASTEWATER DISCHARGES	*0*	*711.6*	*0*	*711.6*	*0*	*1,725.3*	*0*	*1,725.3*	*0*	*3,042.2*	*0*	*3,042.2*	*5,479.1*
INDUSTRIAL WASTEWATER DISCHARGES	---	---	---	---	---	---	---	---	---	---	---	---	---
HYDROELECTRIC POWER	---	---	---	---	---	---	---	---	---	---	---	---	---
WATER ORIENTED OUTDOOR REC.	---	---	---	---	---	---	---	---	---	---	---	---	---
SPORT FISHING	3.8	3.9	0	7.7	9.3	4.6	0	13.9	10.6	5.3	0	15.9	37.5
RECREATIONAL BOATING	0	0	12.1	12.1	0	0	77.2	77.2	0	0	132.6	132.6	221.9
COMMERCIAL FISHING	---	---	---	---	---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	*10.0*	*0*	*0*	*10.0*	*80.0*	*0*	*0*	*80.0*	*120.0*	*0*	*0*	*120.0*	*210.0*
RELATED LAND USES & PROBLEMS													
AGRIC. LAND-TREATMENT	*0*	*0*	*0.3*	*0.3*	*0*	*0*	*3.3*	*3.3*	*0*	*0*	*5.4*	*5.4*	*9.0*
-CROPLAND DRAINAGE	*0*	*0*	*0.2*	*0.2*	*0*	*0*	*1.4*	*1.4*	*0*	*0*	*2.2*	*2.2*	*3.8*
FOREST LAND-TREATMENT	*0.1*	*0.2*	*0.6*	*0.9*	*0.8*	*1.5*	*5.4*	*7.7*	*1.1*	*2.2*	*7.6*	*10.9*	*19.5*
SHORELAND EROSION	0.1	0	0.2	0.3	0.5	0	2.1	2.6	1.0	0	4.0	5.0	7.9
STREAMBANK EROSION	0	0	0	0	0	0	1.9	1.9	0	0	4.9	4.9	6.8
FLOOD PLAINS-URBAN	---	---	---	---	---	---	---	---	---	---	---	---	---
-URBAN	0.0	0.1	0	0.1	0.1	1.7	0	1.8	0.1	2.6	0	2.7	4.6
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
WILDLIFE MANAGEMENT	0	0.7	0	0.7	0	1.9	0	1.9	0	1.3	0	1.3	3.9
AESTHETIC & CULTURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	7.9	31.7	0	39.6	51.5	206.0	0	257.5	88.6	354.3	0	442.9	740.0
-EXTENSIVE	---	---	---	---	---	---	---	---	---	---	---	---	---
TOTAL	*21.9*	*761.1*	*60.0*	*843.0*	*142.2*	*2,071.6*	*377.1*	*2,590.9*	*221.4*	*3,713.7*	*763.4*	*4,698.5*	*8,152.4*

TABLE 1-388 Ohio, Needs, Outputs, and Percent Needs Met, Normal Framework

RESOURCE USE CATEGORY	UNIT	1970 SUPPLY	1980 N	1980 O	1980 %	2000 N	2000 O	2000 %	2020 N	2020 O	2020 %
WATER WITHDRAWALS											
MUNICIPALLY SUPPLIED	MILLION GALLONS PER DAY		101	101	100	341	341	100	684	684	100
SELF-SUPPLIED INDUSTRIAL	MILLION GALLONS PER DAY		203	203	100	1,040	1,040	100	2,180	2,180	100
RURAL DOMESTIC & LIVESTOCK	MILLION GALLONS PER DAY		9.1	9.1	100	25.0	25.0	100	37.9	37.9	100
IRRIGATION	MILLION GALLONS PER DAY		0.6	0.6	100	56.0	56.0	100	155	155	100
MINING	MILLION GALLONS PER DAY		22.0	22.0	100	78.9	78.9	100	180	180	100
THERMAL POWER COOLING	MILLION GALLONS PER DAY		0	0	---	6,180	6,180	100	17,000	17,000	100
NON-WITHDRAWAL WATER USES											
MUNICIPAL WASTEWATER DISCHARGES	MILLION GALLONS PER DAY		805	805	100	1,060	1,060	100	1,380	1,380	100
INDUSTRIAL WASTEWATER DISCHARGES	MILLION GALLONS PER DAY		1,510	1,510	100	1,190	1,190	100	1,640	1,640	100
HYDROELECTRIC POWER	MILLION GALLONS PER DAY		0	---	---	0	---	---	0	---	---
WATER ORIENTED OUTDOOR REC.	1000 RECREATION DAYS		---	10,600	---	---	21,100	---	---	30,000	---
	1000 ACRES WATER SURFACE		---	---	---	---	---	---	---	---	---
SPORT FISHING	1000 ANGLER DAYS		2,490	2,490	100	9,350	9,350	100	13,700	13,700	100
	1000 ACRES WATER SURFACE		---	---	---	---	---	---	---	---	---
RECREATIONAL BOATING	1000 BOAT DAYS		301	224	74	706	677	96	1,130	1,050	93
	1000 ACRES WATER SURFACE		---	---	---	---	---	---	---	---	---
COMMERCIAL FISHING	MILLION TONS PER YEAR		---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	MILLION TONS PER YEAR		---	---	---	---	---	---	---	---	---
RELATED LAND USES & PROBLEMS											
AGRIC. LAND-TREATMENT	1000 ACRES		4,020	385	10	4,020	1,150	29	4,020	1,620	40
-CROPLAND DRAINAGE	1000 ACRES		2,460	50.1	2	2,460	218	9	2,460	476	19
FOREST LAND-TREATMENT	1000 ACRES		733	59.0	8	733	177	24	733	295	40
SHORELAND EROSION	MILES		52.2	2.9	6	52.2	8.8	17	52.2	14.6	28
STREAMBANK EROSION	MILES		991	29.8	3	991	88.8	9	991	148	15
	$1000 AVE ANNUAL DAMAGES		433	79.8	18	433	239	55	433	399	92
FLOOD PLAINS-URBAN	1000 ACRES		30.1	10.4	35	31.1	16.5	53	32.1	25.4	79
-URBAN	$1000 AVE ANNUAL DAMAGES		5,510	3,710	67	10,700	8,590	80	20,900	18,600	89
-RURAL	1000 ACRES		394	110	28	393	176	45	392	211	54
-RURAL	$1000 AVE ANNUAL DAMAGES		6,400	2,230	35	8,620	3,860	45	11,300	5,730	51
WILDLIFE MANAGEMENT	1000 ACRES		368	20.4	6	942	64.0	7	1,610	121	8
	1000 USER DAYS		2,790	168	6	4,430	471	11	6,260	914	15
AESTHETIC & CULTURAL	1000 ACRES		---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	1000 ACRES		---	3.2	---	---	6.3	---	---	8.8	---
-EXTENSIVE	1000 ACRES		---	19.2	---	---	37.3	---	---	51.5	---

TABLE 1-389 Ohio, Capital Costs, Normal Framework (in $1,000,000)

RESOURCE USE CATEGORY	1971-1980 Federal	1971-1980 Non-Fed	1971-1980 Private	1971-1980 Total	1981-2000 Federal	1981-2000 Non-Fed	1981-2000 Private	1981-2000 Total	2001-2020 Federal	2001-2020 Non-Fed	2001-2020 Private	2001-2020 Total	Total
WATER WITHDRAWALS													
MUNICIPALLY SUPPLIED	8.8	20.5	0	29.3	24.2	56.4	0	80.6	30.0	70.1	0	100.1	210.0
SELF-SUPPLIED INDUSTRIAL	0	0	15.2	15.2	0	0	63.6	63.6	0	0	87.2	87.2	166.0
RURAL DOMESTIC & LIVESTOCK	0.0	0	0.2	0.2	0.0	0	0.3	0.3	0.0	0	0.4	0.4	0.9
IRRIGATION	0	0	0.0	0.0	0	0	1.6	1.6	0	0	2.9	2.9	4.5
MINING	0	0	1.0	1.0	0	0	3.0	3.0	0	0	5.3	5.3	9.3
THERMAL POWER COOLING	0	0	0	0	0	10.7	204.0	214.7	0	18.9	359.7	378.6	593.3
NON-WITHDRAWAL WATER USES													
MUNICIPAL WASTEWATER DISCHARGES	141.0	47.0	0	188.0	290.3	96.8	0	387.1	354.8	118.2	0	473.0	1,048.1
INDUSTRIAL WASTEWATER DISCHARGES	---	---	---	---	---	---	---	---	---	---	---	---	---
HYDROELECTRIC POWER	---	---	---	---	---	---	---	---	---	---	---	---	---
WATER ORIENTED OUTDOOR REC.	---	---	---	---	---	---	---	---	---	---	---	---	---
SPORT FISHING	5.9	17.4	0	23.3	1.8	5.8	0	7.6	1.3	4.8	0	6.1	37.0
RECREATIONAL BOATING	17.2	17.2	14.8	49.2	34.3	34.3	29.4	98.0	22.2	22.2	19.0	63.4	210.6

COMMERCIAL FISHING	---	---	---	---	---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	0	0	0	0	0	0	0	0	0	0	0	0	0
RELATED LAND USES & PROBLEMS													
AGRIC. LAND-TREATMENT	4.6	0	12.0	16.6	9.3	0	24.0	33.3	5.6	0	14.3	19.9	69.8
-CROPLAND DRAINAGE	4.0	0	9.3	13.3	12.1	0	28.1	40.2	19.3	0	44.9	64.2	117.7
FOREST LAND-TREATMENT	3.0	0.2	0.5	3.7	6.8	0.4	1.3	8.5	6.8	0.4	1.3	8.5	20.7
SHORELAND EROSION	0.3	0	1.2	1.5	0.6	0	2.3	2.9	0.6	0	2.3	2.9	7.3
STREAMBANK EROSION	0.3	0	0.9	1.2	1.0	0	2.7	3.7	1.7	0	4.3	6.0	10.9
FLOOD PLAINS-URBAN	---	---	---	---	---	---	---	---	---	---	---	---	---
-URBAN	57.7	0	19.2	76.9	40.7	0	13.6	54.3	3.4	0	1.1	4.5	135.7
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
WILDLIFE MANAGEMENT	1.8	16.5	0	18.3	4.6	41.2	0	45.8	6.7	59.9	0	66.6	130.7
AESTHETIC & CULTURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	47.3	87.8	0	135.1	52.7	97.9	0	150.6	37.8	70.1	0	107.9	393.6
-EXTENSIVE	---	---	---	---	---	---	---	---	---	---	---	---	---
TOTAL	291.9	20.6	74.3	572.8	478.4	343.5	373.9	1,195.8	490.2	364.6	542.7	1,397.5	3,166.1

TABLE 1-390 Ohio, Operation, Maintenance, and Replacement Costs, Normal Framework (in $1,000,000)

	1971-1980				1981-2000				2001-2020				
RESOURCE USE CATEGORY	Federal	Non-Fed	Private	Total	Federal	Non-Fed	Private	Total	Federal	Non-Fed	Private	Total	Total
WATER WITHDRAWALS													
MUNICIPALLY SUPPLIED	0	14.8	0	14.8	0	129.9	0	129.9	0	296.9	0	296.9	441.6
SELF-SUPPLIED INDUSTRIAL	0	0	15.4	15.4	0	0	188.0	188.0	0	0	485.1	485.1	688.5
RURAL DOMESTIC & LIVESTOCK	0	0	0.8	0.8	0	0	5.9	5.9	0	0	10.8	10.8	17.5
IRRIGATION	0	0	0	0	0	0	0.5	0.5	0	0	1.7	1.7	2.2
MINING	0	0	1.2	1.2	0	0	11.4	11.4	0	0	29.5	29.5	42.1
THERMAL POWER COOLING	0	0	0	0	0	5.6	105.6	111.2	0	20.9	396.4	417.3	528.5
NON-WITHDRAWAL WATER USES													
MUNICIPAL WASTEWATER DISCHARGES	0	325.0	0	325.0	0	910.0	0	910.0	0	1,120.0	0	1,120.0	2,355.0
INDUSTRIAL WASTEWATER DISCHARGES	---	---	---	---	---	---	---	---	---	---	---	---	---
HYDROELECTRIC POWER	---	---	---	---	---	---	---	---	---	---	---	---	---
WATER ORIENTED OUTDOOR REC.	---	---	---	---	---	---	---	---	---	---	---	---	---
SPORT FISHING	0.4	1.2	0	1.6	1.0	3.2	0	4.2	1.0	3.8	0	4.8	10.6
RECREATIONAL BOATING	0	0	9.6	9.6	0	0	73.3	73.3	0	0	136.0	136.0	218.9
COMMERCIAL FISHING	---	---	---	---	---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	0	0	0	0	0	0	0	0	0	0	0	0	0
RELATED LAND USES & PROBLEMS													
AGRIC. LAND-TREATMENT	0	0	0.5	0.5	0	0	3.2	3.2	0	0	6.0	6.0	9.7
-CROPLAND DRAINAGE	0	0	0.3	0.3	0	0	3.4	3.4	0	0	8.6	8.6	12.3
FOREST LAND-TREATMENT	0.0	0.1	0.1	0.2	0.1	0.2	0.5	0.8	0.2	0.3	1.2	1.7	2.7
SHORELAND EROSION	0.0	0	0.1	0.1	0.2	0	1.0	1.2	0.5	0	1.9	2.4	3.7
STREAMBANK EROSION	0	0	0.1	0.1	0	0	1.2	1.2	0	0	3.1	3.1	4.4
FLOOD PLAINS-URBAN	---	---	---	---	---	---	---	---	---	---	---	---	---
-URBAN	0.0	0.2	0	0.2	0.1	1.8	0	1.9	0.1	2.3	0	2.4	4.5
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
WILDLIFE MANAGEMENT	0	0.9	0	0.9	0	2.3	0	2.3	0	3.8	0	3.8	7.0
AESTHETIC & CULTURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	5.5	22.0	0	27.5	33.9	135.8	0	169.7	55.0	220.2	0	275.2	472.4
-EXTENSIVE	---	---	---	---	---	---	---	---	---	---	---	---	---
TOTAL	5.9	364.2	28.1	398.2	35.3	1,188.8	394.0	1,618.1	56.8	1,668.2	1,080.3	2,805.3	4,821.6

TABLE 1-391 Ohio, Needs, Outputs, and Percent Needs Met, Proposed Framework

RESOURCE USE CATEGORY	UNIT	1970 SUPPLY	1980 N	1980 O	1980 %	2000 N	2000 O	2000 %	2020 N	2020 O	2020 %
WATER WITHDRAWALS											
MUNICIPALLY SUPPLIED	MILLION GALLONS PER DAY	674	101	101	100	341	341	100	684	684	100
SELF-SUPPLIED INDUSTRIAL	MILLION GALLONS PER DAY	1,605	203	203	100	1,040	1,040	100	2,180	2,180	100
RURAL DOMESTIC & LIVESTOCK	MILLION GALLONS PER DAY	61	9.1	9.1	100	25.0	25.0	100	37.9	37.9	100
IRRIGATION	MILLION GALLONS PER DAY	153.9	0.6	---	---	56.0	44.7	80	155	140	90
MINING	MILLION GALLONS PER DAY	42	22.0	22.0	100	78.9	40.2	51	180	66.3	37
THERMAL POWER COOLING	MILLION GALLONS PER DAY	3,400	0	0	---	6,180	6,180	100	17,000	17,000	100
NON-WITHDRAWAL WATER USES											
MUNICIPAL WASTEWATER DISCHARGES	MILLION GALLONS PER DAY	674	805	805	100	1,060	1,060	100	1,380	1,380	100
INDUSTRIAL WASTEWATER DISCHARGES	MILLION GALLONS PER DAY	1,674	1,510	1,510	100	1,190	1,190	100	1,640	1,640	100
HYDROELECTRIC POWER	MILLION GALLONS PER DAY	NA	0	---	---	0	---	---	0	---	---
WATER ORIENTED OUTDOOR REC.	1000 RECREATION DAYS	NA	---	10,600	---	---	21,100	---	---	30,000	---
	1000 ACRES WATER SURFACE	NA	---	---	---	---	---	---	---	---	---
SPORT FISHING	1000 ANGLER DAYS	19,116	2,490	2,490	100	9,350	9,350	100	13,700	13,700	100
	1000 ACRES WATER SURFACE	NA	---	---	---	---	---	---	---	---	---
RECREATIONAL BOATING	1000 BOAT DAYS	1,675	301	224	74	706	677	96	1,130	1,050	93
	1000 ACRES WATER SURFACE	NA	---	---	---	---	---	---	---	---	---
COMMERCIAL FISHING	MILLION TONS PER YEAR	NA	---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	MILLION TONS PER YEAR		---	---	---	---	---	---	---	---	---
RELATED LAND USES & PROBLEMS											
AGRIC. LAND-TREATMENT	1000 ACRES	4,020	4,020	846	21	4,020	2,420	60	4,020	3,380	84
-CROPLAND DRAINAGE	1000 ACRES	2,460	2,460	183	7	2,460	552	22	2,460	812	33
FOREST LAND-TREATMENT	1000 ACRES	733	733	119	16	733	356	49	733	594	81
SHORELAND EROSION	MILES	52.2	52.2	2.9	6	52.2	8.8	17	52.2	14.6	28
STREAMBANK EROSION	MILES	991	991	29.8	3	991	88.8	9	991	148	15
	$1000 AVE ANNUAL DAMAGES	433	433	79.8	18	433	239	55	433	399	92
FLOOD PLAINS-URBAN	1000 ACRES	26.1	30.1	10.4	35	31.1	16.5	53	32.1	25.4	79
-URBAN	$1000 AVE ANNUAL DAMAGES	3,590.1	5,510	3,710	67	10,700	8,590	80	20,900	18,600	89
-RURAL	1000 ACRES	145.1	394	110	28	393	176	45	392	211	54
-RURAL	$1000 AVE ANNUAL DAMAGES	1,108.9	6,400	2,230	35	8,620	3,860	45	11,300	5,730	51
WILDLIFE MANAGEMENT	1000 ACRES	NA	368	20.4	6	942	64.0	7	1,610	121	8
	1000 USER DAYS	NA	2,790	168	6	4,430	471	11	6,260	914	15
AESTHETIC & CULTURAL	1000 ACRES	NA	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	1000 ACRES		---	3.2	---	---	6.3	---	---	8.8	---
-EXTENSIVE	1000 ACRES	NA	---	19.2	---	---	37.3	---	---	51.5	---

TABLE 1-392 Ohio, Capital Costs, Proposed Framework (in $1,000,000)

RESOURCE USE CATEGORY	1971-1980 Federal	1971-1980 Non-Fed	1971-1980 Private	1971-1980 Total	1981-2000 Federal	1981-2000 Non-Fed	1981-2000 Private	1981-2000 Total	2001-2020 Federal	2001-2020 Non-Fed	2001-2020 Private	2001-2020 Total	Total
WATER WITHDRAWALS													
MUNICIPALLY SUPPLIED	8.8	20.5	0	29.3	24.2	56.4	0	80.6	30.0	70.1	0	100.1	210.0
SELF-SUPPLIED INDUSTRIAL	0	0	15.2	15.2	0	0	63.6	63.6	0	0	87.2	87.2	166.0
RURAL DOMESTIC & LIVESTOCK	0.0	0	0.2	0.2	0.0	0	0.3	0.3	0.0	0	0.4	0.4	0.9
IRRIGATION	0	0	0.0	0.0	0	0	1.2	1.2	0	0	3.0	3.0	4.2
MINING	0	0	0.7	0.7	0	0	0.7	0.7	0	0	0.9	0.9	2.3
THERMAL POWER COOLING	0	0	0	0	0	10.7	204.0	214.7	0	18.9	359.7	378.6	593.3
NON-WITHDRAWAL WATER USES													
MUNICIPAL WASTEWATER DISCHARGES	660.8	220.2	0	881.0	434.2	144.8	0	579.0	351.0	117.0	0	468.0	1,928.0
INDUSTRIAL WASTEWATER DISCHARGES	---	---	---	---	---	---	---	---	---	---	---	---	---
HYDROELECTRIC POWER	---	---	---	---	---	---	---	---	---	---	---	---	---
WATER ORIENTED OUTDOOR REC.	---	---	---	---	---	---	---	---	---	---	---	---	---
SPORT FISHING	5.9	17.4	0	23.3	1.8	5.8	0	7.6	1.3	4.8	0	6.1	37.0
RECREATIONAL BOATING	17.2	17.2	14.8	49.2	34.3	34.3	29.4	98.0	22.2	22.2	19.0	63.4	210.6

COMMERCIAL FISHING	---	---	---	---	---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	18.0	0	0	18.0	70.7	0	0	70.7	0	0	0	0	88.7
RELATED LAND USES & PROBLEMS													
AGRIC. LAND-TREATMENT	10.2	0	26.3	36.5	19.3	0	49.6	68.9	11.7	0	30.0	41.7	147.1
-CROPLAND DRAINAGE	9.9	0	23.2	33.1	17.0	0	39.8	56.8	12.7	0	29.8	42.5	132.4
FOREST LAND-TREATMENT	6.9	0.4	1.3	8.6	13.9	0.9	2.6	17.4	13.8	0.7	2.6	17.3	43.3
SHORELAND EROSION	0.3	0	1.2	1.5	0.6	0	2.3	2.9	0.6	0	2.3	2.9	7.3
STREAMBANK EROSION	0.3	0	0.9	1.2	1.0	0	2.7	3.7	1.7	0	4.3	6.0	10.9
FLOOD PLAINS-URBAN	---	---	---	---	---	---	---	---	---	---	---	---	---
-URBAN	57.7	0	19.2	76.9	40.7	0	13.6	54.3	3.4	0	1.1	4.5	135.7
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
WILDLIFE MANAGEMENT	1.8	16.5	0	18.3	4.6	41.2	0	45.8	6.7	59.9	0	66.6	130.7
AESTHETIC & CULTURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	47.3	87.8	0	135.1	52.7	97.9	0	150.6	37.8	70.1	0	107.9	393.6
-EXTENSIVE	---	---	---	---	---	---	---	---	---	---	---	---	---
TOTAL	845.1	380.0	103.0	1,328.1	715.0	392.0	409.8	1,516.8	429.9	363.9	540.3	1,397.1	4,242.0

TABLE 1-393 Ohio, Operation, Maintenance, and Replacement Costs, Proposed Framework (in $1,000,000)

	1971-1980				1981-2000				2001-2020				
RESOURCE USE CATEGORY	Federal	Non-Fed	Private	Total	Federal	Non-Fed	Private	Total	Federal	Non-Fed	Private	Total	Total
WATER WITHDRAWALS													
MUNICIPALLY SUPPLIED	0	14.8	0	14.8	0	129.9	0	129.9	0	296.9	0	296.9	441.6
SELF-SUPPLIED INDUSTRIAL	0	0	15.4	15.4	0	0	188.0	188.0	0	0	485.1	485.1	688.5
RURAL DOMESTIC & LIVESTOCK	0	0	0.8	0.8	0	0	5.9	5.9	0	0	10.8	10.8	17.5
IRRIGATION	0	0	0.0	0.0	0	0	0.4	0.4	0	0	1.5	1.5	1.9
MINING	0	0	1.3	1.3	0	0	7.1	7.1	0	0	11.7	11.7	20.1
THERMAL POWER COOLING	0	0	0	0	0	5.6	105.6	111.2	0	20.9	396.4	417.3	528.5
NON-WITHDRAWAL WATER USES													
MUNICIPAL WASTEWATER DISCHARGES	0	791.1	0	791.1	0	1,926.9	0	1,926.9	0	3,253.1	0	3,253.1	5,971.1
INDUSTRIAL WASTEWATER DISCHARGES	---	---	---	---	---	---	---	---	---	---	---	---	---
HYDROELECTRIC POWER	---	---	---	---	---	---	---	---	---	---	---	---	---
WATER ORIENTED OUTDOOR REC.	---	---	---	---	---	---	---	---	---	---	---	---	---
SPORT FISHING	0.4	1.2	0	1.6	1.0	3.2	0	4.2	1.0	3.8	0	4.8	10.6
RECREATIONAL BOATING	0	0	9.6	9.6	0	0	73.3	73.3	0	0	136.0	136.0	218.9
COMMERCIAL FISHING	---	---	---	---	---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	2.0	0	0	2.0	24.0	0	0	24.0	40.0	0	0	40.0	66.0
RELATED LAND USES & PROBLEMS													
AGRIC. LAND-TREATMENT	0	0	0.9	0.9	0	0	8.0	8.0	0	0	12.7	12.7	21.6
-CROPLAND DRAINAGE	0	0	0.8	0.8	0	0	7.3	7.3	0	0	11.3	11.3	19.4
FOREST LAND-TREATMENT	0.0	0.1	0.2	0.3	0.2	0.3	1.2	1.7	0.4	0.7	2.5	3.6	5.6
SHORELAND EROSION	0.0	0	0.1	0.1	0.2	0	1.0	1.2	0.5	0	1.9	2.4	3.7
STREAMBANK EROSION	0	0	0.1	0.1	0	0	1.2	1.2	0	0	3.1	3.1	4.4
FLOOD PLAINS-URBAN	---	---	---	---	---	---	---	---	---	---	---	---	---
-URBAN	0.0	0.2	0	0.2	0.1	1.8	0	1.9	0.1	2.3	0	2.4	4.5
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
WILDLIFE MANAGEMENT	0	0.9	0	0.9	0	2.3	0	2.3	0	3.8	0	3.8	7.0
AESTHETIC & CULTURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	5.5	22.0	0	27.5	33.9	135.8	0	169.7	55.0	220.2	0	275.2	472.4
-EXTENSIVE	---	---	---	---	---	---	---	---	---	---	---	---	---
TOTAL	7.9	830.3	29.2	867.4	59.4	2,205.8	399.0	2,664.2	97.0	3,801.7	1,073	4,971.7	8,503.3

TABLE 1–394 Pennsylvania, Needs, Outputs, and Percent Needs Met, Normal Framework

RESOURCE USE CATEGORY	UNIT	1970 SUPPLY	1980 N	1980 O	1980 %	2000 N	2000 O	2000 %	2020 N	2020 O	2020 %
WATER WITHDRAWALS											
MUNICIPALLY SUPPLIED	MILLION GALLONS PER DAY		8.3	8.3	100	24.7	24.7	100	40.8	40.8	100
SELF-SUPPLIED INDUSTRIAL	MILLION GALLONS PER DAY		17.0	17.0	100	68.0	68.0	100	129	129	100
RURAL DOMESTIC & LIVESTOCK	MILLION GALLONS PER DAY		0	0	---	1.2	1.2	100	2.5	2.5	100
IRRIGATION	MILLION GALLONS PER DAY		3.1	3.1	100	7.8	7.8	100	14.1	14.1	100
MINING	MILLION GALLONS PER DAY		0.5	0.5	100	1.8	1.8	100	4.0	4.0	100
THERMAL POWER COOLING	MILLION GALLONS PER DAY		0	---	---	0	---	---	0	---	---
NON-WITHDRAWAL WATER USES											
MUNICIPAL WASTEWATER DISCHARGES	MILLION GALLONS PER DAY		91.0	91.0	100	103	103	100	172	172	100
INDUSTRIAL WASTEWATER DISCHARGES	MILLION GALLONS PER DAY		139	139	100	97.0	97.0	100	116	116	100
HYDROELECTRIC POWER	MILLION GALLONS PER DAY		0	---	---	0	---	---	0	---	---
WATER ORIENTED OUTDOOR REC.	1000 RECREATION DAYS		---	337	---	---	502	---	---	992	---
	1000 ACRES WATER SURFACE		---	---	---	---	---	---	---	---	---
SPORT FISHING	1000 ANGLER DAYS		278	278	100	427	427	100	794	794	100
	1000 ACRES WATER SURFACE		---	---	---	---	---	---	---	---	---
RECREATIONAL BOATING	1000 BOAT DAYS		35	11	31	37	29	78	54	48	89
	1000 ACRES WATER SURFACE		---	---	---	---	---	---	---	---	---
COMMERCIAL FISHING	MILLION TONS PER YEAR		---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	MILLION TONS PER YEAR		---	---	---	---	---	---	---	---	---
RELATED LAND USES & PROBLEMS											
AGRIC. LAND-TREATMENT	1000 ACRES		71.7	6.5	9	71.7	19.4	27	71.7	27.3	38
-CROPLAND DRAINAGE	1000 ACRES		23.6	2.1	9	23.6	2.1	9	23.6	2.1	9
FOREST LAND-TREATMENT	1000 ACRES		134	10.1	8	134	30.4	23	134	50.7	38
SHORELAND EROSION	MILES		38.0	6.0	16	38.0	6.0	16	38.0	6.0	16
STREAMBANK EROSION	MILES		157	0.4	<1	157	1.2	1	157	2.0	1
	$1000 AVE ANNUAL DAMAGES		1.8	0.1	4	1.8	0.2	13	1.8	0.4	63
FLOOD PLAINS-URBAN	1000 ACRES		0.3	0.0	0	0.3	0.1	33	0.3	0.3	100
-URBAN	$1000 AVE ANNUAL DAMAGES		8.5	0.2	2	14.6	2.6	18	26.0	26.0	100
-RURAL	1000 ACRES		2.0	0.0	0	2.0	0.0	0	2.0	0.0	0
-RURAL	$1000 AVE ANNUAL DAMAGES		10.7	0.0	0	13.7	0.0	0	15.0	0.0	0
WILDLIFE MANAGEMENT	1000 ACRES		3.6	4.5	over	17.5	9.5	54	26.6	9.5	36
	1000 USER DAYS		33.8	4.8	14	52.5	12.1	23	66.2	12.1	18
AESTHETIC & CULTURAL	1000 ACRES		---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	1000 ACRES		---	0.1	---	---	0.2	---	---	0.4	---
-EXTENSIVE	1000 ACRES		---	0.6	---	---	1.0	---	---	1.9	---

TABLE 1–395 Pennsylvania, Capital Costs, Normal Framework (in $1,000,000)

RESOURCE USE CATEGORY	1971-1980 Federal	1971-1980 Non-Fed	1971-1980 Private	1971-1980 Total	1981-2000 Federal	1981-2000 Non-Fed	1981-2000 Private	1981-2000 Total	2001-2020 Federal	2001-2020 Non-Fed	2001-2020 Private	2001-2020 Total	Total
WATER WITHDRAWALS													
MUNICIPALLY SUPPLIED	1.0	2.2	0	3.2	1.7	4.1	0	5.8	1.8	4.1	0	5.9	14.9
SELF-SUPPLIED INDUSTRIAL	0	0	1.4	1.4	0	0	4.1	4.1	0	0	5.0	5.0	10.5
RURAL DOMESTIC & LIVESTOCK	0	0	0	0	0.0	0	0.1	0.1	0	0	0	0	0.1
IRRIGATION	0	0	0.1	0.1	0	0	0.1	0.1	0	0	0.1	0.1	0.3
MINING	0	0	0.0	0.0	0	0	0.1	0.1	0	0	0.2	0.2	0.3
THERMAL POWER COOLING	0	0	0	0	0	0	0	0	0	0	0	0	0
NON-WITHDRAWAL WATER USES													
MUNICIPAL WASTEWATER DISCHARGES	18.6	6.2	0	24.8	10.9	3.6	0	14.5	43.9	14.6	0	58.5	97.8
INDUSTRIAL WASTEWATER DISCHARGES	---	---	---	---	---	---	---	---	---	---	---	---	---
HYDROELECTRIC POWER	---	---	---	---	---	---	---	---	---	---	---	---	---
WATER ORIENTED OUTDOOR REC.	---	---	---	---	---	---	---	---	---	---	---	---	---
SPORT FISHING	0.9	0.6	0	1.5	0.1	0.1	0	0.2	0.1	0.1	0	0.2	1.9
RECREATIONAL BOATING	0.9	0.9	0.7	2.5	1.1	1.1	1.0	3.2	0.8	0.8	0.7	2.3	8.0

COMMERCIAL FISHING	---	---	---	---	---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	0	0	0	0	0	0	0	0	0	0	0	0	0
RELATED LAND USES & PROBLEMS													
AGRIC. LAND-TREATMENT	0.1	0	0.2	0.3	0.1	0	0.4	0.5	0.1	0	0.2	0.3	1.1
-CROPLAND DRAINAGE	0.2	0	0.3	0.5	0	0	0	0	0	0	0	0	0.5
FOREST LAND-TREATMENT	0.6	0.0	0.2	0.8	1.2	0.1	0.2	1.5	1.3	0.1	0.2	1.6	3.7
SHORELAND EROSION	1.0	0	3.8	4.8	0	0	0	0	0	0	0	0	4.8
STREAMBANK EROSION	0.0	0	0.0	0.0	0.0	0	0.0	0.0	0.0	0	0.0	0.0	0.0
FLOOD PLAINS-URBAN	---	---	---	---	---	---	---	---	---	---	---	---	---
-URBAN	0	0	0	0	0	0	0	0	0	0	0	0	0
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
WILDLIFE MANAGEMENT	0.0	0.4	0	0.4	0.1	0.5	0	0.6	0	0	0	0	1.0
AESTHETIC & CULTURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	0.8	1.6	0	2.4	1.3	2.3	0	3.6	2.5	4.6	0	7.1	13.1
-EXTENSIVE	---	---	---	---	---	---	---	---	---	---	---	---	---
TOTAL	24.1	11.9	6.7	42.7	16.5	11.8	6.0	34.3	50.5	24.3	6.4	81.2	158.2

TABLE 1-396 Pennsylvania, Operation, Maintenance, and Replacement Costs, Normal Framework (in $1,000,000)

	1971-1980				1981-2000				2001-2020				
RESOURCE USE CATEGORY	Federal	Non-Fed	Private	Total	Federal	Non-Fed	Private	Total	Federal	Non-Fed	Private	Total	Total
WATER WITHDRAWALS													
MUNICIPALLY SUPPLIED	0	1.6	0	1.6	0	11.2	0	11.2	0	21.3	0	21.3	34.1
SELF-SUPPLIED INDUSTRIAL	0	0	1.2	1.2	0	0	12.4	12.4	0	0	28.5	28.5	42.1
RURAL DOMESTIC & LIVESTOCK	0	0	0	0	0	0	0.1	0.1	0	0	0.4	0.4	0.5
IRRIGATION	0	0	0.0	0.0	0	0	0.1	0.1	0	0	0.1	0.1	0.2
MINING	0	0	0.1	0.1	0	0	1.1	1.1	0	0	2.9	2.9	4.1
THERMAL POWER COOLING	0	0	0	0	0	0	0	0	0	0	0	0	0
NON-WITHDRAWAL WATER USES													
MUNICIPAL WASTEWATER DISCHARGES	0	9.0	0	9.0	0	24.0	0	24.0	0	40.0	0	40.0	73.0
INDUSTRIAL WASTEWATER DISCHARGES	---	---	---	---	---	---	---	---	---	---	---	---	---
HYDROELECTRIC POWER	---	---	---	---	---	---	---	---	---	---	---	---	---
WATER ORIENTED OUTDOOR REC.	---	---	---	---	---	---	---	---	---	---	---	---	---
SPORT FISHING	0.3	0.2	0	0.5	0.2	0.0	0	0.2	0.1	0.0	0	0.1	0.8
RECREATIONAL BOATING	0	0	0.5	0.5	0	0	3.1	3.1	0	0	5.3	5.3	8.9
COMMERCIAL FISHING	---	---	---	---	---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	0	0	0	0	0	0	0	0	0	0	0	0	0
RELATED LAND USES & PROBLEMS													
AGRIC. LAND-TREATMENT	0	0	0.0	0.0	0	0	0.1	0.1	0	0	0.1	0.1	0.2
-CROPLAND DRAINAGE	0	0	0.0	0.0	0	0	0.1	0.1	0	0	0.0	0.0	0.1
FOREST LAND-TREATMENT	0.0	0.0	0	0.0	0.0	0.0	0.2	0.2	0.0	0.1	0.2	0.3	0.5
SHORELAND EROSION	0.1	0	0.4	0.5	0.4	0	1.5	1.9	0.4	0	1.5	1.9	4.3
STREAMBANK EROSION	0	0	0	0	0	0	0	0	0	0	0	0	0
FLOOD PLAINS-URBAN	---	---	---	---	---	---	---	---	---	---	---	---	---
-URBAN	0	0	0	0	0	0	0	0	0	0	0	0	0
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
WILDLIFE MANAGEMENT	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0.0
AESTHETIC & CULTURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	0.1	0.4	0	0.5	0.7	3.0	0	3.7	1.7	6.9	0	8.6	12.8
-EXTENSIVE	---	---	---	---	---	---	---	---	---	---	---	---	---
TOTAL	0.5	11.2	2.2	13.9	1.3	38.2	18.7	58.2	2.2	68.3	39.0	109.5	161.6

TABLE 1–397 Pennsylvania, Needs, Outputs, and Percent Needs Met, Proposed Framework

		1970	1980			2000			2020		
RESOURCE USE CATEGORY	UNIT	SUPPLY	N	O	%	N	O	%	N	O	%
WATER WITHDRAWALS											
MUNICIPALLY SUPPLIED	MILLION GALLONS PER DAY	65	8.3	8.3	100	24.7	24.7	100	40.8	40.8	100
SELF-SUPPLIED INDUSTRIAL	MILLION GALLONS PER DAY	147	17.0	17.0	100	68.0	68.0	100	129	129	100
RURAL DOMESTIC & LIVESTOCK	MILLION GALLONS PER DAY	3	0	0	---	1.2	1.2	100	2.5	2.5	100
IRRIGATION	MILLION GALLONS PER DAY	3.3	3.1	3.1	100	7.8	7.8	100	14.1	14.1	100
MINING	MILLION GALLONS PER DAY	1.8	0.5	0.5	100	1.8	1.8	100	4.0	4.0	100
THERMAL POWER COOLING	MILLION GALLONS PER DAY	144	0	---	---	0	---	---	0	---	---
NON-WITHDRAWAL WATER USES											
MUNICIPAL WASTEWATER DISCHARGES	MILLION GALLONS PER DAY	46	91.0	91.0	100	103	103	100	172	172	100
INDUSTRIAL WASTEWATER DISCHARGES	MILLION GALLONS PER DAY	147	139	139	100	97.0	97.0	100	116	116	100
HYDROELECTRIC POWER	MILLION GALLONS PER DAY	NA	0	---	---	0	---	---	0	---	---
WATER ORIENTED OUTDOOR REC.	1000 RECREATION DAYS	NA	---	337	---	---	502	---	---	992	---
	1000 ACRES WATER SURFACE	NA	---	---	---	---	---	---	---	---	---
SPORT FISHING	1000 ANGLER DAYS	1,058	278	278	100	427	427	100	794	794	100
	1000 ACRES WATER SURFACE	NA	---	---	---	---	---	---	---	---	---
RECREATIONAL BOATING	1000 BOAT DAYS	44.0	35	11	31	37	29	78	54	48	89
	1000 ACRES WATER SURFACE	NA	---	---	---	---	---	---	---	---	---
COMMERCIAL FISHING	MILLION TONS PER YEAR	NA	---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	MILLION TONS PER YEAR		---	---	---	---	---	---	---	---	---
RELATED LAND USES & PROBLEMS											
AGRIC. LAND-TREATMENT	1000 ACRES	71.7	71.7	*12.1*	*17*	71.7	*34.5*	*49*	71.7	*48.1*	*67*
-CROPLAND DRAINAGE	1000 ACRES	23.6	23.6	*0*	*0*	23.6	*0*	*0*	23.6	*0*	*0*
FOREST LAND-TREATMENT	1000 ACRES	134	134	*14*	*10*	134	*40*	*30*	134	*67*	*50*
SHORELAND EROSION	MILES	38	38.0	6.0	16	38.0	6.0	16	38.0	6.0	16
STREAMBANK EROSION	MILES	157	157	0.4	<1	157	1.2	1	157	2.0	1
	$1000 AVE ANNUAL DAMAGES	1.8	1.8	0.1	4	1.8	0.2	13	1.8	0.4	63
FLOOD PLAINS-URBAN	1000 ACRES	0	0.3	0.0	0	0.3	0.1	33	0.3	0.3	100
-URBAN	$1000 AVE ANNUAL DAMAGES	0	8.5	0.2	2	14.6	2.6	18	26.0	26.0	100
-RURAL	1000 ACRES	0	2.0	0.0	0	2.0	0.0	0	2.0	0.0	0
-RURAL	$1000 AVE ANNUAL DAMAGES	0	10.7	0.0	0	13.7	0.0	0	15.0	0.0	0
WILDLIFE MANAGEMENT	1000 ACRES	NA	3.6	4.5	over	17.5	9.5	54	26.6	9.5	36
	1000 USER DAYS	NA	33.8	4.8	14	52.5	12.1	23	66.2	12.1	18
AESTHETIC & CULTURAL	1000 ACRES	NA	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	1000 ACRES		---	0.1	---	---	0.2	---	---	0.4	---
-EXTENSIVE	1000 ACRES	NA	---	0.6	---	---	1.0	---	---	1.9	---

TABLE 1–398 Pennsylvania, Capital Costs, Proposed Framework (in $1,000,000)

	1971-1980				1981-2000				2001-2020				
RESOURCE USE CATEGORY	Federal	Non-Fed	Private	Total	Federal	Non-Fed	Private	Total	Federal	Non-Fed	Private	Total	Total
WATER WITHDRAWALS													
MUNICIPALLY SUPPLIED	1.0	2.2	0	3.2	1.7	4.1	0	5.8	1.8	4.1	0	5.9	14.9
SELF-SUPPLIED INDUSTRIAL	0	0	1.4	1.4	0	0	4.1	4.1	0	0	5.0	5.0	10.5
RURAL DOMESTIC & LIVESTOCK	0	0	0	0	0.0	0	0.1	0.1	0	0	0	0	0.1
IRRIGATION	0	0	0.1	0.1	0	0	0.1	0.1	0	0	0.1	0.1	0.3
MINING	0	0	0.0	0.0	0	0	0.1	0.1	0	0	0.2	0.2	0.3
THERMAL POWER COOLING	0	0	0	0	0	0	0	0	0	0	0	0	0
NON-WITHDRAWAL WATER USES													
MUNICIPAL WASTEWATER DISCHARGES	*390.8*	*130.2*	*0*	*521.0*	*124.5*	*41.5*	*0*	*166.0*	*20.2*	*6.8*	*0*	*27.0*	*714.[illegible]*
INDUSTRIAL WASTEWATER DISCHARGES	---	---	---	---	---	---	---	---	---	---	---	---	---
HYDROELECTRIC POWER	---	---	---	---	---	---	---	---	---	---	---	---	---
WATER ORIENTED OUTDOOR REC.	---	---	---	---	---	---	---	---	---	---	---	---	---
SPORT FISHING	0.9	0.6	0	1.5	0.1	0.1	0	0.2	0.1	0.1	0	0.2	1.9
RECREATIONAL BOATING	0.9	0.9	0.7	2.5	1.1	1.1	1.0	3.2	0.8	0.8	0.7	2.3	8.0

COMMERCIAL FISHING	---	---	---	---	---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	0	0	0	0	14.0	0	0	14.0	0	0	0	0	14.0
RELATED LAND USES & PROBLEMS													
AGRIC. LAND-TREATMENT	0.1	0	0.1	0.2	0.1	0	0.2	0.3	0.1	0	0.1	0.2	0.7
-CROPLAND DRAINAGE	0	0	0	0	0	0	0	0	0	0	0	0	0
FOREST LAND-TREATMENT	0.8	0.0	0	1.0	1.6	0.1	0.3	2.0	1.6	0.1	0.3	2.0	5.0
SHORELAND EROSION	1.0	0	3.8	4.8	0	0	0	0	0	0	0	0	4.8
STREAMBANK EROSION	0.0	0	0.0	0.0	0.0	0	0.0	0.0	0.0	0	0.0	0.0	0.0
FLOOD PLAINS-URBAN	---	---	---	---	---	---	---	---	---	---	---	---	---
-URBAN	0	0	0	0	0	0	0	0	0	0	0	0	0
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
WILDLIFE MANAGEMENT	0.0	0.4	0	0.4	0.1	0.5	0	0.6	0	0	0	0	1.0
AESTHETIC & CULTURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	0.8	1.6	0	2.4	1.3	2.3	0	3.6	2.5	4.6	0	7.1	13.1
-EXTENSIVE	---	---	---	---	---	---	---	---	---	---	---	---	---
TOTAL	396.3	135.9	6.3	538.5	144.5	49.7	5.9	200.1	27.1	16.5	6.4	50.0	788.6

TABLE 1-399 Pennsylvania, Operation, Maintenance, and Replacement Costs, Proposed Framework (in $1,000,000)

	1971-1980				1981-2000				2001-2020				
RESOURCE USE CATEGORY	Federal	Non-Fed	Private	Total	Federal	Non-Fed	Private	Total	Federal	Non-Fed	Private	Total	Total
WATER WITHDRAWALS													
MUNICIPALLY SUPPLIED	0	1.6	0	1.6	0	11.2	0	11.2	0	21.3	0	21.3	34.1
SELF-SUPPLIED INDUSTRIAL	0	0	1.2	1.2	0	0	12.4	12.4	0	0	28.5	28.5	42.1
RURAL DOMESTIC & LIVESTOCK	0	0	0	0	0	0	0.1	0.1	0	0	0.4	0.4	0.5
IRRIGATION	0	0	0.0	0.0	0	0	0.1	0.1	0	0	0.1	0.1	0.2
MINING	0	0	0.1	0.1	0	0	1.1	1.1	0	0	2.9	2.9	4.1
THERMAL POWER COOLING	0	0	0	0	0	0	0	0	0	0	0	0	0
NON-WITHDRAWAL WATER USES													
MUNICIPAL WASTEWATER DISCHARGES	0	62.8	0	62.8	0	238.6	0	238.6	0	821.8	0	821.8	1,123.2
INDUSTRIAL WASTEWATER DISCHARGES	---	---	---	---	---	---	---	---	---	---	---	---	---
HYDROELECTRIC POWER	---	---	---	---	---	---	---	---	---	---	---	---	---
WATER ORIENTED OUTDOOR REC.	---	---	---	---	---	---	---	---	---	---	---	---	---
SPORT FISHING	0.3	0.2	0	0.5	0.2	0.0	0	0.2	0.1	0.0	0	0.1	0.8
RECREATIONAL BOATING	0	0	0.5	0.5	0	0	3.1	3.1	0	0	5.3	5.3	8.9
COMMERCIAL FISHING	---	---	---	---	---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	1.0	0	0	1.0	6.0	0	0	6.0	8.0	0	0	8.0	15.0
RELATED LAND USES & PROBLEMS													
AGRIC. LAND-TREATMENT	0	0	0.0	0.0	0	0	0.0	0.0	0	0	0.1	0.1	0.1
-CROPLAND DRAINAGE	0	0	0	0	0	0	0	0	0	0	0	0	0
FOREST LAND-TREATMENT	0	0	0	0	0.0	0.1	0.2	0.3	0.0	0.0	0.2	0.2	0.5
SHORELAND EROSION	0.1	0	0.4	0.5	0.4	0	1.5	1.9	0.4	0	1.5	1.9	4.3
STREAMBANK EROSION	0	0	0	0	0	0	0	0	0	0	0	0	0
FLOOD PLAINS-URBAN	---	---	---	---	---	---	---	---	---	---	---	---	---
-URBAN	0	0	0	0	0	0	0	0	0	0	0	0	0
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
WILDLIFE MANAGEMENT	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0.0
AESTHETIC & CULTURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	0.1	0.4	0	0.5	0.7	3.0	0	3.7	1.7	6.9	0	8.6	12.8
-EXTENSIVE	---	---	---	---	---	---	---	---	---	---	---	---	---
TOTAL	1.5	65.0	2.2	68.7	7.2	253.0	18.5	278.7	10.2	850.0	39.0	899.2	1,246.6

TABLE 1-400 Wisconsin, Needs, Outputs, and Percent Needs Met, Normal Framework

RESOURCE USE CATEGORY	UNIT	1970 SUPPLY	1980 N	1980 O	1980 %	2000 N	2000 O	2000 %	2020 N	2020 O	2020 %
WATER WITHDRAWALS											
MUNICIPALLY SUPPLIED	MILLION GALLONS PER DAY		152	39.9	26	407	118	29	761	234	31
SELF-SUPPLIED INDUSTRIAL	MILLION GALLONS PER DAY		135	---	---	304	---	---	661	---	---
RURAL DOMESTIC & LIVESTOCK	MILLION GALLONS PER DAY		10.3	8.6	83	26.3	20.7	79	38.1	31.1	82
IRRIGATION	MILLION GALLONS PER DAY		89.0	63.9	72	171	127	74	265	200	75
MINING	MILLION GALLONS PER DAY		27.1	11.4	42	65.0	25.7	40	130	47.6	37
THERMAL POWER COOLING	MILLION GALLONS PER DAY		1,150	1,150	100	3,900	3,900	100	9,820	9,820	100
NON-WITHDRAWAL WATER USES											
MUNICIPAL WASTEWATER DISCHARGES	MILLION GALLONS PER DAY		461	461	100	688	688	100	996	996	100
INDUSTRIAL WASTEWATER DISCHARGES	MILLION GALLONS PER DAY		515	515	100	511	511	100	782	782	100
HYDROELECTRIC POWER	MILLION GALLONS PER DAY		0	---	---	0	---	---	0	---	---
WATER ORIENTED OUTDOOR REC.	1000 RECREATION DAYS		---	5,800	---	---	13,800	---	---	20,500	---
	1000 ACRES WATER SURFACE		---	---	---	---	---	---	---	---	---
SPORT FISHING	1000 ANGLER DAYS		4,410	4,140	94	8,710	8,340	96	12,900	12,500	97
	1000 ACRES WATER SURFACE		---	---	---	---	---	---	---	---	---
RECREATIONAL BOATING	1000 BOAT DAYS		831	337	41	1,730	817	47	2,910	1,380	47
	1000 ACRES WATER SURFACE		---	---	---	---	---	---	---	---	---
COMMERCIAL FISHING	MILLION TONS PER YEAR		---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	MILLION TONS PER YEAR		---	---	---	---	---	---	---	---	---
RELATED LAND USES & PROBLEMS											
AGRIC. LAND-TREATMENT	1000 ACRES		3,250	217	7	3,250	651	20	3,250	905	28
-CROPLAND DRAINAGE	1000 ACRES		667	118	18	667	145	22	667	172	26
FOREST LAND-TREATMENT	1000 ACRES		4,350	529	12	4,350	1,580	36	4,350	2,650	61
SHORELAND EROSION	MILES		278	7.8	3	278	23.4	8	278	39.0	14
STREAMBANK EROSION	MILES		1,310	52.3	4	1,310	157	12	1,310	262	20
	$1000 AVE ANNUAL DAMAGES		221	34	15	221	102	46	221	170	77
FLOOD PLAINS-URBAN	1000 ACRES		16.6	1.7	10	17.9	5.6	31	19.4	12.9	66
-URBAN	$1000 AVE ANNUAL DAMAGES		3,530	275	8	6,470	1,790	28	12,800	10,100	79
-RURAL	1000 ACRES		665	99.0	15	664	198	30	662	234	35
-RURAL	$1000 AVE ANNUAL DAMAGES		1,810	423	23	2,300	832	36	2,560	1,020	40
WILDLIFE MANAGEMENT	1000 ACRES		443	706	over	1,340	1,770	over	2,470	2,860	over
	1000 USER DAYS		2,220	79.7	4	3,560	167	5	4,800	325	7
AESTHETIC & CULTURAL	1000 ACRES		---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	1000 ACRES		---	2.3	---	---	6.7	---	---	10.6	---
-EXTENSIVE	1000 ACRES		---	10.3	---	---	39.8	---	---	66.0	---

TABLE 1-401 Wisconsin, Capital Costs, Normal Framework (in $1,000,000)

RESOURCE USE CATEGORY	1971-1980 Federal	1971-1980 Non-Fed	1971-1980 Private	1971-1980 Total	1981-2000 Federal	1981-2000 Non-Fed	1981-2000 Private	1981-2000 Total	2001-2020 Federal	2001-2020 Non-Fed	2001-2020 Private	2001-2020 Total	Total
WATER WITHDRAWALS													
MUNICIPALLY SUPPLIED	3.3	7.6	0	10.9	6.1	14.1	0	20.2	8.9	20.8	0	29.7	60.8
SELF-SUPPLIED INDUSTRIAL	0	0	16.3	16.3	0	0	23.8	23.8	0	0	41.8	41.8	81.9
RURAL DOMESTIC & LIVESTOCK	0.0	0	0.4	0.4	0.1	0	0.5	0.6	0.1	0	0.4	0.5	1.5
IRRIGATION	0	0	2.2	2.2	0	0	2.2	2.2	0	0	2.2	2.2	6.6
MINING	0	0	0.7	0.7	0	0	0.9	0.9	0	0	1.2	1.2	2.8
THERMAL POWER COOLING	0	2.0	38.3	40.3	0	4.8	91.5	96.3	0	10.4	196.8	207.2	343.8
NON-WITHDRAWAL WATER USES													
MUNICIPAL WASTEWATER DISCHARGES	235.5	78.5	0	314.0	151.5	50.5	0	202.0	202.5	67.5	0	270.0	786
INDUSTRIAL WASTEWATER DISCHARGES	---	---	---	---	---	---	---	---	---	---	---	---	---
HYDROELECTRIC POWER	---	---	---	---	---	---	---	---	---	---	---	---	---
WATER ORIENTED OUTDOOR REC.	---	---	---	---	---	---	---	---	---	---	---	---	---
SPORT FISHING	1.7	2.1	0	3.8	0.7	1.5	0	2.2	0.9	1.5	0	2.4	8.4
RECREATIONAL BOATING	14.6	14.6	12.6	41.8	15.8	15.8	13.4	45.0	8.3	8.3	7.2	23.8	110.6

COMMERCIAL FISHING	---	---	---	---	---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	0	0	0	0	25.1	0	0	25.1	0	0	0	0	25.1
RELATED LAND USES & PROBLEMS													
AGRIC. LAND-TREATMENT	2.4	0	6.3	8.7	4.9	0	12.6	17.5	2.9	0	7.3	10.2	36.4
-CROPLAND DRAINAGE	9.3	0	16.8	26.1	2.3	0	5.3	7.6	2.5	0	5.9	8.4	42.1
FOREST LAND-TREATMENT	15.9	1.0	3.0	19.9	32.3	2.0	6.1	40.4	31.2	2.0	5.8	39.0	99.3
SHORELAND EROSION	1.0	0	3.8	4.8	1.9	0	7.6	9.5	1.9	0	7.7	9.6	23.9
STREAMBANK EROSION	0.5	0	1.3	1.8	1.5	0	3.9	5.4	2.5	0	6.6	9.1	16.3
FLOOD PLAINS-URBAN	---	---	---	---	---	---	---	---	---	---	---	---	---
-URBAN	6.8	0	2.3	9.1	5.2	0	1.8	7.0	20.4	0	6.8	27.2	43.3
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
WILDLIFE MANAGEMENT	1.9	17.3	0	19.2	3.5	31.3	0	34.8	3.6	32.7	0	36.3	90.3
AESTHETIC & CULTURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	22.3	41.3	0	63.6	21.1	39.3	0	60.4	24.6	45.6	0	70.2	194.2
-EXTENSIVE	---	---	---	---	---	---	---	---	---	---	---	---	---
TOTAL	315.2	164.4	104.0	583.6	272.0	159.3	169.6	600.9	310.3	188.8	289.7	788.8	1,973.3

TABLE 1–402 Wisconsin, Operation, Maintenance, and Replacement Costs, Normal Framework (in $1,000,000)

	1971-1980				1981-2000				2001-2020				
RESOURCE USE CATEGORY	Federal	Non-Fed	Private	Total	Federal	Non-Fed	Private	Total	Federal	Non-Fed	Private	Total	Total
WATER WITHDRAWALS													
MUNICIPALLY SUPPLIED	0	5.8	0	5.8	0	48.6	0	48.6	0	112.1	0	112.1	166.5
SELF-SUPPLIED INDUSTRIAL	0	0	9.1	9.1	0	0	50.0	50.0	0	0	142.0	142.0	201.1
RURAL DOMESTIC & LIVESTOCK	0	0	1.3	1.3	0	0	9.1	9.1	0	0	15.9	15.9	26.3
IRRIGATION	0	0	0.3	0.3	0	0	1.8	1.8	0	0	3.2	3.2	5.3
MINING	0	0	0.7	0.7	0	0	5.2	5.2	0	0	10.9	10.9	16.8
THERMAL POWER COOLING	0	0.5	9.9	10.4	0	4.6	86.5	91.1	0	12.4	234.6	247.0	348.5
NON-WITHDRAWAL WATER USES													
MUNICIPAL WASTEWATER DISCHARGES	0	156.2	0	156.2	0	417.8	0	417.8	0	559.2	0	559.2	1,133.2
INDUSTRIAL WASTEWATER DISCHARGES	---	---	---	---	---	---	---	---	---	---	---	---	---
HYDROELECTRIC POWER	---	---	---	---	---	---	---	---	---	---	---	---	---
WATER ORIENTED OUTDOOR REC.	---	---	---	---	---	---	---	---	---	---	---	---	---
SPORT FISHING	0.8	1.0	0	1.8	1.5	4.0	0	5.5	2.6	5.0	0	7.6	14.9
RECREATIONAL BOATING	0	0	9.3	9.3	0	0	59.1	59.1	0	0	94.5	94.5	162.9
COMMERCIAL FISHING	---	---	---	---	---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	0	0	0	0	6.0	0	0	6.0	12.0	0	0	12.0	18.0
RELATED LAND USES & PROBLEMS													
AGRIC. LAND-TREATMENT	0	0	0.3	0.3	0	0	1.7	1.7	0	0	3.0	3.0	5.0
-CROPLAND DRAINAGE	0	0	0.7	0.7	0	0	2.9	2.9	0	0	4.0	4.0	7.6
FOREST LAND-TREATMENT	0.1	0.1	0.3	0.5	0.4	0.7	2.5	3.6	0.7	1.5	5.1	7.3	11.4
SHORELAND EROSION	0.1	0	0.4	0.5	0.8	0	3.0	3.8	1.5	0	6.1	7.6	11.9
STREAMBANK EROSION	0	0	0.2	0.2	0	0	1.5	1.5	0	0	4.7	4.7	6.4
FLOOD PLAINS-URBAN	---	---	---	---	---	---	---	---	---	---	---	---	---
-URBAN	0.0	0.0	0	0.0	0.0	0.3	0	0.3	0.0	0.9	0	0.9	1.2
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
WILDLIFE MANAGEMENT	0	1.0	0	1.0	0	1.8	0	1.8	0	1.9	0	1.9	4.7
AESTHETIC & CULTURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	2.9	11.6	0	14.5	22.4	89.7	0	112.1	40.1	160.6	0	200.7	327.3
-EXTENSIVE	---	---	---	---	---	---	---	---	---	---	---	---	---
TOTAL	3.9	176.2	32.5	212.6	31.1	567.5	223.3	821.9	56.9	853.6	524.0	1,434.5	2,469.0

TABLE 1-403 Wisconsin, Needs, Outputs, and Percent Needs Met, Proposed Framework

RESOURCE USE CATEGORY	UNIT	1970 SUPPLY	1980 N	1980 O	1980 %	2000 N	2000 O	2000 %	2020 N	2020 O	2020 %
WATER WITHDRAWALS											
MUNICIPALLY SUPPLIED	MILLION GALLONS PER DAY	305	152	39.9	26	407	118	29	761	234	31
SELF-SUPPLIED INDUSTRIAL	MILLION GALLONS PER DAY	595	135	---	---	304	---	---	661	---	---
RURAL DOMESTIC & LIVESTOCK	MILLION GALLONS PER DAY	68.9	10.3	8.6	83	26.3	20.7	79	38.1	31.1	82
IRRIGATION	MILLION GALLONS PER DAY	106.6	89.0	63.9	72	171	127	74	265	200	75
MINING	MILLION GALLONS PER DAY	14.4	27.1	11.4	42	65.0	25.7	40	130	47.6	37
THERMAL POWER COOLING	MILLION GALLONS PER DAY	2,044	1,150	1,150	100	3,900	3,900	100	9,820	9,820	100
NON-WITHDRAWAL WATER USES											
MUNICIPAL WASTEWATER DISCHARGES	MILLION GALLONS PER DAY	308	461	461	100	688	688	100	996	996	100
INDUSTRIAL WASTEWATER DISCHARGES	MILLION GALLONS PER DAY	631	515	515	100	511	511	100	782	782	100
HYDROELECTRIC POWER	MILLION GALLONS PER DAY	NA	0	---	---	0	---	---	0	---	---
WATER ORIENTED OUTDOOR REC.	1000 RECREATION DAYS	NA	---	5,800	---	---	13,800	---	---	20,500	---
	1000 ACRES WATER SURFACE	NA	---	---	---	---	---	---	---	---	---
SPORT FISHING	1000 ANGLER DAYS	13,412	4,410	4,140	94	8,710	8,340	96	12,900	12,500	97
	1000 ACRES WATER SURFACE	NA	---	---	---	---	---	---	---	---	---
RECREATIONAL BOATING	1000 BOAT DAYS	5,113	831	337	41	1,730	817	47	2,910	1,380	47
	1000 ACRES WATER SURFACE	NA	---	---	---	---	---	---	---	---	---
COMMERCIAL FISHING	MILLION TONS PER YEAR	NA	---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	MILLION TONS PER YEAR		---	---	---	---	---	---	---	---	---
RELATED LAND USES & PROBLEMS											
AGRIC. LAND-TREATMENT	1000 ACRES	3,250	3,250	476	15	3,250	1,360	42	3,250	1,910	59
-CROPLAND DRAINAGE	1000 ACRES	667	667	99.9	15	667	205	31	667	286	43
FOREST LAND-TREATMENT	1000 ACRES	4,350	4,350	854	20	4,350	2,560	59	4,350	4,240	97
SHORELAND EROSION	MILES	278	278	7.8	3	278	23.4	8	278	39.0	14
STREAMBANK EROSION	MILES	1,310	1,310	52.3	4	1,310	157	12	1,310	262	20
	$1000 AVE ANNUAL DAMAGES	221	221	34	15	221	102	46	221	170	77
FLOOD PLAINS-URBAN	1000 ACRES	12.2	16.6	1.7	10	17.9	5.6	31	19.4	12.9	66
-URBAN	$1000 AVE ANNUAL DAMAGES	2,414.9	3,530	275	8	6,470	1,790	28	12,800	10,100	79
-RURAL	1000 ACRES	202.1	665	99.0	15	664	198	30	662	234	35
-RURAL	$1000 AVE ANNUAL DAMAGES	358.8	1,810	423	23	2,300	832	36	2,560	1,020	40
WILDLIFE MANAGEMENT	1000 ACRES	NA	443	706	over	1,340	1,770	over	2,470	2,860	over
	1000 USER DAYS	NA	2,220	79.7	4	3,560	167	5	4,800	325	7
AESTHETIC & CULTURAL	1000 ACRES	NA	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	1000 ACRES		---	2.3	---	---	6.7	---	---	10.6	---
-EXTENSIVE	1000 ACRES	NA	---	10.3	---	---	39.8	---	---	66.0	---

TABLE 1-404 Wisconsin, Capital Costs, Proposed Framework (in $1,000,000)

RESOURCE USE CATEGORY	1971-1980 Federal	1971-1980 Non-Fed	1971-1980 Private	1971-1980 Total	1981-2000 Federal	1981-2000 Non-Fed	1981-2000 Private	1981-2000 Total	2001-2020 Federal	2001-2020 Non-Fed	2001-2020 Private	2001-2020 Total	Total
WATER WITHDRAWALS													
MUNICIPALLY SUPPLIED	3.3	7.6	0	10.9	6.1	14.1	0	20.2	8.9	20.8	0	29.7	60.8
SELF-SUPPLIED INDUSTRIAL	0	0	16.3	16.3	0	0	23.8	23.8	0	0	41.8	41.8	81.9
RURAL DOMESTIC & LIVESTOCK	0.0	0	0.4	0.4	0.1	0	0.5	0.6	0.1	0	0.4	0.5	1.5
IRRIGATION	0	0	2.2	2.2	0	0	2.2	2.2	0	0	2.2	2.2	6.6
MINING	0	0	0.7	0.7	0	0	0.9	0.9	0	0	1.2	1.2	2.8
THERMAL POWER COOLING	0	2.0	38.3	40.3	0	4.8	91.5	96.3	0	10.4	196.8	207.2	343.8
NON-WITHDRAWAL WATER USES													
MUNICIPAL WASTEWATER DISCHARGES	228.8	76.2	0	305.0	270.0	90.0	0	360.0	306.0	102.0	0	408.0	1,073.0
INDUSTRIAL WASTEWATER DISCHARGES	---	---	---	---	---	---	---	---	---	---	---	---	---
HYDROELECTRIC POWER	---	---	---	---	---	---	---	---	---	---	---	---	---
WATER ORIENTED OUTDOOR REC.	---	---	---	---	---	---	---	---	---	---	---	---	---
SPORT FISHING	1.7	2.1	0	3.8	0.7	1.5	0	2.2	0.9	1.5	0	2.4	8.4
RECREATIONAL BOATING	14.6	14.6	12.6	41.8	15.8	15.8	13.4	45.0	8.3	8.3	7.2	23.8	110.6

COMMERCIAL FISHING	---	---	---	---	---	---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	25.8	0	0	25.8	58.7	0	0	58.7	0	0	0	0	84.5
RELATED LAND USES & PROBLEMS													
AGRIC. LAND-TREATMENT	5.2	0	13.5	18.7	9.8	0	25.1	34.9	5.9	0	15.3	21.2	74.8
-CROPLAND DRAINAGE	4.0	0	9.4	13.4	4.4	0	10.4	14.8	3.3	0	7.6	10.9	39.1
FOREST LAND-TREATMENT	26.2	1.7	4.9	32.8	52.6	3.3	9.8	65.7	51.4	3.2	9.7	64.3	162.8
SHORELAND EROSION	1.0	0	3.8	4.8	1.9	0	7.6	9.5	1.9	0	7.7	9.6	23.9
STREAMBANK EROSION	0.5	0	1.3	1.8	1.5	0	3.9	5.4	2.5	0	6.6	9.1	16.3
FLOOD PLAINS-URBAN	---	---	---	---	---	---	---	---	---	---	---	---	---
-URBAN	6.8	0	2.3	9.1	5.2	0	1.8	7.0	20.4	0	6.8	27.2	43.3
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
WILDLIFE MANAGEMENT	1.9	17.3	0	19.2	3.5	31.3	0	34.8	3.6	32.7	0	36.3	90.3
AESTHETIC & CULTURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	22.3	41.3	0	63.6	21.1	39.3	0	60.4	24.6	45.6	0	70.2	194.2
-EXTENSIVE	---	---	---	---	---	---	---	---	---	---	---	---	---
TOTAL	342.1	162.8	105.7	610.6	451.4	200.1	190.9	842.4	437.8	224.5	303.3	965.6	2,418.6

TABLE 1-405 Wisconsin, Operation, Maintenance, and Replacement Costs, Proposed Framework (in $1,000,000)

	1971-1980				1981-2000				2001-2020				
RESOURCE USE CATEGORY	Federal	Non-Fed	Private	Total	Federal	Non-Fed	Private	Total	Federal	Non-Fed	Private	Total	Total
WATER WITHDRAWALS													
MUNICIPALLY SUPPLIED	0	5.8	0	5.8	0	48.6	0	48.6	0	112.1	0	112.1	166.5
SELF-SUPPLIED INDUSTRIAL	0	0	9.1	9.1	0	0	50.0	50.0	0	0	142.0	142.0	201.1
RURAL DOMESTIC & LIVESTOCK	0	0	1.3	1.3	0	0	9.1	9.1	0	0	15.9	15.9	26.3
IRRIGATION	0	0	0.3	0.3	0	0	1.8	1.8	0	0	3.2	3.2	5.3
MINING	0	0	0.7	0.7	0	0	5.2	5.2	0	0	10.9	10.9	16.8
THERMAL POWER COOLING	0	0.5	9.9	10.4	0	4.6	86.5	91.1	0	12.4	234.6	247.0	348.5
NON-WITHDRAWAL WATER USES													
MUNICIPAL WASTEWATER DISCHARGES	0	514.6	0	514.6	0	1,230.2	0	1,230.2	0	1,875.9	0	1,875.9	3,620.7
INDUSTRIAL WASTEWATER DISCHARGES	---	---	---	---	---	---	---	---	---	---	---	---	---
HYDROELECTRIC POWER	---	---	---	---	---	---	---	---	---	---	---	---	---
WATER ORIENTED OUTDOOR REC.	---	---	---	---	---	---	---	---	---	---	---	---	---
SPORT FISHING	0.8	1.0	0	1.8	1.5	4.0	0	5.5	2.6	5.0	0	7.6	14.9
RECREATIONAL BOATING	0	0	9.3	9.3	0	0	59.1	59.1	0	0	94.5	94.5	162.9
COMMERCIAL FISHING	---	---	---	---	---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	1.0	0	0	1.0	10.0	0	0	10.0	16.0	0	0	16.0	27.0
RELATED LAND USES & PROBLEMS													
AGRIC. LAND-TREATMENT	0	0	0.6	0.6	0	0	4.3	4.3	0	0	6.4	6.4	11.3
-CROPLAND DRAINAGE	0	0	0.4	0.4	0	0	2.4	2.4	0	0	3.5	3.5	6.3
FOREST LAND-TREATMENT	0.1	0.2	0.5	0.8	0.7	1.4	5.1	7.2	1.2	2.3	8.2	11.7	19.7
SHORELAND EROSION	0.1	0	0.4	0.5	0.8	0	3.0	3.8	1.5	0	6.1	7.6	11.9
STREAMBANK EROSION	0	0	0.2	0.2	0	0	1.5	1.5	0	0	4.7	4.7	6.4
FLOOD PLAINS-URBAN	---	---	---	---	---	---	---	---	---	---	---	---	---
-URBAN	0.0	0.0	0	0.0	0.0	0.3	0	0.3	0.0	0.9	0	0.9	1.2
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
WILDLIFE MANAGEMENT	0	1.0	0	1.0	0	1.8	0	1.8	0	1.9	0	1.9	4.7
AESTHETIC & CULTURAL	---	---	---	---	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	2.9	11.6	0	14.5	22.4	89.7	0	112.1	40.1	160.6	0	200.7	327.3
-EXTENSIVE	---	---	---	---	---	---	---	---	---	---	---	---	---
TOTAL	4.9	534.7	32.7	572.3	35.4	1,380.6	228.0	1,644.0	61.4	2,171.1	530.0	2,762.5	4,978.8

TABLE 1–406 Illinois, Comparison of Total Costs NOR and PRO Frameworks (in $1,000,000)

RESOURCE USE CATEGORY	1971-1980						1971-2020					
	NORMAL			PROPOSED			NORMAL			PROPOSED		
	Capital	OM&R	TOTAL	Capital	OM&R	TOTAL	Capital	OM&R	TOTAL	Capital	OM&R	TOTAL
WATER WITHDRAWALS												
MUNICIPALLY SUPPLIED	93.0	52.8	145.8	93.0	52.8	145.8	446.7	1,250.8	1,697.5	446.7	1,250.8	1,697.5
SELF-SUPPLIED INDUSTRIAL	0.7	0.4	1.1	0.7	0.4	1.1	48.4	151.1	199.5	48.4	151.1	199.5
RURAL DOMESTIC & LIVESTOCK	0	0	0	0	0	0	0	0	0	0	0	0
IRRIGATION	0.9	0.1	1.0	0.9	0.1	1.0	2.3	1.9	4.2	2.3	1.9	4.2
MINING	0.0	0	0.0	0.0	0	0.0	0.0	0.2	0.2	0.0	0.2	0.2
THERMAL POWER COOLING	29.1	7.5	36.6	29.1	7.5	36.6	594.4	545.4	1,139.8	594.4	545.4	1,139.8
NON-WITHDRAWAL WATER USES												
MUNICIPAL WASTEWATER DISCHARGES	0	0	0	0	0	0	0	0	0	0	0	0
INDUSTRIAL WASTEWATER DISCHARGES	---	---	---	---	---	---	---	---	---	---	---	---
HYDROELECTRIC POWER	---	---	---	---	---	---	---	---	---	---	---	---
WATER ORIENTED OUTDOOR REC.	---	---	---	---	---	---	---	---	---	---	---	---
SPORT FISHING	6.3	0.3	6.6	6.3	0.3	6.6	11.5	2.7	14.2	11.5	2.7	14.2
RECREATIONAL BOATING	19.2	4.4	23.6	19.2	4.4	23.6	56.4	74.4	130.8	56.4	74.4	130.8
COMMERCIAL FISHING	---	---	---	---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	0	0	0	9.9	1.0	10.9	0.6	0.6	1.2	66.3	54.0	120.3
RELATED LAND USES & PROBLEMS												
AGRIC. LAND-TREATMENT	0	0	0	0	0.0	0.0	0	0	0	0	0.0	0.0
-CROPLAND DRAINAGE	0	0	0	0	0	0	0	0	0	0	0	0
FOREST LAND-TREATMENT	0	0	0	0	0	0	0	0	0	0	0	0
SHORELAND EROSION	1.7	0.2	1.9	1.7	0.2	1.9	8.4	4.2	12.6	8.4	4.2	12.6
STREAMBANK EROSION	0	0	0	0	0	0	0	0	0	0	0	0
FLOOD PLAINS-URBAN	---	---	---	---	---	---	---	---	---	---	---	---
-URBAN	0	0	0	0	0	0	0	0	0	0	0	0
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---
WILDLIFE MANAGEMENT	0	0	0	0	0	0	0	0	0	0	0	0
AESTHETIC & CULTURAL	---	---	---	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	13.7	2.4	16.1	13.7	2.4	16.1	82.3	57.2	139.5	82.3	57.2	139.5
-EXTENSIVE	---	---	---	---	---	---	---	---	---	---	---	---
TOTAL	164.6	68.1	232.7	174.5	69.1	243.6	1,251.0	2,088.5	3,339.5	1,316.7	2,141.9	3,458.6

TABLE 1–407 Indiana, Comparison of Total Costs NOR and PRO Frameworks (in $1,000,000)

RESOURCE USE CATEGORY	1971-1980						1971-2020					
	NORMAL			PROPOSED			NORMAL			PROPOSED		
	Capital	OM&R	TOTAL	Capital	OM&R	TOTAL	Capital	OM&R	TOTAL	Capital	OM&R	TOTAL
WATER WITHDRAWALS												
MUNICIPALLY SUPPLIED	5.6	3.3	8.9	5.6	3.3	8.9	69.5	156.3	225.8	69.5	156.3	225.8
SELF-SUPPLIED INDUSTRIAL	3.5	2.0	5.5	3.5	2.0	5.5	125.5	354.6	480.1	125.5	354.6	480.1
RURAL DOMESTIC & LIVESTOCK	0.2	0.5	0.7	0.2	0.5	0.7	0.9	11.4	12.3	0.9	11.4	12.3
IRRIGATION	0.8	0.1	0.9	0.8	0.1	0.9	2.8	2.1	4.9	2.8	2.1	4.9
MINING	0.1	0.0	0.1	0.1	0.0	0.1	1.1	5.5	6.6	1.1	5.5	6.6
THERMAL POWER COOLING	3.9	1.0	4.9	3.9	1.0	4.9	112.1	99.6	211.7	112.1	99.6	211.7
NON-WITHDRAWAL WATER USES												
MUNICIPAL WASTEWATER DISCHARGES	18.9	49.0	67.9	273.0	294.0	567.0	186.8	399.0	585.8	722.0	2,199.3	2,921.3
INDUSTRIAL WASTEWATER DISCHARGES	---	---	---	---	---	---	---	---	---	---	---	---
HYDROELECTRIC POWER	---	---	---	---	---	---	---	---	---	---	---	---
WATER ORIENTED OUTDOOR REC.	---	---	---	---	---	---	---	---	---	---	---	---
SPORT FISHING	4.0	1.9	5.9	4.0	1.9	5.9	6.7	8.6	15.3	6.7	8.6	15.3
RECREATIONAL BOATING	8.7	2.0	10.7	8.7	2.0	10.7	58.7	54.4	113.1	58.7	54.4	113.1

COMMERCIAL FISHING	---	---	---	---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	0	0	0	7.7	1.0	8.7	11.2	8.4	19.6	24.9	21.0	45.9
RELATED LAND USES & PROBLEMS												
AGRIC. LAND-TREATMENT	4.8	0.0	4.8	10.5	0.2	10.7	20.1	2.9	23.0	42.5	6.0	48.5
-CROPLAND DRAINAGE	5.4	0.1	5.5	8.6	0.2	8.8	30.8	3.1	33.9	34.6	3.9	38.5
FOREST LAND-TREATMENT	1.5	0.0	1.5	1.7	0	1.7	6.3	0.8	7.1	7.6	0.9	8.5
SHORELAND EROSION	2.1	0.2	2.3	2.1	0.2	2.3	10.4	5.2	15.6	10.4	5.2	15.6
STREAMBANK EROSION	0.3	0.0	0.3	0.3	0.0	0.3	2.7	0.1	2.8	2.7	0.1	2.8
FLOOD PLAINS-URBAN	---	---	---	---	---	---	---	---	---	---	---	---
-URBAN	101.8	0.2	102.0	101.8	0.2	102.0	158.2	3.2	161.4	158.2	3.2	161.4
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---
WILDLIFE MANAGEMENT	1.5	0.1	1.6	1.5	0.1	1.6	5.8	0.3	6.1	5.8	0.3	6.1
AESTHETIC & CULTURAL	---	---	---	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	64.5	12.4	76.9	64.5	12.4	76.9	146.3	207.7	354.0	146.3	207.7	354.0
-EXTENSIVE	---	---	---	---	---	---	---	---	---	---	---	---
TOTAL	227.6	72.8	300.4	498.5	319.1	817.6	955.9	1,323.2	2,279.1	1,532.3	3,140.1	4,672.4

TABLE 1-408 Michigan, Comparison of Total Costs NOR and PRO Frameworks (in $1,000,000)

RESOURCE USE CATEGORY	1971-1980						1971-2020					
	NORMAL			PROPOSED			NORMAL			PROPOSED		
	Capital	OM&R	TOTAL	Capital	OM&R	TOTAL	Capital	OM&R	TOTAL	Capital	OM&R	TOTAL
WATER WITHDRAWALS												
MUNICIPALLY SUPPLIED	253.2	102.1	355.2	253.2	102.1	355.3	1,018.8	1,642.3	2,661.1	1,018.8	1,642.3	2,661.1
SELF-SUPPLIED INDUSTRIAL	7.7	13.9	21.6	7.7	13.9	21.6	146.5	950.9	1,097.4	146.5	950.9	1,097.4
RURAL DOMESTIC & LIVESTOCK	1.5	4.8	6.3	1.5	4.8	6.3	5.9	96.3	102.2	5.9	96.3	102.2
IRRIGATION	14.3	2.1	16.4	14.3	2.1	16.4	35.4	29.8	65.2	35.4	29.8	65.2
MINING	2.4	3.7	6.2	2.4	3.7	6.1	20.8	118.8	139.6	20.8	118.8	139.6
THERMAL POWER COOLING	76.9	19.8	96.7	76.9	19.8	96.7	1,221.4	1,214.4	2,435.8	1,221.4	1,214.4	2,435.8
NON-WITHDRAWAL WATER USES												
MUNICIPAL WASTEWATER DISCHARGES	965.2	663.8	1,629.0	987.0	1,671.9	2,658.9	2,393.5	4,874.8	7,268.3	3,163.0	11,506.5	14,669.5
INDUSTRIAL WASTEWATER DISCHARGES	---	---	---	---	---	---	---	---	---	---	---	---
HYDROELECTRIC POWER	---	---	---	---	---	---	---	---	---	---	---	---
WATER ORIENTED OUTDOOR REC.	---	---	---	---	---	---	---	---	---	---	---	---
SPORT FISHING	13.4	7.2	20.6	13.4	7.2	20.6	47.0	70.3	117.3	47.0	70.3	117.3
RECREATIONAL BOATING	81.9	19.8	101.7	81.9	19.8	101.7	387.0	434.7	821.7	387.0	434.7	821.7
COMMERCIAL FISHING	---	---	---	---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	0	0	0	108.6	14.0	122.6	340.6	258.6	599.2	940.4	747.6	1,688.0
RELATED LAND USES & PROBLEMS												
AGRIC. LAND-TREATMENT	33.4	0.8	34.2	64.7	1.4	66.1	139.9	19.5	159.4	258.9	37.7	296.6
-CROPLAND DRAINAGE	47.1	1.2	48.3	59.0	1.5	60.5	151.1	20.4	171.5	221.1	33.6	254.7
FOREST LAND-TREATMENT	58.6	1.5	60.1	86.4	2.1	88.5	292.9	32.7	325.6	439.0	56.7	495.7
SHORELAND EROSION	9.6	0.9	10.5	9.6	0.9	10.5	48.4	24.2	72.6	48.4	24.2	72.6
STREAMBANK EROSION	13.7	1.5	15.2	13.7	1.5	15.2	123.6	50.9	174.5	123.6	50.9	174.5
FLOOD PLAINS-URBAN	---	---	---	---	---	---	---	---	---	---	---	---
-URBAN	320.0	0.7	320.7	320.0	0.7	320.7	459.8	8.8	468.6	459.8	8.8	468.6
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---
WILDLIFE MANAGEMENT	65.6	3.2	68.8	65.6	3.2	68.8	229.7	11.5	241.2	229.7	11.5	241.2
AESTHETIC & CULTURAL	---	---	---	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	290.8	47.2	338.0	290.8	47.2	338.0	968.8	1,066.6	2,035.4	968.8	1,066.6	2,035.4
-EXTENSIVE	---	---	---	---	---	---	---	---	---	---	---	---
TOTAL	2,255.3	894.2	3,149.5	2,456.7	1,917.8	4,374.5	8,031.1	10,925.5	18,956.6	9,735.5	18,101.6	27,837.1

TABLE 1–409 Minnesota, Comparison of Total Costs NOR and PRO Frameworks (in $1,000,000)

RESOURCE USE CATEGORY	1971-1980 NORMAL Capital	1971-1980 NORMAL OM&R	1971-1980 NORMAL TOTAL	1971-1980 PROPOSED Capital	1971-1980 PROPOSED OM&R	1971-1980 PROPOSED TOTAL	1971-2020 NORMAL Capital	1971-2020 NORMAL OM&R	1971-2020 NORMAL TOTAL	1971-2020 PROPOSED Capital	1971-2020 PROPOSED OM&R	1971-2020 PROPOSED TOTAL
WATER WITHDRAWALS												
MUNICIPALLY SUPPLIED	0.8	0.5	1.3	0.8	0.5	1.3	6.3	16.8	23.1	6.3	16.8	23.1
SELF-SUPPLIED INDUSTRIAL	0	0	0	0	0	0	1.1	2.5	3.6	1.1	2.5	3.6
RURAL DOMESTIC & LIVESTOCK	0	0.1	0.1	0	0.1	0.1	0.1	1.7	1.8	0.1	1.7	1.8
IRRIGATION	0.2	0	0.2	0.2	0	0.2	0.5	0.4	0.9	0.5	0.4	0.9
MINING	1.4	1.4	2.8	1.4	1.4	2.8	4.8	25.3	30.1	4.8	25.3	30.1
THERMAL POWER COOLING	0	0	0	0	0	0	64.2	63.5	127.7	64.2	63.5	127.7
NON-WITHDRAWAL WATER USES												
MUNICIPAL WASTEWATER DISCHARGES	8.0	10.0	18.0	32.0	62.7	94.7	16.6	180.0	196.6	69.0	387.7	456.7
INDUSTRIAL WASTEWATER DISCHARGES	---	---	---	---	---	---	---	---	---	---	---	---
HYDROELECTRIC POWER	---	---	---	---	---	---	---	---	---	---	---	---
WATER ORIENTED OUTDOOR REC.	---	---	---	---	---	---	---	---	---	---	---	---
SPORT FISHING	2.0	1.0	3.0	2.0	1.0	3.0	3.6	2.2	5.8	3.6	2.2	5.8
RECREATIONAL BOATING	19.1	5.2	24.3	19.1	5.2	24.3	46.7	91.3	138.0	46.7	91.3	138.0
COMMERCIAL FISHING	---	---	---	---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	0	0	0	33.6	6.0	39.6	17.8	12.0	29.8	51.4	66.0	117.4
RELATED LAND USES & PROBLEMS												
AGRIC. LAND-TREATMENT	0.8	0.0	0.8	0.5	0.0	0.5	3.2	0.4	3.6	2.3	0.3	2.6
-CROPLAND DRAINAGE	1.2	0.0	1.2	0	0	0	1.7	0.3	2.0	0	0	0
FOREST LAND-TREATMENT	14.3	0.3	14.6	26.5	0.7	27.2	72.8	9.0	81.8	135.3	15.3	150.6
SHORELAND EROSION	0.1	0.0	0.1	0.1	0.0	0.1	0.7	0.4	1.1	0.7	0.4	1.1
STREAMBANK EROSION	0.2	0	0.2	0.2	0	0.2	1.8	0.8	2.6	1.8	0.8	2.6
FLOOD PLAINS-URBAN	---	---	---	---	---	---	---	---	---	---	---	---
-URBAN	3.2	0	3.2	3.2	0	3.2	5.1	0.5	5.6	5.1	0.5	5.6
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---
WILDLIFE MANAGEMENT	2.0	0.1	2.1	2.0	0.1	2.1	21.0	1.0	22.0	21.0	1.0	22.0
AESTHETIC & CULTURAL	---	---	---	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	31.1	3.1	34.2	31.1	3.1	34.2	47.2	66.5	113.7	47.2	66.5	113.7
-EXTENSIVE	---	---	---	---	---	---	---	---	---	---	---	---
TOTAL	84.4	21.7	106.1	152.7	80.8	233.5	315.2	474.6	789.8	461.1	742.2	1,203.3

TABLE 1–410 New York, Comparison of Total Costs NOR and PRO Frameworks (in $1,000,000)

RESOURCE USE CATEGORY	1971-1980 NORMAL Capital	1971-1980 NORMAL OM&R	1971-1980 NORMAL TOTAL	1971-1980 PROPOSED Capital	1971-1980 PROPOSED OM&R	1971-1980 PROPOSED TOTAL	1971-2020 NORMAL Capital	1971-2020 NORMAL OM&R	1971-2020 NORMAL TOTAL	1971-2020 PROPOSED Capital	1971-2020 PROPOSED OM&R	1971-2020 PROPOSED TOTAL
WATER WITHDRAWALS												
MUNICIPALLY SUPPLIED	22.6	11.1	33.7	22.6	11.1	33.7	187.5	421.8	609.3	187.5	421.8	609.3
SELF-SUPPLIED INDUSTRIAL	12.7	11.5	24.2	12.7	11.5	24.2	101.8	382.7	484.5	101.8	382.7	484.5
RURAL DOMESTIC & LIVESTOCK	0.3	0.8	1.1	0.3	0.8	1.1	1.6	15.4	17.0	1.6	15.4	17.0
IRRIGATION	1.6	0.3	1.9	1.6	0.3	1.9	6.4	4.2	10.6	6.4	4.2	10.6
MINING	0.9	0.6	1.5	0.9	0.6	1.5	6.4	17.6	24.0	6.4	17.6	24.0
THERMAL POWER COOLING	137.1	35.2	172.3	137.1	35.2	172.3	467.0	546.7	1,013.7	467.0	546.7	1,013.7
NON-WITHDRAWAL WATER USES												
MUNICIPAL WASTEWATER DISCHARGES	268.0	168.0	436.0	1,785.0	711.6	2,496.6	621.0	768.0	1,389.0	2,657.0	5,479.1	8,136.1
INDUSTRIAL WASTEWATER DISCHARGES	---	---	---	---	---	---	---	---	---	---	---	---
HYDROELECTRIC POWER	---	---	---	---	---	---	---	---	---	---	---	---
WATER ORIENTED OUTDOOR REC.	---	---	---	---	---	---	---	---	---	---	---	---
SPORT FISHING	17.8	7.7	25.5	17.8	7.7	25.5	59.4	37.5	96.9	59.4	37.5	96.9
RECREATIONAL BOATING	49.6	12.1	61.7	49.6	12.1	61.7	150.4	221.9	372.3	150.4	221.9	372.3

COMMERCIAL FISHING	---	---	---	---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	0	0	0	92.0	10.0	102.0	0	0	0	412.0	210.0	622.0
RELATED LAND USES & PROBLEMS												
AGRIC. LAND-TREATMENT	10.4	0.3	10.7	15.1	0.3	15.4	44.2	6.2	50.4	61.1	9.0	70.1
-CROPLAND DRAINAGE	20.2	0.5	20.7	6.5	0.2	6.7	34.0	6.5	40.5	26.1	3.8	29.9
FOREST LAND-TREATMENT	22.2	0.7	22.9	31.0	0.9	31.9	111.1	14.2	125.3	147.0	19.5	166.5
SHORELAND EROSION	3.2	0.3	3.5	3.2	0.3	3.5	15.8	7.9	23.7	15.8	7.9	23.7
STREAMBANK EROSION	2.0	0	2.0	2.0	0	2.0	17.7	6.8	24.5	17.7	6.8	24.5
FLOOD PLAINS-URBAN	---	---	---	---	---	---	---	---	---	---	---	---
-URBAN	36.4	0.1	36.5	36.4	0.1	36.5	254.6	4.6	259.2	254.6	4.6	259.2
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---
WILDLIFE MANAGEMENT	14.2	0.7	14.9	14.2	0.7	14.9	79.2	3.9	83.1	79.2	3.9	83.1
AESTHETIC & CULTURAL	---	---	---	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	121.2	39.6	160.8	121.2	39.6	160.8	451.2	740.0	1,191.2	451.2	740.0	1,191.2
-EXTENSIVE	---	---	---	---	---	---	---	---	---	---	---	---
TOTAL	740.4	289.5	1,029.9	2,349.2	843.0	3,192.2	2,609.3	3,205.9	5,815.2	5,102.2	8,132.4	13,234.6

TABLE 1-411 Ohio, Comparison of Total Costs NOR and PRO Frameworks (in $1,000,000)

RESOURCE USE CATEGORY	1971-1980						1971-2020					
	NORMAL			PROPOSED			NORMAL			PROPOSED		
	Capital	OM&R	TOTAL	Capital	OM&R	TOTAL	Capital	OM&R	TOTAL	Capital	OM&R	TOTAL
WATER WITHDRAWALS												
MUNICIPALLY SUPPLIED	29.3	14.8	44.1	29.3	14.8	44.1	210.0	441.6	651.6	210.0	441.6	651.6
SELF-SUPPLIED INDUSTRIAL	15.2	15.4	30.6	15.2	15.4	30.6	166.0	688.5	854.5	166.0	688.5	854.5
RURAL DOMESTIC & LIVESTOCK	0.2	0.8	1.0	0.2	0.8	1.0	0.9	17.5	18.4	0.9	17.5	18.4
IRRIGATION	0.0	0	0	0.0	0.0	0.0	4.5	2.2	6.7	4.2	1.9	6.1
MINING	1.0	1.2	2.2	0.7	1.3	2.0	9.3	42.1	51.4	2.3	20.1	22.4
THERMAL POWER COOLING	0	0	0	0	0	0	593.3	528.5	1,121.8	593.3	528.5	1,121.8
NON-WITHDRAWAL WATER USES												
MUNICIPAL WASTEWATER DISCHARGES	188.0	325.0	513.0	881.0	791.1	1,672.1	1,048.1	2,355.0	3,403.1	1,928.0	5,971.1	7,899.1
INDUSTRIAL WASTEWATER DISCHARGES	---	---	---	---	---	---	---	---	---	---	---	---
HYDROELECTRIC POWER	---	---	---	---	---	---	---	---	---	---	---	---
WATER ORIENTED OUTDOOR REC.	---	---	---	---	---	---	---	---	---	---	---	---
SPORT FISHING	23.3	1.6	24.9	23.3	1.6	24.9	37.0	10.6	47.6	37.0	10.6	47.6
RECREATIONAL BOATING	49.2	9.6	58.8	49.2	9.6	58.8	210.6	218.9	429.5	210.6	218.9	429.5
COMMERCIAL FISHING	---	---	---	---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	0	0	0	18.0	2.0	20.0	0	0	0	88.7	66.0	154.7
RELATED LAND USES & PROBLEMS												
AGRIC. LAND-TREATMENT	16.6	0.5	17.1	36.5	0.9	37.4	69.8	9.7	79.5	147.1	21.6	168.7
-CROPLAND DRAINAGE	13.3	0.3	13.6	33.1	0.8	33.9	117.7	12.3	130.0	132.4	19.4	151.8
FOREST LAND-TREATMENT	3.7	0.2	3.9	8.6	0.3	8.9	20.7	2.7	23.4	43.3	5.6	48.9
SHORELAND EROSION	1.5	0.1	1.6	1.5	0.1	1.6	7.3	3.7	11.0	7.3	3.7	11.0
STREAMBANK EROSION	1.2	0.1	1.3	1.2	0.1	1.3	10.9	4.4	15.3	10.9	4.4	15.3
FLOOD PLAINS-URBAN	---	---	---	---	---	---	---	---	---	---	---	---
-URBAN	76.9	0.2	77.1	76.9	0.2	77.1	135.7	4.5	140.2	135.7	4.5	140.2
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---
WILDLIFE MANAGEMENT	18.3	0.9	19.2	18.3	0.9	19.2	130.7	7.0	137.7	130.7	7.0	137.7
AESTHETIC & CULTURAL	---	---	---	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	135.1	27.5	162.6	135.1	27.5	162.6	393.6	472.4	866.0	393.6	472.4	866.0
-EXTENSIVE	---	---	---	---	---	---	---	---	---	---	---	---
TOTAL	572.8	398.2	971.0	1,328.1	867.4	2,195.5	3,166.1	4,821.6	7,987.7	4,242.0	8,503.3	12,745.3

TABLE 1–412 Pennsylvania, Comparison of Total Costs NOR and PRO Frameworks (in $1,000,000)

RESOURCE USE CATEGORY	1971-1980 NORMAL Capital	OM&R	TOTAL	1971-1980 PROPOSED Capital	OM&R	TOTAL	1971-2020 NORMAL Capital	OM&R	TOTAL	1971-2020 PROPOSED Capital	OM&R	TOTAL
WATER WITHDRAWALS												
MUNICIPALLY SUPPLIED	3.2	1.6	4.8	3.2	1.6	4.8	14.9	34.1	49.0	14.9	34.1	49.0
SELF-SUPPLIED INDUSTRIAL	1.4	1.2	2.6	1.4	1.2	2.6	10.5	42.1	52.6	10.5	42.1	52.6
RURAL DOMESTIC & LIVESTOCK	0	0	0	0	0	0	0.1	0.5	0.6	0.1	0.5	0.6
IRRIGATION	0.1	0.0	0.1	0.1	0.0	0.1	0.3	0.2	0.5	0.3	0.2	0.5
MINING	0.0	0.1	0.1	0.0	0.1	0.1	0.3	4.1	4.4	0.3	4.1	4.4
THERMAL POWER COOLING	0	0	0	0	0	0	0.0	0	0.0	0.0	0	0.0
NON-WITHDRAWAL WATER USES												
MUNICIPAL WASTEWATER DISCHARGES	24.8	9.0	33.8	521.0	62.8	583.8	97.8	73.0	170.8	714.0	1,123.2	1,837.2
INDUSTRIAL WASTEWATER DISCHARGES	---	---	---	---	---	---	---	---	---	---	---	---
HYDROELECTRIC POWER	---	---	---	---	---	---	---	---	---	---	---	---
WATER ORIENTED OUTDOOR REC.	---	---	---	---	---	---	---	---	---	---	---	---
SPORT FISHING	1.5	0.5	2.0	1.5	0.5	2.0	1.9	0.8	2.7	1.9	0.8	2.7
RECREATIONAL BOATING	2.5	0.5	3.0	2.5	0.5	3.0	8.0	8.9	16.9	8.0	8.9	16.9
COMMERCIAL FISHING	---	---	---	---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	0	0	0	0	1.0	1.0	0	0	0	14.0	15.0	29.0
RELATED LAND USES & PROBLEMS												
AGRIC. LAND-TREATMENT	0.3	0.0	0.3	0.2	0.0	0.2	1.1	0.2	1.3	0.7	0.1	0.8
-CROPLAND DRAINAGE	0.5	0.0	0.5	0	0	0	0.5	0.1	0.6	0	0	0
FOREST LAND-TREATMENT	0.8	0.0	0.8	1.0	0	1.0	3.9	0.5	4.4	5.0	0.5	5.5
SHORELAND EROSION	4.8	0.5	5.3	4.8	0.5	5.3	4.8	4.3	9.1	4.8	4.3	9.1
STREAMBANK EROSION	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0
FLOOD PLAINS-URBAN	---	---	---	---	---	---	---	---	---	---	---	---
-URBAN	0	0	0	0	0	0	0	0	0	0	0	0
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---
WILDLIFE MANAGEMENT	0.4	0.0	0.4	0.4	0.0	0.4	1.0	0.0	1.0	1.0	0.0	1.0
AESTHETIC & CULTURAL	---	---	---	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION-INTENSIVE	2.4	0.5	2.9	2.4	0.5	2.9	13.1	12.8	25.9	13.1	12.8	25.9
-EXTENSIVE	---	---	---	---	---	---	---	---	---	---	---	---
TOTAL	42.7	13.9	56.6	538.5	68.7	607.2	158.2	181.6	339.8	788.6	1,246.6	2,035.2

TABLE 1–413 Wisconsin, Comparison of Total Costs NOR and PRO Frameworks (in $1,000,000)

RESOURCE USE CATEGORY	1971-1980 NORMAL Capital	OM&R	TOTAL	1971-1980 PROPOSED Capital	OM&R	TOTAL	1971-2020 NORMAL Capital	OM&R	TOTAL	1971-2020 PROPOSED Capital	OM&R	TOTAL
WATER WITHDRAWALS												
MUNICIPALLY SUPPLIED	10.9	5.8	16.7	10.9	5.8	16.7	60.8	166.5	227.3	60.8	166.5	227.3
SELF-SUPPLIED INDUSTRIAL	16.3	9.1	25.4	16.3	9.1	25.4	81.9	201.1	283.0	81.9	201.1	283.0
RURAL DOMESTIC & LIVESTOCK	0.4	1.3	1.7	0.4	1.3	1.7	1.5	26.3	27.8	1.5	26.3	27.8
IRRIGATION	2.2	0.3	2.5	2.2	0.3	2.5	6.6	5.3	11.9	6.6	5.3	11.9
MINING	0.7	0.7	1.4	0.7	0.7	1.4	2.8	16.8	19.6	2.8	16.8	19.6
THERMAL POWER COOLING	40.3	10.4	50.7	40.3	10.4	50.7	343.8	348.5	692.3	343.8	348.5	692.3
NON-WITHDRAWAL WATER USES												
MUNICIPAL WASTEWATER DISCHARGES	314.0	156.2	470.2	305.0	514.6	819.6	786.0	1,133.2	1,919.2	1,073.0	3,620.7	4,693.7
INDUSTRIAL WASTEWATER DISCHARGES	---	---	---	---	---	---	---	---	---	---	---	---
HYDROELECTRIC POWER	---	---	---	---	---	---	---	---	---	---	---	---
WATER ORIENTED OUTDOOR REC.	---	---	---	---	---	---	---	---	---	---	---	---
SPORT FISHING	3.8	1.8	5.6	3.8	1.8	5.6	8.4	14.9	23.3	8.4	14.9	23.3
RECREATIONAL BOATING	41.8	9.3	51.1	41.8	9.3	51.1	110.6	162.9	273.5	110.6	162.9	273.5

COMMERCIAL FISHING	---	---	---	---	---	---	---	---	---	---	---	---
COMMERCIAL NAVIGATION	0	0	0	25.8	1.0	26.8	25.1	18.0	43.1	84.5	27.0	111.5
RELATED LAND USES & PROBLEMS												
AGRIC. LAND-TREATMENT	8.7	0.3	9.0	18.7	0.6	19.3	36.4	5.0	41.4	74.8	11.3	86.1
-CROPLAND DRAINAGE	26.1	0.7	26.8	13.4	0.4	13.8	42.1	7.6	49.7	39.1	6.3	45.4
FOREST LAND-TREATMENT	19.9	0.5	20.4	32.8	0.8	33.6	99.3	11.4	110.7	162.8	19.7	182.5
SHORELAND EROSION	4.8	0.5	5.3	4.8	0.5	5.3	23.9	11.9	35.8	23.9	11.9	35.8
STREAMBANK EROSION	1.8	0.2	2.0	1.8	0.2	2.0	16.3	6.4	22.7	16.3	6.4	22.7
FLOOD PLAINS-URBAN	---	---	---	---	---	---	---	---	---	---	---	---
-URBAN	9.1	0.0	9.1	9.1	0.0	9.1	43.3	1.2	44.5	43.3	1.2	44.5
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---
-RURAL	---	---	---	---	---	---	---	---	---	---	---	---
WILDLIFE MANAGEMENT	19.2	1.0	20.2	19.2	1.0	20.2	90.3	4.7	95.0	90.3	4.7	95.0
AESTHETIC & CULTURAL	---	---	---	---	---	---	---	---	---	---	---	---
OUTDOOR RECREATION--INTENSIVE	63.6	14.5	78.1	63.6	14.5	78.1	194.2	327.3	521.5	194.2	327.3	521.5
--EXTENSIVE	---	---	---	---	---	---	---	---	---	---	---	---
TOTAL	583.6	212.6	796.2	610.6	572.3	1,182.9	1,973.3	2,469.0	4,442.3	2,418.6	4,978.8	7,397.4

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GLOSSARY

Accelerated Growth objective (ACC)—the term adopted in this Framework Study to denote the Regional Development objective (RD), as stated by the Water Resources Council, for water and related land resource planning.

acre-foot—the volume of water needed to cover one acre to a depth of one foot. (See water measurement conversions.)

activity day—the participation by one person in one outdoor recreational activity during all or any part of one day. Thus, one person participating in several activities during a day could account for several activity days.

ADSUN (Alternative Demand, Supply, Needs)—acronym for the computer program used in this study for projecting various rates of economic and demographic growth and deriving anticipated levels of resource supply and demand.

advanced waste treatment (AWT)—the selective application of usually uncommon physical and chemical processes to remove organic and inorganic contaminants that remain after secondary treatment. Sometimes known as tertiary treatment, it is the "polishing stage" of wastewater treatment and produces a high-quality effluent.

angler day, boat day, and hunter day—all have similar meanings. (See recreation day.)

average annual damages (AAD)—the weighted yearly average of all flood damages that would be expected to occur under specified economic conditions and development. Such damages are computed on the basis of the expectancy in any one year of the amounts of damage that would result from events throughout the full range of potential magnitude. Average annual damages from streambank and gully erosion, among other things, are also expressed as a uniform estimate of annual damage.

bank-mile—length of streambank on one side of stream channel. There are two bank-miles in each mile of stream channel.

bgd—billion gallons per day, a unit for measuring liquid flow. (See water measurement conversions.)

biochemical oxygen demand (BOD)—the quantity of oxygen consumed by microbial life while assimilating and oxidizing the organic matter present. It provides an index of the degree of organic pollution of water.

capital costs—first time costs, including installation costs and such related nonstructural program costs as technical and financial assistance, i.e., labor, materials, equipment, rights-of-way, water rights, relocations, contingencies, and the costs for engineering and administration.

cfs—cubic feet per second. (See water measurement conversions.)

channelization—the process of mechanically altering natural stream characteristics to increase the water-carrying capacity by clearing, excavating, enlarging, realigning, lining, and reshaping a channel and its banks; also known as channel modification.

combined sewer—a sewerage system that carries both sanitary sewage and storm-water runoff. During dry weather combined sewers carry all wastewater to the treatment plant. During a storm the plant cannot always handle the entire flow; some of it bypasses the plant and goes untreated to the receiving stream.

comprehensive coordinated joint plan (CCJP)—a specific document composed of elements approved and adopted by the Great Lakes Basin Commission, identifying those water and related structural and nonstructural projects, programs, and other measures designed to enhance the economic, environmental, and social conditions of the area.

conservation needs inventory (CNI)—a study made by the U.S. Department of Agriculture to determine the amount of land needing conservation treatment to preserve long-term values. The report was prepared in 1958 and revised in 1968. The inventory was based upon sampling from soil surveys of soil, slope, erosion, land use, and other factors. Needed conservation practices were also recorded. A given percent of an area, generally a county, was sampled and the data expanded to the entire area.

consumption (depletion) (consumed water)—the loss of water through use, measured indirectly as the difference between the volumes of water intake and water discharge. It is primarily the result of evaporate losses; but includes seepage from holding ponds, water incorporated into manufacturing processes, water consumed by people and animals, and similar, unaccounted losses. It is representative of a depletion of a water resource to the extent that the water consumed may be transferred out of a particular watershed and to the extent that the water may be relocated to the vapor phase of the hydrologic cycle. It is water that is not immediately available for planned reuse. (See water withdrawal.)

criterion—a quantifiable constraint or assumption which assists the planner in selecting programs responsive to a specified subobjective.

critical erosion—lakeshore erosion conditions in which the loss of land, economic losses, and other considerations appear to justify protective measures.

dissolved oxygen (DO)—the amount of dissolved oxygen present in water, expressed in parts per million by weight or milligrams per liter.

effluent—the discharge from an industrial plant or any sewer into a receiving body of water; often the treated water discharged by a wastewater treatment plant.

Environmental Quality objective (EQ)—enhancement of the quality of the environment by the management, conservation, preservation, creation, restoration, or improvement of the quality of certain natural and cultural resources and ecological systems.

existing projects—water or land resource developments completed, under construction, or funded for construction as of fiscal year 1972.

extensive recreation land—land developed for low density recreational use, such as trails, open areas, bicycle paths, vegetative screens, etc.

flood plain—that portion of a river valley, adjacent to the river channel, which is built of sediments during the present regimen of the stream and which is covered with water when the river overflows its banks at maximum flood stages.

flood plain zoning—adoption of ordinances by local or State governments that recognize the hazards inherent in flood plains and restrict the allowable uses of the flood plains to uses which are compatible with these flood hazards.

flow-through cooling—a method of condensing the steam in a steam-electric power plant after the steam has passed through turbines. In flow-through cooling, water is continually diverted from an outside source and continually discharged back into the source. (See supplemental cooling.)

forest land—land at least 10 percent stocked by forest trees of any size, or formerly having had such tree cover, and not currently developed for nonforest use. The minimum area for classification of forest land is one acre. Roadside, streamside, and shelterbelt strips of timber must have a crown width of at least 120 feet to qualify as forest land. Unimproved roads and trails, streams or other bodies of water, or clearings in forest areas shall be classed as forest if less than 120 feet in width.

framework study—a preliminary investigation intended to provide broad-scaled analyses of a set of related problems in the field of water and related land resource use, and to provide a general outline of the nature, extent, and timing of their solutions. (See Subsection 4.1.)

GLEPS—Great Lakes Environmental Planning Study.

goal—the end to which a plan is directed. The goal provides a specific direction or bearing by which the ideal condition is approached, but is not necessarily attainable. In the plural, goals are the aspirations that people have for their social, economic, and environmental well-being.

gpcd (gallons per capita per day)—water use expressed in gallons used per person per day, obtained by dividing the total water use per day by the population served. (See water measurement conversations.)

Great Lakes Basin—In connection with the Framework Study, the area defined by the drainage areas in the United States of Lake Superior, Lake Michigan, Lake Huron, Lake Erie, Lake Ontario, and the St. Lawrence River to the point where the river ceases to be the

Canada-New York international boundary line, and including all closed basins within the topographic divides separating the Great Lakes Basin from adjacent major drainages. Often referred to as the Basin.

Great Lakes Region—the area approximating the Great Lakes Basin bounded by selected county lines so that statistical data may be gathered and economic analyses made more easily. Often referred to as the Region.

green belt—a form of buffer zone. A belt of land around a city or town where the erection of houses and other buildings is severely restricted and the open character of the country is preserved in the form of woods, commons, fields, farms, etc.

gross national product (GNP)—the market value of goods and services produced by the nation in one year before deduction of depreciation charges and other allowances for business and institutional consumption of durable capital goods.

gross water used—the total quantity of water needed in a process, including both new water and any other water recirculated or reused.

ground water—water in the ground in the zone of saturation, from which wells, springs, and ground-water runoff are supplied.

ground-water runoff—the part of stream runoff derived from ground-water seepage.

high risk erosion area—a lakeshore physically prone to erosion where there is a high probability of lake conditions that will cause such erosion.

intensive recreation land—land developed for intensive, high density recreational use, such as picnic areas, playgrounds, etc.

interceptor sewers—sewers used to collect the flows from main and trunk sewers and carry them to a central point for treatment and discharge.

irrigation—the controlled application of water to lands to supply water requirements not satisfied by rainfall. In the Great Lakes Basin Framework Study, golf courses as well as cropland are included in irrigation.

land area—the solid portion of the earth's surface including bodies of water less than 40 acres and streams of less than ⅛ mile wide.

Limited Growth objective (LIM)—the term adopted for this Framework Study to denote the Environmental Quality objective (EQ) prescribed by the Water Resources Council for water and related land resource planning.

linkage corridor—an environmental system that links urban areas.

mgd—million gallons per day. (See water measurement conversions.)

moderate erosion—streambank erosion in which the losses or damages do not warrant protective measures.

National Economic Development objective (NED)—enhancement of national economic development by increasing the value of the nation's output of goods and services and improving national economic efficiency.

national income (NI)—the aggregate earnings of labor and property from current production.

need—a quantifiable present or projected demand exceeding supply of a water or related land resource. A need is thus a measurable deficit in resource commodities or related services available to meet total demand at a specific time, location, and price.

noncritical erosion—lakeshore erosion conditions in which losses do not justify protective measures.

nonpoint source pollution—pollution processes that tend to be nondiscrete and diffuse, and create discharges to the environment not amenable to treatment. An example is sediment entering a stream from agricultural activities, forestry, or construction.

Normal Framework (NOR)—the set of programs for development of water and related land resources in the Great Lakes Basin formulated in the Framework Study to meet the Normal Growth objective.

Normal Growth objective (NOR)—the term adopted for this Framework Study to denote the National Economic Development objective (NED) prescribed by the Water Resources Council for water and related land resource planning.

OBERS—acronym for population and economic projections prepared for the nation by the Office of Business Economics, now Bureau of Economic Analysis, Department of Commerce, and the Economic Research Service, Department of Agriculture.

objective—an attainable step to be taken or point to be emphasized on the way toward meeting or attempting to meet a goal. The objective implements the goal. In the plural, objectives are groupings of subobjectives related to each other, which collectively define one of the four categories of objectives of water resource planning—social well-being, national economic development, regional development, and environmental quality.

operation, maintenance, and replacement costs (OM&R)—the total annual cost of operating, maintaining, and repairing a plant or facility to keep it at its original operating capability. This includes labor, material, utilities, rent, etc., but not any amortization of the investment cost.

opportunity—a chance for the enhancement of a resource, the extension of the possibilities for its use, or the solution of a related problem. The term opportunity describes resource development, while the term requirement describes resource use.

personal income—see total personal income.

phosphorus—phosphorus is the nutrient chemical given the most attention in the Great Lakes, not only because it is often implicated as the key nutrient involved in the eutrophication of the Great Lakes, but also because it is the essential nutrient whose input is most easily controlled. Phosphorus in Great Lakes waters may result from leaching of rocks, runoff from soils and urban areas, normal decomposition of organic material, sewage, and industrial effluents.

plan area—a division of the Region for planning purposes using county lines as boundaries to approximate as closely as possible the hydrologic boundaries of a Lake basin. There are five plan areas in the Great Lakes Basin, one for each Lake. (See Figure 1–1.)

planning subarea (PSA)—a division of the Great Lakes Region for planning purposes using county lines as a boundary to approximate the hydrologic boundary of a river basin group. The 15 PSAs are named and numbered to correspond to the 15 RBGs. (See Figure 1–2.)

point source—a discrete location or origin of a specific polluting discharge. It may emanate from a single origin or from a group of origins discharging to the receiving water at a common location.

preliminary waste treatment—the conditioning of an industrial waste at its source prior to discharge, to remove or to neutralize substances injurious to sewers and treatment processes and/or to effect a partial reduction in load on the treatment process. This term also refers to unit operations in the treatment process which prepare the liquor for subsequent major operations.

primary wastewater treatment—the first major process or group of processes in sewage treatment. It usually consists of screening, shredding, and sedimentation. It is designed to remove a high percentage of suspended matter but little colloidal and dissolved matter. It removes approximately 35 percent of the biochemical oxygen demand (BOD).

problem—an unsatisfactory situation connected with water and related land resources. Some problems, like erosion and flooding, are physical and quantifiable, while many others, such as conflicts in legal or institutional arrangements, are qualitative and not directly measurable. (See Subsection 4.5.)

program—a deliberate undertaking or series of undertakings intended to accomplish one or more chosen objectives.

project action—cooperative action for improvement of agricultural land that can be effected only through formal organizations having the authority to raise funds and allocate monies to install, operate, and maintain works of improvement.

Proposed Framework (PRO)—a set of programs for development of water and related land resources in the Great Lakes Basin, formulated in the Framework Study, and based on meeting needs projected for the Normal Growth objective, but using solutions reflecting desires of specific interests or groups in the Basin, and generally trending toward a greater emphasis on environmental considerations.

pumped storage power plant—a hydroelectric power generation system whereby water is pumped to a reservoir above the generating site, and then released through turbines to generate electricity. Pumped storage systems are used principally to meet peak power demands.

recreation day—a visit by one individual to a recreation development or area for recreation purposes during a reasonable portion or all of a 24-hour period. It is assumed that the average person participates in 2.5 activities during an average visit to a recreational area. Therefore, 2.5 activity days equal one recreation day.

Regional Development objective (RD—enhancement of regional development through increases in a region's income; increases in employment; and improvements of its economic base, environment, social well-being, and other specified components of the regional objective.

requirement—a desirable or essential demand for a particular water or related land resource, usually quantifiable. Requirements, whether actual or projected, measure total demand, in contrast to needs.

resource cluster—grouping of similar or dissimilar resource features that is considered important enough to be identified either as part of the environmental systems or separate from them. Individually these features might not be important, but when four or more are close together they warrant special planning and management consideration.

river basin group (RBG)—one of the 15 hydrologic subdivisions into which the Great Lakes Basin is divided for planning purposes. Each RBG is made up of individual river basins and complexes. The latter consist of small stream basins lumped together for data gathering and planning purposes. (See PSA in Glossary and Figure 1–2.)

runoff—that amount of the precipitation that appears in surface streams.

salmonid species—a family of fish that includes groups such as salmon, trout, char, whitefish, and grayling.

sanitary sewers—sewers that carry only domestic or commercial sewage. Storm water runoff is carried in a separate system.

secondary wastewater treatment—wastewater treatment beyond the primary stage in which bacteria consume the organic parts of the wastes. This biochemical action is accomplished by use of trickling filters or the activated sludge process. Effective secondary treatment removes virtually all floating and settleable solids and approximately 90 percent of both BOD and suspended solids. Customarily, disinfection by chlorination is the final stage of the secondary treatment process.

7-day, 10-year low flow—the minimum 7-day average flow at a given point in a given stream that is likely to occur once in 10 years, as determined by probability analysis.

severe erosion—streambank erosion in which the losses or damage are of a magnitude to warrant the cost of protective measures.

shore zone—the environmental system that parallels or encompasses portions of the shorelines of the Basin's lakes, streams, and wetlands.

Social Well-Being objective (SWB)—to enhance social well-being by the equitable distribution of real income, employment, and population, with special concern for the effects of a plan on persons or groups; by contributing to the security of life and health; by providing educational, cultural, and recreational opportunities; and by contributing to national security. (Has sometimes been called "Quality of Life".)

standard metropolitan statistical area (SMSA)—a county or group of counties containing at least one city of 50,000 inhabitants or contiguous cities with a combined population of 50,000 or more. In addition to the county containing such city or cities, contiguous counties are included in an SMSA if they are metropolitan in character and are integrated socially and economically with the central city. The criteria of metropolitan character relate to the attributes of the outlying county as a place of work or residence for a concentration of nonagricultural workers and stipulate that at least 75 percent of the labor force in a county must be nonagricultural and, usually, that the county must have 50 percent or more of its population living in contiguous minor civil divisions with a density of at least 150 persons per square mile.

storm sewer—a conduit that collects and transports rain and snow runoff back to the ground water. In a separate sewerage system storm sewers are entirely separate from those carrying domestic and commercial waste.

subobjective—an action that allocates human and natural resources and/or utilizes other programs to move toward a defined goal. Some subobjectives are general in nature, while others are quite specific in terms of either geographic location or program content. (See Subsections 2.1, 2.2.)

supplemental cooling—any power plant cooling system that provides for dissipation of the heat in condenser cooling water, and usually reuse of the water, before it is discharged into a stream or lake that is not a part of the system. (Supplemental cooling techniques may include cooling ponds, evaporative (wet) cooling towers, and convective/conductive (dry) cooling towers.) (See flow-through cooling.)

suspended solids—small particles of solid pollutants in sewage that contribute to turbidity and that resist separation by conventional means. Examination of suspended solids and the BOD test constitute the two main determinants for water quality performed at waste water treatment facilities.

tertiary waste water treatment—See advanced waste treatment.

thermal plant—a generating plant that uses heat to produce electricity. Such plants may burn coal, gas, oil, or use nuclear energy to produce the necessary thermal energy. The common types of heat engines used to drive generators are steam turbines, gas turbines, and internal combustion engines.

thermal pollution—rise in water temperature of a receiving water body due to heat released by cooling waters from a thermal plant, with resulting adverse effects on other uses of the water, for example, by aquatic life.

total personal income—income from wage and salary disbursements and other labor income, proprietor's income, property income (interest, dividends, and rental income) and government and business transfer payments, which may also be called total income.

urban buffer zone—environmental system that because of its proximity to existing urban concentrations serves as a natural buffer to urban expansion.

water measurement conversion—

mg	×	3.0689	=	acre-feet
cfs	×	1.9835	=	acre feet/day
	×	724	=	acre feet/year
mgd	×	1.5472	=	cfs
	×	1120	=	acre feet/year
gpcd	×	population	=	gpd

water-oriented activity—an all-inclusive term embracing water-dependent, water-enhanced, and any other outdoor recreation activities in which water augments or is essential to the recreation experience.

water pollution—the addition of any material or any change in quality or character of a body of water which lessens suitability for a desired use.

GREAT LAKES BASIN FRAME-WORK STUDY - APPENDIX 1

AUTHOR

TITLE GREAT LAKES BASIN FRAMEWORK STUDY - APPENDIX 1

DATE DUE	BORROWER'S NAME

GREAT LAKES BASIN COMMISSION
Frederick O. Rouse, Chairman

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